



Government of Nepal
Ministry of Physical Infrastructure and Transport
Singha Durbar, Kathmandu

Environmental Impact Assessment (EIA)
for the construction and upgrading of
Kathmandu (Nagdhunga)-Naubise-Mugling (KNM) Road and Bridges
Kathmandu, Dhading, Gorkha and Chitwan Districts
Bagmati and Gorkha Provinces



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परिचय

नेपाल एक सानो भूपरिवेष्ठित राष्ट्र हो जुन भारत र चीन जस्तो ठुला मुलुकहरुका विचमा अवस्थित छ । वीरगंज देखि काठमाण्डौ सम्मको मुख्य राजमार्गले राजधानी काठमाण्डौलाई भारतको सिमासँग जोड्ने हालसम्मको एक मात्र प्रमुख नाका वीरगंज रहेको छ । वीरगंजदेखि काठमाण्डौसम्म जोड्ने मुख्य राजमार्गको सुधार एवम् स्तरोन्नोतीले नेपाल - भारत विच हुने व्यापार अझ सुधार हुने देखिन्छ । वीरगंज देखि काठमाण्डौ सम्म २७६ कि.मि. लामो दुरीको यस राजमार्ग एशियाली हाईवे (AH-42) को एउटा महत्वपूर्ण खण्ड हो । काठमाण्डौदेखि वीरगंज हुँदै भारतसँग राम्रो यातायात प्रणाली कायम गर्न, सडक सुरक्षा बढाउन, मालवाहक ढुवानी सेवाको सुधार गर्न, कम समय र खर्चमा यातायात संचालन गर्न सडक सुधार तथा नयाँ संरचनाहरुको निर्माण अपरिहार्य भएको छ । काठमाण्डौदेखि मुग्लिङ सम्मको राजमार्ग प्रमुख रणनीतिक राजमार्गमध्ये एक हो जसको सुधार तथा स्तरोन्नति ले मुलुकका सम्पूर्ण सडक सञ्जालको दक्षतालाई सुनिश्चित प्रदान गर्नुका साथै राष्ट्रिय अर्थव्यवस्था समुन्नत बनाउन यसले अझ ठूलो भूमिका खेल्दछ । काठमाण्डौ(नागदुङ्गा)-नौबिसे-मुग्लिङ सडक खण्डले केवल काठमाण्डौ र तराई क्षेत्रलाई भारतीय सिमानासम्मको मार्ग प्रदान गर्नु मात्र नभई पोखरा र अन्नपूर्ण संरक्षण क्षेत्रजस्ता प्रमुख पर्यटकीय स्थलहरुलाई पनि जोड्ने काम गरेको छ । यस राजमार्गको सुधार तथा स्तरोन्नोति पश्चात आन्तरिक तथा वाह्य पर्यटकहरुको आगमनमा पनि वृद्धि हुने सम्भावना रहन्छ । साथै काठमाण्डौ(नागदुङ्गा)-नौबिसे- मुग्लिङ सडक खण्डको सुधारले स्थानीय र क्षेत्रीय विकासलाई टेवा पुऱ्याउन सहयोग गर्नेछ र स्थानीय वासिन्दा/समुदायहरुको जीवनस्तर सुधारमा महत्वपूर्ण योगदान पुऱ्याउने छ ।

आयोजनाको प्रस्तावक

यस आयोजनाको प्रस्तावक नेपाल सरकार भौतिक पूर्वाधार तथा यातायात मन्त्रालय, सडक विभाग अन्तरगतको विकास सहकारिता कार्यन्वयन महाशाखा रहेको छ ।

प्रस्तावकको नाम र ठेगाना

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आयोजनाको विवरण

यो काठमाण्डौ(नागदुङ्गा)-नौबिसे- मुग्लिङ सडकको वातावरणीय प्रभाव मूल्याङ्कन अध्ययनको प्रतिवेदन हो । यस सडक आयोजना नेपाल भारत क्षेत्रीय व्यापार तथा यातायात आयोजना अन्तरगत पर्दछ । काठमाण्डौ(नागदुङ्गा)-नौबिसेदेखि मुग्लिङसम्मको पृथ्वी राजमार्गलाई सुधार तथा स्तरोन्नोति गर्ने साथै नयाँ सडकहरु निर्माण गर्न प्रस्ताव गरिएको छ । यसले काठमाण्डौ, धादिङ्ग, चितवन, र गोरखा जिल्लाहरुलाई प्रत्यक्ष प्रभावित पार्नेछ । प्रस्तावित आयोजना काठमाण्डौ(नागदुङ्गा)वाट सुरु भई मुग्लिङमा गई अन्त्य हुन्छ भने यसको दूरी नागदुङ्गादेखि मुग्लिङसम्म ९६ कि.मि रहेको छ । यो साविक पृथ्वी राजमार्ग खण्ड अन्तर्गत नागदुङ्गा, नौबिसे, खानीखोला, महादेववेशी, गल्छी, बैरेनी, मलेखु, बेनीघाट, कुरिनटार हुँदै मुग्लिङसम्म रहेको छ । साथै सिस्नेखोला-धार्के सडक करिब ११.२ कि.मि.को नयाँ राजमार्ग सिस्नेखोलावाट सुरु भई महेशखोलाको दाहिने किनार हुँदै धार्के छिचोलिने र विशालटार देखि फिस्लिङ्ग सम्म करिब १५.३ कि.मि.(त्रिशुली नदीको दायाँ किनार गोरखा जिल्लामा) नयाँ राजमार्गको निर्माण गर्ने प्रस्ताव गरिएको छ । यस आयोजनाले साविक पृथ्वी राजमार्गलाई सुधार तथा स्तरोन्नोति गरी (दुई लेनको राजमार्ग स्तरमा) पूर्णता दिईनेछ । साथै नयाँ निर्माण हुने सडक खण्डहरु पनि दुई लेनको हुनेछ । यसका अलावा साविकको पृथ्वी राजमार्ग अन्तर्गत सञ्चालनमा रहेका चारवटा पुलहरु खहरे खोला पुल, हुग्दीखोला पुल, गोमती खोला पुल, र चरौदी खोला पुलसंगै अन्य २२ पुलहरुलाई पनि सुधार गरी संचालनमा ल्याउने छन् भने सिस्नेखोला-धार्के खण्डमा थप ५ वटा र विशालटार-फिस्लिङ्ग खण्डमा थप ८ वटा नयाँ पुलहरु निर्माण गरी संचालनमा ल्याउने प्रस्ताव गरिएको छ । साथै, प्रस्तावित सिस्नेखोला-धार्के सडक अन्तर्गत वाग्लेथोकमा १८० मिटर लामो सुरुङ्गको पनि प्रस्ताव गरिएका छन् ।

भूवनोट, भूक्षयको खतरा, माटोको क्षयीकरण, जलाधार निकास प्रणालीमा असर आदि लाई आधार मानी विभिन्न विकल्पहरु प्रस्ताव एवम् सोको विश्लेषण कार्य गरियो । राजमार्गको स्तरोन्नति र यातायात क्षेत्रका समस्याको उचित सम्बोधन गर्ने उद्देश्यका साथै आयोजना कार्यान्वयनका क्रममा न्यूनतम क्षति होस भनी ६ विकल्पहरुविच तुलनात्मक वैकल्पिक अध्ययन एवम् विश्लेषणका आधारमा एउटा विकल्पलाई छनौट गरिएको छ ।

प्रस्तावित विकल्पलाई प्रत्येक खण्डमा निम्नरूपमा विभाजित गरिएको छ :

- नागदुङ्गा-नौबिसे खण्डलाई २ लेन स्तरको राजमार्गमा स्तरोन्नोति गर्ने
- नौबिसे-मुग्लिङ्ग खण्डलाई २ लेन स्तरको राजमार्गमा स्तरोन्नोति -धार्केदेखि बेनिघाट ८२.६४ कि.मि. र कुरिनटारदेखि मुग्लिङ्ग १२.७१ कि.मी. सहित) गर्ने
- वाग्लेथोक वस्तीक्षेत्रमा अन्दाजी १८० मि. लम्बाईको सुरुङ्ग सहितको सिस्नेखोला-धार्के नयाँ सडक खण्डको निर्माण गर्ने
- गोरखा जिल्लाको त्रिशुली नदीको दायाँ किनार तर्फ विशालटार-फिस्लिङ्ग नयाँ सडक खण्डको निर्माण गर्ने

प्रस्तावित नयाँ सडक खण्डले कृषि भूमि, जंगल र सानातिना वस्तिहरुलाई छिचोल्दै अगाडि बढ्छ । त्यसकारण साविक काठमाण्डौ(नागदुङ्गा)-नौबिसे-मुग्लिङ्ग सडक खण्डको सुधार एवम् स्तरोन्नति र २

वटा नयाँ सडक खण्ड सिस्नेखोला-धार्के र विशालटार-फिस्लिङ्ग सडक खण्डको प्रस्तावका लागि वातावरणीय प्रभाव मूल्याङ्कन अध्ययन गरिएको छ ।

साविक काठमाडौं(नागदुङ्गा)-नौबिसे-मुग्लिङ्ग सडक खण्डमा पर्ने जिल्ला, नगरपालिका र वडाहरुको विवरण

जिल्ला	नगर पालिका/गाउँपालिका	वडा
काठमाडौं	चन्द्रागिरी न.पा.	२
धादिङ्ग	धुनिवेशी न.पा.	२, ६, ७, ८, ९
	थाके गा.पा.	६, ७, ८, ९, २
	गल्छी गा.पा.	४, ६, ७
	गजुरी गा.पा.	५, ६, ९, २
	वेनिघाट रोराङ्ग गा.पा.	३, ५, ७, ८, ९, १०
चितवन	ईच्छाकामना गा.पा.	३, ५

प्रस्तावित सिस्नेखोला देखि धार्के खण्डमा पर्ने जिल्ला, नगरपालिका र वडाहरुको विवरण

जिल्ला	गाउँपालिका	वडा
धादिङ्ग	धुनिवेशी न.पा.	६, ८, ९, २, ५

प्रस्तावित विशालटार देखि फिस्लिङ्ग खण्डमा पर्ने जिल्ला, गाविस र वडाहरुको विवरण

जिल्ला	गाउँपालिका	वडा
धादिङ्ग	वेनिघाट रोराङ्ग गा.पा.	५
गोरखा	गण्डकी गा.पा.	७, ८, ६
	ईच्छाकामना गा.पा.	३

विद्यमान वातावरणीय अवस्था

प्रस्तावित काठमाण्डौं(नागदुङ्गा)-नौबिसे-मुग्लिङ्ग सडक र त्यसका अन्य नयाँ प्रस्ताव गरिएका सडक रेखाङ्कनहरु काठमाण्डौं, धादिङ्ग, चितवन, र गोरखा जिल्लाहरु छिचोल्दै अगाडि बढेको छ । नयाँ संरचना अनुसार यो बागमती प्रदेश र गण्डकी प्रदेश सीमा अन्तर्गत रहेको छ । यसै गरी भौगोलिकता अनुसार प्रस्तावित सबै सडकहरु मध्य पहाडी क्षेत्र अन्तर्गतको भु-भागमा पर्दछ । समुन्द्री सतहबाट करिब १५०० मिटरको उचाईमा अवस्थित काठमाण्डौंको नागदुङ्गावाट आयोजना सुरु भई करिब २६५ मिटरमा अवस्थित मुग्लिङ्गमा पुगी आयोजनाको अन्त्य हुन्छ । यस आयोजना नागदुङ्गावाट क्रमशः नौबिसे हुँदै महेशखोला किनार र त्रिशुली नदीको किनार तय गर्दै अघि बढेको छ । साविकको राजमार्गको शुरुको खण्ड महेशखोलाको किनार हुँदै गल्छिसम्म पुगेपछि त्रिशुली नदी किनारलाई पछ्याउँदै अघि बढ्छ । यसैगरी प्रस्तावित नयाँ सिस्नेखोला-धार्के सडक खण्ड सिस्नेखोलाको किनारवाट सुरु भई धुनिखोला किनार हुँदै शुरुको खण्डमा महेशखोलाको बायाँ किनार हुँदै अन्तिम खण्डतिर दाहिने किनार हुँदै धार्केमा पुगी पुनः साविककै पृथ्वी राजमार्ग खण्ड संग जोडिन पुग्छ । प्रस्तावित सडक आयोजना भित्र करिब ३६ वटा सामुदायिक वन, ८ वटा सरकारी वन तथा ८ वटा कबुलियती वनहरु पर्दछन् ।

हालको राजमार्गको अवस्थालाई सुधार गर्न अत्यन्तै आवश्यक रहेको छ । काठमाण्डौदेखि मुग्लिङ्गसम्मको सडक अवस्था पनि एकैनासको पाईदैन । साविक राजमार्ग २ लेन स्तरको सडक हो जसमा उच्च भिरालोपनाका साथै साँघुरा चोकहरु प्रशस्तै मात्रामा रहेका पाईन्छ । यस राजमार्गको

सम्पूर्ण भाग कालोपत्रे गरिएको छ । साविकको पृथ्वी राजमार्ग खण्डमा ट्राफिक संकेत बत्तीहरुको पर्याप्त व्यवस्था गरिएको पाईदैन । प्रमुख तथा मुख्य चोकहरु तथा बजार क्षेत्रहरुमा समेत स्पष्ट ट्राफिक संकेत वा चिन्हहरुको व्यवस्था भएको पाईदैन । पैदलयात्रीहरुलाई वाटो/सडक वारपार गर्न कुनै किसिमको सरल माध्यमको व्यवस्थाहरु गरिएको पाईदैन । अधिकांश सडक खण्डमा सवारी गति-सीमालाई नियमित एवम् कडाई साथ लागू गरिएको विरलै भेटिन्छ । केही स्थानहरुमा छिटफुट रुपमा ट्राफिक संकेतहरु देख्न पाईन्छन् । धेरै स्थानहरुमा सडकको उच्च चढाइलाई न्यून गर्नु पर्ने र कठिन सडक घुम्तिहरुको सुधार एवं वस्ती क्षेत्रहरुमा उल्लेख सुधार गर्नु पर्ने देखिन्छ । कठिन सडक घुम्तिहरु एवं कम चौडा सडकका कारण साविक राजमार्ग खण्डमा सवारी दुर्घटना पनि उच्च संख्यामा नै रहेको पाईन्छ । सडकको भारक्षमता कम, यातायात साधनको अधिक चाप एवं न्यून गतिमा सवारी चलाउनु पर्ने बाध्यताका कारण प्रत्येक दिन यस सडक खण्डमा सुचारु सवारी आगमनमा घण्टाको अवरोधका घटनाक्रमहरुलाई सामान्य रुपमा लिनु पर्ने बाध्यता जस्तो नै बनेको छ । काठमाण्डौं मुग्लिङ सडक खण्डका प्रायः भागहरुमा अधिक स्तरमा वायु प्रदूषण, अत्याधिक धुलो उडेको, सडक किनारामा ठोस फोहरको डुङ्गुर प्रयाप्त मात्रामा अवलोकन एवं महसुस गर्न सकिन्छ ।

सन्दर्भ सामाग्रीहरुको अध्ययन; सम्बन्धित नितिहरु; कानूनहरु; निर्देशिका; टोपोग्राफिक नक्सा; गुगल नक्सा विश्लेषण एवं साविक भूउपयोग अवस्थाको आर्क जि.आई.एस. प्रोग्रामिङ्ग; प्रत्यक्ष असरमा केन्द्रित स्थलगत अनुसन्धान मार्फत जैविक तथा भौतिक प्यारामिटरको अध्ययन; छलफल तथा परामर्श; लक्षित वर्ग छलफल; र जैविक एवं सामाजिक सूचकका लागि जानिफकार व्यक्तिसंग अन्तरवार्ता; आयोजना स्थलका महत्वपूर्ण वातावरणीय एवं साँस्कृतिक अवयव लक्षित सर्भेक्षण आदि जस्ता तथ्याङ्क तथा सूचना संकलन कार्य संचालन गरिएको छ । संकलन गरिएका सम्पूर्ण तथ्याङ्कहरु मार्फत आयोजना कार्यान्वयनका क्रममा पर्ने प्रत्यक्ष एवम् अप्रत्यक्ष प्रभाव र असरहरु साथै त्यसका सम्भावित न्यूनीकरणका उपायहरुको अवलम्बन विधिहरुको मूल्याङ्कन गरी आयोजना चक्रभरी कार्यान्वयन गरिन्छ । तल उल्लेखित विधिहरु मार्फत प्रस्तावित साविक एवम् नयाँ सडक खण्डको भौतिक, जैविक र सामाजिक आर्थिक र साँस्कृतिक वातावरण सम्बन्धि तथ्याङ्कहरु संकलन गरिएको छ ।

- ❖ भौतिक वातावरण: भौगोलिक अध्ययन; जलवायु र जलविज्ञान; आयोजना क्षेत्रको भूक्षय तथा भूस्थिर विश्लेषण; सडकको क्षेत्राधिकारभित्रको जमिनको उपयोग; प्रत्यक्ष असर र अप्रत्यक्ष असर क्षेत्र; वायु र जलको गुणस्तर; ध्वनिको स्तर; ठोस फोहर व्यवस्थापन ।
- ❖ जैविक वातावरण: स्थल वसोवास (आयोजना क्षेत्रको वनहरु, तिनका प्रकार साथै रुखका प्रजाति); माछा लगायत जलचरको वासस्थान; आयोजना क्षेत्रका स्तनधारी, चराचुरुङ्गी, उभयचर एवम् स्थानीय र भौगोलिक रुपमा लोपोन्मुख स्थल जीवजन्तुको अवस्थाको जानकारी; अति जोखिम अवस्थाका वन्यजन्तुका वासस्थान र उनीहरुको सडक दूरीसंग निकटताको अवस्थाको विश्लेषण ।
- ❖ सामाजिक-आर्थिक र साँस्कृतिक वातावरण: स्थानीय आर्थिक र आर्थिक सवलम्बन; सामाजिक बोनोट र सेवाहरु; स्थानीय समुदायको संरचना; प्रभावित व्यक्तिहरु; जमिन र सम्पत्ति; र वसाई सराईको अवस्था, रोजगारीको अवस्था, जमिनको उपयोगको अवस्था, कृषि उत्पादन,

खाद्यान्नको प्रयाप्तता, सामाजिक एवं अन्य भौतिक संरचनाहरूमा पहुँच, शिक्षा, साधारण स्वास्थ्य सेवा, स्वच्छता, र सर-सफाई लगायतका जनसाङ्ख्यिक विवरणहरू।

प्रस्तावित आयोजनाले वातावरणमा पर्ने प्रभावहरू

प्रस्तावित काठमाण्डौ(नागदुङ्गा)-नौविसे-मुग्लिङ्ग सडक तथा पुल आयोजना अन्तर्गत काठमाडौंको नौविसेदेखि मुग्लिङ्गसम्मको राजमार्गलाई स्तरोन्नोती तथा नयाँ पुलहरूको निर्माण गर्नुका साथै सिस्नेखोला-धार्के नयाँ सडक खण्ड र विशालटार-फिस्लिङ्ग नयाँ सडक खण्डको निर्माण गर्ने यस आयोजनाको लक्ष्य रहेको छ। यस कारण हालको काठमाण्डौ(नागदुङ्गा)-नौविसे-मुग्लिङ्ग सडक तथा पुलहरूको स्तरोन्नोति तथा नयाँ पुलहरूको निर्माणबाट वातावरणमा पर्नसक्ने सम्भाव्य प्रभावहरूको अनुमान लगतै सिस्नेखोला-धार्के र विशालटार-फिस्लिङ्ग नयाँ राजमार्गको निर्माणबाट पर्न सक्ने सम्भाव्य प्रभावहरूको छुट्टै लेखाजोखा गरिएको छ। आयोजनाको विभिन्न चरण जस्तै: निर्माण पहिले, निर्माणको समयमा, र आयोजना संचालनको समयमा पर्न सक्ने प्रभावहरूलाई अनुमान गरी अध्ययन गरिएको छ। आयोजनाबाट पर्नसक्ने प्रभावहरूलाई त्यसको परिमाण (उच्च, मध्यम, र न्युन), सीमा (स्थान विशिष्ट, स्थानीय, र क्षेत्रगत), र अवधि (छोटो, मध्यम, र लामो अवधि) गरी असरहरूलाई विश्लेषण गरिएको छ। प्रस्तावित आयोजनाको कार्यान्वयनले पर्न सक्ने असरहरू मध्य पहिरो, भूक्षय, भूउपयोगमा परिवर्तन, रुख तथा वोटविरुवाको क्षति, प्रभावित मानिसहरूको वसाईं सराईं प्रमुख असरहरू हुन्।

सकारात्मक असर तथा प्रभावहरू

प्रस्तावको कार्यान्वयन तथा स्तरोन्नतिबाट ९६ कि.मि. लम्बाई रहेको यस काठमाडौं (नागदुङ्गा)-नौविसे-मुग्लिङ्ग सडककले सर्वसाधारणहरूको पहुँचमा सरलता, समयको बचत तथा सुरक्षित यात्रा प्रदान गर्दछ। आयोजनाले सामुदायिक वन तथा आयोजना क्षेत्रभित्र वृक्षारोपणका कार्यक्रमहरू पनि सञ्चालन गर्नेछन्, जसबाट हरियाली र प्राकृतिक सम्पदाको संरक्षणमा टेवा पुग्ने छ। आयोजना निर्माण अवधि भर दक्ष कामदार तथा अर्धदक्ष कामदारहरू यस आयोजनालाई समयमै निर्माण सम्पन्न गर्न आवश्यक पर्ने हुनाले प्रशस्त सडक निर्माण कामदारहरूको आवश्यकता पर्नेछ।

त्यस्तै, पूर्वाधार विकाससंगै यस क्षेत्रमा आन्तरिक तथा अन्तर्राष्ट्रिय पर्यटन वृद्धि हुने छ। साना तथा ठूला यातायातका साधनहरू पनि आवत जावतमा सूचारु हुनुका साथै छोटो समयमा धेरै आन्तरिक र वाह्य पर्यटकहरू यस क्षेत्रमा वृद्धिहुने छन्। नयाँ सडक खण्डको निर्माण र साविक खण्डको स्तरोन्नोति कार्यले सुरक्षित यातायात सेवा संचालनका दृष्टिले पनि निकै सुधार आउने छन्। पूर्वाधार विकास संगै यस क्षेत्रको मात्र नभई अन्य वरपरका गाउँपालिका तथा जिल्लाहरूको पनि विकासमा सहयोगी भूमिका पुग्ने देखिन्छ। पूर्वाधार विकास तथा बाटोको निर्माणले यस क्षेत्र हुँदै आवतजावत गर्ने यात्री, पर्यटन क्षेत्रमा विकास तथा यस क्षेत्रमा आउने भक्तजनहरू पनि बढ्नुका साथै यस क्षेत्रको आर्थिक विकास हुनुका साथै स्थानीयको आयआर्जनमा पनि राम्रो टेवा पुग्ने देखिन्छ। जम्मा, १,११२,४५२.५० मानव-दिन दक्ष कामदार तथा ५,५६७,४४८.०० मानव-दिन अदक्ष कामदारका लागि निर्माणको समयमा उपलब्ध हुने देखिन्छ। काठमाडौं(नागदुङ्गा)-नौविसे-मुग्लिङ्ग सडक स्तरोन्नतिका लागि ७४१,६३५.०० मानव-दिन दक्ष कामदार तथा ३,७११,६३२.०० मानव दिन अदक्ष कामदारको आवश्यकता पर्ने देखिन्छ। सिस्नेखोला-धार्के सडकको निर्माण समयमा १८४,३९८.७५ र

८४७,९६८.०० मानव-दिन कमश दक्ष र अदक्ष कामदारहरु आवश्यक पर्नेछन् । त्यस्तै, १८६,४१८.७५ र १,००७,८४८.०० मानव-दिन कमश दक्ष र अदक्ष कामदारहरु विशालटार-फिस्लिङ्ग सडकको निर्माणको समयमा आवश्यक पर्नेछन् ।

नकारात्मक प्रभावहरु

प्रस्तावित परियोजनाको सुधार, स्तरोन्नति तथा कार्यान्वयनबाट वन क्षेत्रको क्षति, पहिरो र प्राकृतिक खोल्सी तथा खहरेहरुमा प्रत्यक्ष असर पर्ने देखिन्छ । नयाँ सडक खन्ने कार्यबाट पहाडको भिरालो पट्टि उत्खनन् गरेका माटोहरु फाल्ने सम्भावना रहेको देखिन्छ भने त्यसो गर्नाले सडक निर्माण वा सञ्चालनको क्रममा जमिनको स्थिरतामा असर पर्न गई प्रस्तावित नयाँ राजमार्गहरुमा पहिरो जाने वा भूक्षय हुने प्रबल सम्भावना देखिन्छ । विशेष गरी नयाँ सडक खन्ने क्रममा सडक रेखाभित्र अथवा क्षेत्राधिकार भित्र पर्ने वन क्षेत्रमा असर पर्ने देखिन्छ जसका कारण पहिरो तथा भूक्षयको प्रबल सम्भावना रहन्छ । यस आयोजनाको कार्यान्वयनले करिब ३७.४४ हे. वन क्षेत्र प्रभाव हुने देखिन्छ भने सामुदायिक वनहरुका करिब ९७९ वटा ठूला रुखहरु र करिब १०,९८२ वटा साना गरी जम्मा ११,९६१ वटा रुखहरु काट्नु पर्ने देखिन्छ । काट्नुपर्ने रुखहरु मध्ये मुख्यतया साल, सल्ला, खयर, उत्तिस, आदि, प्रजातिका पर्दछन् । बाटो निर्माणका क्रममा उत्खननबाट माटो निस्कनुका साथै त्यस्ता माटो जथाभावी फ्याँकेमा प्राकृतिक खोलानालामा असर पर्न सक्दछ, जसका कारण पहिरोको सम्भावना अधिक रहन्छ । करिब ९०१,७६५ घन मि. माटोलाई सुरक्षित संग व्यवस्थापन गर्नु पर्ने हुन्छ ।

सडक निर्माण तथा सुधार गर्दा आयोजनाबाट ७१० घरधुरी प्रभावित हुनेछन् । उक्त प्रभावित मध्ये आयोजनाले ७८ घरधुरीका निजी संरचनाहरु, ४४ घरधुरीका जग्गा साथै संरचनाहरु, र ५८८ घरधुरीका जग्गा मात्र प्रभावित हुनेछ । सडक खण्ड अनुसार विश्लेषण गर्दा आयोजनाले सबै भन्दा धेरै सिस्नेखोला-धार्के सडक खण्डमा ३८४ घरधुरीहरु प्रभावित हुनेछ । यसैगरी विशालटार-फिस्लिङ्ग सडक खण्डमा २८४ घरधुरीहरु र नागदुङ्गा-मुग्लिङ्ग सडक खण्डमा ७८ घरधुरीहरु प्रभावित हुनेछ । आयोजना कार्यान्वयन (नयाँ सडक निर्माण र स्तरोन्नति कार्य) गर्दा जम्मा ४३.३३ हेक्टर निजी जग्गा विनाश हुनेछ । उक्त प्रभावित जग्गामध्ये आयोजनाले सडक खण्ड अनुसार विश्लेषण गर्दा सबैभन्दा धेरै सिस्नेखोला-धार्के सडक खण्डमा २५.४० हेक्टर (५९० कित्ता) जग्गा प्रभावित हुनेछ । यसैगरी विशालटार-फिस्लिङ्ग सडक खण्डमा १७.७२ हेक्टर (३५६ कित्ता) र नागदुङ्गा-मुग्लिङ्ग सडक खण्डमा ०.२१ हेक्टर (११ कित्ता) प्रभावित हुनेछ । त्यसैगरी १८१ निजी घर तथा संरचना (१२२ घरधुरीका) सडक आयोजनाबाट प्रभावित हुने देखिन्छ । प्रभावित निजी घर तथा संरचना मध्ये आयोजनाले सडक खण्ड अनुसार विश्लेषण गर्दा सबै भन्दा धेरै नागदुङ्गा-मुग्लिङ्ग सडक खण्डमा ७६ निजी घर तथा संरचना प्रभावित हुनेछ । यसैगरी सिस्नेखोला-धार्के सडक खण्डमा ५८ निजी घर तथा संरचना र विशालटार-फिस्लिङ्ग सडक खण्डमा ४७ निजी घर तथा संरचना प्रभावित हुनेछ । यसैगरी आयोजनाले व्यापार संचालन भईरहेका ५१ संरचनाहरु प्रभावित हुनेछ जसमध्ये नागदुङ्गा-मुग्लिङ्ग सडक खण्डमा ४८ व्यापार संचालित संरचनाहरु र सिस्नेखोला-धार्के सडक खण्डमा ३ वटा व्यापार संचालीत संरचनाहरु प्रभावित हुनेछन् । विशालटार-फिस्लिङ्ग सडक खण्डमा भने कुनै किसिमका व्यापार संचालीत संरचना पर्दैनन् । सडक आयोजनाले १० वटा सार्वजनिक संरचनालाई प्रभाव पार्ने देखिन्छ । प्रभावित सार्वजनिक संरचनामध्ये ९ वटा नागदुङ्गा-मुग्लिङ्ग सडक खण्डमा र १ वटा सिस्नेखोला-

धार्क सडक खण्डमा पर्दछ भने विशालटार-फिस्लिङ्ग सडक खण्डमा कुनै किसीमका सार्वजनिक संरचना पर्दैनन् ।

आयोजनाबाट प्रभावित ७१० घरधुरीमध्ये ९६ परिवार अति प्रभावित हुने देखिन्छ । अति प्रभावित परिवार मध्ये ६२ घरपरिवारले आवासीय घर गुमाउने देखिन्छ भने ३४ घरपरिवारले आवासीय घरसँगै व्यापार गुमाउने देखिन्छ । आयोजनाबाट प्रभावित जम्मा घरधुरीमध्ये ९९ घरधुरी जोखिमयुक्त समुदाय सूचीमा पर्ने देखिन्छन् । जस अन्तर्गत ३३ घरधुरी दनुवार राई, २९ घरधुरी चेपाङ्ग, १९ दलित, १० महिला घरमुली भएको परिवार, ८ वृद्ध सदस्य भएको परिवार रहेका छन् ।

पुनर्वास कार्य योजना लागत अर्न्तगत प्रभावित जग्गा तथा घरसंरचनाको मुआब्जा, पुनर्वास तथा पुनर्स्थापना सहायता लगायत पुनर्वास कार्य योजना कार्यान्वयनका लागि लाग्ने अन्य खर्चहरु समावेस गरी छुट्टै पुनर्वास कार्य योजना तयार गरिएको छ ।

प्रभाव न्यूनिकरणका उपायहरु

प्रत्येक खण्डको बोलपत्र बमोजिम स्थान विशिष्ट वातावरण व्यवस्थापन कार्य योजना (ई.एम.ए.पि.) तयार गरी निर्माण व्यवसायीको बोलपत्र र ठेक्का सम्झौता करारनामामा खुलस्त हुने गरी अनुसूचिकरण गरिने छ । प्रस्तावित काठमाडौं(नागदुङ्गा)-नौविसे-मुग्लिङ्ग सडकको सुधार, स्तरोन्नति तथा सञ्चालन गर्ने साथै प्रस्तावित अन्य नयाँ राजमार्गको निर्माणकार्यबाट आयोजना क्षेत्रको भौतिक, जैविक, सामाजिक तथा साँस्कृतिक वातावरणमा केही सकारात्मक तथा नकारात्मक असर पर्नुका साथै विद्यमान अवस्थामा केही परिवर्तन हुने हुँदा त्यस्ता नकारात्मक असरहरुको पहिचान गरी तिनको प्रभाव न्यूनिकरण गर्नका लागि विभिन्न उपायहरु प्रस्तावित गरिएका छन् भने सकारात्मक प्रभावलाई हौसला प्रदान गरिने छ ।

सकारात्मक प्रभावलाई टेवा

गरीब, अशिक्षित, महिला तथा निम्न वर्गलाई आयोजनामा सहभागी हुन हौसला तथा प्रोत्साहन गरिने छ । यस आयोजनाले उक्त क्षेत्रको वातावरणमा टेवा पुर्याउन वृक्षारोपणका कार्यक्रमहरु पनि गर्ने छ । सडकको निर्माणको क्रममा सृजना हुने रोजगारीको अवसरहरु दक्ष तथा अदक्ष कामदारका लागि अवसर तथा सीप र साधनको प्रयोगबाट लाभ दिइने छ ।

नकारात्मक प्रभाव न्यूनिकरणका उपायहरु

सडक खन्ने वा पुर्ने कार्यगर्दा सकेसम्म सन्तुलन राखी खनिएको माटो वा ढुङ्गाको अधिकतम प्रयोग गरि उभ्रिएका माटो ढुङ्गालाई उचित स्थानमा लगी विसर्जन गर्ने रणनीति अपनाइने छ । यस्ता ढुङ्गा माटो विसर्जनका लागि उचित स्थानहरुको चयन गरिएको छ र विसर्जन पछि उक्त क्षेत्र पुनः उपयोगमा आउने किसिमले अथवा रुख विरुवा र घाँस रोप्ने कार्य गरिने छ । आयोजनाको प्रयोगका लागि बनाईएका क्याम्पहरु आयोजनाको समाप्ति पश्चात पुनः सरसफाई गरी पहिलेकै अवस्थामा छाडिने छन् । प्रभावित रुखहरुको हकमा वनसम्बन्धी सरोकार कार्यालयबाट स्वीकृति लिई काटिने छन् भने काटिएका रुखहरु सट्टाभर्ना स्वरुप एक रुख बराबर दशवटा रुखका विरुवाहरु रोपिने प्रस्ताव गरिएको छ । ११२.२ हे. (सट्टाभर्नाका लागि ७४.७६ हे. र वनक्षेत्र प्रयोग गरेवापत ३७.४४ हे.) क्षेत्रफलका साथै १,७९,५१४ गोटा बोटविरुवा (काटिन रुखहरुको हकमा १,१९,६१० र वनक्षेत्र प्रयोग गरेवापत

५९,९०४ गोटा) सट्टाभर्नाका लागि आवश्यक हुने छन् । नेपाल सरकारको प्रचलित नियम बमोजिम र स्थानीय निकाय, सामुदायिक वन उपभोक्ता समितिहरु र अन्य सरोकारवालाहरुको सहमतिमा वृक्षारोपण कार्य गरिने छ । भू-क्षय तथा पहिरो नियन्त्रणका उपायहरु अपनाई वृक्षारोपण तथा भीर पहरामा बायो-इन्जिनियरिङ्ग गरिने छ । निर्माण व्यवसायीले कामदार क्याम्पमा सफा पानीको व्यवस्था गरिने छ । निर्माण व्यवसायीले क्याम्पका सबै खाले सुरक्षा जस्तै; आगलागी नियन्त्रणका उपायहरु, सञ्चार साधन, विजुली तथा प्राथमिक उपचारका उपायहरु उपलब्ध गरिने छन् । सडक क्षेत्राधिकारभित्र रहेका प्रभावित तथा अस्थायी घर-टहराहरु जग्गा प्राप्ति ऐन, २०३४ अन्तर्गत रही अधिग्रहण गरिने छन् ।

वातावरण व्यवस्थापन योजना

यस वातावरणीय अध्ययनमा उल्लेखित सबै प्रभाव न्यूनिकरणका उपायहरु आयोजनाका विभिन्न चरणहरुमा कार्यान्वयन गरिने छन् । सडक निर्माण तथा सञ्चालनबाट पर्ने नकारात्मक असर तथा वातावरण व्यवस्थापन गर्न नेपाल सरकार तथा सडक विभागबाट प्रकाशित विभिन्न निर्देशिकाहरु एवं विश्व बैंकका सुरक्षण निती समेत पालना एवं कार्यान्वयन गर्नेछ । साथै, आयोजनाको विभिन्न चरणहरुमा चुस्त तथा प्रभावकारी अनुगमन भएमा उक्त सडक दिगो हुनका साथै स्थानीय सर्वसाधारणको राम्रो आर्थिक वृद्धि हुनेछन् । न्यूनिकरणका उपायहरु आयोजनाको ठेक्का पट्टाका कागजात तथा अनुगमन कार्यहरुमा समावेश गरिनेछन् । निर्माण व्यवसायीले वातावरण मैत्री निर्माण गर्न यस वातावरण प्रभाव मुल्याङ्कन प्रतिवेदनमा उल्लेखित विभिन्न योजनाहरु बनाइ कार्यान्वयनमा ल्याउनेछन् ।

निष्कर्ष

त्रिभुवन र पृथ्वी राजमार्गको नागदुङ्गादेखि नौबिसे हुँदै मुग्लिङ्ग सम्मको सडकको स्तरोन्नती तथा नयाँ राजमार्ग सिस्नेखोला-धार्के र विशालटार-फिस्लिङ्ग त्रिशूली नदिको दाहिने तर्फ निर्माण गरिने नयाँ मूल रणनितिक सडक संजालको निर्माण पश्चात राजमागले उक्त खण्डले समेट्ने जिल्लाहरु, नगरपालिकाहरु, गाउँपालिकाहरु शाखा सडकहरु मार्फत जोड्ने मात्र नभई विरगंजदेखि काठमाडौँ सम्मको यातायात तथा पारवहन क्षेत्रमा समेत सुध्दि हुने देखिन्छ । काठमाण्डौ(नागदुङ्गा)-नौबिसे-मुग्लिङ्ग सडकको निर्माण पश्चात उक्त सडक खण्डमा जोडिएका गोरखा जिल्लाका नगरपालिका/गाउँपालिकाहरु लगाएतका अन्य क्षेत्रका मानिसहरु आवत जावतको चाप भारीरूपमा वृद्धि हुने देखिन्छ । आयोजना क्षेत्रमा पहिचान गरिएका महत्वपूर्ण प्रभावकारी वातावरणीय असरहरु र सोको न्यूनिकरणका उचित उपायहरुलाई समाहित गरी वातावरणीय र सामाजिक प्रभाव मूल्याङ्कन अध्ययन प्रतिवेदन तयारी गरिएको छ ।

प्रस्तावित आयोजनाको कुल निर्माण लागत नेपाली रु. २२,५८१,३१६,५१५.६७ (अक्षरमा बाईस अर्ब अन्ठाउन्न करोड तेह्र लाख सोह्र हजार पाँच सय पन्ध्र र सरसाष्टी पैसा मात्र) अनुमान गरिएको छ । (पुर्नवासको लागत बाहेक) । प्रभावित १,३५१ विजुलीका खम्बाहरु सार्न रु. छ करोड पचहत्तर लाख तथा खानेपानीका पाईपहरु सार्न करिब रु. एकतिस लाख चार हजार प्रस्ताव गरिएको छ । त्यस्तै, आयोजनाले प्रभावितहुने सिंचाइ कुलोहरु स्थानान्तरण गर्न रु. सत्तरी लाख सतासी हजार नौ सय पैसष्टी प्रस्ताव गरिएको छ । क्षतीहुने रुखहरु काट्न तथा उक्तरुखहरुको सट्टाभर्नाका लागि र साथै

नर्सरी स्थापन तथा तालिम आदिका लागि रु. छ करोड उन्नान्सय लाख एकहत्तर हजार पाँच सय छयाँलि र सत्तरी पैसा अनुमान गरिएको छ। पुर्नःवासको लागि रु. तीन अर्ब एकाउन्न करोड अन्ठाउन्न लाख एक्काइस हजार चार सय अठासी प्रस्ताव गरिएको छ। सबै न्यूनिकरणका उपायहरुका साथै वायो-इन्जिनियरीङ्ग, तालिम तथा अभिमुखिकरण, सुरक्षा र पुर्नवास गरि जम्मा लागत रु. चार अर्ब चौतिस करोड एक्काइस लाख चौतिस हजार चार सय पैसठ्ठी प्रस्ताव गरिएको छ। पुनः आयोजनाको निर्माण तथा संचालनमा अनुगमनका लागि रु. उन्नाइस करोड पचहत्तर लाख अन्ठान्नवे हजार प्रस्ताव गरिएको छ।



Executive Summary

Introduction

Nepal is geographically a small landlocked country, situated between India and China. The major road corridor from Kathmandu to Birgunj connects the capital city with national border to India. Nepal government has the responsibility of improving the performance of road corridor from Birgunj to Kathmandu to increase the trade. The 276 Km stretch of road from Birgunj to Kathmandu is part of Asian Highway (AH-42) and is most important trade corridor in Nepal. Road improvement, upgrades, and construction of new alignments will be inevitable to maintain good transportation system, enhancing road safety and optimizing of freight transportation, correspondingly, minimizing and reducing time and costs of transportation, resources, and energy on the way from Kathmandu to the national border with India in Birgunj. The improvement of Kathmandu – Mugling section of existing highway is one of major strategic projects, ensuring efficiency of the entire road system, having enormous value for national economy. This section of the road is one of the key elements, providing connectivity not only to Terai Region on the way to Indian border, but also to one of the magnificent places of touristic destinations in the country: Pokhara and Annapurna Conservation Area. More tourists will be able to visit this area, likely, after improvement of the existing road and enhanced accessibility of the one of the major touristic destinations in the country. Further, improvement of Kathmandu- Naubise – Mugling highway will facilitate development of physical infrastructures, thus, contributing to local and regional development, economic initiatives, and improvement of local wellbeing.

Project Proponent

The Proponent of this project is the Department of Roads (DoR) implementing through Development Cooperation Implementation Division, Jwagal, Lalitpur under the Ministry of Physical Infrastructure & Transport (MoPIT).

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Project Description

The present report deals with the Environmental Impact Assessment of Kathmandu (Nagdhunga)- Naubise-Mugling Road project located in Kathmandu, Dhading, Chitwan of Bagmati Province and Gorkha district of Gandaki Province included in Nepal India Regional Trade and Transport Project (NIRTTP) project in Nepal. The project road starts at Nagdhunga and ends at Mugling covering a total length of 96 kms. The alignment passes through Nagdhunga, Naubise, Khanikhola, Mahadevbesi, Galchi, Baireni, Malekhu, Benighat, and Kurintar to reach Mugling. The KNM road alignment is an existing state road; with proposed new alignments such as Sisnekhola-Dharke approx- 11.2 km and Bishaltar-Phisling 15.3 km. The present road section is proposed for improvement and upgradation to two lane carriageway configurations with shoulders, side drains, bridges etc. 4 existing bridges Khahare Khola Bridge, Chiraudi Khola Bridge, Gomati Khola Bridge; and Hugdi River Bridge along the KNM section of Prithvi Highway will be relocated with the rehabilitation and construction of remaining bridges. In addition, 180 meter long tunnel has also been proposed at Wagalthok settlement along the proposed Sisnekhola-Dharke alignment.

Due to rugged landscape and threat of landslides, soil erosion and impact on watershed drainage system, several alternatives were proposed and analyzed. In the result of analysis, one of 6 proposed alternatives were selected, because it is responding to needs in highway improvement and solution of accumulated transportation problems and because assessed impacts from implementation of this alternative will cause less damages, comparing to others. The alignment Alternative No. 6 has been considered as the most feasible alternative that shall be implemented, enhancing economic activities with trade and transport as well as linking adjacent rural areas situated along the proposed highway with minimizing every environmental impact and the impacts that has been occurred during construction and operation phase properly. The project implementation time schedule has been estimated as 2 years to 3 years.

Proposed alternative has been divided into several sections:

- Improvement of Nagdhunga – Naubise part to 2-lane standard highway;
- Upgrading Naubise – Mugling section to 2-lane standard highway (with sections from Dharke to Benighat – 82.64 km and Kurintar to Mugling – 12.71 km);
- Construction of new Sisnekhola-Dharke alignment with approximately 180 m tunnel at Wagalthok settlement area;
- Construction of new Bishaltar to Phisling alignment on the right bank of Trishuli River in the Gorkha District.

In the new proposed alignments, the highway will cross-agricultural area, forest, and small settlements. So, the EIA was conducted for existing Kathmandu (Nagdhunga)-Naubise-Mugling road for its improvement and upgrading and for two new proposed sections: Sisnekhola – Dharke and Bishaltar – Phisling.

Affected Location with Wards along the existing KNM highway of DIA		
District	Municipality/Rural Municipality	Wards
Kathmandu	Chandragiri Municipality	2



District	Municipality/Rural Municipality	Wards
Dhading	Dhunibeshi Municipality	2, 6, 7, 8, 9
	Thakre RM	6, 7, 8, 1, 2
	Galchi RM	4, 6, 7
	Gajuri RM	5, 6, 1, 2
	Benighat Rorang RM	3, 5, 7, 8, 9, 10
Chitwan	Ichakamana RM	3, 5

Wards along the Sisnekhola-Dharke new alignment

District	Municipality/Rural Municipality	Wards
Dhading	Dhunibeshi Municipality	6, 8, 9, 2, 5

Wards along the Bishaltar-Phisling new alignment

District	Municipality/Rural Municipality	Wards
Dhading	Benighat Rorang RM	5
Gorkha	Gandaki RM	7, 8, 6
Chitawan	Ichakamana RM	3

Existing Environmental Conditions

The proposed KNM Road and its alternative alignments pass through the hilly area of Kathmandu, Dhading, Chitwan Districts in Bagmati Province and Gorkha District in Gandaki Province of the country. The proposed road alignment lies in the Middle Mountain (Lesser Himalaya). The elevation ranges from 1,500 m (Nagdhunga) to 265 m (Mugling) from above mean sea level (amsl). Nagdhunga is the highest point of the alignment, with most villages lying at about 1500m above sea level. The road alignment passes through hilly area from Nagdhunga to Naubise, after Naubise the road alignment passes river valley of the Mahesh Khola and Trishuli River, initially the road alignment follows bank of the Mahesh Khola valley to Galchhi, before meeting with Trishuli River. After Galchhi, road alignment follows the left bank of the Trishuli River valley upto Mugling. The project area comprises about 36 community forests, 8 governmental and 8 leasehold forests.

Present condition of the highway is poor and requires improvement. The Prithvi Highway has varied road conditions from Kathmandu Valley to Mugling. The highway is a two-lane single carriageway road with high grade and narrow intersections, sealed with Double Bituminous Surface Treatment (DBST) in almost all areas except, where regular maintenance is done. There is no traffic signage even at major intersections such as Naubise, Galchi, Malekhu, including no any traffic lights. No passing lanes are being provided. Speed limits aren't applied on most of the section, except some warning signs near urban and town areas and a few sharp bends. There are many areas to be treated for high grades, sharp bends and visibility for all road users. Accidents due to sharp bending and narrow width are high. Still the passing lanes along the proposed section are lacking and not sufficient, though some are being implemented in the Naubise - Nagdhunga Section. The road capacity is very low and often delays in transportation and traffic jams has been observed within this highway practically every

day. Very high level of air pollution, dust exposure, pollution of the road by solid wastes are observed almost along all length of the highway from Kathmandu to Mugling.

The methodology for data collection covered the literature review, analysis of relevant policies, laws, manuals and guidelines, studies of topographic maps, analysis of google map and existing landcover layers in Arc-GIS program, field investigation for physical and biological parameters with focus on the direct area of impact, interaction meetings, focus group discussion and key informant interview for biological and social parameters, specific surveys relevant to Valued environmental and cultural components in the project area. All obtained data were analysed for the identification of predicted direct, indirect and indirect impacts and evaluation possible mitigation measures in the project cycle. Following to selected methods and strategy, the detailed data were collected for the existing road and two new alignments for Physical, Biological and Socio-economic and Cultural environment, including:

- ❖ Physical environment: topography and geomorphology; climate and hydrology; regional geology with analysis of landslide and slope stability in the project area; land use in RoW, direct impact area and indirect impact area, air and water quality, noise level, solid waste management.
- ❖ Biological environment: terrestrial habitats (forests in the project area, their types including tree species and management); aquatic habitats including fish and aquatic fauna; terrestrial fauna in the project area comprising of mammal fauna, bird fauna and herpetophauna with assessment of presence and distribution of globally and nationally threatened species within the project area, analysis of critical wildlife habitats and their closeness to the road.
- ❖ Socio-economic and Cultural environment: local economy and wellbeing, social structure and services, structure of local communities, affected people, land and property, demographic features, including migration patterns, employment, landholding size, agricultural production, food sufficiency, access to social and other infrastructures, education, general health, hygiene and sanitation conditions.

Specific Impact of the Proposal on the Environment

Improvement of Kathmandu (Nadhunga) – Naubise – Mugling Road and Bridges comprises improvement and upgrading of existing road (from Kathmandu to Naubise and from Naubise to Mugling) and construction of new highway in new alignments (Sisnekhola – Dharke and Bishaltar – Phisling). Therefore, after the review of predicted general impacts in the KNM section, the analysis of the specific impacts has been done for separate packages requiring new construction. The identification and assessment of impacts has been carried out by considering activities in terms of pre construction, construction and operation phases. The impacts have been predicted in terms of their magnitude of significance (minor, moderate and high), extent (site specific, local, and regional), and duration (short, medium and long term). Most of the identified impacts have been quantified to the extent possible. Landslide, soil erosion, land use change, loss of trees and resettlement of local people are the major specific impact with the implementation of the proposal.

Beneficial Impacts

Strategic value of the KNM section development has been defined at the feasibility stage. The improvement of the existing road is highly beneficial for country economic development and transport efficiency, providing multiple services to local communities and industries, contributing to safety issues and allowing solving the environmental problems, associated with road inefficiency and traffic congestions.

Beneficial impacts of the KNM improvement include facilitated economic development, covering generation of employment and arising opportunities for businesses, tourism development, access to services and markets, improved road infrastructure contributing to safety issues and better transportation, etc. Beneficial impacts are related to improvement of road infrastructure and its technical efficiency, economic development and livelihoods of the local people. In total, 1,112,452.50 mandays of skilled labour and 5,567,448.00 mandays of unskilled labour will be generated during the time of construction. 741,635.00 mandays of skilled labour and 3,711,632.00 mandays of unskilled labour will be generated for the improvement and upgrading existing KNM. 184,398.75 and 847,968.00 mandays for skilled and unskilled labour respectively will be generated for Sisnekhola-Dharke alignment during the time of construction. Similarly, 186,418.75 and 1,007,848.00 mandays of skilled and unskilled labour respectively will be generated during the time of construction for Bishaltar-Phisling alignment.

Adverse Impacts

The project activities during construction and in subsequent operation and maintenance stages will create also a number of adverse issues and affect environment directly, indirectly, or in the result of cumulative effects and interactions between various impacts. In general, more than 70 adverse impacts were predicted and found by the team after visits to the project area and consultations with local people. Adverse impacts have been appeared as effects on physical environment: topography, geology, meteorology, hydrology, air and water quality, noise and pollution; effects on biological environment, including forest and aquatic habitats, terrestrial and aquatic biotic communities, species and ecosystems; and effect on socio-economic environment such as safety, health and sanitation, water and land use, cultural resources and practices, etc. Direct disposal of excavated material with the construction of new alignments Sisnekhola-Dharke and Bishaltar-Phisling can be consider as most significant. Impacts such as landslide, erosion, and slope stability issue are likely during construction and operation. After analysis, all impacts were grouped to several clusters for physical environment, for biological environment and for socio-cultural environment. The assessment of the impacts was quantified in packages for the existing highway from Kathmandu to Mugling and for two new alignments: Sisnekhola-Dharke, Bishaltar-Phisling by experts, engaged in data collection and analysis for physical and biological environment and for socio-economic and cultural components. Loss of cultivated land, landslide along the new open cut section especially along the proposed Sisnekhola-Dharke and Benighat-Phisling, loss of private and public physical structures and infrastructures is the major impact with the improvement of existing KNM and construction of proposed new alignments. Impact upon existing forests and wildlife is also likely due to opening of Sisnekhola-Dharke and Benighat-

Phisling new alignments. 37.44 ha of forest area will be affected and 11,961 trees of different species will be felled down; among which 979 is big trees with wider diameter and 10,982 pole trees with smaller diameter. Similarly, 901,765 cums of excavated materials generated from the construction of new roads and improvement of existing highway needs to be disposed safely.

Altogether 710 households are affected by the road project. Among them 78 households will be affected by losing private structures only. Similarly, 44 households will be affected by losing land and structure. Likewise, 588 households will be affected by losing land only. In Sisnekhola-Dharke road section the project affected HHs number (384 HHs) is higher than Nagdhunga-Mugling road section (78 HHs) and Bishaltar-Phisling road section (284 HHs). A total 43.33 hectare private land is required for the road construction and improvement. Out of total affected private land, in Sisnekhola-Dharke section 25.40 hectare (590 Parcels), Bishaltar-Phisling section 17.71 hectare (356 Parcels) and Nagdhunga-Mugling section 0.21 hectare (11 Parcels) will be affected during upgrading and new road construction works. Altogether, 181 private structures (of 122 HHs) are affected due to the project. Out of total affected private structure, 76 private structures in Nagdhunga-Mugling section, 58 private structure in Sisnekhola-Dharke section, and 47 private structures in Bishaltar-Phisling section will be affected. Trade conducted total 51 structures has been affected. Among them 48 trade conducted structures have been identified in Nagdhunga-Mugling road section and 3 trade operated structures have been identified in Sisnekhola-Dharke road section. None of household has been identified in the Benighat-Phisling road section. Likewise, a total of 10 public structures are affected by project. Most of the affected public structures (9 structures) lies Nagdhunga-Mugling section. No any public structure fall on Bishaltar-Phisling section.

A total of 96 households are categorized under severely project affected family among 719 households. Among them 62 households are losing residential houses and 34 households are losing residential cum trade house. The assets loss inventory and census of available project affected household identified 62 households of ethnic minorities as Danuwar Rai (33) and Chepang (29). Likewise, 19 Dalits households, 10 women-headed and 8 aged member households were identified. Calculating the above mentioned group, a total of 99 households have been categorized under vulnerable households.

The summary of resettlement action plan implementation cost includes all the expenses required to compensate the affected assets including rehabilitation costs and other financial assistance, a separate Resettlement Action Plan has been prepared.

Mitigation Measures

A series of Site-Specific Environmental Management Action Plans (EMAPs) tailored specifically for construction contractors for each of the bid packages, developed, so as to be directly annexable to bidding documents and contracts. Permanent change in land use, loss of forest cover, generation of spoil due to earthwork excavation and requiring safe disposal are considered as the major impacts with its implementation. Construction and operation of KNM road project will generate substantial economic opportunities easing transportation reducing time and cost. Most of the impacts during construction activities can be reduced or restricted through construction works. Mitigation Measures were proposed with the identification of both

positive and negative environmental impacts to avoid, reduce, or minimize significant adverse environmental impacts and to augment beneficial environmental impacts upon physical, biological, socio-economic and cultural environment from the operation of road project.

Benefit Augmentation Measures

Poor people, women and minorities has been motivated and emphasized to work as a labour; which will generate livelihood for such minorities. On the job trainings has been provided to labours.

Adverse Impact Mitigation Measures

Any sort of discarded construction materials shall be disposed off in the designated tipping site. Such tipping site will not be located closer to settlement areas, community forest, steep slope areas, water bodies and any other environmentally sensitive areas. Natural beauty shall be magnified with the plantation of trees maintaining vegetation within the project area. Contractor will ensure the sufficient supply of clean water to labour camp for cleaning, drinking, washing, and bathing of labours. Re-plantation has been carried out at the end of construction stage in the ratio of 1:10 within the project area and in community forest area as far as possible. 179,514 saplings (119,610 for compensatory plantation and 59,904 for the use of forest area) will be required for compensatory plantation with 112.2 ha. (74.76 ha. for re-plantation and 37.44 ha for the use of forest land) of land. Landslide areas has been protected by applying toe protection walls such as gabion wall and will apply bioengineering on hill slopes above it. The workers have been provided with helmets, masks, etc. depending on the nature of the construction work. Workers has been provided with first aid and health facilities. There has been provision for group accidental insurance for the workers. Contractor will maintain precautionary measures for extinguish accidental fire hazards, shot circuit in electricity etc. in labour camp and will also provide proper communication and first aid facility and proper lighting facilities at camp sites and near to the working area. The provision of relocation of affected structures has been carried out as per Land Acquisition Act, 2034.

Environmental Management Plan (EMP)

The EMP was designed to help clients meeting both statutory regulations and social obligations in reducing or eliminating adverse impacts as well as World Bank safeguard policy requirements. The EMPs defined technical work programme including details of required tasks and reports and necessary staff skills, supplies and equipment a detailed accounting of the estimated costs to implement the plan including proposed staffing, schedules of participation and inputs of different agencies. Environmental Management Plans (EMP) includes the main roles and responsibilities of the different agencies at different stages of project implementation including monitoring and supervision program. The monitoring and supervision program is employed to measure the effectiveness of environmental enhancement and mitigation measures implemented for the proposed project that can be beneficial as well as adverse environmental impacts. The environmental monitoring ensures that the impacts do not exceed the established standards, checking the implementation of enhancement and mitigation measures in the manner described in EIA. Further, guidelines prepared by DOR and GON have been followed to manage environment as well as minimize environmental impacts resulting from road



construction and operation. Contractor has been responsible to prepare different plans during construction survey stage in order to safeguard environment. Environmental monitoring will be carried out to ensure effective implementation of the proposed measures for the mitigation of anticipated and predicted environmental impacts. Timely and regular monitoring of the project activities will be required to ensure the effectiveness of the proposed environmental mitigation measures. The objective of monitoring is to provide information that the predicted impacts of a project are within the acceptable limits and to provide early warning about unacceptable environmental conditions; checking the implementation of enhancement and mitigation measures in the manner described in the impact chapter of EIA report. Environmental Monitoring will be carried out with the identification of a set of indicators. At the same time, EMP assists to ensure compliance with environmental laws and in ameliorating and eliminating adverse impacts caused by the project. A detailed monitoring program in the form of an Environmental Management Plan (EMP) was prepared for its effectiveness during monitoring.

Conclusion

Improvement and upgrading of existing section of Tribhuwan and Prithvi Highway starting from Nagdhunga to Mugling via Naubise and construction of additional new sections Sisnekhola-Dharke and Bishaltar-Phisling the development of strategic road along the right bank of Trishuli River will enhance accessibility not only to interlink adjacent villages, district municipalities along the the alignments but also enhances freight transportation from Birgunj to Kathmandu. Flow of people from all over the adjacent Municipalities of Gorkha district will be substantially increased along the KNM Road. EIA report has been prepared with the identification of significant environmental impacts with its suitable mitigation measures.

The estimated total project cost for the construction is NRs. 22,581,316,515.67 in words Twenty two billion five hundred eighty one million three hundred sixteen thousand five hundred fifteen and sixtyseven paisa only (Excluding Resettlement cost). The cost estimated for relocation of 1351 numbers of electric poles is NRs. 67,550,000.00 and relocation of water supply pipes is NRs. 3,104,000.00. Similarly, the cost for relocation of irrigation canals is NRs. 7,087,965.00. Cost of compensatory plantation and nursery establishment including trainings is estimated to be NRs. 69,971,546.70. The estimated resettlement cost is NRs. 3,515,821,488.00. The total cost estimated for environmental mitigation including cost for bioengineering, orientation and trainings, safety and resettlement is NRs. 4,342,134,465.80. Moreover, the estimated cost for the monitoring during construction and operation period is NRs. 197,598,000.00.



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Abbreviation

CBS	- Centre Bureau of Statistics
CFUG	- Community Forest User Group
°C	- Degree Celsius
DBST	- Double Bituminous Surface Treatment
DCID	- Development Cooperation Implementation Division
DIA	- Direct Impact Area
DOR	- Department of Roads
EIA	- Environmental Impact Assessment
EMAP	- Environment Management Action Plan
EMP	- Environmental Management Plan
EPA	- Environment Protection Act
EPR	- Environment Protection Rules/Regulation
ESIA	- Environmental and Social Impact Assessment
ESMF	- Environmental and Social Management Framework
GESU	- Geo-Environmental and Social Unit
GoN	- Government of Nepal
Ha	- Hectare
IEE	- Initial Environmental Examination
IIA	- Indirect Impact Area
Km/km	- Kilo Meter
Km ²	- Square Kilometer
KNM	- Kathmandu(Nagdhunga)-Naubise-Mugling
l/s	- Liter per Second
M	- Meter
Mm	- Millimeter
MoFE	- Ministry of Forest and Soil Conservation
MoPIT	- Ministry of Physical Infrastructure and Transport
NPC	- National Planning Commission
NGO	- Non-Governmental Organization
NIRTP	- Nepal India Regional Trade and Transport Project
NTFP	- Non-Timber Forest Product
NTIS	- Nepal Trade Integration Strategy
NLTA	- Non-Lending Technical Assistance Program
PRM	- Prithvi Rajmarg
ROW	- Right of Way
RM	- Rural Municipality
TOR	- Terms of Reference
TRP	- Tribhuvan Rajpath
VDC	- Village Development Committee
WB	- World Bank
ZOI	- Zone of Influence



CHAPTER 1: Name and Address of the Proponent and Institution/s Preparing the Report

1.1 Name and Address of Proponent

The Proponent of this project is the Department of Roads (DoR) implementing through Foreign Cooperation Branch, Kathmandu. It functions under the Ministry of Physical Infrastructure & Transport (MoPIT) and has the responsibility of the planning, design, construction and maintenance of strategic road networks and feeder roads including its associated other physical structures e.g. Bridge. The name and address of the proponent is as follows;

Name and address of proponent

Nepal India Regional Trade and Transport Project, Development Cooperation Implementation Division, Department of Roads, Jwagal, Lalitpur, Kathmandu, Nepal Facsimile: 977-1-5542532 Phone No.: +977-1-5541686/87 Email: dordcid@dor.gov.np	Geo-Environment and Social Unit (GESU), Department of Roads, Chakupat, Lalitpur, Nepal Phone No.: 977-01-5005520 Email: gesunit@dor.gov.np
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1.2 Name and Address of the Institution preparing the report

The present report for the “Environmental Impact Assessment of Kathmandu (Nagdhunga)-Naubise-Mugling Road and Bridges” has been prepared for the Project Proponent by the following Consultants:

Environment Resource Management Consultant, (ERMC) (P.) Ltd.

Joint venture with

Group of Engineers’ Consortium (P) Ltd. (GEC) and Udaya Consultancy (P.) Ltd.

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CHAPTER 2: Introduction

2.1 The Project Background

Nepal is geographically a small landlocked country situated between India and China. Most of the commercial transactions are conducted through India. Thus, the Government of Nepal (GoN) has the responsibility of improving the performance of road network in the country to improve trade and ensure communication networks between different regions of the country. The 276 Km stretch of road from Birgunj to Kathmandu is part of the Asian Highway (AH-42) and it is an important trade corridor in Nepal. The road transport between Kathmandu to Birgunj plays a vital role in both the trade and transit between Nepal and India, and provides access to the markets of third countries through Kolkata seaport. Kathmandu connects with Birgunj via Naubise-Mugling-Narayanghat-Hetauda-Pathlaiya for the freight transportation.

To enhance efficiency in the road transport and improve road safety, Nepal government intends to improve the road corridor from Birgunj to Kathmandu. As a first step, improvement of road section from Narayanghat to Mugling is considered under Nepal India Regional Trade and Transport Project (NIRTTP).

Enhancing trade competitiveness is one of six priorities of the Government of Nepal's development plan. For this, the Government of Nepal (GoN) has requested the World Bank to provide IDA financing, to support Nepal in addressing its commitments to enhancing regional trade including along the Kathmandu-Kolkata Corridor. The GoN's 2010 Nepal Trade Integration Strategy (NTIS) seeks to enable inclusive growth in Nepal through enhancing the competitiveness of Nepal's exports and reducing the cost of trade.

The priorities of this strategy include: (i) reducing the time and cost of trade-related transactions through efforts on simplification, harmonization, and automation; (ii) building the capacity of domestic trade-related institutions including for sanitary and phytosanitary inspections, trade negotiations, trade facilitation and logistics, and monitoring and regulating trade-related sectors; and, (iii) enhancing the Government's ability to coordinate trade-related institutions and development partners.

Towards meeting the priorities identified in the NTIS, the World Bank is implementing the Nepal Regional Trade Non-Lending Technical Assistance Program (NLTA), designed to enhance the government's capacity to implement the NTIS by providing technical assistance to the key trade-related institutions to: (a) develop plans for trade facilitation and logistics; (b) put in place an effective monitoring system; (c) undertake key sector studies and receive just-in-time expertise (as needed) and; (d) draft capacity development plans (including for HR development, change management and coordination).

Institutions covered by this NLTA include the Ministry of Commerce and Supplies (and its agencies Nepal Intermodal Transport Development Board Secretariat and Trade and Export Promotion Council), Department of Customs, and Ministry of Physical Planning, Works and Transport Management. Key results expected include: (i) Enhanced capacity to monitor transport time and costs at Nepal's main trade corridor, the Kolkata-Raxaul-Birgunj-Kathmandu Corridor; (ii) Enhanced capacity to coordinate trade-related institutions and development partners; and (iii) Enhanced capacity/knowledge in trade facilitation and logistics.



The name of the Proposal is “Environmental and Social Impact Assessment of Kathmandu (Nagdhunga)-Naubise-Mugling Road and Bridges”. However, the project also comprises new alignments such as Sisnekhola to Dharke, which is approximately 11.2 km and Bishaltar to Phisling approximately 15.3 km.

2.2 Context of the Proposed Project

The proposed **Kathmandu (Nagdhunga)-Naubise-Mugling (KNM)** road starts from Nagdhunga. The construction of Prithivi Highway started in 1967 with the help of the Chinese government and the construction was completed in 1974. The highway is a 2-lane connecting Kathmandu to Pokhara via Naubise, Malekhu, Mugling, Anbukhaireni, Dumre and Damauli. Along the Kathmandu-Naubise-Mugling Section of Prithvi highway has a junction with Tribhuvan Highway at Naubise. The highway also connects Nuwakot District via a newly constructed road in Galchhi and connects to the district headquarter of Dhading District at Phurke Khola, Malekhu. Similarly, at Mugling the highway has junction of Mugling-Narayanghat Road Section connecting this highway to Mahendra Highway, the longest highway in Nepal.

The project starts in Kathmandu District and ends in Chitwan District passing through Dhading and Gorkha District. The entire districts fall in Bagmati Province and Gandaki Province of Nepal. The road section starts at Thankot Check post and ends at Mugling Bazaar of the Chitwan district. The actual distance to Mugling Bazaar is 96 Km from Nagdhunga of Chandragiri Municipality.

Present condition of the highway is poor and requires improvement. The Prithvi Highway, because of the terrain it follows, the loading on the roads and amount of traffic it carries, has varied road conditions from Kathmandu Valley to Mugling. The highway is a two-lane single carriageway road with high grade and narrow intersections, sealed with Double Bituminous Surface Treatment (DBST) in almost all areas, except where regular maintenance is done. There is no traffic signage even in major intersections such as Naubise, Galchi, Malekhu, including no any traffic lights. No passing lanes are being provided. Speed limits aren't applied on most of the section, except some warning signs near urban and town areas and a few sharp bends. There are many areas to be treated for high grades, sharp bends and visibility for all road users. Accidents due to sharp bending and narrow width are high. Still the passing lanes along the proposed section are lacking and not sufficient, though some are being implemented in the Naubise - Nagdhunga Section.

As the populations residing on both sides of the highway are increasing, care should be taken for the safety along the highway. No any road crossing structures are established at the populated settlement areas all along the alignment. The local intersections constructed by local residents should be addressed, before they become critical for road safety. Proper signage and other roadside furniture are required to be installed.

With a view to all these constrains the DOR has carried out feasibility study of the KNM section through a feasibility consultant. The feasibility consultant team has identified several alternatives for the KNM section. The EIA team has investigated and analysed each alternative for the analysis of alternatives identified by the feasibility and detail design team. Alternative

analysis has been carried out with various assessment criteria such as road length, slope stability and geology, hydrology, loss of structures, change in land-use pattern, etc.

Table 2-1: Project road is part of two major Highways of Nepal as described in below

Highway Section	Length in Km
Nagdhunga-Mugling	96.0
Sisnekhola-Dharke	11.2
Bishaltar-Phisling	15.3
Total	122.5

Nagdhunga — Naubise Road

Nagdhunga- Naubise 12.5 Km existing Road is part of Tribhuvan Rajpath (TRP) which is a national highway as per DOR classification with road reference no. H 02. This road was initially constructed in 1956 AD, and, then, rehabilitated in 1997 AD.

Further, the section also comprises proposed new alignment from Sisnekhola to Dharke with approximately 11.2 km that splits from existing highway at Sisnekhola and traverse towards northern hill and passing through pine forest; which will again traverse towards hilly area of Waglethok settlement and gradually declines towards cultivated land before reaching to United cement factory. The proposed alignment then traverses through northern boundary of the cement factory and crosses the existing river near the confluence of Dhuni Khola and Rupse Khola. The proposed alignment then passes through the right bank of Maheshkhola all through the cultivated land before it reaches to existing highway at Dharke. The proposed new alignment Sisnekhola-Dharke will also comprise 5 new bridges along the alignment.

Naubise — Mugling Road

Naubise — Mugling Road is a part of Prithvi Rajmarg (PRM), a national highway as per DOR classification with road reference no. H04. The road was constructed in 1973 AD and rehabilitated/upgraded in 1995 AD.

Moreover, the section also comprises proposed new alignment from Benighat to Phisling along the right bank of Trishuli River with approximate length of 15.3 km. The proposed alignment passes through terraces and undulation cultivated land, steep hilly areas covered by vegetation before it reaches to the Phisling. The proposed alignment will comprise 8 new bridges along the Benighat-Phisling. The bridge at Trishuli River at Phisling is under construction by separate construction package.

2.3 Existing Highway

Based on investigations by the Design Consultants the salient features of existing project road have been given in Table 2-2.

Table 2-2: Salient Features of the existing highway

Sn.	Salient features	Descriptions
1	Name of the Project Road	Nagdhunga-Naubise-Mugling Road
2	Length	96 Km



Sn.	Salient features	Descriptions
3	Terrain	Steep Hilly and Mountainous
4	Existing bituminous carriageway width	5.50m to 6.50m
5	Existing shoulders widths	0.50m to 1.00m
6	Number of major horizontal curves	107
7	Location of steep vertical gradients	46
8	Number of hairpin bends/blind curves	6
9	Number of major villages/bazaar	12
10	Length of existing side drains	102 Km
11	Number of existing bridges	26
12	Number of existing culverts	445
13	Length of existing retaining walls	14985 m
14	Length of existing breast walls	6701 m
15	Length of existing gabion walls	5135 m
16	Number of major junctions	6
17	Number of minor junctions	64
18	Length of existing median	Nil
19	Length of existing footpath	Nil
20	Right of Way	50 m

Nagdhunga — Naubise Road

Nagdhunga- Naubise Road is part of Trivuvan Rajpath (TRP) which is a national highway as per DOR classification with road reference no. H 02. This road was initially constructed in 1956 AD and then rehabilitated in 1997 AD. The present salient existing features of this section of road are mentioned below:

- **Name of Road** : **Nagdhunga — Naubise Road**
- **Road Reference No** : **H 02**
- **Link Code**
 - **Nagdhunga to Peepalmod** : **H 0214**
 - **Peepalmod to Naubise** : **H0213**
- **Length** : **12.5 Km**
- **Carriageway Width** : **5.5 to 7.5 m**
- **Shoulder Width** : **0.5 m**
- **Formation Width** : **7.5 — 9.5 m**
- **Minimum Radius of**
- **Horizontal Curve** : **17 m**
- **Number of Horizontal Curves** : **169**
- **Number Curves with R=or<25m** : **33**
- **Maximum Gradient** : **10.19% at Km 0+289; 10.34% at Km 1+512; 10.31% at 2+451**
- **Grade more than 7 %** : **At 20 locations**
- **Pavement Composition** : **Sub-base 20 cm**
Base 18-25 cm and
Bituminous Layer 5 - 10 cm

- **Condition of Road Pavement** : Fair to Poor; IRI >7; SDI 1.7— 3.
- **Number of Bridges** : 2 Nos, Total Length: 45 m
- **Number of Culverts**
 - **Hume Pipe** : 52
 - **Slab Culvert** : 8

Naubise — Mugling Road

Naubise — Mugling Road is a part of Prithvi Rajmarg (PRM), a national highway as per DOR classification with road reference no. H04. The road was constructed in 1973 AD and rehabilitated/upgraded in 1995 AD. Some of the existing features of this road are depicted below:

- **Name of Road** : Naubise - Mugling Road (Part of PH)
- **Length** : 82+850Km
- **Road Reference No** : H 04
- **Link Code**
 - **Naubise to Galchhi** : H 0401
 - **Galchhi to Trishuli Bridge** : H 0402
 - **Trishuli Bridge to Mawa Khola** : H 0403
 - **Mawa Khola to Mugling** : H 0404
- **Carriageway Width** : 6.5 m
- **Shoulder Width** : 1.0 m
- **Formation Width** : 8.5 m
- **Minimum Radius of Horizontal Curve** : 20 m at Km 12+324 and Km 79+786
- **Number of Horizontal Curves** : 577 Nos.
- **Maximum Gradient** : 8.21 % at Km 38+324
- **Gradient more than 7%** : At 30 places
- **Pavement Composition** :

Wearing Course	40 mm
Binder Course	60 mm
Wet mix Base/ESB	150-200 mm
Granular Sub-base	200-250 mm
- **Condition of Road Pavement** : Fair to Good; IRI <6, SDI <3
- **Number of Bridges** : 24 Nos. Total Length 766.5 m
- **Number of Culverts**
 - **Hume Pipe** : 50
 - **Box Culvert** : 2
 - **Slab Culvert** : 333
- **Major Landslide Areas**
 - Krishnabhir at Km 58
 - Jogimara at Km 64
- **Major Junctions**
 - Naubise at Km 0+000 : Junction to Hetauda (TRP)
 - Galchhi at Km 22+400 : Junction to Nuwakot



- | | | |
|--------------------------|---|---------------------------------------|
| ➤ Malekhu at Km 42÷200 | : | Junction to Dhadingbesi |
| ➤ Benighatat Km 50+900 | : | Junction to Gorkha District |
| ➤ Darechaur at Km 78+100 | : | Junction to Manakamana Cable Car Gate |
| ➤ Mugling at Km 82+000 | : | Junction to Narayanghat and Pokhara |

2.4 Basis of Selection of the Road Alignment

Different alternative routes identified and prioritized by feasibility consultant have been analyzed. The alternative routes identified and studied focuses on major two options as Two-Lane Option and Four-Lane Option, including existing road upgrading and new road.

2.4.1 Alignment for Conduction of EIA

As it is mentioned above, the alignment Alternative No. 6 has been considered as the most feasible alternative. During the detailed feasibility study period, alternative 6 has been investigated in detail at site. Geometric and road standards have been verified based on the technical parameters, social, environmental, economic, and financial aspects. This alternative was recognized as the most appropriate alignment that will provide higher level of services including acceptable level of performance from all sorts of criteria. Alternative 6 technically is comprised by several components:

- Improvement of existing KNM road into 2-lane standards with bridges;
- Construction of two new proposed sections (Sisnekhola-Dharke 11.2 km and Beshaltar – Phisling 15.3 km) with 14 bridges.

Existing road and bridges as well as new proposed sections were studied in details in terms of identification for possible predicted physical, biological, and socio-economic impacts.

2.5 EIA Study Team and Declaration

The present ESIA report was prepared by the Environment & Resource Management Consultant ERMC (P) Ltd., Group of Engineers' Consortium (P) Ltd. (GEC) and Udaya Consultancy (P) Ltd. The list of involved project team is presented in Annex.

2.6 Objectives of EIA

As set out in the Environment Protection Rules (EPR) of 1997 and its amendment in 1999, and the National EIA Guidelines 1993, the main objectives of this EIA are to:

- Collect baseline data on physical, biological, socio-economic and cultural environment;
- Identify, predict, and evaluate the potential environmental impacts of the alternatives in proposed Kathmandu (Nagdhunga)-Naubise-Mugling Road and Bridges, covering Kathmandu, Dhading, Gorkha and Chitwan districts in Bagmati Province and Gandaki Province of Nepal.
- Calculate loss of different categories of land, property, forest and other resources as a part of site clearance and maintaining the RoW of the proposed road alignment.
- Suggest mitigation measures for adverse impacts and enhancement measures to maximize beneficial impacts.
- Consult and inform the project affected parties and other concerned stakeholders and ensure active people participation.

- Provide information for decision makers regarding environmental implementation of the project.
- Develop Environmental Management Action Plan (EMAP), comprising of:
 - Environmental Monitoring Plan (with implementation modalities of the proposed mitigation measures and monitoring requirement), and
 - Environmental Auditing Plan.
- Develop information dissemination and consultation strategy for implementation of the project.

2.7 Rationality of the EIA

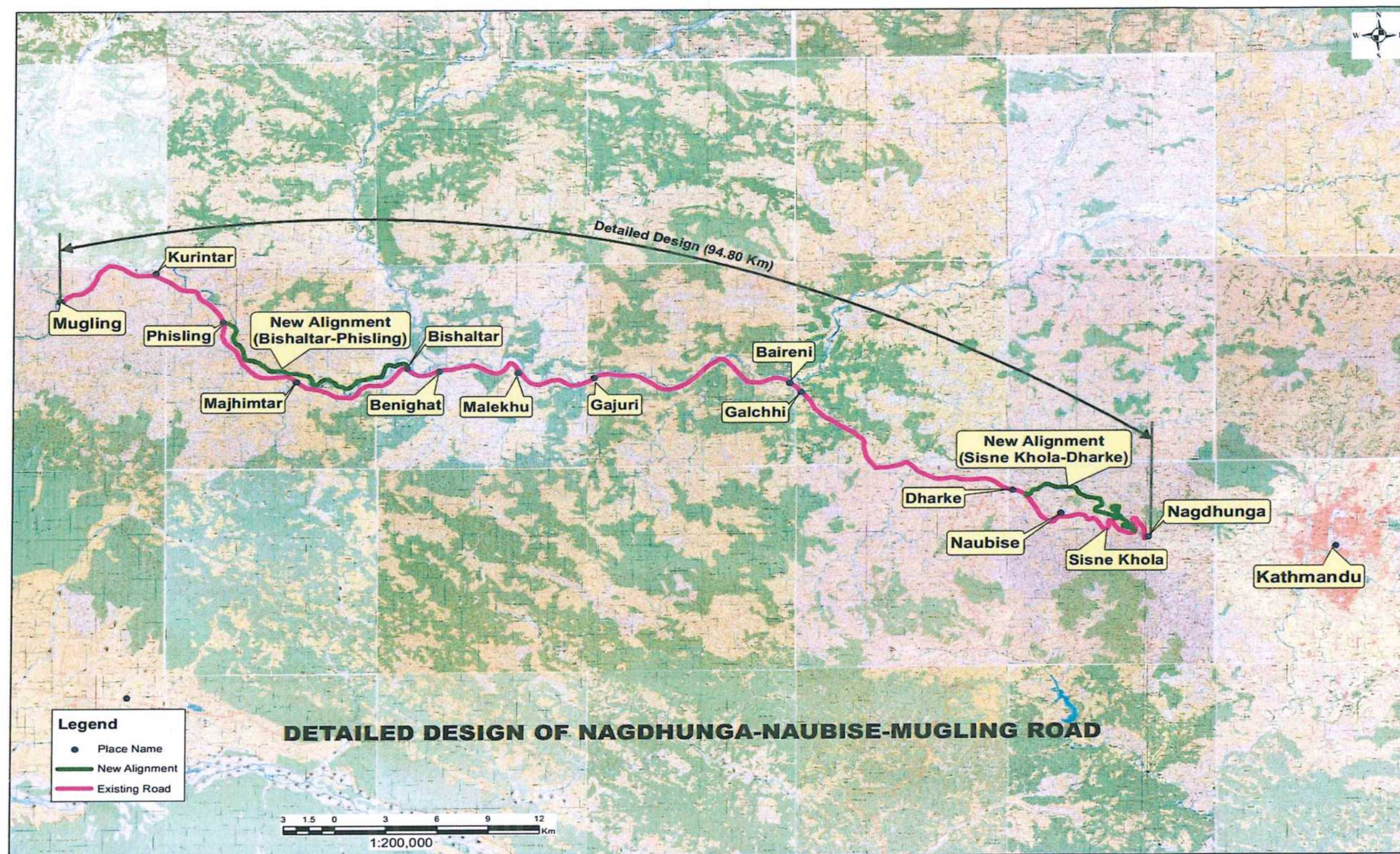
The rationality for conducting EIA is to determine whether the implementation of project will result adverse environmental impacts such as triggering of landslides, soil erosion and depletion of existing forest condition, displacement of local people, etc. The work on upgrading of existing highway and construction works in new alignments likely might cause environmental impacts in the physical, biological, socio-economic, and cultural aspects. Thus, an EIA level study is necessary to identify and study the extent and magnitudes of the impacts and to suggest necessary mitigation measures following to mitigation hierarchy principles.

The integration of environmental conservation with development endeavors is reinforced with the mandatory provision through the Environment Protection Act, 1997 (EPA) and Environmental Protection Rules, 1997 (first amendment, 1999), (EPR-section 3). Also, the Policy Document of DoR on Environmental Assessment in the Road Sector of Nepal (January 2000) requires an Environmental Impact Assessment for national highways and main feeder roads category. As per Schedule 2 (pertaining to Rule 3) Clause D Road Sector – No. 1 (a) of EPR (1997), EIA report should take approval from Ministry of Forest & Environment (MoFE), prior to its implementation. The EPR obliges the proponent to follow the set of legal processes and get the approvals from the competent authorities before the implementation of the development projects requiring a full-scale EIA. Proposals, which are likely to have significant adverse impact on the environment, require an environmental impact assessment report to be prepared (Schedule 2, of EPR, 1997). Further, Schedule 2 (pertaining to Rule 3) of EPR; Clause A Forest Sector No.17, also states that “Any proposal requiring clearance of over 5 hectares of forest area”. The project will require acquisition of 37.44 ha forest area with the construction of new alignments; hence requiring a full-scale EIA. In this context, the EIA Report of the Proposal has been prepared after the approval of Scoping Document and Terms of Reference (ToR) from the MoFE. EIA study has been conducted and mitigation measures are proposed for every environmental impact from all the anticipated project activities.

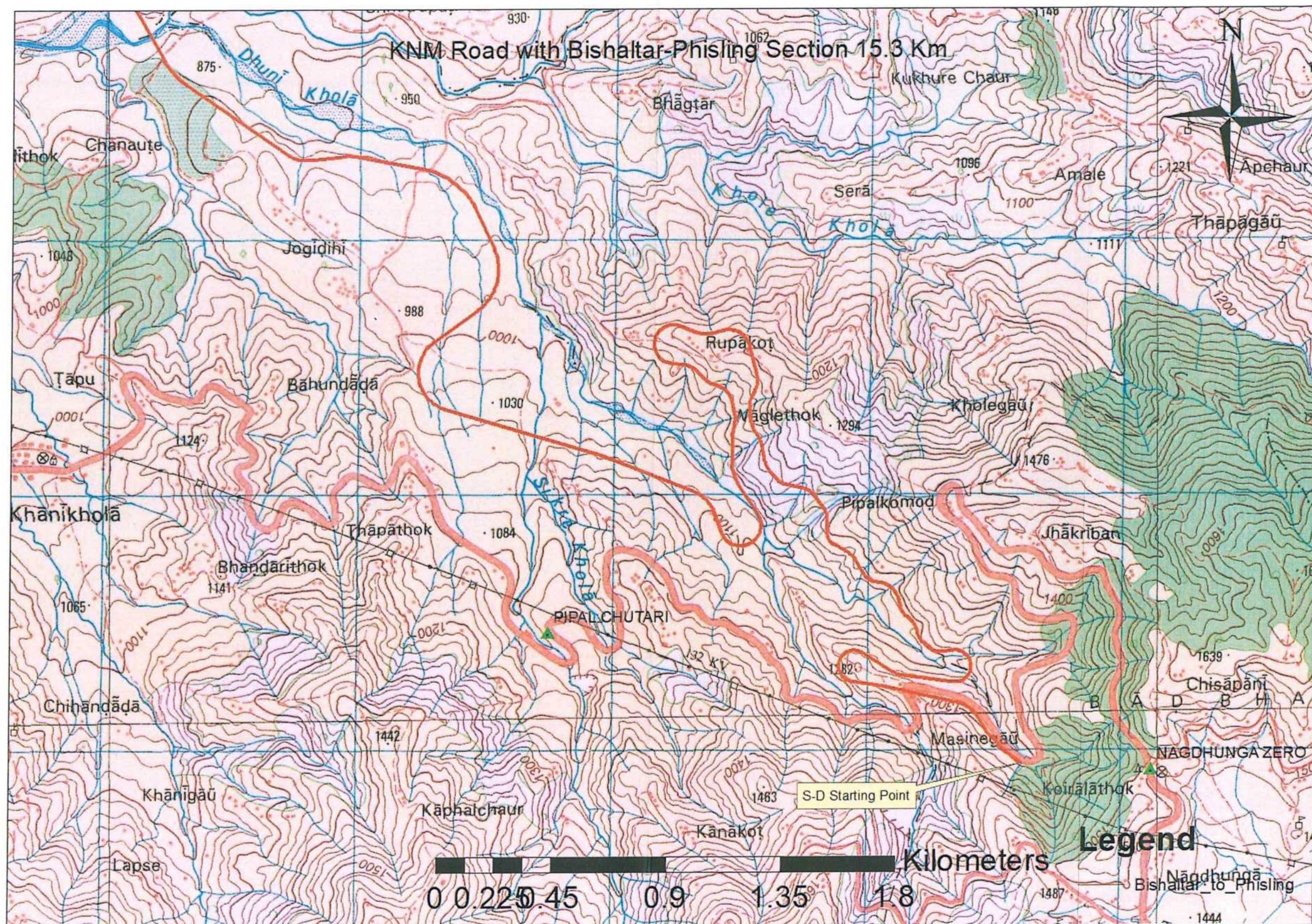
2.8 Scope of EIA

The scope of this EIA covers improvement of existing highway from Nagdhunga to Mugling including construction of Sisnekhola-Dharke and Bishaltar-Phisling new alignment with bridges. In addition to that, the EIA also covers assessment of construction materials, quarry sites, location for labour camps, and spoil disposal sites proposed within direct as well as indirect impact zone.

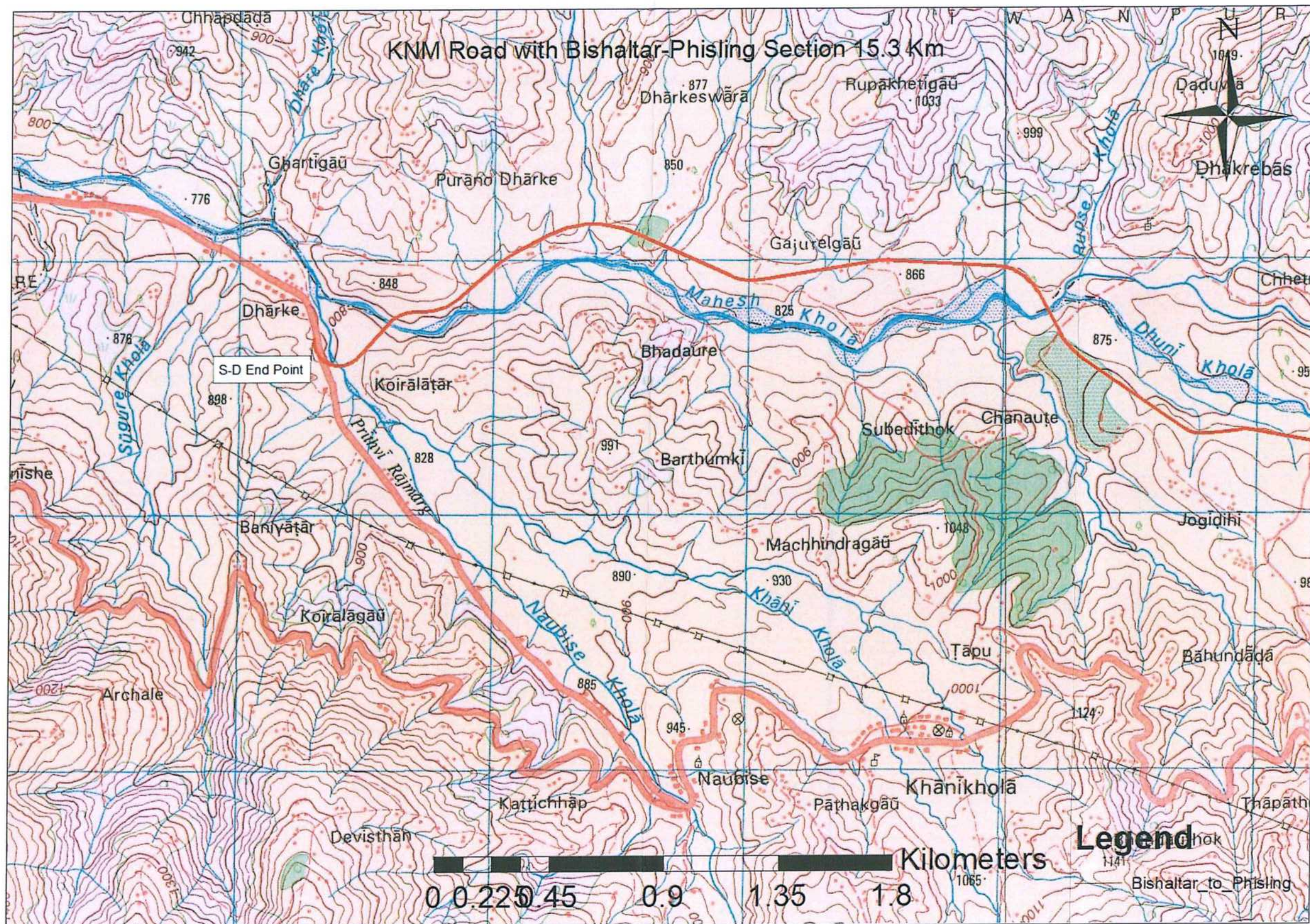




Map 2-1: Project area: existing highway and proposed new alignments in Sisnekhola-Dharke and Bishaltar-Phisling.

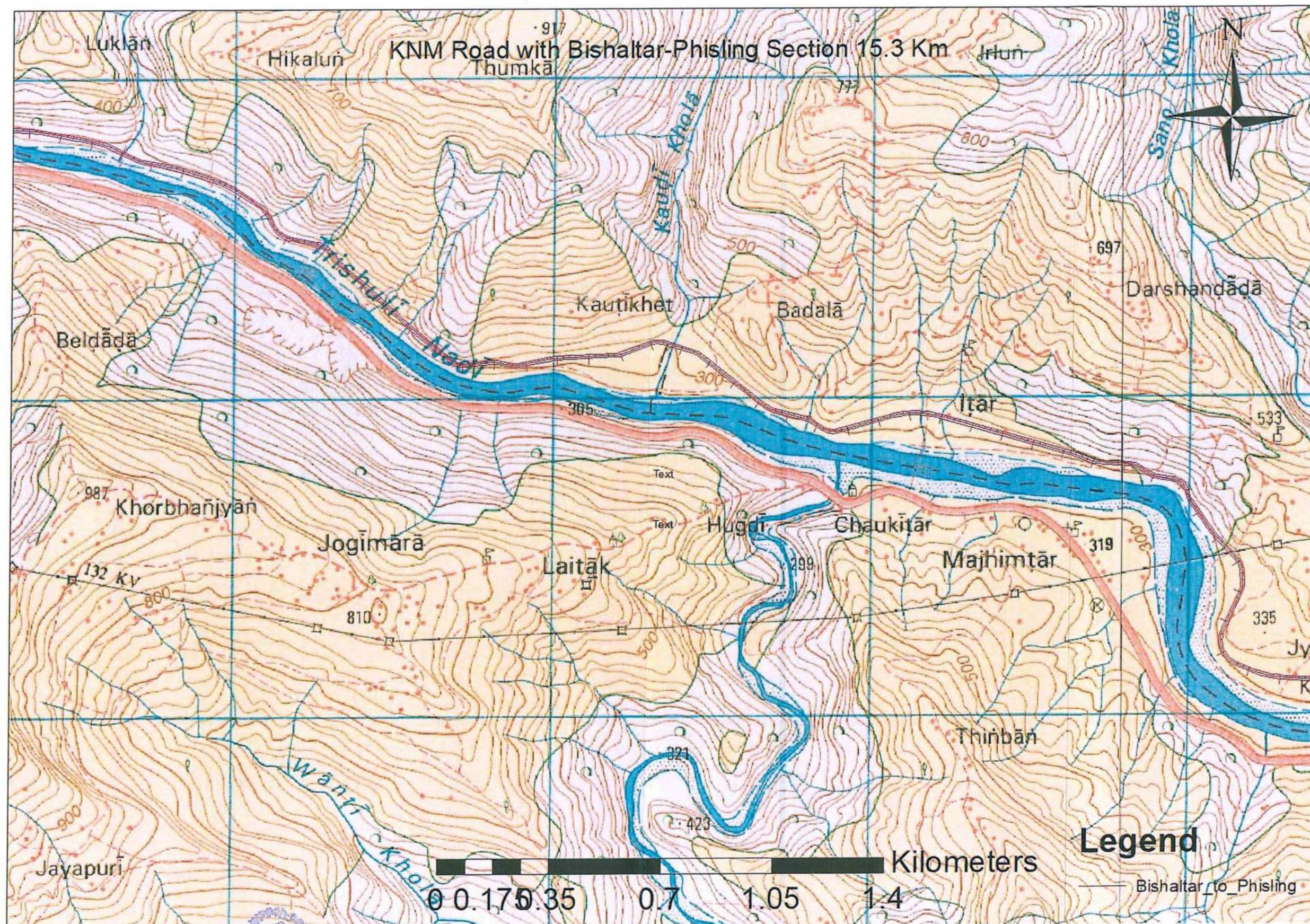


Map 2-2: Proposed new Sisnekhola-Dharke Alignment Section (Sheet 1)

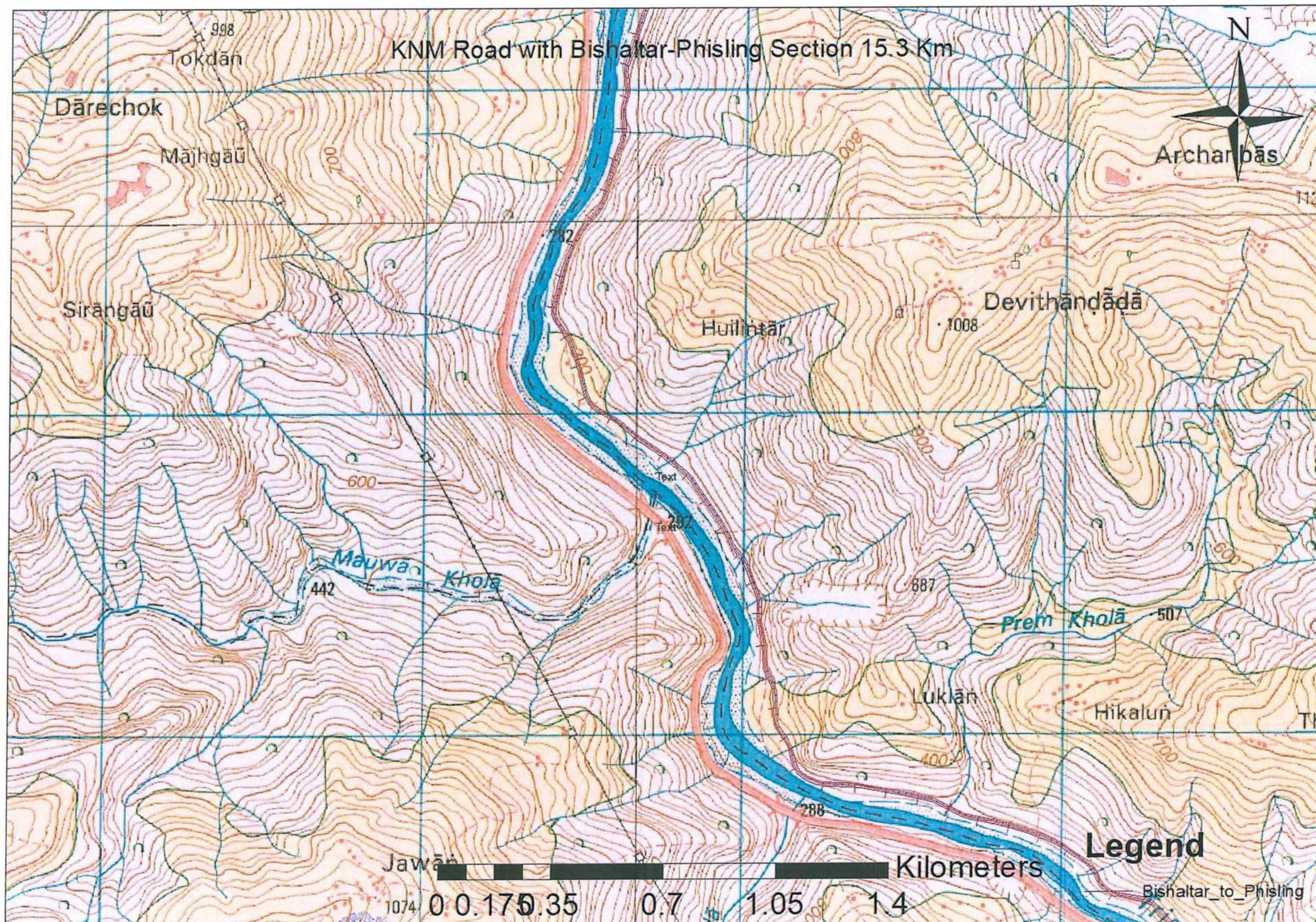


Map 2-3: Sisnekhola-Dharke Alignment Section (Sheet-2)

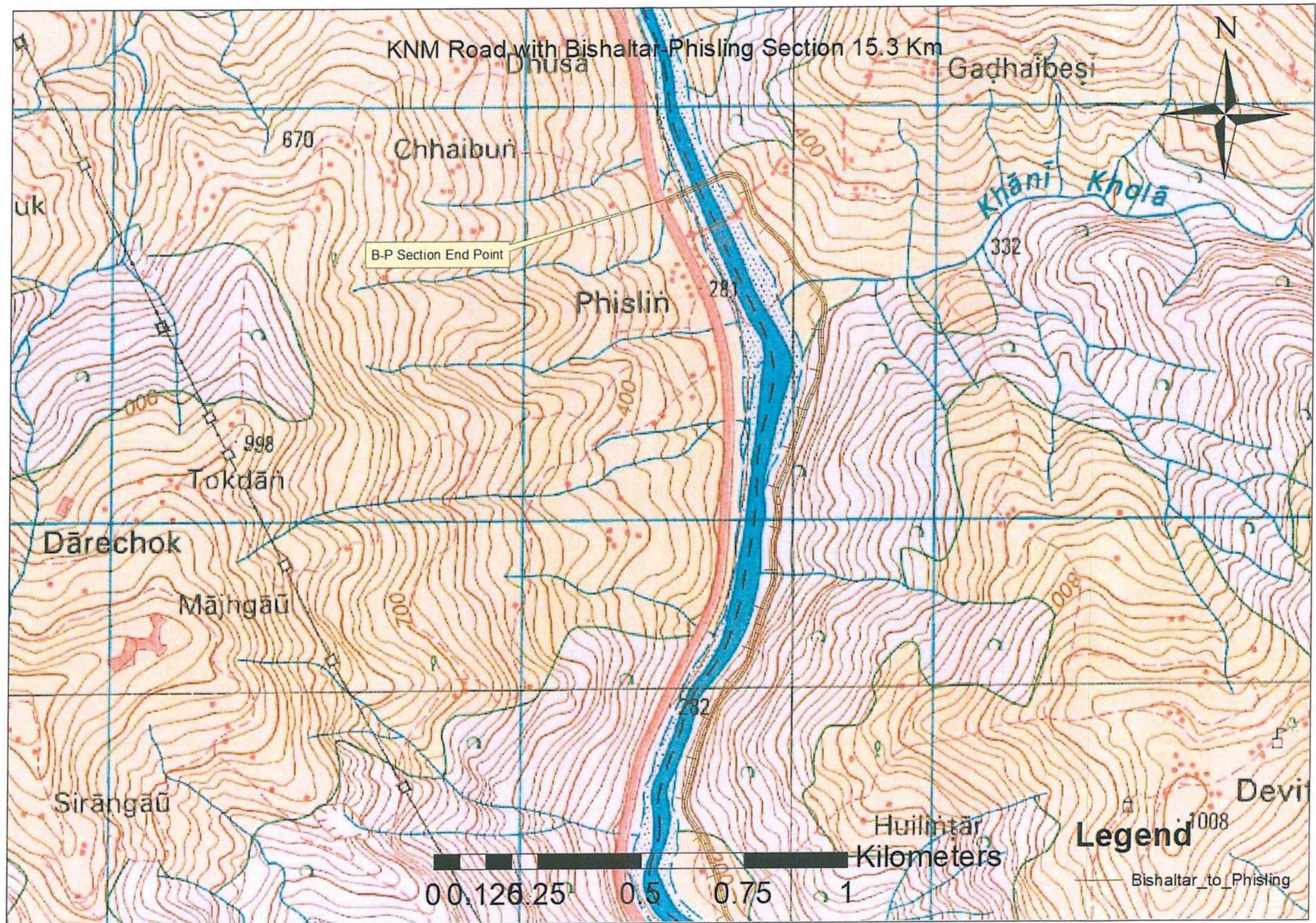




Map 2-6: Bishaltar-Phisling Alignment Section (Sheet3)



Map 2-7: Bishaltar-Phisling Alignment Section (Sheet4)



Map 2-8: Bishaltar-Phisling Alignment Section (Sheet5)

CHAPTER 3: Description of the Proposed Project

3.1 Type of proposal

The present report deals with the Environmental Impact Assessment of Kathmandu (Nagdhunga) - Naubise-Mugling Road project located in Kathmandu, Dhading, Chitwan and Gorkha districts of Bagmati Province and Gandhaki Province included along proposed KNM highway under NIRTTP project in Nepal. The project road starts at Nagdhunga and ends at Mugling covering a total length of 96 kms. The alignment passes through Nagdhunga, Naubise, Khanikhola, Mahadevbesi, Galchi, Baireni, Malekhu, Benighat, Kurintar to reach Mugling. The project consists of the present road sections, proposed for improvement and upgrades to two lane carriageway configurations with shoulders and side drains, and by new projected alignments such as Sisnekhola-Dharke 11.2 km and Bishaltar-Phisling 15.3 km.

3.2 Objectives and anticipated benefits from the proposed project

The objective of the proposal is to enhance efficiency in the road transport, avoid or minimize road accidents and improve transportation and road safety along the Birgunj to Kathmandu trade corridor.

3.3 Description of the project

Highway

The proposed project is aimed to improve existing alignments from Nagdhunga to Naubise (12.5 km) and from Naubise to Mugling (83 km) through road upgrades, replacement of 4 major bridges and construction of by-pass roads in several places. Besides, the new alignments were proposed such as Sisnekhola – Dharke along the bank of Maheshkhola River in the Nagdhunga to Naubise section, and Bishaltar - Phisling new alignment on the right bank of Trishuli River, connecting to the Naubise –Mugling section of the road.

Nagdhunga- Naubise Road is part of Trivuan Rajpath (TRP), which is a national highway as per DOR classification with road reference no. H 02. This road was initially constructed in 1956 AD, and, then, rehabilitated in 1997 AD. The existing highway comprises about 26 major existing bridges in between Nagdhunga and Mugling. Most of the bridges are narrow single lane and situated at the road bendings on the natural drainages.

The proposed new alignment Sisnekhola – Dharke splits from existing highway at Sisnekhola and traverses towards northern hill, passing through pine forest (Nisakot Community Forest). Then, it again traverses towards hilly area of Waglethok settlement and gradually declines towards cultivated land before reaching to United Cement Factory. This proposed alignment then traverses through northern boundary of the cement factory and crosses the existing river near the confluence of Dhuni Khola and Rupse Khola and then, it passes through the right bank of Maheshkhola all through the cultivated land before it reaches to existing highway at Dharke. The length of alignment is 11.2 km.



Naubise — Mugling Road is a part of Prithvi Rajmarg (PRM), a national highway as per DOR classification with road reference no. H04. The road was constructed in 1973 AD and rehabilitated/upgraded in 1995 AD.

The another proposed new alignment Beshaltar – Phisling passes through terraces and undulation cultivated land, steep hilly areas covered by vegetation before it reaches to the Phisling. The length of alignment is 15.3 km. Construction of new bridge is planned over Trishuli River in the Bishaltar. Whereas, under construction bridge at Phisling will be used in order to switch the Bishaltar-Phisling alignment to existing highway at left bank of Trishuli River. The alignment will comprise 8 bridges to be constructed.

Bridges

Nearly 50% of the all bridges are with pedestrian safety barriers beside the carriageway and others are without it. Relocation of four existing bridges along the existing KNM will be carried out. The location and name of the bridges are as Khahare Khola Bridge: Ch. 12+355, Chiraundi Khola Bridge: Ch. 26+570, Gomati Khola Bridge: Ch. 50+170, and Hugdi River Bridge: Ch. 61+940. Whereas, repair and rehabilitation of all bridges along the existing highway will also be carried out. The list the of the existing bridges along the KNM highway is presented in the Table 5-3.

There are 6 bridges to be constructed along the proposed new alignment (Sisnekhola-Dharke) crosses Mahesh Khola and major bridges at Km.8+010 and 10+860 and Naubise Khola at Km.11+150. There are about 33 number of Cross Drainage Structures. The other Project Amenities include 6 no of Bus bays, 2 no of underpasses and about 1 no of overpass along the proposed Sisnekhola-Dharke alignment.

Similarly, there are 8 bridges to be constructed along the proposed another new alignment (Bishaltar-Phisling 15.3 km road) on the right bank of Trishuli River. New bridges will be constructed at Trishuli River near Chandrodya Higher Secondary School, Lamu Khola, Dhawadi Khola, Judi Khola, Majuwa Khola, Kaudi Khola, Prem Khola and Khani Khola.

Tunnel

A short tunnel has been proposed to cross small ridge at Km.2+590 of the Sisnekhola-Dharke new alignment. The tunnel has been proposed between Km 2+ 500 to Km 2+ 680 and the length of tunnel is about 180 m. The proposed tunnel begins at Waglethok Village Km 2+500 Outlet portal of proposed tunnel is at Km 2+680 making a tunnel length 180 m. Carriageway width inside tunnel will be minimum 7.0 m and walkway for road staff and in case of accident for pedestrians also will be minimum 1.0 on both sides. Vertical clearance will be minimum 5.0 m.

3.4 Salient features of the project

The existing KNM including two new alignment has been proposed improved into 2-lane Asian Highway Standard. Existing KNM and proposed two new alignments will be constructed with the standard carriageway width of 7 meters with shoulder width 1 to 2.5 meters in accordance with the terrain (plain, rolling, mountainous, and steep).



Table 3-1: Proposed standards with comparison

Design Parameters	Nepal Road Standards (Class-II Road)				Asian Highway Standards				Proposed Standards			
	P	R	M	S	P	R	M	S	P	R	M	S
Design Speed (Kmph)	100	80	60	40	80	60	50	40	100	80	50	35
Vertical Gradient (%)	5	6	7	9	4	5	6	7	5	6	6	7
Maximum Length of Gradient (m)	450	400	300	200	700	600	500	400	450	400	400	200
Radius of Horizontal Curve (m)	370	210	110	40	210	115	80	50	370	210	80	30
Super Elevation (%)	7 - 10				10				Max. 8%			
Carriageway Width (m)	7.0				7.0				7.0			
Shoulder Width (m)	2.5				2.0 – 2.5				1.0 - 2.5			
Camber (%)	2.5				2.0				2.5			
Stopping Sight Distance (m)	190	130	80	50					190	130	80	50
Minimum Transition Curve Length (m)	400	250	40	35	70	50	40	35	400	250	40	35
Right of Way (m)	30 – 50				40				30 - 50			
Location with wards												
Province	Bagmati Province and Gandhaki Province											
Districts	Kathmandu, Dhading, and Chitwan (Bagmati Province) and Gorkha (Gandhaki Province)											

Districts along existing KNM	Municipality	Wards
Kathmandu	Chandragiri Municipality	2
Dhading	Dhunibeshi Municipality	2,6,7,8,9
	Thakre RM	6,7,8,1,2
	Galchi RM	4,6,7
	Gajuri RM	5,6,1,2

Districts along existing KNM	Municipality	Wards
	Benighat Rorang RM	3,5,7,8, 9,10
Chitwan	Ichakamana RM	3,5

District along Sisnekhola-Dharke new alignment	New Municipality	Wards
Dhading	Dhunibeshi Municipality	6,8,9,2,5

Districts along Bishaltar-Phisling new alignment	New Municipality	Wards
Dhading	Benighat Rorang RM	5
Gorkha	Gandaki RM	7, 8, 6
Chitawan	Ichakamana RM	3

The proposed standard will be implemented for the improvement and upgrading of existing Nagdhung-Naubise-Mugling (Prithvi Highway) into two lane standards as well as for the proposed new same standard alignments Sisnekhola-Dharke and Bishaltar-Phisling.

3.4.1 Project design

The project has been designed for the construction and improvement of existing 96 km Kathmandu (Nagdhunga)-Naubise-Mugling section of Prithvi Highway. Improvement of existing highway will enhance movement of traffic from Kathmandu; not only to Mugling, but also to Birgunj connecting Indian boarder. This section of highway is important, especially for the freight transportation and export of goods and commodities. The project has been designed for the improvement of the existing highway into 4-lane Asian Highway. However, it is quite difficult to enhance the existing section of the Prithvi highway into 4-lane Asian Standard Highway due to fragile geology, topography, and undulations. Several alternatives have been studied along the proposed section in order to achieve 4-lane Asian Highway Standard. Hence, the project has been designed improving existing KNM highway into 2- lane standards with significant improvement at urban areas, situated along the highway, and also with the construction of new 2-lane sections in order to achieve KNM as a 4-lane in combine. The project comprises 11.2 km new section starts from Sisnekhola and ends at Dharke. The alignment traverses through undulated landscape and community forest at the beginning; then follows terraces and flat cultivated land before crossing the banks of Mahesh khola (a small stream) to reach Dharke settlement connecting existing highway. Further, a new section of 15.3 km from Bishaltar to Phisling has been proposed through the right bank of Trishuli River. Approximately 53km of existing highway from Dharke to Bishaltar will be improved into 2-lane. The new Bishaltar-Phisling section has been proposed through the right bank of the river in order to avoid likely landslide hazards at Krishnabhir and Jogimara, considered as very fragile area for the expansion. This new section of the alignment starts from Bishaltar, left bank of Trishuli River, and switches to the right bank of the river and proposed through cultivated lands, undulations, community forests along the right bank to reach Phisling, where the

proposed new alignment again connects to existing highway. The last 5.5 km of this proposed section traverses through very steep, rocky, fragile, and vegetated area.

3.4.2 Construction Approach and Methods

Construction works will be carried out in several packages Table 3-23. Construction work will be passed from accessible sections of the alignment; as most of the proposed sections are manageable, when road track has already been excavated. There will be different packages for the construction of proposed bridges, upgrading works for existing highway sections, excavation packages for the new alignments of Sisnekhola-Dharke and Bishaltar-Phisling. The design parameters adopted for this highway are 30Kmph design speed with maximum gradient of 4 to 8%. The RoW is fixed 25 meters in all terrains whereas the formation width is fixed to 12 meters with 7-meters carriage width in mountainous and steep terrain and rolling terrains. The pavement type of the highway will be granular sub-base, crushed stone base and asphalt concrete. Crusher plants and borrow pits will be established in several proposed locations to obtain sand, soil and aggregates. It is suggested that the general construction method of highway construction will be mechanical however; will be environmental friendly. Drill and Blast (soft ground tunnelling) method will be carried out for the tunnel excavation at Waglethok along the Sisnekhola-Dharke Alignment. Machines and equipment will be used for the excavation of last 5.5 km along the proposed Bishaltar-Phisling Section. Machines and excavators will be used throughout the length for the formation of road width and site clearance. Disposal of spoil will be carried out using loader and trucks to haulage from excavated road alignment to proposed tipping site for safe disposal. Appropriate environmental safeguards will be adopted during the time of construction. Required safety and personal protection equipment such as helmet, visibility vest, gumboot, mask, gloves and other equipment will be provided to all labour workers during the time of construction.

Prevention of landslides along the proposed new alignment will be carried out with the adoption of new technologies such as installation of rock bolts and application of shotcrete in order to avoid installation of heavy structures, like gabion boxes along the new cut slopes, cutting of hill slopes with stable benching, etc.

Construction activities will be carried out in peacemeal approach for the improvement of existing Prithvi Highway. Construction contractor will not allowed to stoppage or complete halt of existing traffic movement along the highway during the time of construction. Traffic mobilization will be maintained during construction within under construction section with one-way movement of traffic as applicable to site condition. However, construction contractor for each package will prepare traffic management plan and will seek approval from construction supervision consultant prior to the implementation.

Procedure of Operation

The road is coming under the Strategic Road network of Prithvi Highway; whereas Foreign Cooperation Branch, Department of Roads (DOR) will be the responsible organization for the operation and maintenance of project. The mode of operation will be similar to other Strategic Roads of the country. Other local bodies shall not be responsible to operate and to collect any sort of direct benefits from its operation.



3.4.3 Project Implementation Time Schedule

The project implementation time schedule is presented below, including 2-3 years allocated to construction work:

Implementation Schedule of KNM Road Project						
Sl. No.	DESCRIPTION OF ACTIVITIES	Period of Implementation				
		Year 1	Year 2	Year 3	Year 4	Year 5
1	PRE-CONSTRUCTION ACTIVITIES					
A	Submission of Draft DPR and Approval of DPR					
B	Invitation of Bids including Receipt of Bids					
C	Evaluation of Bids including approval from World Bank					
D	Award of Contract / Signing of Contract					
2	CONSTRUCTION ACTIVITIES (ALL PACKAGES)					
A	General					
B	Earthworks					
C	Pavement Works					
D	Bridge Structures					
E	Other Structures					
F	Road Furniture and Traffic Safety Measures					
G	Environmental Mitigation and Bio-Engineering Works					
H	Miscellaneous Works					
3	DEFECT LIABILITY PERIOD FOR ALL CONTRACT PACKAG					

Figure 3-1: Project implementation Schedule of KNM Road Project

3.4.4 Construction Materials

Sources of Rock Aggregates and Natural Sand

Most of the borrow soil suitable for embankment and subgrade will be used within the project area. Average lead for most of the borrow area sources from the nearest point on the project road is less than 5 km. These deposits are accessible from the project road with little or no improvement of existing accesses. Quantities of aggregates, sand, stone and soil material for use in the embankment and sub-grade construction of the project road is adequate from the project area. All the proposed bypasses will be constructed balancing cut and fill balance consideration. Therefore, alignment soil at cut locations will be used for filling valley side. Aggregate and sand required for the construction will be collected from the project influence area. The details of the construction material is presented in Table 5-16.

Source of Construction Water

Water from Trisuli River and its tributaries are likely to be used by the construction contractor during the time of construction.

Manufactured materials such as Cement, Steel and Bitumen

Cement for construction purpose is available from India/China or from local suppliers. Steel of various grades will be obtained from India and China. Bitumen will be obtained from India or China.



3.5 Comparison of Capital Investment and E&S Costs and Returns

3.5.1 Adverse Environment and Social Impacts

Air pollution, landslides, and change in land use are the adverse environmental impacts with the construction of proposed new alignments: Sisnekhola-Dharke and Bishaltar-Phisling. Construction and excavation of tunnel at Waglethok settlement and stabilization of hill slopes along the Nisakot Community Forest of Sisnekhola-Dharke alignment will be challenging during the time of construction. Similarly, excavation of last 5.5 km section of Bishaltar-Phisling Section will be further challenging maintaining slope stability and preventing landslides. Significant amount of cultivated land along the proposed new section will also be affected with the construction and operation. Approximately 456 private structures, 70 public structures, 748 land owners will be affected by proposed alternatives and improvement of existing alignment.

Risks of climate change with the implementation of proposal

Heavy rains and other extreme weather conditions damage the asphalt road, and such roads need to be repaired frequently. However, asphalt roads provide a little better safety of the vehicles against snow and skidding. However, the project area is not situated under any extreme cold area and cold weather with 0 degree centigrade last only for 2 to 3 months from approximately December to February. The area does not receive any extreme weather conditions such as extreme heat and cold. The impact due to change in climatic conditions will be very little and could not be considered as significant. There will be very low risks, requiring maintenance costs due to the impact of climate change in next decades.

Substantial safety measures to control speed of vehicles are required such as traffic signals and markings, speed breaker in the settlement and market areas and traffic awareness programs to the local drivers to cope with this sort of risks.

3.5.2 Use of Energy and Energy Saving Measures during Project Implementation

During project implementation, the construction contractor should provide the alternative sources of energy for workers, such as gas or kerosene stoves to prevent pressure on natural forests in the project area. Contractor will avoid using fuelwood for the construction purpose and for cooking purpose in labour camps. Contractor will established fuel storage yard near the proposed campsites to manage and control the sustainable use of diesel and other energy resources required during construction. Other measures will include economy of energy and resources, when possible in the project cycle to minimize energy use and avoid pressure on natural resources. The operation of Sisnekhola-Dharke and Bishaltar-Phisling alignments will be a significant measure in minimizing the use of fuel energy and travel time of all road users from Birgunj to Kathmandu.

3.6 Economic Rationale.

The deficiency of transport network has resulted in high transport costs and poor national and regional connectivity, and hindered the growth of the economy by limiting the development of competitive industries, impeding trade, and reducing the potential of Nepal to benefit from the strong growth of neighboring countries. Exports have decreased at an average annual rate of –



6.1% in real terms during FY2007–FY2017. As of fiscal year (FY) 2017, India accounts for 65% of Nepal's imports and 57% of its exports, and the PRC for 13% of imports and 2.3% of exports. Excluding India trades with all other countries of the South Asia Sub regional Economic Cooperation (SASEC) and South Asian Association for Regional Cooperation (SAARC) account for only 0.8% of Nepal's total trade.¹ The project will promote economic growth and trade by enhancing the efficiency and adequacy of the transport system, improving national and regional connectivity, and addressing the deficient safety of the road network. The project supports the strategy of the Government of Nepal and will improve regional and domestic connectivity.

3.6.1 Project Road

The Project Road is located in Bagmati Province and Gandaki Province of Nepal. The road starts at Nagdhunga, a place located at outskirts of Kathmandu, the capital city of Nepal and traverses through Naubise, Dharke, Gajuri Bazar, Malekhu, Kurintar and ends at Mugling. The length of project road is about 94.80 Km and is located in Mountainous and Hilly terrain.

The road is part of two major Highways of Nepal. The section of project road from Naghunga to Naubise (12.40 Km) is part of Tribhuwan Rajpath (TRP) and the portion from Naubise to Mugling (82.40 Km) is part of Prithvi Rajmarg (PRM).

3.6.2 Road Design

The project road currently has a intermediate/two lane operational carriageway and does not segregate slow-moving vehicles and pedestrians. The pavement is in fair to poor condition with an average international roughness index of 6.4, rough edges, and cracks and potholes on part of its length. The road section requires capacity augmentation and pavement reconstruction to maintain acceptable levels of service. The road will be upgraded to a two-lane carriageway to cater the expected growth in traffic demand.

Based on the Final Feasibility Study and further discussion with various Stakeholders, and as per client's instruction following activities are proposed for road upgrading:

- Improvement of Existing Road Alignment between Nagdhunga to Naubise to intermediate/2 lane (without involving Major cut/Fill)
- Improvement of Existing Road Alignment between Naubise to Mugling to 2 lane with Shoulders with Provision of 4 lane at Semi-Urban/Urban Areas.
- New 2 lane Alignment between Sisne Khola to Dharke
- New 2 lane Alignment between Bishaltar to Phisling Bazar

3.6.3 Economic Analysis

The economic analysis of the project was carried out with the Highway Design and Management (HDM-4) model. The HDM-4 model requires input data on traffic, road geometry, pavement condition, maintenance and improvement costs, vehicle operating costs, and value of time. Costs and benefits accruing to the road agency and to road users were

¹ Government of Nepal, Department of Customs. 2018. *Annual Foreign Trade Statistics FY2016/17*. Kathmandu. SAARC countries include Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. SASEC countries include Bangladesh, Bhutan, India, Maldives, Myanmar, Nepal, and Sri Lanka.

calculated in with- and without-project cases, and were used to estimate the net costs and benefits of the project roads, and to calculate the economic viability of the project.

3.7 Demand Analysis

3.7.1 Traffic Demand

Traffic levels in the project road section are determined based on the results of traffic counts carried out by DoR in 2017 supplemented by the results of a series of traffic counts along the road section in the beginning of 2018. The counts reflected different levels of traffic volumes in different sub-sections particularly in the following four sub-sections:

- Nagdhunga-Naubise – 12.40km
- Naubise-Galchhi – 22.41km
- Galchhi-Malekhu – 19.88km
- Malekhu-Mugling – 40.19km

Estimated traffic volumes by vehicle type in terms of annual average daily traffic for 2018 in the four homogenous sub-sections are presented in Table 3-2.

Table 3-2: Estimates of Normal Traffic in 2018 by Sub-sections (AADT)

Vehicle	AADT 2018			
	Nagdhunga-Naubise Section	Naubise-Galchhi Section	Galchhi-Malekhu Section	Malekhu-Mugling Section
MC	2384	1857	935	1807
Car	1299	1136	816	907
B	1086	1340	1220	1214
MB	434	414	242	179
MiB	1071	858	670	710
4WD	552	609	332	487
Utility	468	461	260	300
MAT	620	800	626	627
HT	2996	2867	1841	1436
LT	319	467	375	277
Total	11231	10809	7317	7944

Source: Consultants' surveys and estimates, 2018

3.7.2 Traffic Growth

Traffic growth forecasts are based on economic and population growth outlook for future years, on economic growth elasticity of registered vehicles growth, and on historical traffic growth trends on the project road corridor. Available historical traffic data was obtained from annual traffic counts carried out by DOR. Owing to low vehicle ownership rates, with only 0.08 vehicles per capita as of FY2017, vehicle sales have increased at an average annual growth rate of 17.5% between FY2007 and FY2017 (Table 3-3)².

² Government of Nepal, Department of Transport Management, 2018. *Vehicle Registration Details up to Fiscal Year 2073-74*. Kathmandu. Compared to 0.42 vehicles per capita in India and 0.80 in the United States.

The gross domestic product (GDP) of Nepal grew at an average annual rate of 4.5% between FY2007 and FY2017 and is forecast to grow at 4.9% in FY2018 and 3.8% annually between FY2019 and FY2022, with tapered assumptions over time.³ Economic parameters, including GDP and per capita income (Table 3-4) were analyzed to estimate vehicle growth elasticity. The elasticity is adopted for traffic projection. The traffic growth rates by vehicle classes forecasted for the analysis are summarized in

Table 3-5.

3.7.3 Diverted and Generated Traffic

As the project road is an already established traffic corridor for regional and domestic trade, the analysis did not assume a diversion of traffic from other corridors. The magnitude of generated traffic depends on the estimated level of benefits accrued to the project by the improvement of road conditions. Based on the extent of VOC and travel timesavings, generated traffic is not considered in the analysis.

Table 3-3: Registered Vehicles in Nepal, 1997–2017

Year	Annual Sales					Total Registered Vehicles
	Car	Motorcycle	Bus	Commercial	Total	
1997	4,521	15,739	968	2,537	23,76	203,445
2002	4,379	36,117	1,591	5,073	47,16	364,444
2007	6,030	72,568	2,520	7,617	88,73	626,174
2012	11,84	145,135	3,420	9,682	170,0	1,348,995
2017	32,80	354,071	25,973	31,407	444,2	2,783,428
Growth p.a. 2007–2017 (%)	18.5	17.2	26.3	15.2	17.5	16.1

Source: Department of Transport Management (DoTM), 2018.

Table 3-4: Economic Growth in Nepal, 2000–2018

Parameters	2000	2008	2015	Growth p.a. 2000–2015 (%)	2018 Growth Rate Forecast (%)
GDP (million NRs)	379,488	815,658	2,120,470	12.2	4.9
Population (million)	21.0	25.5	28.0	2.0	1.0
GDP per capita (NRs)	18,036	31,946	75,855	10.0	-

Source: Nepal Rastra Bank, 2018.

³ Government of Nepal, Central Bureau of Statistics. 2018. *National Accounts of Nepal 2016/17*. Kathmandu; ADB. 2018. *Asian Development Outlook: How Technology Affect Jobs*. Manila; and International Monetary Fund. April 2018. [World Economic Outlook Database](#).

Table 3-5: Traffic Growth Forecasts by Vehicle Class

Vehicle	2018-2021	2022-2032	2033 Onwards
2-Wheelers	6.8%	6.1%	5.0%
Car/Jeep/Van	5.4%	5.2%	4.5%
Buses	5.0%	4.8%	4.1%
Trucks	4.5%	4.3%	4.1%

Source: Consultants' estimates

3.7.4 Economic Analysis

Key parameters. The economic analysis is conducted using the domestic price numeraire presented in national currency. All costs and benefits are valued in monetary terms as of July 2018, and expressed in economic prices. A discount rate of 9% is used for calculating the net present value (NPV). Key economic analysis assumptions are summarized in following table.

Table 3-6: Input Parameters Used for the Analysis

Input Parameters	Parameter Value
Analysis period from opening year (years)	20
Discount rate (%)	9
Construction period (years)	3
Construction start year	2019
Opening year for road traffic	2022

Source: DPR, KNM, 2018

3.7.5 Project Costs

The estimated total project cost for the construction is NRs. 22,581,316,515.67 in words Twenty two billion five hundred eighty one million three hundred sixteen thousand five hundred fifteen and sixtyseven paisa only (Excluding Resettlement cost). Financial construction cost estimates are based on consultants' estimates. Economic costs include the civil works cost, environmental costs, resettlement costs, utility shifting costs, and physical contingencies. Physical contingencies are included in project costs as they are part of the value of resources to be used in the construction, but price contingencies are excluded from the economic analysis. The economic costs of construction were derived from the financial costs by removing taxes and applying a shadow exchange rate factor of 1.10 for tradable goods, based on Nepal's international trade data.⁴ A shadow wage rate factor of 0.70 was applied to unskilled labor components, based on wages in the construction and agricultural sectors. The economic cost of relocation and resettlement is based on economic value of resettlement allowances given to displaced families, and of replacement of private and community structures. The analysis assumes that periodic maintenance needs are met in the with-project

⁴ International Monetary Fund. *International Finance Statistics and Global Financial Stability Report* databases. Accessed May 2018. Washington, DC.

case only. Maintenance costs comprise of (i) annual routine maintenance, including patching, crack sealing, edge repair, and cleaning of drainage system and structures; and (ii) periodic maintenance, with resurfacing at 5-years intervals. The economic project cost and maintenance costs are shown in Table 3-7.

Table 3-7: Estimated Economic Project and Maintenance Costs

Headings	(NRs million per km)
Project Cost	192.59
Recurrent Maintenance Cost in Without Project Case	0.25
Recurrent Maintenance Cost in With Project Case	0.35
Periodic Maintenance Cost in With Project Case	5.63

3.7.6 Residual value

A straight-line depreciation method is used to calculate the residual value of project elements at the end of the analysis period. Among the project elements, roadwork is assumed to have a life of 20 years with regular and periodic maintenance as needed but with no residual value at the end of the analysis period. Bridge and culverts are assumed to have a 50-year life and an estimated residual value is 30% at the end of the analysis period.

3.7.7 Project Benefits

The quantified benefits of the project include travel time savings and vehicle operating cost (VOC) savings for motorized vehicles, which results from higher vehicle speeds and improved riding quality with the project (Table 3-8), and CO2 emission savings. Without the project, speeds will significantly reduce as road capacities will be reached earlier than with the project, which would in turn contribute to a higher rate of road degradation.

Table 3-8: Operating Characteristics in the First Year of Operation

Scenario	Average Roughness (m/km)	Average Vehicle Speed (km/h)	Average Vehicle Operating Cost (NRs/vehicle-km)
Without project	5.2	39.6	12.85 (car), 30.63 (bus), 60.42 (truck)
With project	2.1	27.5	11.7 (car), 26.38 (bus), 48.83 (truck)

Source: DPR, KNM, 2018

3.7.8 Vehicle characteristics and costs

The data of physical conditions of the road required for the analysis with HDM-4 was obtained from inventory and condition surveys and the material and pavement investigations. The HDM-4 model takes the vehicle technical and operational characteristics and vehicle prices, tire prices, fuel prices, and vehicle maintenance and operation costs as input (Table 3-9), and predicts the vehicle operating cost as a function of operating conditions. The study adopted (i) vehicle and tire prices (excluding taxes) and labor cost for vehicle maintenance and operation collected from surveys of vehicle and tire sales agents and maintenance workshops in the first quarter of 2018; and (ii) fuel prices (excluding taxes and duties) derived from the Nepal Oil Corporation and fuel pumps.

Table 3-9: Representative Prices of vehicles and tires and other parameters

Vehicle	New Vehicle (Rs./vehicle)	New Tire (Rs./tire)	Fuel (Rs./liter)	Lubricating Oil (Rs./liter)	Maintenance Labor (Rs./hour)	Crew Wages (Rs./hour)	Annual Overhead (Rs./year)	Annual Interest (%)
MC	69442	1609	57.80	482.00	220.00			12.0
Car	493459	3818	57.80	482.00	220.00			12.0
B	2153461	22279	59.76	482.00	220.00	118.4	600,000	12.0
MB	1321808	12545	59.76	482.00	220.00	99.0	200,000	12.0
MiB	978631	10217	59.76	482.00	220.00	134.6	50,000	12.0
4WD	2279164	10217	59.76	482.00	220.00	238.5	50,000	12.0
Utility	1139582	10217	59.76	482.00	220.00	238.5	50,000	12.0
MAT	2819075	24712	59.76	482.00	220.00	248.9	200,000	12.0
HT	1875770	22279	59.76	482.00	220.00	246.9	200,000	12.0
LT	1352366	12545	59.76	482.00	220.00	177.2	50,000	12.0

Source: DPR, KNM, 2018

3.7.9 Value of time for passengers

For passenger vehicles, the values of passenger time were calculated based on the GDP, population, employment rate, and survey of travelers and drivers. The proportion of work trips ranges from 25% to 60%. The value of time for non-work travel of income-earning persons is taken as 30% of the value of their time. No value of time is considered for travel by non-income-earning persons. The estimated values of time for each passenger-carrying vehicle are summarized in table below.

Table 3-10: Adopted Values of Passenger Time

Items	Basic Value of Passenger Time/hour	Value of Vehicle-wise Passenger time (NRs)				Passengers in Working Time (%) (a)	Number of Passengers/ Vehicle	Total Value of Passengers Time/Vehicle
		Vehicle Category	Weightage	Working time	Non-working Time			
GDP (NRs, million)	2,427,600	Motorcycle	1.50	168.89	38.09	50%	1.5	155.24
Population (million)	29.30	Car	2.00	225.18	50.79	25%	3.0	283.17
GDP(NRs)/capita	82,853.24	4WD/UV	1.50	168.89	38.09	60%	14.0	1631.97
Employment ratio	46%	Micro/Mini Bus	1.50	168.89	38.09	40%	20.0	1808.22
Total No. of employed person (million)	13.48	Bus	1.30	146.37	33.02	40%	40.0	2193.97(b)
GDP(NRs)/employed person	180,115.74							
Household Consumption Expenditure	0.94							
Consumption - Employed Person (NRs.)	169,308.80							
Working hour/year	2,000.00							
Basic Working Time travel cost (NRs.)	84.65							
Employment Overhead Cost Factor	0.33							

Items	Basic Value of Passenger Time/hour	Value of Vehicle-wise Passenger time (NRs)				Passengers in Working Time (%) (a)	Number of Passengers/ Vehicle	Total Value of Passengers Time/Vehicle
		Vehicle Category	Weightage	Working time	Non-working Time			
Value of Working Time/Hour (NRs.)	112.59							
Value of non-working time@30%	25.40							
Source: Economic Survey Report, Ministry of Finance, 2017								
(a) = Travellers, drivers and consultants' estimate								
(b) = Factored by shadow price factor of 0.7								

3.7.10 CO₂ emissions

The project will result in an overall increase in CO₂ emissions, as higher traffic volumes will offset the decrease in unit emission rates per vehicle-kilometer due to improved pavement conditions and improved speeds. CO₂ emissions are valued at \$36.3/ton increasing at 2% per year in real terms.

3.7.11 Un-quantified benefits

In addition to quantified benefits, the project is expected to deliver significant economic benefits which have not been quantified in the analysis. Primarily, this includes: (i) expected reduction in traffic accidents and fatalities due to improved road geometry and signage, notably for vulnerable road users (pedestrians, cyclists and motorcyclists) residing in roadside settlements, and on the project road; (ii) contribution to economic growth and overall trade between Nepal and India through additional investments expected under improved road transport infrastructure, particularly in the industry, agriculture, and tourism sectors; and (iii) improved access to markets, employment, social, and education opportunities.

3.7.12 Economic analysis

The overall economic internal rate of return of the project is estimated at 19.69%, above the threshold of 9%. (Table 3-11). Economic cost and benefit streams are presented in Table 3-12.

3.7.13 Sensitivity analysis

Sensitivity tests were carried out to investigate the robustness of the project to adverse changes in costs and benefits in the following cases: (i) increase in capital costs by 10%, (ii) decrease in benefits by 10%, (iii) increase in capital costs by 10% and decrease in benefits by 10%, (iv) decrease in the value of time by 20%, (v) 2-year delay in construction, and (vi) CO₂ emissions excluded from the analysis. In the most sensitive case, with a delay in completion of project construction, the project has an EIRR of 16.57% which remains above the 9% threshold (Table 3-11). Sensitivity analyses demonstrate the economic viability of the project to adverse changes in costs and benefits, and the project is thus recommended for implementation on the basis of its economic benefits.



Table 3-11: Results of Economic and Sensitivity Analyses

Sn.	Scenario	EIRR	NPV	Switching Value
		(%)	(NRs million)	(%)
	Base Case	19.69%	18,967	-
1	Increase in capital costs by 10%	18.20%	17,540	214
2	Decrease in benefits by 10%	18.02%	15,581	(68)
3	Increase in capital costs by 10% and decrease in benefits by 10%	16.63%	14,155	183
4	Decrease in value of time by 20%	18.23%	15,938	(66)
5	2-year delay in construction	16.57%	14,633	-
6	CO ₂ emissions excluded	19.91%	19,372	-

3.7.14 Financial Sustainability

Road maintenance is funded through the Roads Board of Nepal, which receives its funds from allocations of the Ministry of Finance and from toll revenues. The annual budget for the maintenance of the strategic road network increased by 107% between FY2012 and FY2019, from NRs2.61 billion to NRs5.50 billion, which represent an average annual increase of about 4.7% in real terms.⁵ The funding allocation in recent years covered 100% of routine and 70% of periodic maintenance needs, and the Ministry of Finance further committed to finance 100% of periodic maintenance needs provided that budget utilization increases along with budget allocation. Incremental recurrent costs associated with the project are estimated at 1.1% of the annual maintenance budget of the strategic road network. Consequently, considering the past budget allocation trends and the priority given to the main road corridors, it is reasonable to expect that the budget allocation will be sufficient to meet the maintenance costs.

Table 3-12: Economic Costs and Benefits Streams

Year	Incremental Costs					(NRs million)		
			Incremental Benefits					Net Benefits
			VOC	Travel Time	Generated Traffic	CO ₂ Emissions		
	Capital Works	Recurrent Works	Normal Traffic	Normal Traffic				
2019	3,654.59	0.00	0.00	0.00	0.00	0.00	(3,654.59)	
2020	5,481.88	0.00	0.00	0.00	0.00	0.00	(5,481.88)	
2021	9,136.47	0.00	0.00	0.00	0.00	0.00	(9,136.47)	
2022	0.00	9.49	1,861.81	1,467.70	166.48	(57.23)	3,429.26	
2023	0.00	9.49	1,937.64	1,539.55	173.86	(57.26)	3,584.30	

⁵ Government of Nepal, Ministry of Finance. May 2018. *Budget Speech FY2018-19*. Kathmandu.

Year	Incremental Costs					(NRs million)		
			Incremental Benefits					Net Benefits
			VOC	Travel Time	Generated Traffic	CO ₂ Emissions		
	Capital Works	Recurrent Works	Normal Traffic	Normal Traffic				
2024	0.00	9.49	2,010.71	1,608.55	180.96	(57.29)	3,733.44	
2025	0.00	9.49	2,088.14	1,682.19	188.52	(57.32)	3,892.04	
2026	534.17	9.49	2,168.61	1,760.32	196.45	(57.34)	3,524.37	
2027	0.00	9.49	2,252.53	1,843.46	204.80	(57.37)	4,233.93	
2028	0.00	9.49	2,339.61	1,931.93	213.58	(57.40)	4,418.22	
2029	0.00	9.49	2,430.33	2,026.76	222.85	(57.43)	4,613.02	
2030	0.00	9.49	2,556.37	2,146.33	235.14	(57.46)	4,870.89	
2031	534.17	9.49	2,664.76	2,259.46	246.21	(57.49)	4,569.28	
2032	0.00	9.49	2,779.05	2,381.51	258.03	(57.51)	5,351.59	
2033	0.00	9.49	2,907.66	2,527.36	271.74	(57.54)	5,639.73	
2034	0.00	9.49	3,044.43	2,686.60	286.54	(57.56)	5,950.52	
2035	0.00	9.49	3,189.52	2,862.73	302.60	(57.59)	6,287.77	
2036	534.17	9.49	3,352.61	3,065.27	320.88	(57.61)	6,137.48	
2037	0.00	9.49	3,538.85	3,303.19	342.08	(57.64)	7,117.00	
2038	0.00	9.49	3,852.58	3,633.56	374.29	(57.67)	7,793.27	
2039	0.00	9.49	3,048.50	3,384.57	321.64	(57.69)	6,687.53	
2040	0.00	9.49	3,336.89	3,765.20	355.09	(57.72)	7,389.98	
2041	(5,481.88)	9.49	3,708.63	4,256.33	398.23	(57.74)	13,777.85	
						EIRR	19.69%	
						NPV	18,966.85	

Source: DPR, KNM, 2018

3.8 Delineation of the Project Area

3.8.1 Zone of Influence (ZOI)

The project area delineation of proposed road alignment will be the area that will receive both beneficial as well as adverse impacts due to its construction and implementation. The project affected municipalities and rural municipalities are considered to be zone of influence of the project. The ZoI of the project area has been categorized as Direct Impact Area (DIA) and Indirect Impact Area (IIA), which is described below:

3.8.1.1 Direct Impact Area (DIA)

Direct Impact Area (DIA) of the project includes all the areas, where activities related to the construction will take place. The areas within the 150 m on either side from the centre of the



road (300m corridor) will be considered as the Direct Impact Area (DIA), because land use change will occur there and land and property acquisition will take place within this corridor. During operation stage this area will be impacted by increased level of traffic volume, which can impact the safety issues. This area will have a greater likelihood of impact on human population, private land and resources and impacts on physical, biological as well as socio-economic and cultural environment and, thus, it is considered as high impact area.

The DIA might be further increased in some locations based on topography and stakeholder consultations/feedback during scoping stage. As operation of burrow sites, quarry sites, spoils management sites, campsites, etc. will be included within the area. In addition, labour related issues affect the socio-economic and cultural environment of the project area. The following table Table 3-13 and Table 3-14 presents affected locations and wards existed within the Direct Impact Area along the Highway alignment.

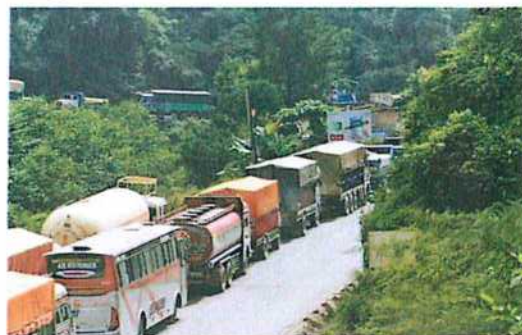


Figure 3-2: Direct impact area along existing road.

Table 3-13: Affected Location with Wards along the existing KNM highway of DIA

District	Municipality/ VDCs	Earlier Wards		New Municipality	New Wards
		Along the alignment	Indirect influence wards		
Kathmandu	Chandragiri Municipality	3		Chandragiri Municipality	2
Dhading	Chhatredeurali VDC	1		Dhunibeshi Municipality	2
	Naubise VDC	3,5,6,4,7,8,1		Dhunibeshi Municipality	6,7,8,9
	Thakre VDC	2,8,5,4,3	6	Thakre RM	6,7,8
	Bhumisthan VDC	4,6,7,8,9		Thakre RM	1,2
	Baireni VDC	8,9,7		Galchi RM	4,6,7
	Pida VDC	1,3,2		Gajuri RM	5,6
	Gajuri VDC	1,2		Gajuri RM	1,2
	Benighat VDC	1,9,8,7	2	Benighat Rorang RM	3,5
	Dhusa VDC	1,3		Benighat Rorang RM	7,8
	Jogimara VDC	8,9,1,2		Benighat Rorang RM	9,10

District	Municipality/ VDCs	Earlier Wards		New Municipality	New Wards
		Along the alignment	Indirect influence wards		
Chitwan	Darechok VDC	9,1,2,7,3,4	5	Ichakamana RM	3,5

Source: Field Survey, 2017

Table 3-14: Wards along the Sisnekhola-Dharke new alignment (DIA/IIA)

District	VDC/ Municipality	Wards		New Municipality	New Wards
		Along the alignment	Indirect influence wards		
Dhading	Naubise	3, 4, 2, 1		Dhunibeshi Municipality	6,8,9
	Chhatreaurali		1, 3	Dhunibeshi Municipality	2
	Jiwanpur	9		Dhunibeshi Municipality	5

Source: Field Survey, 2017

Table 3-15: Wards along the Bishaltar-Phisling new alignment (DIA/IIA)

District	VDC	Wards		New Municipality	New Wards
		Along the alignment	Indirect influence wards		
Dhading	Benighat	8		Benighat Rorang RM	5
Gorkha	Ghyalchok	9, 5, 6	3	Gandaki RM	7, 8
	Bhumlichok	8, 9, 2, 4		Gandaki RM	6
Chitawan	Darechok	7		Ichakamana RM	3

Source: Field Survey, 2017

3.8.1.2 Indirect Impact Area (IIA)

The adjacent areas within 2 kilometers either side of road alignment are considered as the Indirect Impact Area (IIA). In this area, physical and biological environment will experience impacts during the time of construction. Indirect impacts will appear as cumulative effects during operation stage in the form of adverse impacts linked to better access to the area such as increased poaching, fodder collection, deforestation, unplanned human encroachment along the road and other similar activities.





Impacts inadvertently during construction phase are likely in these areas due to various construction activities. Altogether 1 RM of Gorkha District, and 3 RMs of Dhading District, 1 RM of Chitwan District and 1 Municipality of Kathmandu District is located within the Indirect Impact Area (IIA). The RM and Municipalities of Dhading, Chitwan and Gorkha district through which the alignment passes are considered to be the

Figure 3-3: Direct impact area along existing road. The wards of the RMs and Municipalities that will come under IIA are also presented in the above tables Table 3-14, and Table 3-15.

3.9 Technical Characteristics of the Project/ Road alignment and Bridge site

A. Kathmandu (Nagdhunga) — Naubise Road

This section of project road was originally constructed in 1956 AD with the assistance from Government of India. Thus, the design standards adopted during the construction time are not known. However later on this section was rehabilitated by DOR in 1997 AD under RMRP project financed by the IDA and after that continuous improvement works such as curve widening, pavement strengthening and slope stabilization etc. are being carried out in each fiscal year. Examining the existing geometric features, the present road may even not meet the design standards of class IV road as defined in Nepal Road Standards, 2070 (Table 3-16).

Table 3-16: Comparison of Design Parameter between Standards of DoR and Kathmandu Naubise Road

Sn.	Design parameters	DOR standards class IV				Existing road			
		P	R	M	S	P	R	M	S
1	Carriageway Width m	7	7	7	7			6-7	6-7
2	Design Speed, Km/hr	60	40	30	20			30	10
3	Radius of Horizontal Curve, m	110	40	20	10			12	12
4	Max Vertical Gradient, %	7	7	7	7			8	8
5	Shoulder Width, m	1.5	1.5	1.5	1.5			0.5	0.5

B. Naubise — Mugling Road

Naubise — Mugling Road is a section of Prithvi Highway built in 1974 AD with the assistance of Government of People's Republic of China. At that time, the design standards were combination of Chinese and Nepalese standards with carriageway width 3.5 and formation width 6.0 m. In 1991, the road was upgraded with assistance from IDA and ODA, when the physical parameters and design standards were also adopted as per DoR standards. Since the upgrading was carried out on the existing road alignment, certain design criteria were difficult

to improve and they were left below DoR Standards. Some of the existing design parameters are as shown in Table 3-17.

Table 3-17: Design Standards for Class IV Road Type

SN	Design parameters	DOR standards class IV			
		P	R	M	S
1.	Carriageway Width, m	6.5	6.5	6.5	6.5
2.	Shoulder width, m	1	1	1	1
3.	Design Sped	80	50	30	30
4.	Min Radius of Horizontal Curve, m	175	70	25	25
5.	Max Vertical Gradient, %	4	8	8	8
6.	Max Super Elevation, %	8%			
7.	Camber, %	2.5%			
8.	Min Transition Curve, m	400	250	40	40
9.	Stopping Sight Distance, m	110	65	30	30
10.	Right of Way, m	50			

Source: Nepal India Regional Trade and Transport Project (NIRTTP) Detailed Design of Improvement of Nagdhunga-Naubise-Mugling Road and Bridges, 2018.

3.10 Design Standards

Proposed road standards for Improvement of existing roads to two-lane, construction of two-lane new road and construction of four-lane road are provided in Table 3-18 to Table 3-20.



Table 3-18: Two-Lane Road: New Construction Sisne-Khola-Dharke and Bishaltar-Phisling Road

SN	Design Parameters	Design Standards				Remarks
		P	R	M	S	
1.	Carriageway Width, m	7.0	7.0	7.0	7.0	
2	Formation Width, m	12.0				
3	Shoulder Width, m	2.5	2.5	2.5	2.5	
4	Design Speed, Km/hr	100	80	60	40	
5	Radius of Horizontal Curve, m	110	80	40	40	
6	Vertical Gradient in %	4	6	7	8	
7	Super Elevation in %	Max 8 %				
8	Camber in %	2.5 %				
9	Min Transition Curve, m	400	250	40	35	
10	Stopping Sight Distance, m	190	130	80	50	
11	Extra widening, m	0.0 – 1.2				
12	Max Length of Gradient, m	400	400	400	300	
13	Min value of K for Summit Curve	29				
14	Min Value of K in Valley Curve	17				
15	Right of Way, m	50				

Table 3-19: Two-Lane Road: New Construction and Improvement of Nagdhunga-Naubise Road

SN	Design Parameters	Design Standards	Remarks
1.	Carriageway Width, m	5.5 – 7.0	
2	Formation Width, m	7.5 – 9.0	
3	Shoulder width, m	1m on both sides	
4	Design Speed, Km/hr	30 Km/hr	
5	Radius of Horizontal Curve, m	30 m	Except in critical areas, where it is 20 m
6	Vertical Gradient in %	7 %	Except in critical areas
7	Super Elevation in %	Max 8 %	
8	Camber in %	2.5 %	
9	Min Transition Curve, m		

SN	Design Parameters	Design Standards	Remarks
10	Stopping Sight Distance, m	50 m	
11	Extra widening, m	0 – 1.2 m	
12	Max Length of Gradient, m	400 m	
13	Min value of K for Summit Curve	29	
14	Min Value of K in Valley Curve	7 - 17	
15	Right of Way, m	30 m	

Table 3-20: Two-Lane Road: New Construction and Improvement of Naubise-Mugling Road

S No	Design Parameters	Design Standards				Remarks
		P	R	M	S	
1.	Carriageway Width, m	7.0	7.0	7.0	7.0	
2	Formation Width, m	9.0				Except in Urban areas
3	Shoulder width, m	1	1	1	1	
4	Design Speed, Km/hr	100	80	60	40	
5	Radius of Horizontal Curve, m	110	80	40	40	
6	Vertical Gradient in %	4	6	7	8	
7	Super Elevation in %	Max 8 %				
8	Camber in %	2.5 %				
9	Min Transition Curve, m	400	250	40	35	
10	Stopping Sight Distance, m	190	130	80	50	
11	Extra widening, m	0.0 – 1.2				
12	Max Length of Gradient, m	400	400	400	300	
13	Min value of K for Summit Curve	29				
14	Min Value of K in Valley Curve	17				
15	Right of Way, m	50				

Source of above tables: Nepal India Regional Trade and Transport Project (NIRTTP)
Detailed Design of Improvement of Nagdhunga-Naubise-Mugling Road and Bridges, 2018

3.11 Technical Standard of Road and Bridges

a) Road

The new design of the highway and proposed new sections is to enhance the road capacity by decreasing the road congestion, improving the speed of commercial vehicles. The terrain classifications along the project road are as follows:



Plain (P)	:	Slope 0 to 10%
Rolling (R)	:	Slope more than 10 to 25 %
Mountainous (M)	:	Slope more than 25 to 60 %
Steep (S)	:	Slope more than 60 %

b) Bridges

Different types of superstructures for bridges have been required for design such as RCC T Beam, PSC Girder, IPC Girder, PSC Box Girder, Steel Deck, etc. DOR Nepal Bridge Standards (2067) has been the main guideline for the design of bridges. All bridges shall be designed for a discharge of 100 yrs. return period. For the calculation of design discharge empirical formulas especially developed for other catchments shall not be used. All bridges shall be designed as per IRC loadings or AASHTO loadings.

c) Pavement

Pavement shall be design to withstand the traffic volume and axle load for 20-years period. Adequate drainage has been provided below the pavement layers and sub-grade level. Pavement layers in general will consist of granular sub-base, crushed stone base and asphalt concrete. Capping layer of suitable material will also be provided in those areas, where deemed necessary. Pavement has been designed adopting structural catalogue of Overseas Road Note 31 published by Transport Research Laboratory of UK or as per IRC 37: 2001 guidelines published by Indian Road Congress.

d) Culverts

All existing culverts has been tested for capacity adequacy and accordingly inferior culverts has been modified. New culverts have been designed for 50-years return period of flood.

e) Side Drain

Type and size of side drain has been selected based on 25 years return period of flood. It may be open drain, covered drain, masonry drain, or RCC drain as per site requirement and safety guidelines.

f) Retaining Structures

Different types of retaining walls are proposed in the design of road such as Gabion wall, Stone Masonry wall, Reinforced Concrete wall and Geogrid Reinforced Retaining wall as required at site. Geogrid reinforced retaining wall, also known as mechanically stabilized earth wall, is the application of geogrid of different strength as per need for the stabilization of high fill embankment. Height of wall may be up to 40 m, so high tensile strength geogrid is used in this structure basically ultimate tensile strength ranging from 192 KN/m to 600 KN/m. All retaining structures are designed for design life of 50 years.

g) Protection Works

Protection works has been provided in all vulnerable areas like upstream and downstream areas of culverts, bridges, river banks, roadsides and other special structures, all protection structures has been designed for design life of 50 years.

h) Tunnel

Planning and design of the road tunnel will be considered on the basis of geological, geo-technical and ground water conditions for initial and final rock support system design and environmental considerations of the site. Carriageway width inside tunnel will be minimum 7.0 m and walkway for road staff and in case of accident for pedestrians will be minimum 1.0 m on both sides. Vertical clearance will be minimum 5.0 m. All safety measures, monitoring system and operation rules will be as per World Road Congress Technical Committee on road tunnels guidelines.

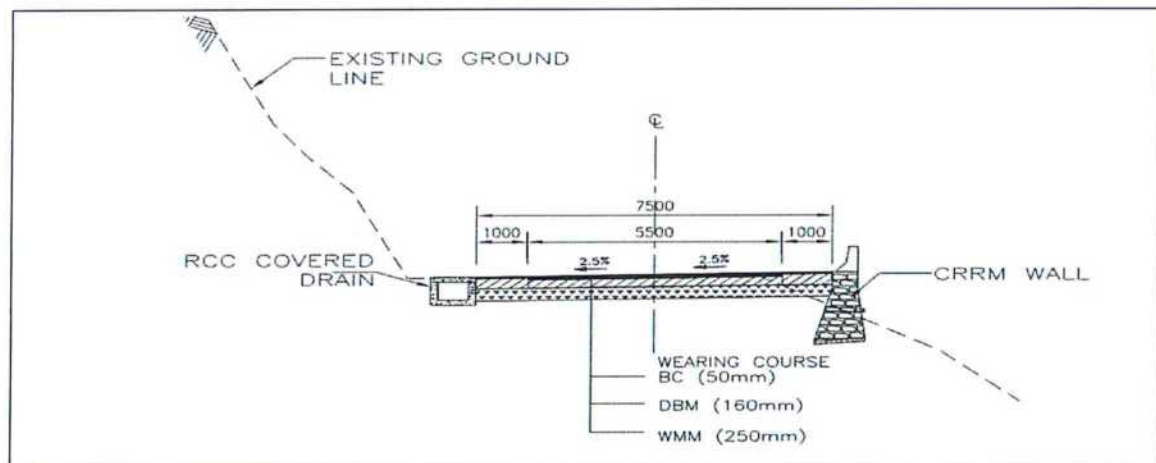


Figure 3-4: Typical Cross Section at Nagdhunga - Sisne Section

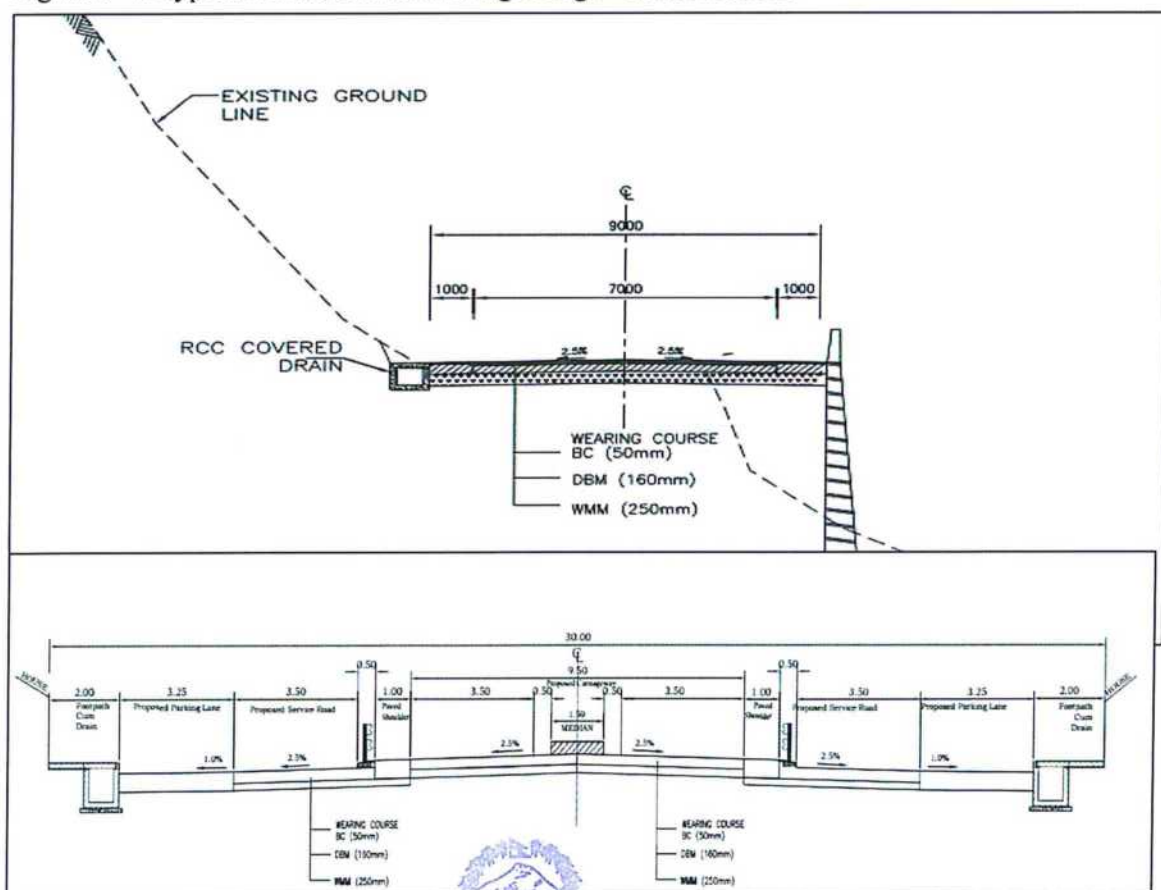


Figure 3-5: Improvement of Existing Road to 2 Lane Carriageway

Figure 3-6: Typical Section of Road

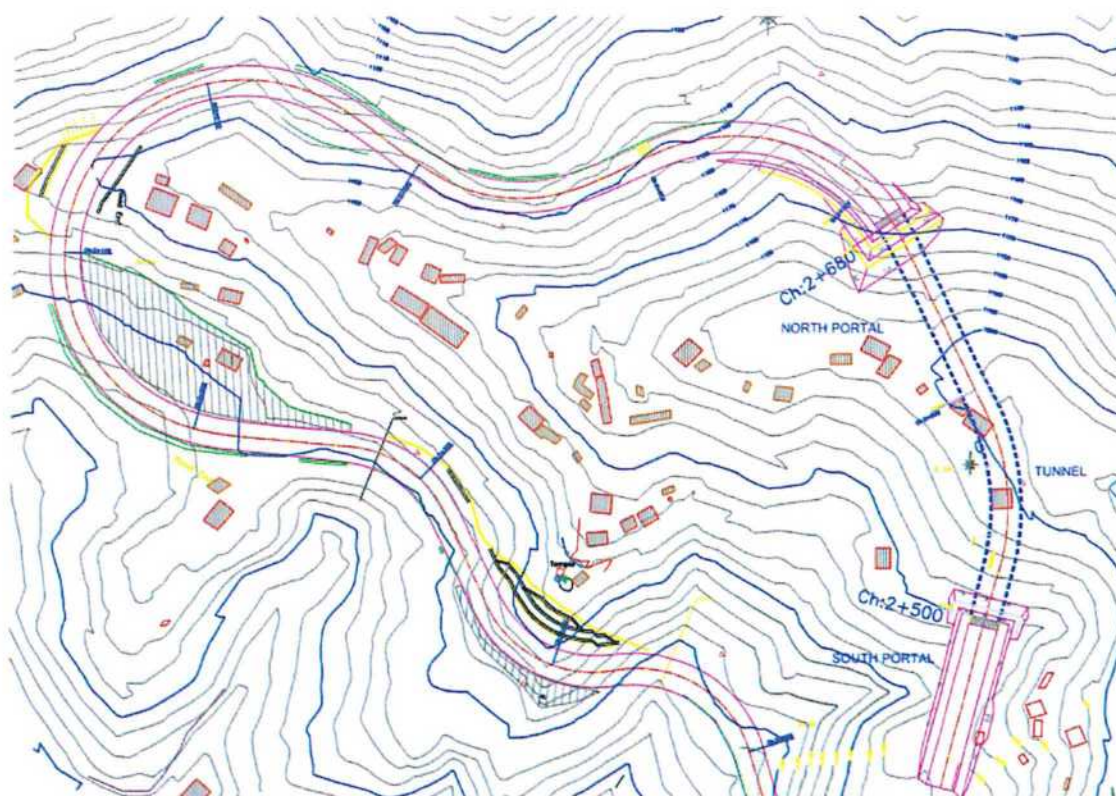


Figure 3-7: Tunnel alignment proposed at Waglethok

3.12 Design Standards for Bridges

Design standard for bridges and Foot Over Bridges have been described in following three sections.

1. Planning for New Bridges
2. Planning for Retained Bridges
3. Planning for Foot Over Bridges

Detailed standards for all types of bridges are established in detail design, considering siting, hydraulic and hydrological studies, span arrangement, carriageway and deck width, deck configuration, design loading, congestion and reduction factors, seismic analysis based on the disaster of 2015, soil parameters, design mixes, type of structures and other parameters.

3.13 Planning for Retained Bridges

All the bridges on existing road from Nagdhunga to Mugling have been proposed to be retained as there is no alternative route to carry the existing traffic on the road. Some of them have inadequate waterway and therefore may be dismantled after construction of a new bridge parallel to the existing bridge.

The existing bridges have to be repaired for various common repairs to make them safe and sound for rest of their life. Bridges proposed to be retained after required repair and rehabilitation have been planned as hereunder:

Hydraulic and Hydrological Studies

Bridges proposed to be retained have been verified for hydraulic adequacy. All the hydraulic data for bridges have been collected from the field and is being analyzed and studies to be carried out by the Hydrologist to determine the adequacy of waterway of existing bridges proposed to be retained as per provisions of IRC: 5-2015 and IRC: SP-13 - 2004. Bridge at Gardo Khola which is hydraulically inadequate may be abandoned / dismantled after new bridge is constructed.

Span Arrangement

No changes have been made in span arrangement and length of the retained bridges for 2-lanes.

Carriageway Width / Deck Width

No changes have been made in carriageway width / deck width of the retained bridges except repairing and reconstruction of the railings and footpaths.

Repair and Rehabilitation

The defects found during inventory and condition survey have been recommended for required corrective measures and repair works shall be carried out accordingly. Replacements of wearing coat, expansion joints, replacement of old non-functional bearings, reconstruction of railing are some of the common repair rehabilitation measures to be executed in each of the retained bridges. The details of repair and rehabilitation activity have been reported separately in Bridge Inventory and Condition Survey.

3.13.1 Planning for Foot Over Bridge

Safety aspect along the project corridor has been identified by the Safety Expert and reported separately. On line of the recommendations, pedestrian safety aspects have also been considered. The requirement of providing Foot Over Bridges (FOB) for pedestrian to cross the road are planned and designed accordingly.

Locations

Siting of the foot bridges identified by the Safety Expert are primarily located in the market and town area where schools, colleges, hospitals and other public facilities are being used by the pedestrians. There are 12 nos. of pedestrian bridges proposed for construction.

Span Arrangement

Span arrangement conforms to the width available for highway design. There are two types of cross sections proposed in road design. Accordingly, two types of Pedestrian footbridges have been design. These FOBs have two equal spans with a central pier to be constructed in median.



Typical elevation showing the arrangement of FOB with respect to road cross section has been shown in Figure 3-8.

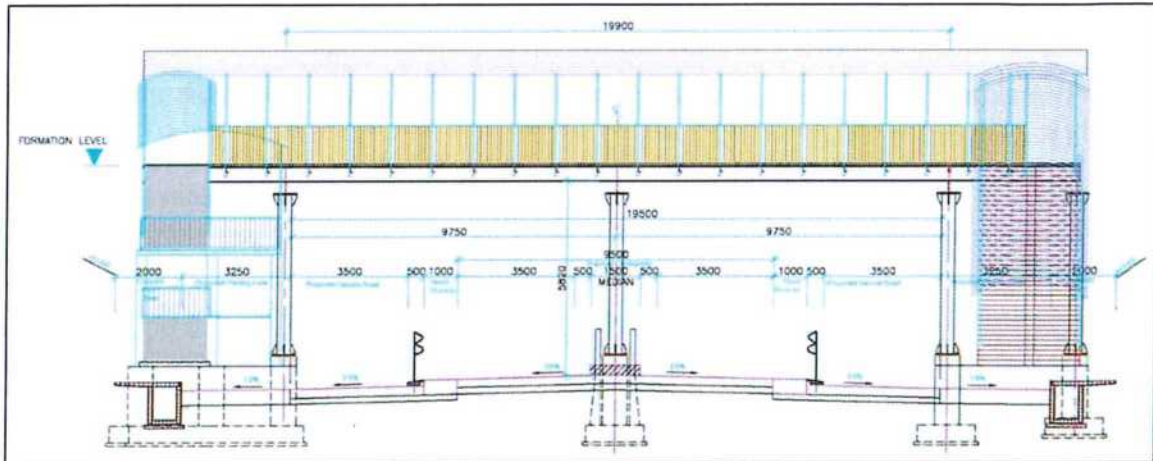


Figure 3-8: Typical elevation of FOB (road width 30m)

Pedestrian Facilities

All FOBs have been provided with access by stair for the abled users whereas disabled users have facilities of ramp so that wheelchairs can be moved on the FOB to cross the roads. The stairs and ramps are easily accessible from the footpath and service road. The FOBs are also provided with roof cover to protect the pedestrian from heats and rains. The safety barriers are provided to keep the things and users from falling on the roads. Anti-skidding textured deck tiles have been recommended for safety and slipping of the users.

Design Loading

FOBs have been designed for pedestrian live loads of 500kg/m^2 , wind loads, self-weight and superimposed dead loads as per IRC: 6-2017.

Type of Structures

a) Foundations

Individual and combined RCC footing has been adopted for foundations of the FOBs.

b) Substructure

Steel circular pipes which provide economical and aesthetically pleasing appearance shall be provided in all the supports of the FOBs. Support in median is protected from direct collision of the vehicles.

c) Superstructure

Steel structures have been provided at all locations in order to keep the uniformity in appearance along the project road.

The steel structures for FOBs are generally preferable in respect of following aspects:

- Easy fabrication, transportation and assembling at site

- Minimum disturbances to running traffic
- Long life with minimum and regular maintenance
- Light weight structures

3.14 Planning for Grade Separated Structures (Vehicular Underpass and Overpass)

Improvement by providing a new road along a new alignment needs to maintain and improve the existing road and road facilities as well, if required. At many locations along the project road on Sisnekhola-Dharke new road, existing roads are crossing the project road at different levels. In order to provide un-interrupted crossing of the vehicles of wither roads, a structure is provided so that there is no cross-over of the vehicular movements. Vehicular Underpass (VUP) is provided where existing road passes under the Project Road and Vehicular Overpass (VOP) is provided where existing road goes over the Project Road.

Locations

These grades separated structures are located as per highway plan and profile drawings. The location of existing cross roads is generally improved and made to cross the project roads at right angle. The improved cross roads are generally regarded to provide a standard design of the underpasses. The details of grade separated structures are provided in table below.

Span Arrangement

Span arrangements are decided on the basis of which road carries which roads. In case of VUP, the width of existing road governs the span of the structure. The width of Project Road decides the width of the structure. In case of VOP, the width of Project Road governs the span of the structure. The width of cross road decides the width of the structure. It is proposed to provide a typical design and drawings for these two types of Grade separated structures.

Table 3-21: VUP and VOP along the Sisne Khola-Dharke Road

Sl. No.	Tentative Chainage (km)	Overpass / Underpass	Size of Box (m)	Barrel length (m)	Remarks
1	1+370	VUP	7 x 5.5	12	Existing road under project road
2	5+500	VOP	12 x 5.5	7	Existing road over project road.
3	6+760	VUP	7 x 5.5	12	Existing road under project road
4	8+460	VUP	7 x 5.5	12	Existing road under project road

Source: Nepal India Regional Trade and Transport Project (NIRTTP) Detailed Design of Improvement of Nagdhunga-Naubise-Mugling Road and Bridges, 2018.

Table 3-22: VOP and VUP along Bishaltar-Phisling Road

Sl. No.	Tentative Chainage (km)	Overpass / Underpass	Size of Box (m)	Barrel length (m)	Remarks
1	3+760	VOP	12 x 5.5	7	Existing road under project road
2	5+740	VUP	7 x 5.5	12	Existing road over project road



Source: Nepal India Regional Trade and Transport Project (NIRTTP) Detailed Design of Improvement of Nagdhunga-Naubise-Mugling Road and Bridges, 2018.

Design Loading

Components of the Grade Separated structures have been designed for the respective vehicular loading which it carries according to the no. of vehicle lanes. That component which carries the Project Road shall be designed for loading as the New Bridges described in Section 9.6.1 above.

Type of Structures

For the size of the structures as mentioned in above Table, RCC box cell structures will be most suitable in terms of constructability, economy and the effectiveness.

3.14.1 Design Codes and Standards

Following codes and specifications shall be followed in Design of bridges.

- IRC Code of Practice
- IS Codes
- Standard Specifications for Road and Bridge Works, Nepal, 2073
- MoRTH Specifications for Roads and Bridges (5th Edition)
- Guidelines and circulars issued by MoRTH and NHAI

3.15 Relevancy of the Proposed Project

The major means of transportation in Nepal has been identified as automobile roads and air transport. Other than these two, there were also some efforts to work with ropeways, railways and waterways, but they all remain in an elementary state. Nepal's lack of infrastructure and geographic constraints has also led to poor road conditions and chronic trade deficits every year. The growing and continued mismatch between import and export has resulted in an alarming level of trade deficit in Nepal. Over the years, export has almost been stagnated, and the import skyrocketed. All types of infrastructure such as trade related as well as others remain inadequate and in poor condition. The needs in improvements of basic industrial infrastructures of the country become very urgent. Nagdhunga-Naubise-Mugling road provides connections to the Birgunj dry port near Nepal-India border via Narayanghat and serves as a major road section for the freight transportation connecting capital city. The improvement and upgrading of this road section is needed to support communication for the growing population of the country and for the sustainable plying of existing highway and adjacent road users as well as to improve trade with neighboring countries. Besides, the improvement of this road will provide opportunities for local and national development as an important arteria for touristic activities, providing access to the markets for local producers, enhancing local industry development, cooperation, and communication between different districts and Bagmati Province and Gandaki Province of Nepal.

3.16 Project Implementation Approach and Modality

Both labour intensive environmental friendly method and machinery equipment will be used for the improvement and upgrading of existing highway as well as for the construction of



proposed new road sections. Blasting and excavation will be required especially at the proposed tunnel section of Sisnekhola-Dharke and along the last 5.5 km section of Bishaltar-Phisling new proposed alignment where hard rock is existing and will be difficult for human labour to excavate. Human labour will be used for the opening of road width formation on the flat terrains. Appropriate environmental safeguards will be adopted during the time of construction and operation of the project to mitigate detected adverse environmental impacts. Influences due to construction works such as blasting, road width formation and other construction activities will be handled safely to minimize adverse impact upon local resources, residences and upon local inhabitants. Generated spoil will be disposed safely with the identification of proper spoil disposal sites. Haphazard disposal of spoil will be avoided strictly. Locals and Community Forest User Groups will be consulted for the identification of tree plantation spaces for compensatory re-plantation activities including protection of planted species for at least 5 years. Further, construction activity will be executed by avoiding adverse impacts upon natural drainages and rivers.

Construction and opening of new proposed alignments such as Sisnekhola-Dharke and Bishaltar-Phisling including construction of proposed bridges will be carried out after the improvement and upgrading of existing KNM Highway. The proposed project for the improvement and upgrading of existing highway including construction of new bridges at four locations.

The civil works contract packages of KNM Road Project is divided in six contract packages as per table below;

Table 3-23: Civil work contract packages

Contract Packages	Description of Works	Road Length (Km)
Package-I	Improvement of Nagdhunga-Naubise Road and Bridges	12.40
Package-II	Improvement of Naubise-Galchhi Road and Bridges	24.20
Package-III	Improvement of Galchi-Benighat Road and Bridges	28.80
Package-IV	Improvement of Benighat-Mugling Road and Bridges	29.40
Package-V	Construction of 2 lane road and bridges on New Alignment from Sisnekhola to Dharke including the Tunnel	11.20
Package-VI	Construction of 2 lane road and bridges on New Alignment from Benighat to Kurintar	15.30

3.17 Land Requirement of the Project

The total land area requirements for the construction of new alignment (Sisne-Khola-Dharke Section and Bishaltar-Phisling Section) and upgrading of existing KNM road has been estimated at least 80.77 ha. Out of total, 43.33 ha of private land and 37.44 ha of public land (forest land) will be acquired permanently for the improvement. The construction of new highway alignments will acquire 30.68 ha. of land permanently along Sisinekhola Dharke section and 45.87 ha of land permanently along Bishaltar-Phisling section.



37.44 ha of government land (Forest land belongs to Department of Forests and Soil Conservation) will be required permanently for the implementation of proposed project (construction of new alignments and upgrading of existing highway). However, not all land area within the ROW will be utilized for the construction of formation width. It is further estimated that, 12 ha. of Government land (under the jurisdiction of local government) will be acquired temporarily for establishments of labour camps, workshops, project engineer camp station, and construction material storage, vehicle parking areas and other facilities, during construction. The government lands that are in the form of *parti* land (not registered), barren land, grass land etc. will be used temporarily. Forest area is located along the existing KNM highway and also significantly extends along the new proposed Bishaltar-Phisling and Sisne Khola Dharke alignment.

Table 3-24: Types and Area of Land Requirement (50m ROW)

Road Section	Permanent land acquisition		Temporary land acquisition
	Agricultural land and settlement in Ha. (Private Land)	Forest in Ha. (Government Land)	Barren land in Ha. (Government Land)
Nagdhunga-Mugling	0.21	4.01	Barren land in Ha. (Government Land) 5 ha. for labor camp, engineer camp and other necessary camp; 5 ha for crusher plant, batching plant, Workshop; 2 ha for stock piling and miscellaneous purpose temporarily
Sisnekhola-Dharke	25.40	5.28	
Bishaltar-Phisling	17.72	28.15	
Total	43.33	37.44	12
Grand Total	80.77		

Source: Field Survey, 2017

12 ha. of temporary land acquisition will comprise 5 ha. barren land for labor camp, engineer camp and other necessary camp; 5 ha for crusher plant, batching plant, workshops; and 2 ha for stock piling and miscellaneous purpose.



CHAPTER 4: EIA Approach and Methods

The ESIA study is carried out in accordance with the EPR of GoN. The National EIA Guidelines (1993), NPC/IUCN was referred to carry out the study. Moreover, this study of the proposed project has been carried out by referring approved Terms of Reference.

4.1 Desk Study/Literature Review and Reconnaissance Visit

Relevant literatures, documents, including plan and policies, acts and rules, published reports pertaining to environmental standards, acts, regulations and conventions guidelines and manuals, world bank operational policies and other available sources were collected; and intensive desk study was carried out to assemble information regarding the project area, project related issues and other important questions during the EIA Study. Available literatures and maps (topographic, land use, land system), aerial photographs, etc. were also collected and reviewed. Detail Project Report and Feasibility Study Report of the project served as the key documents reviewed to determine the nature and scope of activities of the project that influences the environmental conditions of the proposal area. Published literatures of the project area pertaining to biological, social, chemical, physical and cultural environments in the form of reports were collected from various sources and reviewed to get information on the coverage of the studies and fulfill the data gaps.

4.2 EIA Screening, Scoping, and Preparation of Terms of Reference

Screening exercise was carried out in order to fulfill the requirement of World Bank. The screening report has been prepared as per the format presented in the Environment and Social Management Framework of NIRTTP. Screening exercise was executed using a checklist. The Screening report concluded that the project is categorized as category A project with significant adverse environmental and social impacts requiring mitigation measures and detailed environmental impact assessment.

Scoping report was also prepared in accordance with the Environment Protection Regulation (EPR) of 1997 and its amendments (first in 1999 and second in 2007), the National EIA Guidelines (1993), and Environmental Safeguard Policies of World Bank. During preparation the Scoping report there were identified relevant issues to be considered in ESIA study, evaluated their significance on the basis of available information, determined procedures for adaptation in the course of EIA, established priorities for environmental assessment and prepared a TOR for the EIA study. The TOR was also prepared for the EIA study as per the schedule-4 of the Environment Protection Regulation (EPR) of 1997, pertaining to Rule 5.

4.3 Field Survey and Investigations for EIA

Field studies were conducted in project site areas in an extensive manner by a multidisciplinary team, which comprised of an environmental expert, biologist, geologist, socio-economist and highway engineer. During the visits, baseline information on physical and cultural, chemical, biological, and social conditions of the project direct and indirect impact areas were collected. The sub-sections below present briefly the various approaches and methodological tools used during the field exploration.



4.3.1 Physical and Chemical Environment

Geology and Land Use: Field investigation was carried out by the consultant for surface geology, geomorphology and slope stability inventory (in particular identification of existing landslide or erosion-prone areas). Based on the regional geological map prepared by DMG (1987) and field visit data, distribution of the rocks and soil, rock types and soil types along the road alignment was analysed. Basing on the field visits, the information on surface geological conditions also was collected. Distribution of the instability area, its level of hazard in soil and rock has been clarified, also basing on field visits. Distribution and location of construction materials has been identified after survey and mapped accordingly. The project team identified and described the mitigation measures after excavation of construction materials and slopes in instability areas or possible instable areas. The spoil disposal area and its stability conditions as well as engineering geological conditions of the road alignment were designated and clarified in the report. The slope stability conditions were analysed by measured discontinuities in the field. The measured and estimated data were plotted in computer program DIP 5.1 in stereographic projection. The data were analysed in relation to natural hill slope and wedges, formed by discontinuities.

Collected data includes land use patterns and other information, regarding physical resources of the project area. Besides, the categories of land uses have been described, including areas used for cultivation of crops, grazing areas, hilly and forested areas, industrial and urbanized areas, land ownership (Public, Private, and Community forest), common properties, etc. Land use patterns and geology of the project area, as well as other relevant information has been derived from available topographical maps, site observations, geological mapping, site specific photographs, consultations with local communities and inquiring history of landslides in the area. Finally, the probable seismic hazard and its likely impact on physical structures has been predicted and evaluated.

Primary land use data was derived from Landsat satellite imagery as well as Google Earth program to assess present conditions and current land use in the area. Supervised classification was carried out on the images in the ERDAS Imagine 2011 suite in this scenario, a standard procedure for creating Supervised Classification on Landsat images, the following seven objects were considered for evaluation of land use in the project area:

- Forest
- Agricultural Land
- Grass Land
- Built Up Areas
- Barren Land
- Shrub Land
- Water Bodies

To create areas in ERDAS 2011, the Resource Sat II image was loaded in the viewer and Supervised > Signature Editor Tool was selected. The supervised classification was performed after re-editing and deleting some of the signature classes and by merging multiple training areas per class. The results were compared, and it was found that the signature classes with unmerged training areas gave better result. Example of land use maps provided in Chapter 5.



The use of Permanent, Temporary, Barren and Agricultural land was evaluated along the proposed alignment. Land area required for temporary and permanent acquisition was also estimated. The possible locations for establishment of Labour Camp sites along the highway were identified and described with presentation of environmental management procedure. The traffic study and its analysis were presented in the EIA report; this study was based mostly on secondary data. Then, the burrow pit areas and quarry sites, including amount of required construction material, were designed with estimated amount and area required for stock piling, storage of topsoil, dumping of excavated soil, treatment of slope stabilization of tipping sites and natural slopes, waterlogging and management of runoff water. All relevant data were collected, analysed and presented in the EIA report. The EIA report incorporated also information about possible workshop locations and store yards for its proper establishment and maintaining healthy environment during operations. All these locations are presented in the EMP in order to monitor and safeguard the environment of the project site.

Besides, existing infrastructures and physical structures that are likely to be affected with the construction works were taken into account that to develop adequate mitigation measures, if relocation and rehabilitation is required. The data on common property resources (water supply, electricity, temples, cultural heritage sites etc.), cultural water resources, unique features (rocks, waterfalls, etc.) were also collected through field visits. The information on chemical features of the project area was investigated and the impacts of project construction on the chemical environment was identified and predicted in order to propose appropriate mitigation and enhancement measures.

Hydrology: The hydrology assessment covered estimating of flood magnitudes as the result of precipitation. For most road drainage design purposes, there are three primary categories of hydrologic data sets such as surface water runoff, precipitation and drainage basin characteristics. The evaluation of water runoff includes daily and annual averages, peak discharges, instantaneous values, and high-water marks. Precipitation includes rainfall, snowfall, hail, and sleet characteristics. Drainage Basin Characteristics were estimated and measured from maps and field reviews.

The information on climatic and meteorological conditions was gathered, including available historical and modern data on average annual and monthly temperature and precipitation. Records of highs and low parameters, available information on flood levels and areas of influence were compiled from secondary sources (including flood maps where available, identification of areas susceptible to flash floods from runoff, etc.), taking into account various intervals for storm events (for example, 5-year, 20-year, and 100-year storm events). The available information on climate change projections for the study area was also compiled and analyzed. The description of weather patterns is based on the analysis of potential effects of temperature/rainfall and storm intensity variations, covering present variability and anticipated effects of climate change along the route, which may be relevant to the design of road segments and bridges. Available information on climate change projections for the study area was also compiled. Finally, the conclusion was made on the potential effects of climate change along the route, which may be relevant to the design of road segments and bridges.



In the design of road drainage structures, floods are usually considered in terms of peak runoff or discharge in cubic meter per second and hydrographs as discharge per time. In this study, hydrological assessment is based on secondary sources.

Detail inventory of water resources and their use, surface and ground water, irrigation waters, drinking waters, public taps and other structures was prepared.

The data on **Air quality, Water quality and Noise level** has been gathered as baseline information. Air quality data was collected in three places along the Nagdhunga-Naubise-Mugling with identification of content for Carbon Monoxide, Sulphur Dioxide, Nitrogen Dioxide, Lead, PM10 and Total Suspended Particles (Exact name of places is provided below). Noise level has been investigated, at least, in 5 places along the alignment. Samples to identify water quality of major rivers, crossing the road alignment, has been collected during field visits. Physio-chemical parameters such as water temperature, pH, total dissolved solid, Ammonia, Nitrate, Phosphorous, Sulphate, Dissolve Oxygen, Biological Oxygen Demand, Coliform (cfu/100ml), Calcium, Sodium, Magnesium, Potassium, Chlorine, Fluoride, Sulphate, Cadmium, Iron, Copper, Mercury, Lead, Hardness, Oil and grease has been measured.

The main activities are field sampling, *in situ* analysis and laboratory test of the collected water samples from various 22 points along the route: Sisne Khola, Sikre Khola, Khani Khola, Naubise Khola, 100 m downstream of Dhuni Khola & Reupse Khola, Mahesh Khola, Agra Khola, Kheste Khola, Belkhu Khola, Galaudi Khola, Barban Khola, Mauwa Khola, Hugdi Khola, Charaudi Khola, Malekhu Khola, Majhimtar Cross at Trisuli River, Pang Khola, Pashupati Khola, Kaudi Khola, Dhaubadi Khola, Lamu Khola and Near Shree Chandrodya H. S. School at Trisuli River. Similarly, noise measurements were carried out at 5 locations: Mungling, Fisling, Malekhu, Galchhi and Nagdhunga Checkpost whereas air quality monitoring was conducted at 3 locations: Mungling, Malekhu and Nagdhunga Checkpost. The finding data of the study and measurements were assessed to make necessary conclusions and recommendations for suitable mitigation measures for improvement, if necessary in comparison with reference to the prevailing national drinking water, noise, and ambient air quality standards.

Scope of Work

WETC laboratory conducted the field sampling, *in situ* and laboratory test activities with adopting following activities:

- ✓ Sample collection at field & laboratory testing of water samples
- ✓ Field recording of noise data and assessment
- ✓ Field sampling, laboratory analysis and assessment of air quality data
- ✓ Preparation of report

Study Locations for Water, Noise and Air Quality Sampling

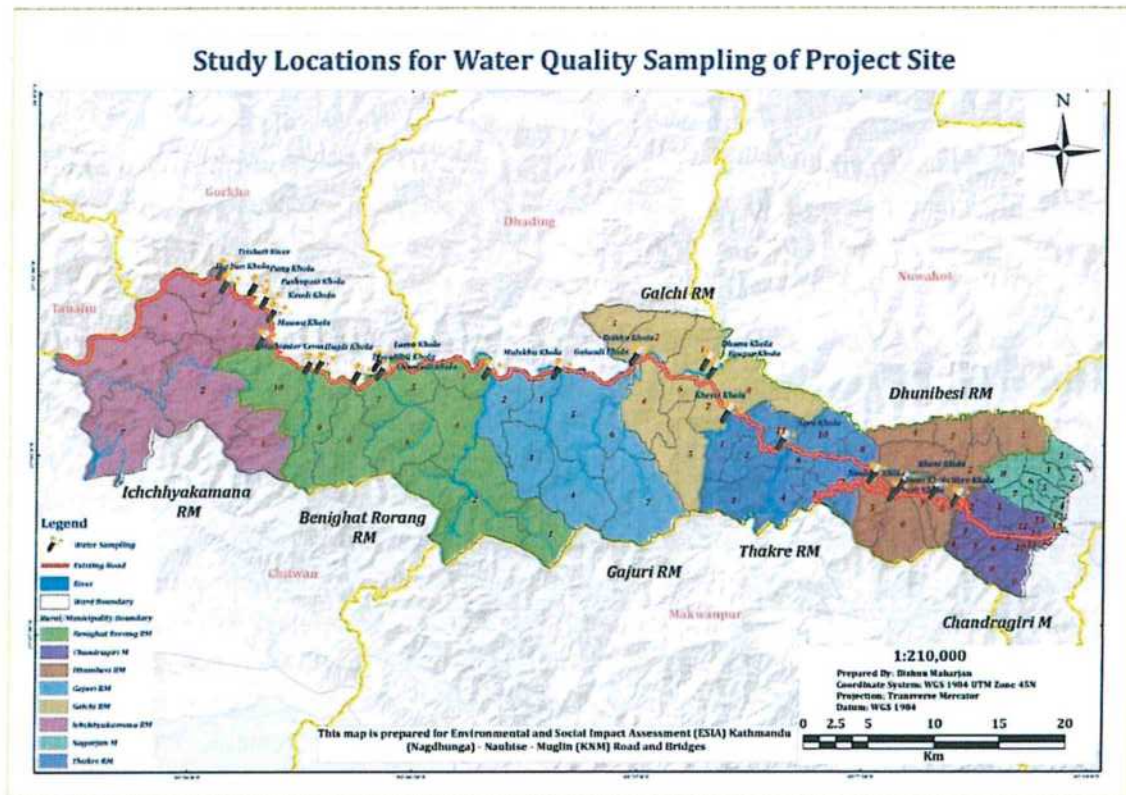
The study area was across the Kathmandu -Naubise- Mugling road at following locations:

Air Quality- Mugling (Near 3 Sister Restaurants), Malekhu (At Temple – Near Ambe Petrol Pump), and Nagdhung Checkpost (At Chandragiri Ward Office)



Water Quality

Data on water quality were gathered in 22 points including Barban Khola, Pang Khola, Pashupati Khola, Hugdi Khola, Kaudi Khola, Mauwa Khola, Majhimtar across Trishuli River, Charaudii Khola, Galaudi Khola, Malekhu Khola, Dhaubadi Khola, Lamu Khola, near Shree Chandrodaya H. S. School at Trisuli River, Belkhu Khola, Kheste Khola, Agra Khola, Mahesh Khola, 100 m downstream of Dhuni Khola & Reupse Khola, Naubise Khola, Khani Khola, Sikre Khola, Sisne Khola.



Map 4-1: Sampling Point for Water Quality Monitoring

Noise Quality

Mugling: (Longitude: 27.857957, Latitude: 84.561587)

Fishling: (Longitude: 27.8698230, Latitude: 84.630718)

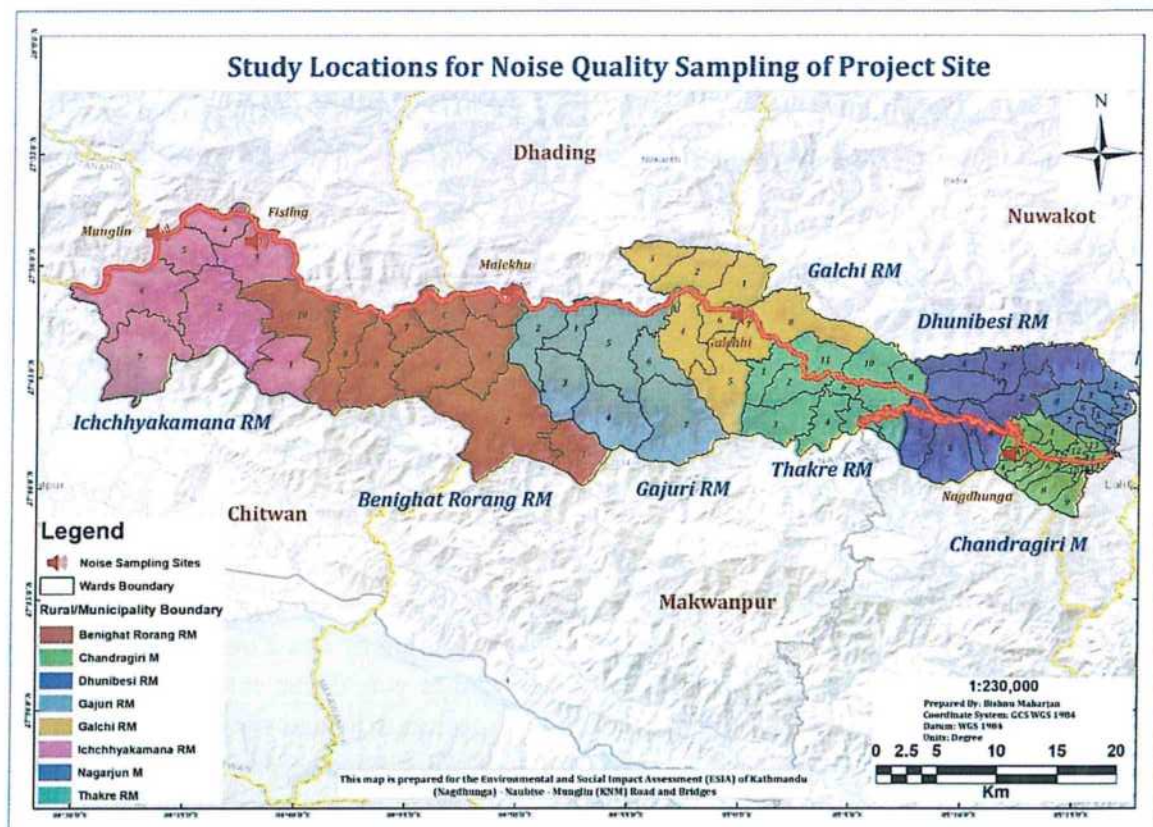
Malekhu: (Longitude: 27.8138017, Latitude: 84.827331)

Galchhi: (Longitude: 27.796052, Latitude: 85.000279)

Nagdhunga Checkpost: (Longitude: 27.699046, Latitude: 84.209573)

All coordinates are given in decimal degrees.





Map 4-2: Study Area Location for Monitoring Noise Quality

4.3.2 Biological Environment

In order to meet the objectives of EIA, information was obtained through field visits and field surveys. Secondary data were collected through study of relevant literature and maps. During field visits, area experts were involved in identifying prevailing status of the natural resources, potential issues and impacts on the natural resources after the execution of the project. Additional tools and techniques of inspection, verifications, observations and discussions with locals and key informants were followed to acquire more information.

Documentation has been gathered for assessment of (i) Forest and vegetation, including flora and fauna in the project area and forest cover quality, (ii) Wildlife in the Project Area, including mammals, birds, aquatic fauna, reptiles and amphibians and possible impacts on them with the construction of road and bridges, (iii) description of wildlife habitat area within or in proximity to the project influence area (Direct or Indirect) and possible impact to habitat, which may further threaten or endanger wildlife species and their movements through landscape, including any zones or locations of known wildlife crossing along the existing alignment, and (iv) Endangered, vulnerable, threatened species or legally protected species, species listed in IUCN red-list, found in the Project Area. Areas of natural habitat for flagship species and critical natural habitats has been identified. Details of used methodologies for biological surveys have been provided below.

4.4 Field Investigation

While implementing a project, it is important to learn biological details about species distribution and abundances in the project area as well as existing situation and possible impacts on wild flora and fauna. Study on key features of the wildlife and birds and their habitats such as water bodies, nesting trees and bushes preferred by important birds were studied. Same process was also applied for aquatic organisms, which may be found near the bridge sites and in rivers adjacent to project area.



Figure 4-1: Data collection in the field

4.5 Forest Survey

During the biological survey, observational visits to all the forests along the alignments were made. General information on the state of forest, composition of forest trees, shrub/herbs and other species of different values available in the forests was documented. Information on number of community forests, types of forests and species, existing condition of community forest was also collected. Teams of experts on wildlife, aquatic and herpeto-fauna and avifauna conducted separate surveys to document species occurring in and nearby the project area. Information regarding terrestrial and aquatic flora and fauna of the existing forest area was established as baseline data and impact of project construction on the flora and fauna was identified and predicted in order to propose appropriate mitigation and enhancement measures.

i. Forest Inventory: Number of trees that required to be removed while implementing the project was assessed following a sample plot method. Inventory technique recommended by the Government of Nepal (GoN), Ministry of Forests, and Soil Conservation (MoFSC) has been followed. The inventory acquired information regarding vegetation status, forest area, non-timber forest product (NTFP), grasses and climbers, in accordance with the established and prevailing requirement and practices.

- a. Sample plot for data collection: When census is not practical, statistically significant sampling intensity should be designed and implemented. Sample plot to collect data on forest flora is as shown in Figure 4-2. As specified in GoN (2000), sample plots were laid in the affected forest areas. The plots are mosaic sample plots. Each sampling plots with a mosaic have four different sized of plots within it, to measure different stages of a tree/plants. The outer plot is 500 sq. m. area (20 m X 25 m) for the enumeration of tree species only, second sub-plot of 100 sq. m. area (10 m X 10 m) for the poles sized, third subplot of 25 sq. m area (5 m X 5 m) within the outer plot for the enumeration of saplings (also shrub species) and finally the fourth number of 4 sq. m (2m X 2m) plot within the quadrat in the left hand corner of the quadrat is used to count regeneration (also herb species). The number of trees and volume of timber to be cleared will be estimated using quarter girth formula. The details are presented in table 4-1 and figure 4-2.

Table 4-1: Size of sample plot prescribed

Dimensions and measurements			
Plot size	Length of plot arms	Forest condition to be measured	Diameter range dbh (ob)
.0025 ha	5 x 5 m ²	Regeneration (2X2m ²) - (D)	Less than 4 cm (count only)
		Sapling – (C)	4 to 9.9 cm
.01 ha	10 x 10 m ²	Pole trees – (B)	10 to 29.9 cm
.05 ha	20 x 25 m ²	Timber trees – (A)	Greater than 30 cm

Source : GoN (2000)

- b. Sampling intensity: A sampling intensity of 7.88% was measured for the inventory.

. This exceeds the prescribed intensity of the MoFSC of 1%. A systematic strip sampling technique was followed, as specified in GoN (2000), a total of 59 sample plots were laid. Assuming forests to be a continued chunk, with a plot to plot distance of 500m, these plots were laid. For the purpose of inventory, total forest was stratified into four stratas/ blocks and these are

- i. Kathmandu (Nagdhung) to Naubise,
- ii. Naubise to Mugling,
- iii. Sisne Khola to Dharke section, and
- iv. Benighat to Kurintar section.

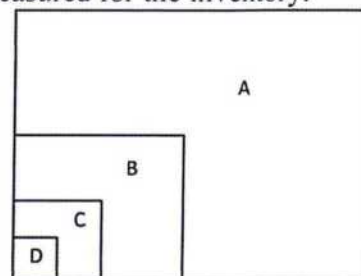


Figure 4-2: Layout of vegetation sampling plot

- c. Estimation of wood/stem volume: Following standard volume model practice in (Sharma and Pokula 1990) for standing tree volume are enumerated and based on the directives of MoFSC (2017); number and volume of trees are enumerated. Standing Tree Volume will be calculated on the basis of following formula:

$$\text{Ln}(v) = a + b \times \text{Ln}(d) + c \times \text{Ln}(h) \quad (\text{i})$$

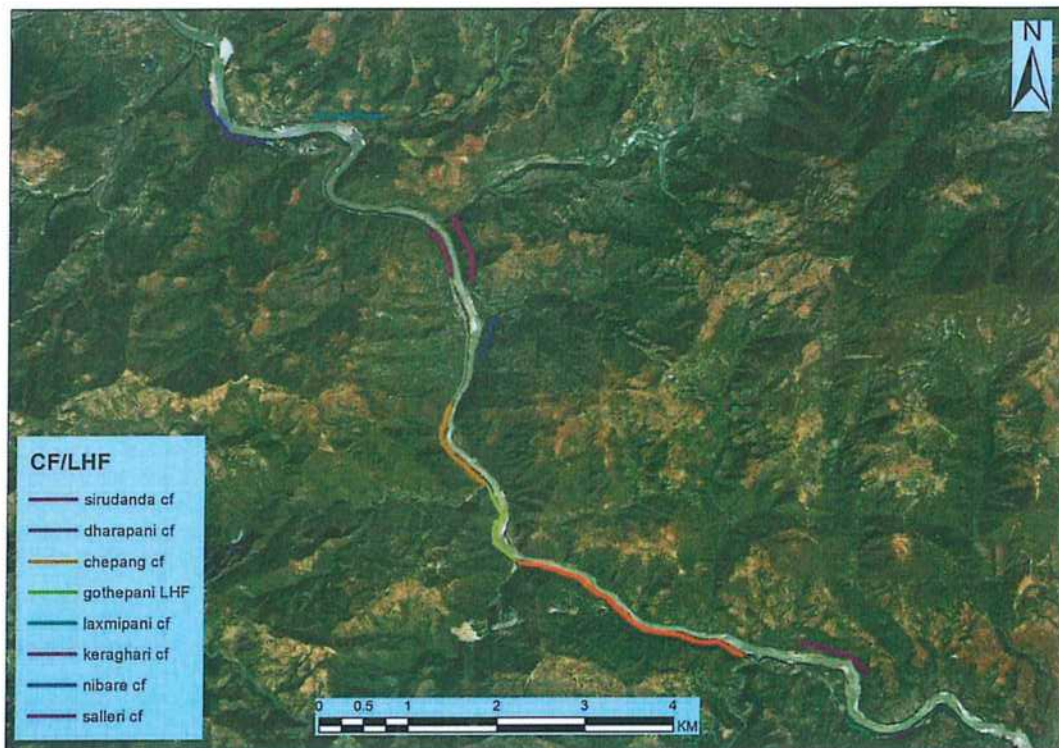
Where a, b and c are volume constants, d: diameter at breast height and h: height of the tree.

- a. Estimating Carbon off-take: Biomasses of a tree/shrub was estimated using a biomass models (Tamrakar, 2000) and biomass tables for tree species. Above ground carbon losses were calculated based on total biomass (Negi et al., 2003), which is total above ground biomass (Chaturvedi and Khanna, 1982) and root biomass (RB, FAO, 2000).

- b. Above Ground Biomass (AGB) = SB + BB + LB (ii)

Where, SB is Stem Biomass and is calculated as Stem Volume multiplied by Wood Density, BB is Branch Biomass and LB is Leaves Biomass.





Map 4-3: Map of sampling sites, visited during forest survey.

Alignment in Google Earth depicting the length of forest patches (colored polyline is the length of each CF/LHF).

4.6 Wildlife Survey:

The study intended to document the mammalian species and their habitats present in the project area. To address the designated objectives, following scientific techniques were carried out.

- a. Direct field observation: To establish primary information, evidences of wild animals as far as possible, photographic evidences together with GPS information was collected to be used later for identification.
- b. Secondary information was collected through discussion with local people including representatives of community forest user groups, forest offices, local residents and elites and literature review including report on "Feasibility study of Kathmandu (Nagdhunga) Naubise Mugling Road".

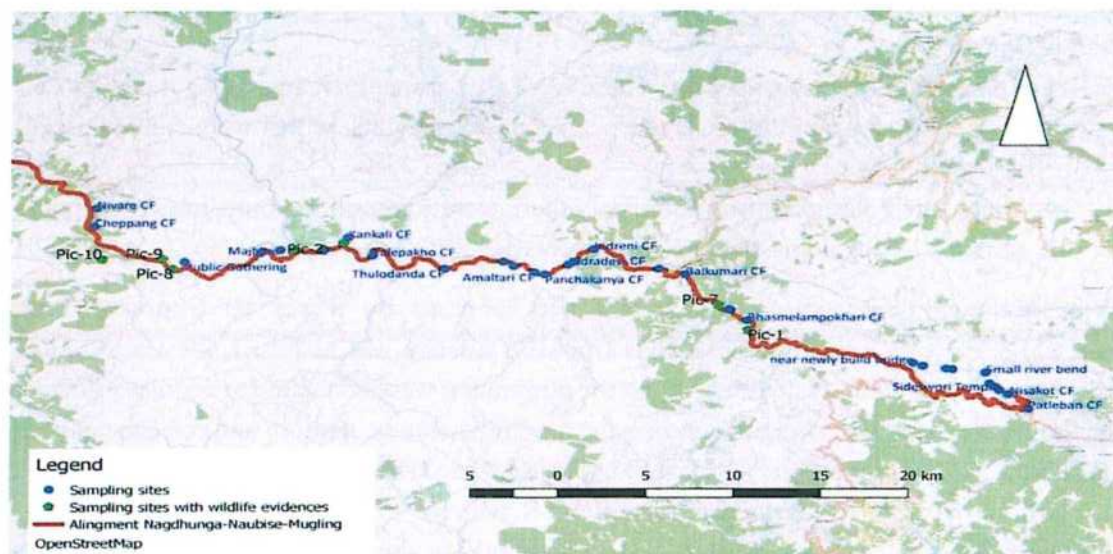
A random sampling method was followed to collect evidences of wildlife present in the areas, especially near water sources. A 2-week field study was carried to record primary and secondary evidences of wildlife along the forest areas adjacent to the highways and other nearby forests. Further, after identifying valuable ecological habitat of the mammalian species in the project area, study also concentrated on documentation of potential impacts that implementation of the project (construction and operation) might bring about on the mammalian fauna and their habitats. The approaches and methodology that was followed for the study are described above and include the literature review, discussions and interview as well as direct sightings with fixing of the mammal locations, using GPS- units and describing

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4.7 Bird Survey

Different techniques during direct field visit, discussion with local people and literature review were used to record birds along proposed KNM alignment. During field visit, line transects method was used with unlimited radius to record all heard or seen birds (Bibby et al. 2000, Thomas et al. 2002, and Urfi et al. 2005). Bird monitoring was done along the highways as well as in the visited nearby forests.



Map 4-5: Bird study areas and distribution of sample points in the project area

The walking speed during survey was approximately 1km per hour that to detect all possible species. Bird observations were conducted from 7:00am to 6:30pm with some breaks in the

afternoon. Binocular of 8x42 and the guidebook on Birds of Nepal (Grimmett et al. 2000) were used to locate and identify the birds. Migration, habitats, and breeding status were categorized with help of Grimmett et al. (2000, 2016), while the threatened status were based on Inskipp et al. (2016) and IUCN (2017).

4.8 Studies of Herpetofauna and Aquatic fauna:

Assessment of fish diversity (species and abundance) was carried out through description of habitats, communities, and species identification. Fish sampling was done using Wading Method in the rivers and wetlands within the project area.

All the river/springs distributed in the project Zone of influence were selected as a sampling sites. A purposive sampling technique was followed. In total 39 sites were studied. The sampling sites for both aquatic fauna and herpetofauna were close by.

Selected sampling sites incorporate all feeder springs and Major Rivers, i.e., Mahesh Khola and Trishuli River, flowing across the existing road and proposed new road sections. Thus, sampling sites were divided accordingly to existing and new road sections.

- a) **Nagdhunga-Naubise section:** Starting from Nagdhunga Checkpost, Kathmandu to Naubise, there are five prominent springs. Points where the spring and existing road intersect were considered as sampling point. 5 sample points along the Nagdhunga-Naubise section were studied.
- b) **Naubise-Mugling section:** There are 27 sample points studied in this section. The existing road from Naubise to Mugling pass through numerous feeder rivers of Mahesh khola and Trishuli River. All feeder streams those were flowing during the survey. In addition, some sample points were also studied where Mahesh khola and Trishuli River flowing were close to existing road.
- i) Sampling sites along the proposed new road section is also further divided into two sub-sections;
 - a) **Sisne khola Dharke Section:** There were 4 prominent streams along the proposed new alignment and these were selected sampling points, which were studied and data collected.
 - b) **Bishaltar Fisling Section:** Similarly there were 3 sampling points incorporating four streams falling across the proposed new road alignment here.

Aquatic fauna was studied through cast net, loop net by fisher. At Chumkhola Bazar, electrofishing was found practiced, data from the practice was acquired, for a better study of the sample population. Fishermen, along the alignment, were consulted to acquire information, as they were the key informants. During the amphibian study, capture and release method was followed. More information on herpatofauna was gathered through citizen scientists of the area. In addition, literature review was carried, as it was the major source of aquatic fauna and herpatofauna. The habitat characteristics of the sampling sites were studied following "Aquatic Survey Methods developed by Oregon Department of Fish and Wildlife".



i. Sample Site Selection

Thirty-nine sites/points were set for the stream habitat survey and aquatic fauna inventory across the Mahesh Khola River Basin (Nagdhunga to Galchi) and Trishuli River Basin (Galchi to Mugling). Selected sampling sites incorporate all feeder springs and major rivers (i.e. Mahesh Khola and Trishuli River) across the existing and proposed new road sections. Sample sites were selected according to sectors: i) Existing road section and ii) New road section.

ii. Stream habitat and aquatic life survey

Stream habitat survey provides the quantitative information on habitat conditions such as aquatic species diversity and distribution, differing significantly within the valley and streams. Such surveys and aquatic inventories along existing and proposed new road alignment carried out referring to "Aquatic Survey Methods", developed by Oregon Department of Fish and Wildlife. General information through map and direct observation of the stream characteristics in the field were collected with study on presence/absence of fish specific.

iii. Sample Collection Technique

Capture and Release method was applied for sample collection of small aquatic creatures and amphibians. They were captured using Insect Mesh Net with short span and released back after taking photographs. In case of reptiles, photographs of directly observed individuals during survey were taken for identification. Fish sample collection was done using net and electro-fishing techniques as well as trapping and angling with help of local fishermen. Electro-fishing was applied in limited sampling sites. Institutional Animal Care and Use Committee and Animal Welfare Act were referred for humanitarian collection of samples.

iv. Species identification

Various guidebooks and online sources were used for species identification. Fish species were identified following "Ichthyology of Nepal: A Study of Fishes of the Himalayan Water" and "Fish, Fisheries and Farmers in Nepal". Whereas, "Herpetofauna of Nepal-A Conservation Companion" was followed for identification of herpetofauna. Similarly, "A field guide to freshwater Mollusks" was followed for identification of Mollusca. Consultations with experts allowed to refine species identification.

4.9 Review of Relevant Policies, Laws, Guidelines and Manuals

Relevant information for the study was collected through extensive review of literature, previous study reports of development projects. Review of literature regarding the related Policies, National legislations, Environment related guidelines and Technical documents were carried. Desk Review of important secondary sources such as past EIA reports, VDC/DDC Profiles, topographical and Google maps, statistical procedures, relevant websites and relevant reports of MoFE (then MoSTE), MoFSC, and DNPWC. National Forest Policy, 2075, Land Use Policy 2072, National Environment Policy 2076, Forest clearance guideline 2076 (राष्ट्रिय प्रथमिकता प्राप्त आयोजनाको लागि राष्ट्रिय वन क्षेत्र प्रयोग गर्ने सम्बन्धी मापदण्ड सहितको कार्यविधि, २०७६) are some important legal documents reviewed.

Literature Review:

Literature review was carried also to understand flora and fauna of the project area. The review gave indication on forests and vegetation, forest cover quality, wildlife, birds, aquatic fauna and potential impacts due to construction and expansion of roads on wildlife habitat and their

movement. Endangered, vulnerable, threatened species or legally protected species available in the project area, including any areas of natural habitat and critical natural habitats were documented. Previous study reports on wildlife of development projects, publications of National Parks and wildlife reserves and other relevant literatures were reviewed during the study. Information of the mammalian diversity of project area was obtained. Review also included report on "Feasibility study of Kathmandu- Naubise-Mugling Road".

4.10 Study of topographic maps and other maps

Topographic map and Google map, including land use pattern along the proposed alignment (PA) were studied. Within the 50 meters of Right of Way (RoW) of proposed alignment, land use detail of the PA was analyzed for this study. Topographical maps were analyzed carefully and field verification made by all experts analyzing direct and indirect impact zones in the project area and zone of impact (ZOI). Google Maps including all the aforementioned maps were used to identify impacts.

4.11 Interaction Meetings, focus group discussions and key informant interview

Several meetings were held as a part of the study. The various stakeholders were invited to participate in the meetings. Through these meetings, concerned participants were requested to provide their comments and suggestions, foreseen impact on the forests resources and their own lifestyles and issues on the development. Focus Group Discussions and Key Informant Interviews were carried out also in various locations along existing and new alignments.



Figure 4-3: Discussions with the forest officers at Benighat (right) and with local person at Charaudi

4.12 Socio-economic and Cultural Environment

Information on socio-economic and cultural features of the project area were collected, including population, ethnic composition, employment and education, health and sanitation conditions. At the same time, data on cultural and religious sites, sources of energy, infrastructures, market centers, agricultural practices, and development activities in project area were collected and compiled. Methodology to collect these data included the site visits, site survey, and interaction with interested stakeholders, consultation, and discussion with people of concerned rural municipalities, district coordination committee, and municipality, through dissemination of checklists and questionnaires and Focus Group Discussion (FGD).



Figure 4-4: Discussion with local stakeholders

Information on general socio-economic conditions of people of the project-affected wards of Rural Municipalities (RMC) was collected through community consultations or informal public consultation at the settlement level by the use of rapid rural appraisal or participatory rural appraisal methods as applicable. The information was collected through pre-designed checklists, which include key socio-economic characteristics of the people of all class, caste and economic categories.

This information includes demographic features of households, migration pattern, employment, land hold size, agricultural production, food sufficiency, other productive resources, livestock raising, access to different social infrastructures such as drinking water, education, health-posts, general health, hygiene and sanitation condition, etc. The households located in RoW were focused in the socioeconomic study. Such households were surveyed for their socio-economic conditions by using structured questionnaires. The survey question includes, the family size, education, health, religion, economic activities, land holding size, agricultural production, horticultural production, livestock, household income (farm and off-farm), general household expenditures, etc. to unravel the living status of the affected households.

Information on social infrastructures such as schools, health posts, drinking water and other facilities was collected from the RMC or Ward offices, through consultation with village elites and through key informant interview at RMC/municipality and settlement levels to assess the current situation of these facilities and the general sanitation status of the project area community. Information was collected also about these facilities, their adequacy and beneficiary population.



Figure 4-5: Conversation with local farmers in the Benighat-Phisling section

The Socio-economic environment survey was carried out by questionnaire survey, checklists and community consultations in order to collect the baseline information on socio-economic environment. The secondary information about the socio-economic condition of district and ward level were collected from CBS, 2011. Similarly, the cultural environments of the project area, relating to cultural sites, archeological/historical and religious sites were studied through consultation meetings, informal public consultation and at the ward level of concern RMC by the use of checklists. Direct observation was carried out for the cultural sites such as temples, festival sites, and cultural sites within the direct project affected areas.

All sites of religious, cultural and historical importance on the directly project affected area was observed in the project area.

4.13 Database Preparation, Analysis, Prediction and Assessment of Impact

After the complete documentation of baseline environmental data of the project area, each of the environmental parameters were examined against the project activities in the different stages of project development using various methods and tools. Basing on collected data the valued environmental and social components were identified and described that to predict possible environmental and social impacts. The physical and biological information was tabulated to the extent possible. Socio-economic and cultural information were cross-checked, analyzed, processed using computer-spreadsheets and presented in the simple tabular form.

4.14 Impact Identification, Prediction and Assessment/Evaluation Method

The project team carried out analysis of proposed activities at pre-construction, construction and operation stages that to identify and predict possible impacts. All impacts have been sorted out on their nature: physical, biological and socio-economic, and on their value – positive and adverse using extrapolative method, expert judgment and available maps. Then, the impacts are categorized as direct and indirect. The direct and indirect impacts were further evaluated in terms of their extent as site, local or regional and further analyzed in terms of duration as short-term, medium-term and long-term. The magnitude of the impact was then evaluated based on the conditions of the environmental parameters, including estimated or projected damage. The Numerical values, provided by national EIA guidelines (1993) were used that to evaluate identified and predicted impacts in terms of their importance, significance, and nature. The possible impacts were assessed covering both adverse and beneficial issues. Standard checklists were utilized as a methodology, adopted for impact identification and prediction. A sum of impact values for magnitude, extent, duration provides a maximum of 140-point score and a minimum of 25 points. Impact values or scores for each selected alternative were summed up and multiplied by the probability of occurrence of the particular impact. Then, final impact scores for all alternatives are compared and the highest value detected corresponding to the greatest potential for environmental impact.

4.15 Preparation of Environmental Management Plan and Monitoring Plan

Basing on the analysis of impacts and their nature, the measures to increase beneficial impacts and mitigate adverse impacts were proposed in accordance with mitigation hierarchy in road projects. The identification and selection of measures was based on site-specific issues, past experience on similar projects, and expert judgments. The monitoring plan to assess the effectiveness of mitigation measures during implementation also was prepared. After analysis of all relevant information, the Consultant prepared an Environmental Management Plan (EMP), covering the cost for mitigation as well as prescribed monitoring activities and selected indicators of mitigation effectiveness. The EMP is divided into two sections:

- First, a “project owner’s” (Employer’s EMP) version containing the comprehensive set of mitigation, management and monitoring measures, requirements, and institutional responsibilities for both construction and operation stages in order to fully address all identified impacts within reasonable budgets.



- Second, a monitoring program including indicators, parameters/thresholds, and locations, frequency with a methodology for monitoring to enable verification that mitigation measures are successful.

4.16 Public Notice, Public Hearing and Stakeholders Consultations

Public hearing was carried out at four locations along the entire stretch of road alignment, covering all project affected Rural Municipalities and Municipalities. Public hearings were held after preparing the draft of EIA. For Public Hearing, a leaflet was prepared in Nepali language with major findings, potential impacts, and suggestions as well as suggested mitigation measures were distributed to all concerned stakeholders during Public Hearing Programme. The program has been conducted with participation of representatives of DoR, DFO, DCC, CDO, NGOs, CBOs, political parties, and other public representatives. The locations where public hearing were conducted were 1. New Activities Youth Club, Ward 9, Khatripauwa, Dhunibesi Municipality, 2. RIMS Hall, Jintetar, Bairani Ward 6, Galchhi Rural Municipality, 3. Ward office of Bishaltar Ward 5, Benighat-Rorang Rural Municipality, and 4. Agricultural Hall, Phisling, Gandaki Rural Municipality from April 9 to 12, 2018 with the total participants of 259. The details of public consultation and hearings are presented in Chapter 6. Further, the recommendation letters have been collected from all project affected rural municipalities and municipalities and has been attached in the Annex 10 of EIA report.



CHAPTER 5: Existing Environmental Conditions

5.1. Physical Environment

5.1.1. Topography and Geomorphology

The proposed KNM Road and its alternative alignments pass through the hilly area of Kathmandu, Dhading, Chitwan and Gorkha district in Bagmati Province and Gandaki Province of the country. The proposed road alignment lies in the Middle Mountain (Lesser Himalaya). The elevation ranges from 1,500 m (Nagdhunga) to 265 m (Mugling) from above mean sea level (amsl). Nagdhunga is the highest point of the alignment, with most villages lying at about 1500m above sea level; the Sisne-Khola has elevation of 1320 m amsl. The road alignment passes hilly area from Nagdhunga to Naubise (about 13%); after Naubise this alignment passes the valleys of Mahesh Khola and Trishuli River, following on the left bank of Mahesh Khola to Galchhi before meeting with Trishuli River. After Galchhi, the road alignment follows left bank of the Trishuli River upto Mugling (about 87%). Overall topography of road alignment is rolling type, ascending and partially descending in different sections.

The alignment starts from Nagdhunga on border of Kathmandu and Dhading district and ends at Mugling of Chitwan district. The existing road runs from Nagdhunga to Mahadev Besi on the north aspect, after then the road traverses on the northeast aspect up to Belkhu. From Belkhu to Majhimtar the road alignment runs again on the north aspect. The alignment traverses from the north to northeast slope from Majhimtar to Mugling. The proposed new alignment between Sisne Khola and Dharke has the south to southwest aspect, crossing major rivers (kholas) like Sirke, Khani, Naubise, Sugure, Sopyang, Juge, Agra, Phedi, Kheste, Machhedi, Belkhu, Galaudi, Malekhu, Gomati, Charaudi, Khataudi, Hugdi, Mauwa, Chum, Dahaki, Barban and Nagdi Kholas. The road alignment follows more than 90% along the river valley of the Mahesh Khola and Trishuli River; then, it follows on the left bank of the valley, running 5 to 150 m above from the riverbed of the Mahesh Khola and Trishuli River.

Table 5-1: Elevation with chainage of locations

Sn.	Location	Chainage	Elevation (m)
1	Nagdhunga	0+000	1500
2	Sisne Khola	3+250	1320
3	Naubise	12+000	840
4	Dharke	14+500	800
5	Mahadev Besi	23+000	500
6	Galchhi (Baireni)	34+000	428
7	Belkhu	40+500	400
8	Gajuri	49+500	400
9	Malekhu	56+500	400
10	Benighat	62+500	375
11	Bahuntar	63+000	380
12	Bishaltar	65+500	380
14	Majhimtar	73+000	320
15	Kuringhat	86+000	300



Sn.	Location	Chainage	Elevation (m)
16	Mugling	94+000	268

5.1.2. Climate and Hydrology

Nepal has a very sharp relief topography leading to unusually high inter-variability of climate and hydrology. Climate in the project area varies from sub-tropical to tropical type. There are two types of rainfall in Nepal. Summer monsoon rain usually begins in the second week of May and lasts until the end of September; winter monsoon generally occurs in between the months of October to May. The summer monsoon originates from the Bay of Bengal and the winter monsoon originates from the Mediterranean Sea. There is direct influence of rainfall in the discharge of water volume in the rivers of Nepal. Nepalese rivers drain around 174 billion cubic meters of water per year as surface run-off, based on an average annual rainfall of about 1400 mm.

River System

The Kathmandu-Naubise-Mugling road is located in mid-hill areas. There are 27 rivers and rivulets along Kathmandu (Nagdhunga)-Naubise-Mugling and tributaries of Trisuli River Basin. They are entirely dependent on rainfall for their runoff. Rivers and rivulets crossing the KNM road are listed in Table 5-2.

Table 5-2: Rivers/rivulets along KNM roadside

1. Mahesh Khola	10. Khesre Khola	19. Gomati Khola
2. Thare Khola	11. Trishuli Ganga Nadi	20. Bisural Khola
3. Jhapre Khola	12. Chiraudi Khola	21. Charaudi Khola
4. Sikre Khola	13. Belkhu Khola	22. Khatauti Khola
5. Khani Khola	14. Trishuli River	23. Hughdi Khola
6. Naubise Khola	15. Pokhare Khola	24. Mauwa Khola
7. Agra Khola	16. Galaudi Khola	25. Chum Khola
8. Phedi Khola	17. Malekhu Khola	26. Dahaki Khola
9. Machhedi Khola	18. Kadam Khola	27. Barban Khola

The existing road is mainly following the left bank of Trisuli River with 26 major/minor bridges, most of them are built on tributaries of the Trisuli River. Additionally, a lot of small seasonal streams are crossing the existing road, where pipe and slab culverts of different sizes are established. Inadequate sizes of drains have been identified at some places; therefore, recommendations were made to replace them by larger size (DoR, 2017).

There are 7 minor bridges over Mahesh Khola and its tributary and Khani Khola along new alignment from Sisnekhola to Dharke (DPR, 2017). Another proposed alignment from Benighat to Kurintar has 2 major bridges over Trisuli River and 8 minor bridges on its tributary. Many seasonal streams are also crossing the new alignments.

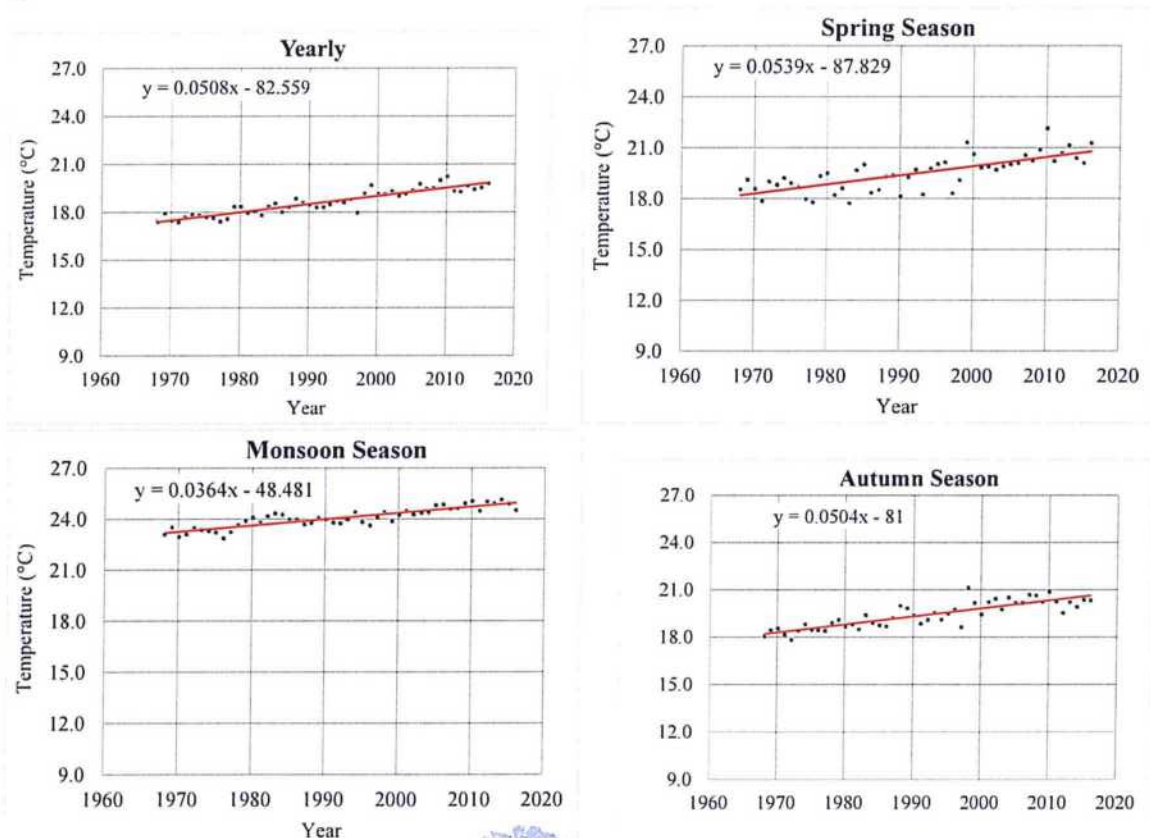
Meteorology

In order to provide some information on the climate patterns of the study area, an analysis of 30 years of past recorded meteorological data on temperature and rainfall were analyzed.



i) Temperature

Kathmandu Airport (27°42' N, 85°22' E) – Index No. 1030 is the weather station located in close proximity of the study area. Analysis of 49 years of data from Kathmandu Airport records, recorded in DHM (1968-2016), shows that the temperature pattern was observed to be increasing in the rate of 0.0508°C per year. The yearly average highest temperature was recorded in 2010 (20.3°C), whereas the yearly average lowest temperature was recorded in 1971 (17.4°C). The overall patterns of seasonal temperatures were found to be increasing. The rate of increase in spring, monsoon, autumn and winter temperatures were recorded to be 0.0539, 0.0364, 0.0504 and 0.0625°C per year, respectively. The annual, spring, monsoon, autumn and winter patterns of temperature is presented in Figure 5-1. Monthly maximum and minimum temperatures of the Kathmandu Airport from 1968 to 2016 are presented in **Annex 1**.



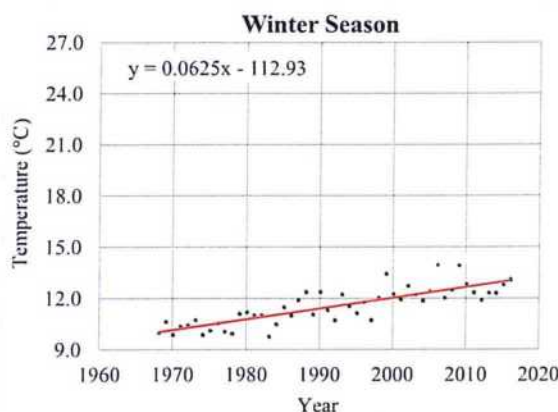
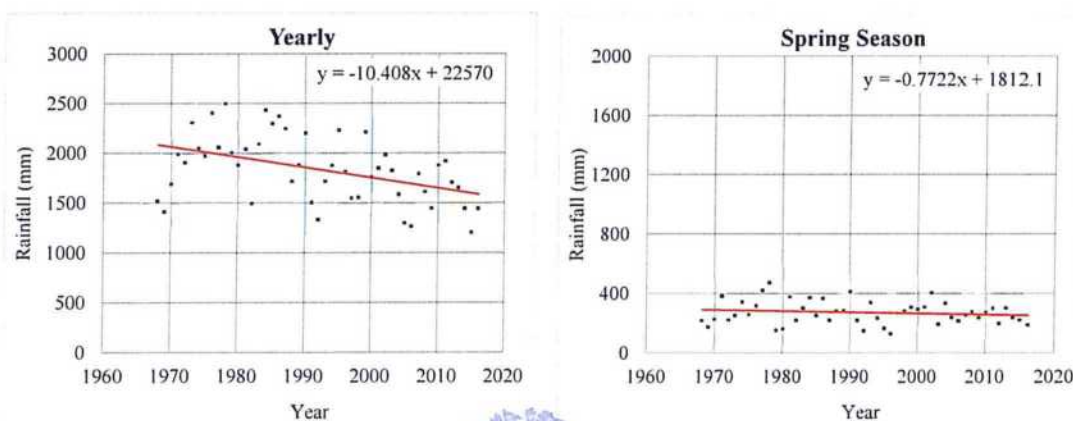


Figure 5-1: Annual, spring, monsoon, autumn and winter patterns of temperature

ii) Rainfall

Gorkha (28°00' N, 84°37' E) – Index No. 0809, Dhading (27°52' N, 84°56' E) – Index No. 1005 and Thankot (27°41' N, 85°12' E) - Index No. 1015, are the rainfall stations located within the distance of 20 km from the project alignment. Analysis of 49 years of data, recorded in DHM (1968-2016), shows that the rainfall pattern of the study area indicates that the annual rainfall of the study area is of decreasing pattern. The rate of decrease was observed to be 10.408 mm per year with maximum rainfall in 1978 (2501.4 mm) and minimum rainfall in 2015 (1207.5 mm). The overall patterns of seasonal rainfalls were also found to be decreasing. The rate of decrease in spring, monsoon, autumn and winter rainfalls were recorded to be 0.7722, 5.6198, 3.7369, and 0.2786 mm per year, respectively. The annual, spring, monsoon, autumn and winter patterns of rainfall is presented in Figure 5-2. Monthly and yearly rainfall of Gorkha, Dhading and Thankot from 1968 to 2016 are presented in **Annex 2**.



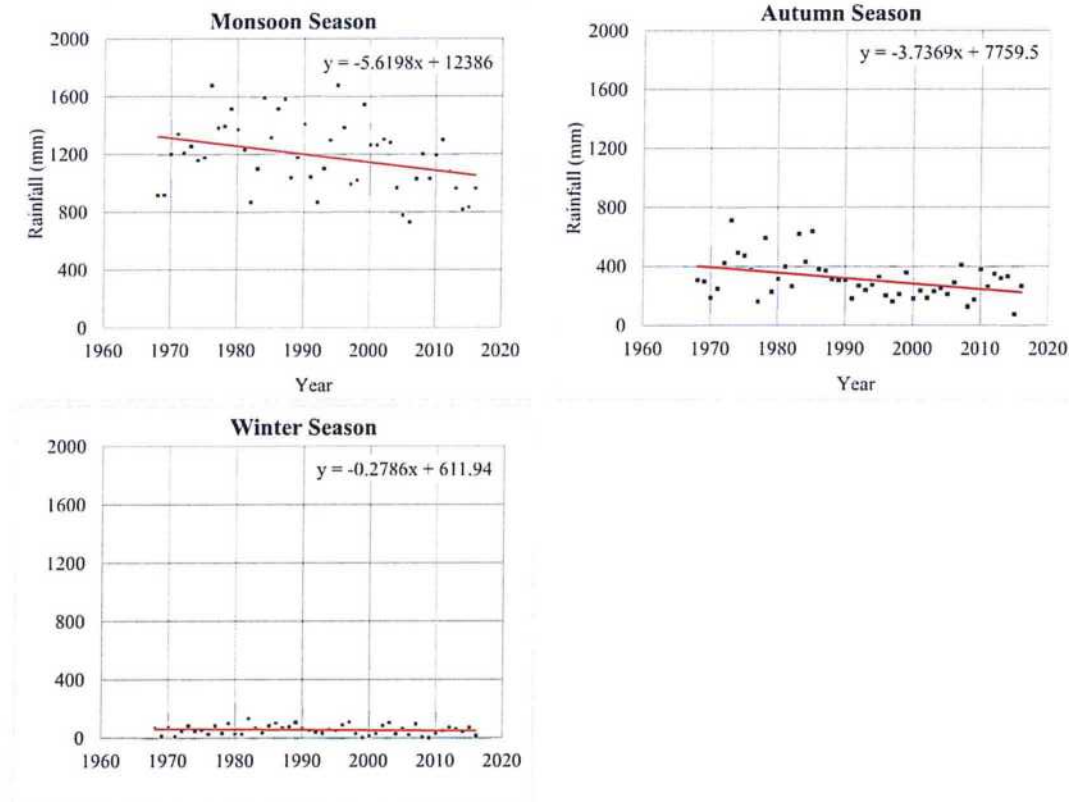


Figure 5-2: Annual, spring, monsoon, autumn and winter patterns of rainfall

Hydrology

In order to provide some information on the discharge patterns of the study area, an analysis of past recorded discharge data of Trishuli River at Betrawati (27°58' N, 85°11' E) – Station No. 447 from 1977 to 2015 (39 years) and Kali Khola (27°50' N, 84°33' E) – Station No. 449.91 from 1994 to 2015 (22 years) were analyzed. The discharge pattern of the Trishuli River indicates that the annual flow has increasing pattern (Figure 5-3), whereas the annual instantaneous maximum flow has decreasing pattern (Figure 5-4). The rate of increase at Betrawati was observed to be 0.0289 m³ per year with maximum discharge in 2003 (275.1 m³) and minimum discharge in 2009 (142.2 m³). Similarly, the rate of increase at Kali Khola was observed to be 0.0289 m³ per year with maximum discharge in 2003 (1068.8 m³) and minimum discharge in 2001 (654.6 m³). The rate of decrease of instantaneous maximum flow at Betrawati was observed to be 1.2134 m³ per year and that of Kali Khola was observed to be 14.912 m³ per year.

According to the rainfall trend analysis, the annual average rainfall of the study area is decreasing at the rate of 10.408 mm per year (Figure 5-2), however, the Trishuli River shows increasing trend. However, the annual trend of maximum instantaneous flow of this river follows the decreasing trend of rainfall. Trishuli River is snow-fed river. Annual increasing trend of temperature (Figure 5-1) causes increase in snowmelt trend. It indicates that the growing trend of annual flow this river is linked to snowmelt in runoff, however, the maximum instantaneous flow is of direct contribution of rainfall rather than snowmelt runoff. Monthly and yearly discharge of the Trishuli River at Betrawati (from 1977 to 2015) and Kali Khola

(from 1994 to 2015) are presented in Annex 3. Annex 4 shows the maximum instantaneous discharge of the river at Betrawati and Kali Khola for the same period.

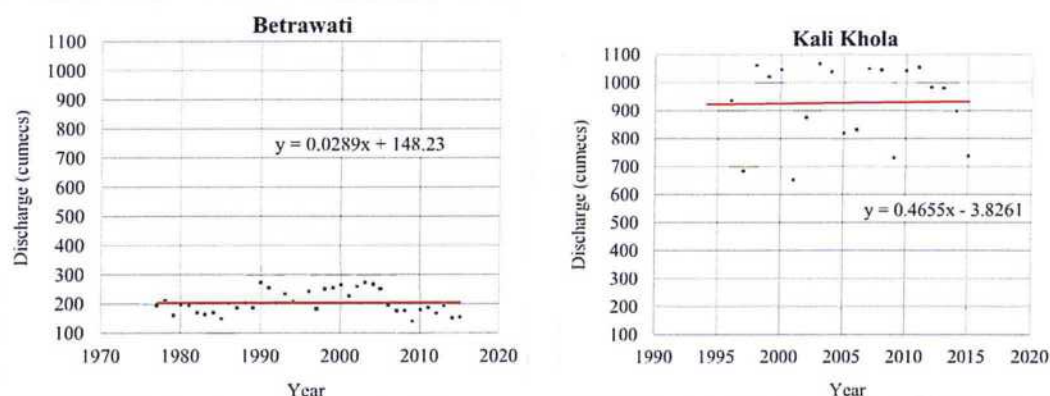


Figure 5-3: Annual patterns of river flow

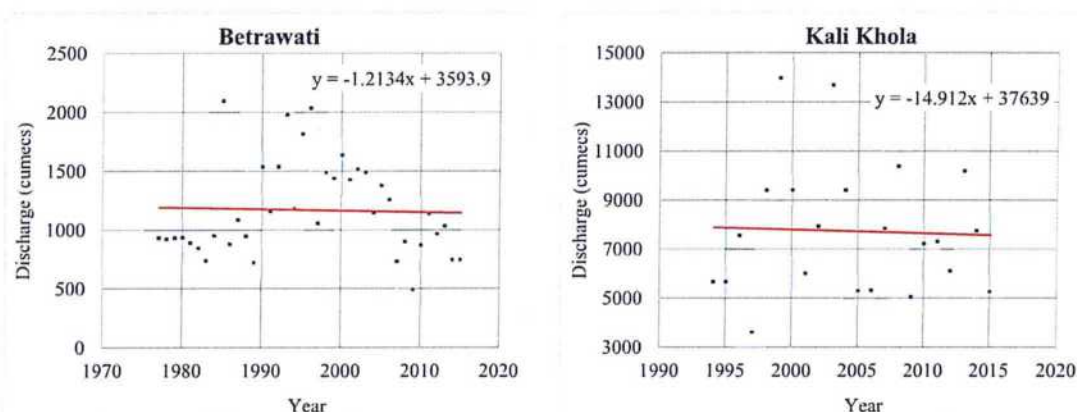


Figure 5-4: Annual patterns of instantaneous maximum flow

Flood Estimation for Drainage Structures

i) Existing Road Alignment

Taking 100 years return period, DoR (2017) estimated the design flood discharge passing through the existing bridges using rational formula and were compared with flood discharge estimated using several regional/empirical methods (Table 5-3).

Table 5-3: Design flood estimation for existing bridges in the existing road alignment (cumecs)

SN	Bridge Name	Chainage (km)	Catchment Area, km ²	WECS/DHM 1990	Sharma & Adhikari (2004)	PCJ (1996)	Modified Dicken's Formula	Rational Method
1	Khatripauwa	4+139	0.8	22	17	10	4	13
2	Naubise	12+449	16.1	118	153	92	83	176
3	Ganesh	2+965	4.0	48	57	36	22	57
4	Sopyang	5+096	6.0	61	75	47	32	70
5	Agra Khola	10+923	111.8	470	618	410	473	495

SN	Bridge Name	Chainage (km)	Catchment Area, km ²	WECS/DHM 1990	Sharma & Adhikari (2004)	PCJ (1996)	Modified Dicken's Formula	Rational Method
6	Khahare	12+376	1.6	29	29	21	9	26
7	Phedi	14+453	3.1	41	46	63	17	50
8	Dangdunge	14+735	7.9	73	91	117	42	86
9	Kheste	18+165	22.8	150	197	257	114	165
10	Machedi	19+484	1.3	27	25	31	7	25
11	Gardo	23+128	4.8	53	64	85	26	80
12	Jundi	24+989	2.5	36	40	54	14	39
13	Chiraudi	26+488	12.0	96	124	152	63	100
14	Belkhu	28+803	88.0	395	520	653	383	424
15	Pokhare	33+155	5.3	57	69	92	29	64
16	Galaudi	36+316	19.7	135	177	228	99	150
17	Soti	38+384	1.7	30	30	39	9	32
18	Malekhu	43+379	101.5	438	576	711	434	435
19	Gomati	49+942	8.0	74	93	119	43	95
20	Charaudi	55+246	46.6	249	329	439	217	311
21	Khatauti	58+186	6.8	66	83	109	37	96
22	Hugdi	61+706	53.1	274	362	459	244	303
23	Mowa	65+887	9.6	83	105	120	51	101
24	Dahaki	72+344	1.0	24	21	23	5	17
25	Barbang	73+275	5.8	60	73	92	1	63
26	Nagdi	80+182	6.8	66	82	102	37	69

Note: For Khatripauwa and Naubise Bridges, 0+000 is at Nagdhunga while for rest of the bridges, 0+000 is at Naubise

Source: DoR (2017)

Cross drains will be designed for 50 years return period flood (DoR, 2017). Using rational formula for discharge estimation of cross drains, this study pointed out the necessity of new crossing structures along with replacing of existing culverts which are inadequate to pass design discharge.

DoR (2017) also found that the existing side drains are more or less adequate for 25 years return period flood but might to be increased for increased return period of flood. In any case during the improvement works, these side drains will be dismantled and the new side drains will be constructed.

ii) Proposed Road Alignment

For the proposed new alignment of Sisne - Dharke section, seven minor bridges are recommended in the Mahesh Khola and its tributaries as presented in Table 5-4.



Table 5-4: Design flood estimation for existing bridges in the existing road alignment (cumecs)

SN	Chainage	Location	Design discharge (m ³ /s)	Lowest Bed Level (masl)	HFL (masl)	Recommended waterway (m)	Velocity of flow (m/s)
1	4+110	Sisne Khola	43	1072.33	1073.45	10	8.5
2	5+170	Sikre Khola	80	1020.76	1022.69	15	7.36
3	8+010	Mahesh Khola	258	846.12	849.87	35	3.84
4	10+860	Mahesh Khola	292	787.86	791.25	50	2.86
5	11+150	Naubise Khola	228	796.31	797.74	40	6.61

Source: Detail Design Report (DDR, 2017)

Similarly, for the proposed new alignment of Benighat - Kurintar section, 2 major bridges over Trisuli and 8 minor bridges in its tributaries are recommended (DDR, 2017) as presented in Table 5-5.

Table 5-5: Recommended bridges along new alignment of Benighat - Phisling section

SN	Chainage	Location	Design discharge (m ³ /s)	Lowest Bed Level (masl)	HFL (masl)	Recommended waterway (m)	Velocity of flow (m/s)
1	1+320	Trishuli River	127.01	304.7	317.22	216	8.39
2	1+659	Lambu Khola	71	336.45	338.57	15	3.58
3	3+863	Dhawadi Khola	60	319.55	321.49	20	3.11
4	4+607	Judi Khola	71	335.78	338.07	15	3.58
5	6+395	Majuwa Khola	61	312.84	315.25	15	3.42
6	9+514	Kaudi Khola	78	308.43	310.47	15	3.27
7	11+461	Prem Khola	35	295.98	297.3	15	2.86
8	14+985	Khani Khola	56	291.13	292.89	15	3.38
9	15+430	Trishuli River Bridge under construction					

Source: DDR 2017

Using rational formula for discharge estimation of cross drains, DDR (2017) pointed out the necessity of 46 cross drains for Sisne to Dharke section; and 67 cross drains for Benighat to Kurintar. This study also revealed that the side drains proposed in new road sections would be adequate to pass the floods of 25 years return period.

Climate Change Impacts

Climate in the project area varies from sub-tropical to tropical type. Maximum average temperature of the project districts is more than 30°C and minimum average temperature less than 10°C. Various studies done in consultation with Department of Hydrology and

Meteorology (DHM) show that climate change induced threats would affect differently people living in various regions in Nepal, socio-economic development, biological diversity and other sectors. The climate change induced threats produce increased risks of floods, landslides, glacier outbursts, drought and other natural calamities. They are determined through analysis of past extreme events and trends and through climate modelling and downscaling of future climate and hydrology against various scenarios.

According to IPCC (2013) global mean surface temperature in the near-term future (2016-2035) compared to reference period of 1986-2005 will be in the range of 0.3 to 0.7°C. Similarly, the area encompassed by monsoon systems will increase over the 21st century and monsoon season is likely to intensify due to the increase in atmospheric moisture. Nepal has been identified as one of four global hotspots for climate change risk, which is a result of complex and extreme topography, quick responding catchments with intense seasonal and climatic variability (MoFE, 2014). NCVST (2009) suggested that mean annual temperature across Nepal is projected to increase by 0.5 to 2°C by 2030s; 1.7 to 4.1°C by 2060s; and 3 to 6.3°C by 2090s. The study suggested that annual precipitation will change by -34 to +22 % by 2030s; -36 to +67 % by 2060s; and -43 to +80 % by 2090s. The rainfall analysis of the present study shows decreasing trend for the study area. An assessment of future floods in the Bagmati River basin carried out by Mishra and Herath (2014) has predicted that in future period (2075 - 2099), magnitude of 2 to 100 year return period floods will increase by 24 to 40%.

Even though present rainfall analysis shows decreasing trend of rainfall for the study area, different studies (Viviroli et al., 2011; Nepal & Shrestha, 2015; Nepal, 2016; etc.) have suggested that extreme events in future are likely to be more frequent and magnitude of such events are likely to increase. Increased extreme rainfall could trigger landslides in several stretches of the road alignment and bring large flood discharge, which can wash away bridges, and other cross drainage structures along the alignment (like during 1993 flood event). Side drains may be inadequate to quickly remove water from the road surface. Similarly, high floodwater can cause toe cutting of the road slopes. It is advisable to consider these aspects during design. However, it will lead to increase in sizes of the structures. In Nepal, guidelines for considering climate change in the design is not available currently. However, increasing the design discharge to cover climate change uncertainty and/or designing cross drainage structures and side drains at higher return period will help reducing their vulnerability from extreme events (DoR, 2017).

Dhading, Gorkha, and Chitwan districts are ranked as having high vulnerability to climate change; where the Kathmandu District is ranked as highly vulnerable according to an overall climate change vulnerability index. Nepal's low level of development and complex topography renders it vulnerability to climate change. The ongoing climate change and changes projected to occur are likely to have impacts on different sectors of Nepal. The sensitive sectors to climate change are agriculture, forestry, water and energy, urban development and infrastructure, tourism, some types of industry, overall livelihoods, and economy. More than 1.9 million people are highly vulnerable and 10 million are increasingly at risk to climate change, and this number will likely increase significantly in the future (NAPA, 2010).

a. Temperature

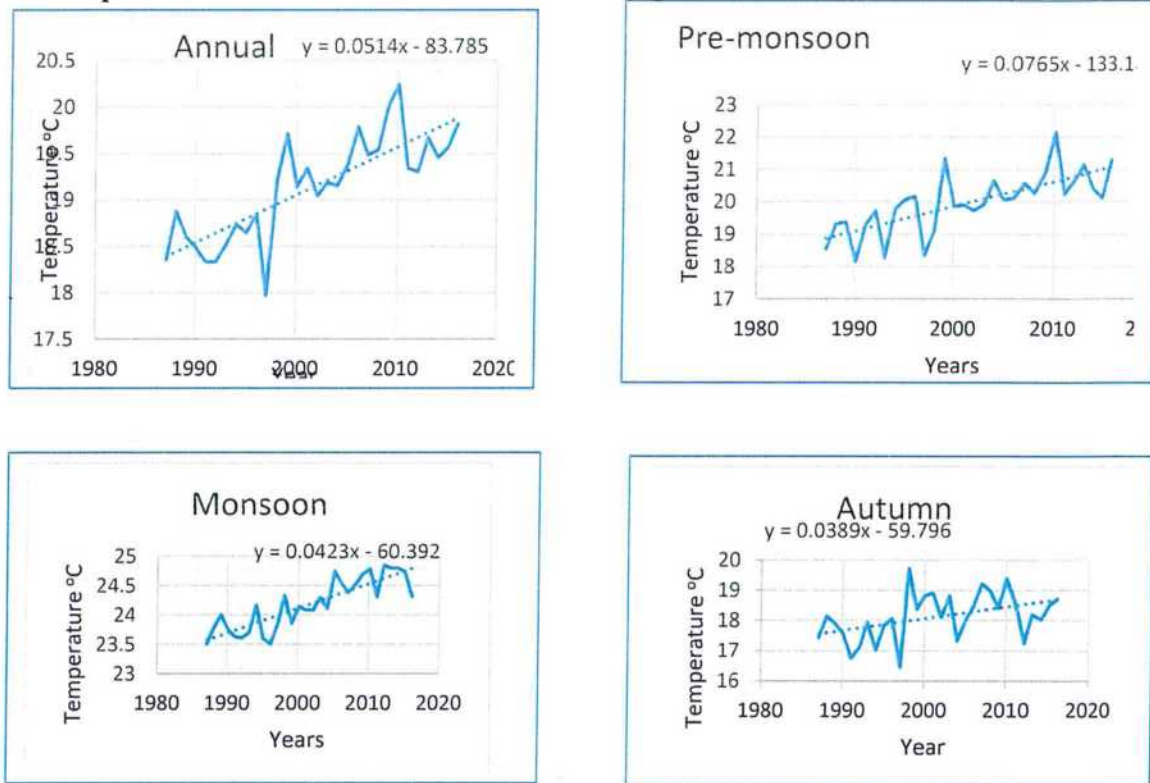


Figure 5-5: The temperature in different season (Source: SESA/Sustainability Study, 2017)

The annual pattern of temperature in Kathmandu and Hilly area was observed to be increasing in the rate of 0.0514 degrees per year (Fig. 5-6). The highest temperature recorded in 2010 (20.25°C) whereas the lowest temperature was recorded in 1997 which was 17.97°C. The overall pattern of seasonal temperatures was also found to be increasing. The rate of increment of pre-monsoon, monsoon, autumn and winter temperature were recorded to be 0.076, 0.042, 0.039 and 0.046 degrees per year respectively.

The annual rainfall of the Hilly area of the BHNMK corridor showed increasing pattern. The rate of increase was observed to be 6.487 mm per year with maximum rainfall in 2013 (1899.3 mm) and minimum rainfall in 1999 (1067.9 mm). All the seasons showed increasing trend of rainfall.



b. Rainfall

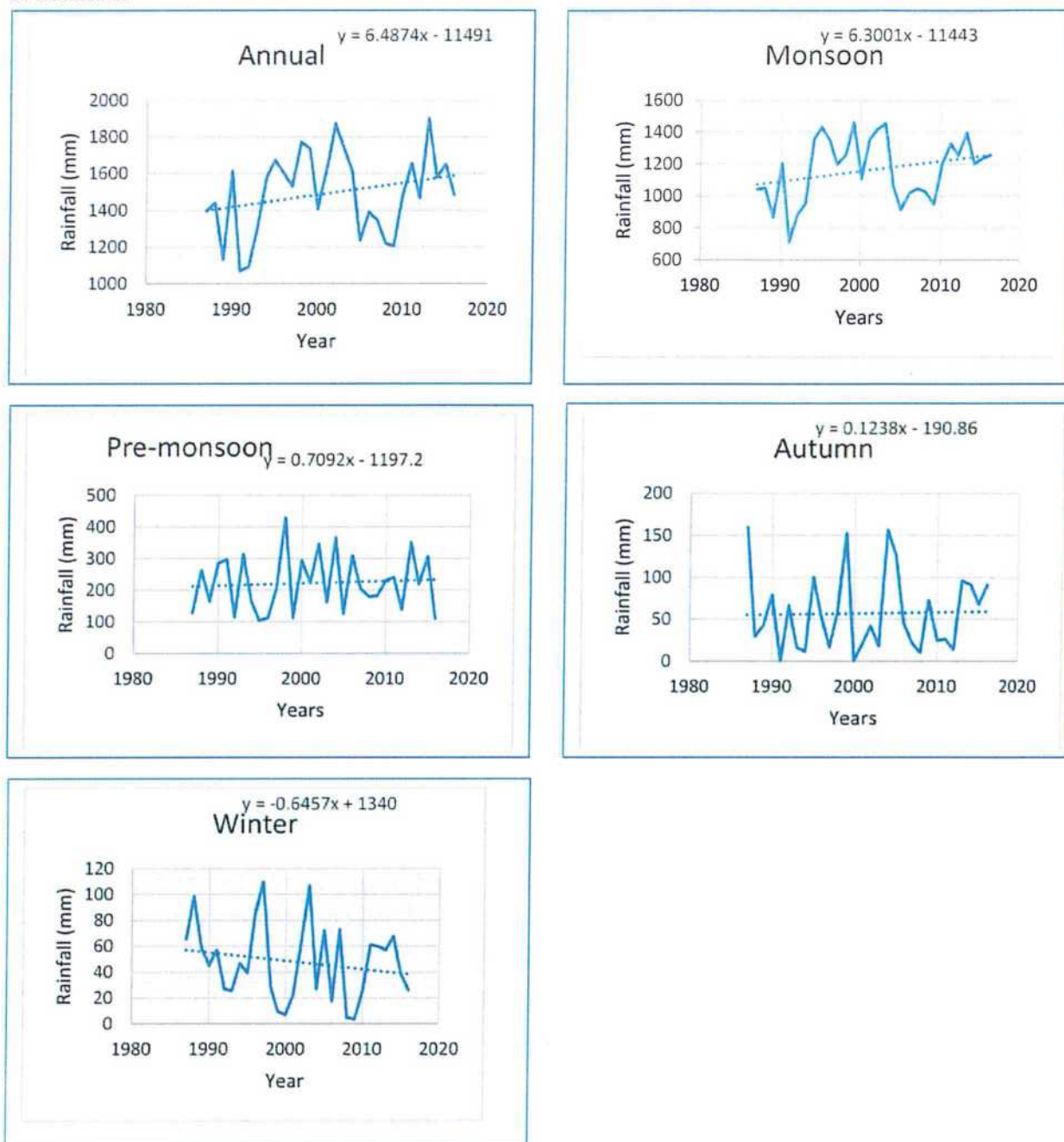


Figure 5-6: The annual rainfall of KNM corridor

Hydrological condition of the entire road section is dry and wet, depending on locality and season. During construction phase of the road, there is chance that some failures may occur, so it is highly recommended to manage the surface drain and wall.

5.1.3. Regional Geology

Sisne Khola-Dharke (03+850 to 11+500): The road alignment runs on the southwest to south aspect and passes through bedrock of the Chandragiri Formation and Sopyang Formation, Kathmandu Group with colluvial and residual soil deposits. Some part of the proposed road

alignment has alluvial deposits. On the alignment, bedrocks such as quartzite and phyllite area exposed were observed. Thickness of the soil is more than 5 m and along the road alignment, exposed rocks are too highly weathered in nature.

Initial part of the road alignment passes from rocky terrain just down to the existing road and runs on hilly part. Last part of the alignment passes on the alluvial, residual soil deposits and goes parallel to the Dhuni Khola. This section of the road alignment is about 11.50 km. Slope stability condition is more or less stable in rock mass, due to presence of low height of the cut slope. Road alignment seems to be stable. Some cut slope failures are seen developed in the colluvial and residual soil deposits along the road alignment.

Hydrological condition of the entire road section is dry and wet, depending on locality and season. During construction phase of the road, there is chance that some failures may occur, so it is highly recommended to manage the surface drain and wall.

Naubise (08+500 to 12+500): This section of the road alignment is 4.0 km long including short tunnel alignment and runs on the north aspect. Geologically, this section passes through the rocks of quartzite and phyllite of the Chandragiri Formation of the Lesser Himalaya. The rocks are slightly weathered in nature. Colluvial as well as residual deposits were observed along the road section. Thickness of residual soil and colluvial deposits is more than 5 m at the end part of the road section. The section passes through cultivated land, bushes and forest area.

Hydrological condition of this section is wet. Slope stability condition is more or less stable but high possibility to occur failure in loose and thick soil area. In the rocks area, the slope stability condition is good.

Sureni Bazaar (Bahuntar)-Chuwatar (00+000-07+500): This is option one of the alternative three. The road alignment passes from the southwest to south aspect of the hilly slope. The bedrocks are presented by quartzite and phyllite, limestone and slate of the Galyang Formation, Lakharpata Formation and Syangja Formation. Colluvial and residual soil deposits were encountered along the road alignment. Thickness of the soil deposits along the road alignment is more than 5 m. Along the proposed road section some paleo erosion and landslides can be seen. Initial part of the alignment on the right bank of Trishuli River is covered with bedrocks of the Galyang Formation and colluvial deposits. It is mainly composed by fresh boulders of phyllite. Limestone, quartzite, and phyllite can be seen in middle and end part of the proposed road alignment. The section is 07.50 km. It passes through cultivated land and forest area.

Bishaltar-Chuwatar (00+000 to 07+500): This is option 2 of the alternative 3 and about 1 km towards west from the option 1. Geology is more or less same because same alignment is followed.

Chuwatar-Kurintar (07+500 to 21+000): This section of the road alignment is 13.50 km. It ascends very gently through the southwest aspect. The alignment passes through the rocks of limestone as well as quartzite and phyllite. Thin layers of residual soil and colluvial deposits were noticed along the alignment. Most of the section of alignment passes through the forest area including some parts though cultivated land. Some gully erosion and old slide scarp can be seen along the steep slope.



Geologically, the project area (Nagdhunga-Naubise-Mugling Road) belongs to the rocks of the Lesser Himalaya and falls in Central Nepal. Geological conditions are more or less the same in all proposed new alignments.

The proposed project area lies on the Mahabharat Range. This range is consisting of sedimentary rocks, mainly mudstone, sandstone and conglomerates. Geomorphologically, the alignment runs along middle mountains and high mountains in presence of ordinary soil, boulder mixed soil, hard rock and soft rock. The lithological units available within the district are Carbonaceous Schist, Limestone Schist, Dolomite and Limestone Schist and Gneiss Schist.

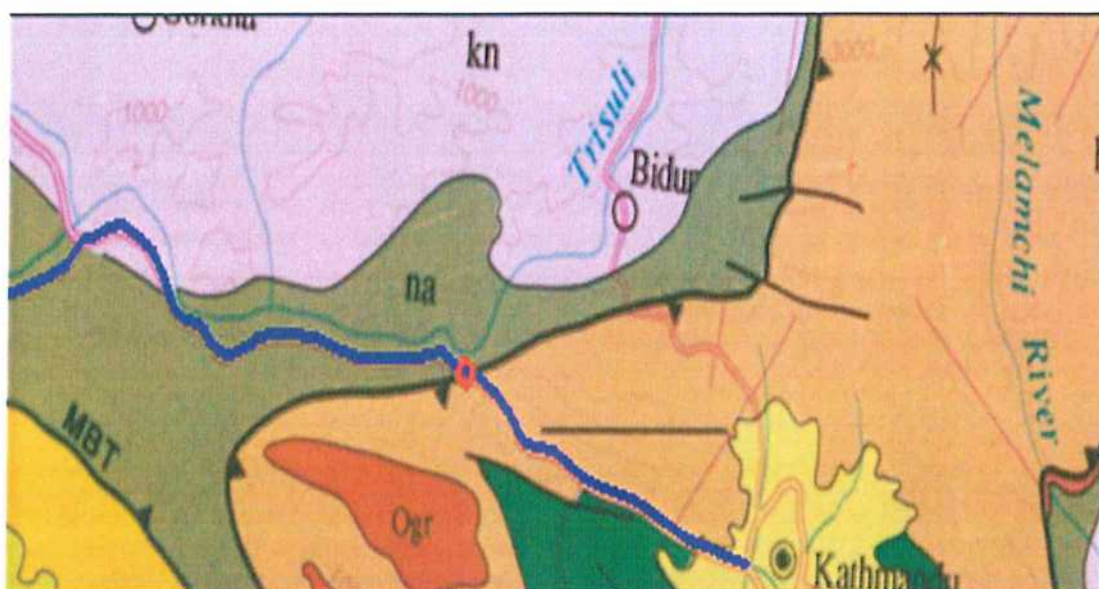
The Nepal Himalaya has been subdivided into five tectonic zones from south to north and separated by south propagated thrust faults (e.g., *Main Central Thrust (MCT)*, *Main Boundary Thrust (MBT)*, and *Main Frontal Thrust (MFT)*). The project area is located in the Lesser Himalaya in between the MBT at south and MCT at north.

Table 5-6: Geological Characteristic of the Road Corridor area (explanation of Map 6)

Regional Geological Characteristics(insequence)	
na:	Nawakot Group (Precambrian to Lower Paleozoic. Mainly shallow marine sediments, lower part dominant clastic (Phyllites, Sandstones, Quartzite and Calcareous Sandstones). Stromatolitic limestone and black slates occur in the upper part. Basic Sills and Dykes present)
kn:	Kuncha Group, Precambrian, mainly flyschoid sequence (bedded schists, phyllites and metasandstones), locally shallow water quartzite beds and basic sills and dykes present

The Lesser Himalaya lies in between the Sub-Himalaya (Siwalik Group) in the south and Higher Himalaya in the north. Both the southern and northern limits of this zone are represented by thrusts, the Main Boundary Thrust (MBT) and the Main Central Thrust (MCT), respectively. Tectonically, the entire Lesser Himalaya consists of allochthonous and para-autochthonous rocks. Rock sequences are developed with nappes, klippe and tectonic windows, which have complicated geology. The Lesser Himalaya is made up of mostly the unfossiliferous sedimentary and metasedimentary rocks, consisting of quartzite, phyllite, slate and limestone ranging in age from Pre-Cambrian to Miocene. Some areas are covered by high-grade metamorphic rocks in Lesser Himalayan terrain. Geologically, the project area (Nagdhunga-Naubise-Mugling Road) belongs to the rocks of the Lesser Himalaya and falls in Central Nepal.





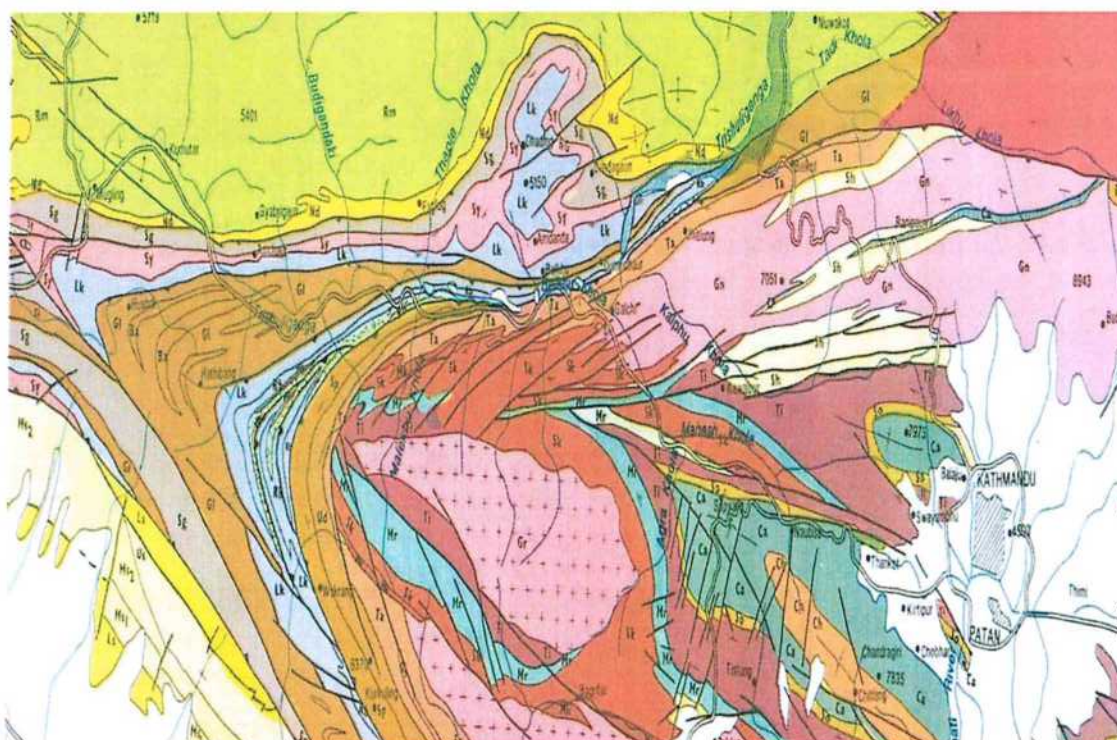
Map 5-1: Geological Map of the Corridor

5.1.4. Engineering Geological Condition

Table 5-7: Geomorphology and Geology of road alignment of Existing Road alignment

Sn	Section	Chainage	Length (km)	Elevation range (m)	Cross slope	Aspect	Geology	Geomorphology	Soil type	Land use pattern
1.	Nagdhun ga-Sisne Khola	00+000-03+750	3.75	1500-1320	15-30°	North east	Phyllite and quartzite/limestone	Gentle to steep sloped	Colluvial/residual soil deposits	Cultivated land/forest/barren/river valley
2.	Sisne Khola-Naubise	03+750-12+000	8.25	1320-840	10-30°	North to north east	Quartzite/phyllite	Gentle to steep sloped	Colluvial and residual soil deposits	Forest/cultivated land/ bushes
3.	Naubise-Tharke	12+000-16+500	4.50	840-800	5-25°	North east	Phyllite/quartzite	Gentle to steep	Residual soil and Colluvial deposits	Cultivated land/bushes
4.	Tharke-Simle	16+500-25+500	9.00	800-500	10-30	North	Schist / gneiss	Gentle slope	Residual soil and Colluvial deposits	Forest/cultivated /barren land
5.	Simle-Belkhu	25+500-40+500	15.0	500-400	5-30°	North to north east	Gneiss/schist/quartzite	Gentle slope	Residual soil and Colluvial deposits	Forest/barren land
6.	Belkhu-Majhim tar	40+500	23.00	400-320	5-25°	North	Quartzite/slate/limestone	Gentle to steep slope	Colluvial and residual soil deposits	Forest

Sn	Section	Chainage	Length (km)	Elevation range (m)	Cross slope	Aspect	Geology	Geomorphology	Soil type	Land use pattern
7.	Majhimtar-Kurintar	73+500-89+000	15.5	320-300	5-20°	North east to east	Quartzite/slate and phyllite	Gentle to steep slope	Colluvial and residual soil deposits	Forest/cultivated land
8.	Kurintar-Mugling	89+000-94+000	5.00	300-265	20-35°	North	Quartzite/phyllite	Steep slope	Colluvial deposits	Forest/cultivated land



Map 5-2: Regional Geological Map of Kathmandu-Mugling Area



Figure 5-7: Alluvial soil type in the open deposit area along existing Highway

Road alignment between Nagdhunga and Mugling consists of three types of soil namely, colluvium, residual and alluvium. Residual soil deposits are dominantly found throughout the road alignment. The main reason for appearing of the residual soil is weathering of the parent rocks of phyllite as well as gneiss. Alluvial deposits are mainly found on banks of the Trishuli River. Thickness of soils on the bedrocks ranges from 2 to 10 m, and in some places alluvial deposits are found up to 15 m. Alluvial

deposits along the road alignment cover 8.84 km or 9.40% and colluvial and residual soil deposits covers about 28.82 km/30.66% length of the road alignment, whereas the remaining alignment (55.34 km/ 58.81%) runs on the rocky terrain.

Table 5-8: Soil Types and their distribution

Chainage	Length	Phyllite/ quartzite	Limestone	Slate	Gneiss/ Schist	Colluvium/ Residual soil	Alluvium
00+000-03+750 Nagdhunga- Sisne Khola	3.75 km	2.62 km				1.13 km	
00+000-11+500 Sisnekhola-Dharke	8.25 km	5.78 km				2.47 km	
16+500+000-25+500 Darke-Thakre	4.50 km	3.78 km				1.25 km	
16+500-25+500	9.00 km	6.75 km				1.75 km	0.50 km
25+500-40+500	15.00 km	2.75 km	2.65 km	2.10 km		5.50 km	2.50 km
40+500-73+500	33.50 km	2.50 km	3.50 km	9.65 km	3.55	7.40 km	3.45 km
73+500-89+000	15.50 km	3.56 km	1.23 km	2.34 km		5.68 km	2.39 km
89+000-94+000	15.00 km	9.35 km				6.65 km	

Source: Field Survey, 2016

Table 5-9: Distribution of the soils and terrain along the road alignment

S.N.	Common soils	Coverage length (%)	Coverage length (m)	Remarks
1	Boulder mixed soils of alluvial deposits	9.40%	8840	Alluvial soils
2	Boulder mixed soils of colluvial/residual soil deposits	30.66%	28820	Colluvial and residual soil
3	Rock (phyllite/quartzite/gneiss/limestone)	55.81%	55340	Soft and hard rock

Source: Field Survey, 2016

Table 5-10: Lithostratigraphy of Lesser Himalaya, Central Nepal

Table 5-10: Lithostratigraphy of Lesser Himalaya, Central Nepal				
Group	Formation	Main Lithology	Thickness (m)	Age
Main Central Thrust (MCT)				
Kathmandu	Chadragiri (Ca)	Limestone	1000	Pre-Cambrian- Paleozoic
	Shiprin Khola (Sp)	Schist	1000	
	Udayapur		1500	
	Markhu (Mr)	Marble/schist	2000	
	Sorang Khola (Sk)	Schist/quartzite	1000	
	Tawa Khola (Ta)	Quartzite/schist	1000	
Main Central Thrust (MCT) or Mahabharat Thrust (MT)				
Midland	Robang (Rb)	Schist, quartzite, amphibolite,	1500	Paleozoic
	Galyang (Gl)	Slate/ Calcareous slate/limestone	2000	
	Sangram (Sg)	Shale/quartzite/limestone	1000	
	Lakharpata (Lk)	Limestone/dolomite	2000	

Syangja (Sy)	Quartzite/shale	1000	Pre-Cambrian
Naudanda	Quartzite	400	
Quartzite (Nd)			
Ranimatta (Rm)	Phyllite/quartzite	3000	

Table 5-11: Section wise Hazard Category

Section	Hazard category
Mugling-Benighat	High to medium
Benighat-Galchhi	Low
Galchhi-Naghdhunga	Medium to high
Naghdhunga-Kalanki	Very Low

Source: Field survey, 2016

5.1.5. Seismicity

Earthquake records in Nepal since 1253 indicate that Nepal was hit by at least 19 earthquakes (the last major earthquake was that of 1988) with various digress of damage. However, the records may not be complete, and the data on loss of life and property may not be very accurate as such data with high reliability are difficult to find. Out of these, the records of the 1833 (magnitude 7.7) and 1934 (magnitude 8.3) earthquakes that occurred at an interval of 100 years give better details and show that these earthquakes were highly disastrous. The effects of these earthquakes were particularly severe in the Kathmandu basin. Nepal established its first seismic station in 1978 under the Department of Mines and Geology, Government of Nepal. Today it has 21 telemetric seismic stations covering the whole country with Kathmandu (central Nepal) and Surkhet (mid-western Nepal) as base recording stations. Over the years a great amount of data has been collected which have become very useful for earthquake research in the region.

According to Bajracharya (1994), the Nepal Himalaya has been subdivided five seismic zones (Zone1, Zone 2, Zone 3, Zone 4, Zone 5) with relation to the seismic hazard (Low, Moderate and High). The road alignment falls in the seismic low to moderate hazard area (Seismic zone 2 to 3) (Figure 1). According to Thapa and Wang (2012), the area has Peak Gravitational Acceleration (PGA) value range from 0.105 to 0.145g (Figure 2).

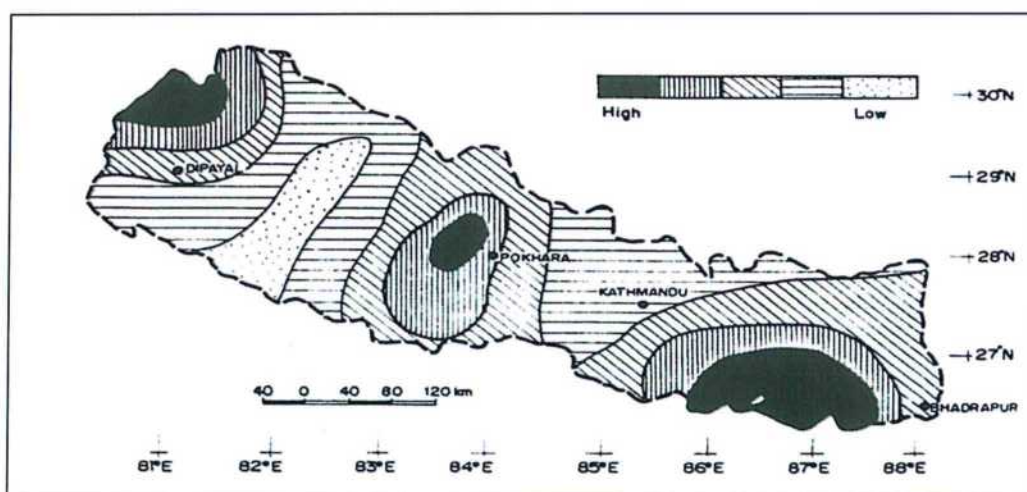


Figure 5-8: Simplified seismic risk map of Nepal (Bajracharya 1994).

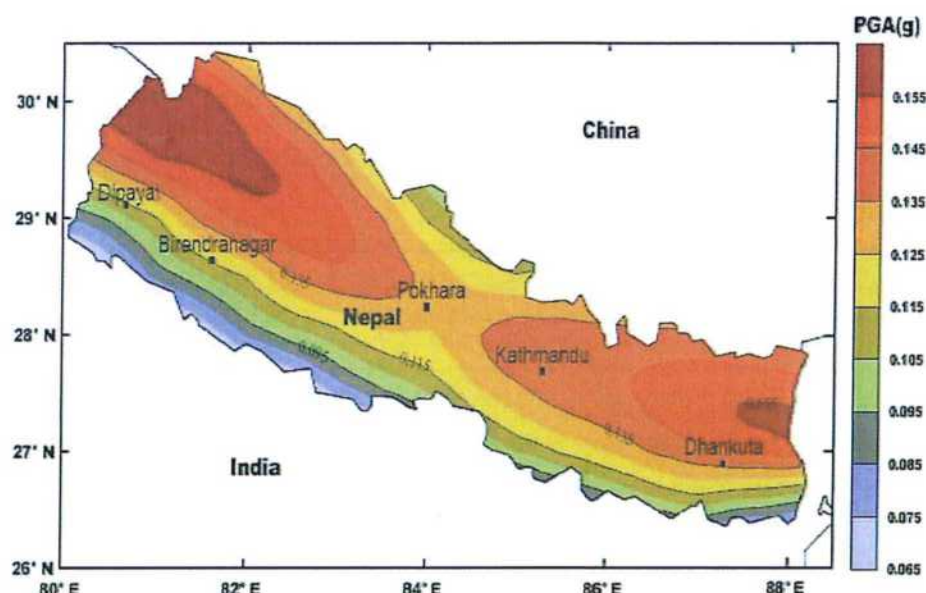


Figure 5-9: PGA map of the Nepal Himalaya (Thapa and Wang 2012)

Historical Seismic Activity

The Nepal Himalaya has experienced several large earthquakes over the past centuries. The earthquakes of larger magnitudes that have occurred in Nepal Himalaya are summarized below in Table 5-12.

Table 5-12: Larger Magnitude of Earthquake Occurred in Nepal Himalaya

S.N	Location of Earthquake	Year	Magnitudes
1	Udayapur, Eastern Nepal	1988	6.6
2	Chainpur, Eastern Nepal	1934	8.3
3	Dolakha, Central Nepal	1934	8.0
4	Sindhupalchowk, Central Nepal	1833	8.0
5	Kaski, Central Nepal	1954	6.4
6	Myagdi, Central Nepal	1936	7.0
7	Bajhang, Far Central Nepal	1980	6.5
8	Dharchula, Far Central Nepal	1966	6.1
9	Dharchula, Far Central Nepal	1966	6.3
10	Dharchula, Far Central Nepal	1916	7.3
11	Gorkha, Central Nepal	2015	7.9

Earthquake Catalogue

The National Building Code Development Project (BCDP, 1994) has developed an earthquake catalogue using earthquake data catalogues of the US Geological Survey, The National Earthquake Information Center (NEIC), National Oceanic and Atmospheric Administration

and National Geological Data Center (NGDC). The complete earthquake catalogue for the magnitudes M 4.5 and greater is given in Table 5-13.

Table 5-13: Instrumentally Recorded Earthquake

S.N	Magnitudes	Catalogue Year
1	M 6.0 and greater than M 6.0	Catalogue complete for the period 1911 to 1992
2	M 5.5 and greater than M 5.5	Catalogue complete for the period 1925 to 1992
3	M 5.9 and greater than M 5.9	Catalogue complete for the period early 1960 to 1992
4	M 4.5 and greater than M 4.5	Catalogue complete for the period late 1970 to 1980s

The largest event reported in the catalogue is the magnitude 8.3 Bihar–Nepal earthquake (Chainpur), which appears to have occurred in 1934. The big earthquake was occurred in 2015 of the Richter scale of 7.9. The quake of 2015 had not damaged (subsidence and collapsed) the road alignment between Nagdhunga and Mugling.

There are several method to convert the maximum acceleration of the earthquake motion into the design seismic coefficient. The Simplest Method has been applied in this study. The effective design seismic coefficient from the Simplest Method is determined by using the simplest method, the following equation:

$$A_{eff}=R*A_{max}/980$$

Where, A_{eff} is effective design seismic coefficient R =Reduction factor (empirical value $R=0.50-0.65$).

The basic horizontal seismic coefficient is considered to be 0.50. By using the above empirical method, the effective design coefficient according to the seismic design code of Nepal is given by the equation

$$A_{eff}=R*A_{max}/980$$

For the minimum acceleration of 300 gal, reduction factor of 0.50 the calculated effective design seismic coefficient is approximately 0.15.

For the maximum acceleration of 350 gal, reduction factor of 0.50 the calculated effective design seismic coefficient is approximately 0.18.

Hence, the design horizontal seismic coefficient ranges from 0.15 to 0.18g (calculated values).

Based on above results the design seismic coefficient for the project can be taken range of 0.11g to 0.15g which is more or less same value represent from the return period of the earthquake (Figure 5-9).

5.1.6. Landslide and Slope Stability

As of November 2004, the condition of Prithvi Highway (Mugling-Naubise) Highway had been very poor due to a number of slope failure sites and landslide deposits. The problem of Krishnabhir landslide, which had been reported several times in various national and international publications, has remained almost unaltered except for the reduction in the amount of new debris deposits due mainly to natural stabilization of the failed debris and complete failure of all unstable slope masses. Efforts of the Department of Roads, particularly

by applying vegetation and surface drainage system, however, have reduced the chance of its further failure. A number of other places along the section can also be observed to have been hazardous due to unprotected rock mass failures, creeping landslide-caused road level subsidence, river cutting failures, etc. The active and relict landslides (indicated by red ovules) and the debris deposits, terrace deposits, and talus deposits (indicated by red-spotted ovules/areas) lies along the Prithvi Highway corridor.

The entire section of the road from Manakamana Cable Car to Mugling from Km 90+100 to Km 92+500 is old landslide zone. However, only the road section from Km 91+900 to 92+500 for about 600m is active landslide zone and the rest has been stabilized in due course of time.

The road section from Chumlingtar to Manakamana Cable Car is aligned either through the river terraces of Chumlingtar and Kurintar made by Trishuli River and its tributaries or through the colluvial deposit consisting of talus material as Lewatar. The rock types to be encountered are mainly slightly weathered to fresh fairly strong gritty phyllite and quartzite of Kunchha Formation belonging to Lower Nawakot group dipping into the hill slope.

The road section from Hugdi Khola to Chumlingtar is one of the most challenging sections for road widening. The famous Jogimara landslide (Rock fall) is located in this section of the road. The road alignment passes through very rugged topography and complex geological arrangements in steep slope. The rock types appearing in this area are dolomite, quartzite, phyllites and grit-stone or gritty phyllite and meta-sandstones of Lower Nawakot group of rocks. However, toward the Hudgi Khola area the rocks are black slates and some limestone and/or dolomite. At least three different faults are dissecting the area and they are Khani Khola fault at Phisling running along Khani Khola F2, the Trishuli fault running almost along the Trishuli River from near Mauwa Khola to Phisling and beyond F1 and a fault running almost east west direction from Ghyalchok crossing Trishuli River near Mauwa Khola confluence and continue beyond the project area.

Tectonically the area is very complex and the rocks dip in different directions. Although recently active large-scale mass movement is not observed in this area but evidence of old landslides and creeping slopes were observed at some places. Since the famous Jogimara landslide is located in this section of the road it will be necessary to make sure not to reactivate it while widening the road. Previously in Jogimara area there was a stone quarry just above the road level and such that rock fall occurred in the direction of road causing many accidents. At present that particular quarry is shut and no problem is faced. The road was also shifted slightly toward the valley side and enhanced the road safety by constructing high wall to trap from Benighat to Hugdi Khola the existing road is aligned not only through the alluvial terraces of Trisuli River and its tributaries but also through the steep rock slopes vulnerable to landslides as the road passes through Bishaltar, Charaundi, Krishnabhir, Majhimtar, up to Hugdi Khola and Jogimara, Phisling and Kurintar and beyond. The rocks area highly fractured and frequently sheared. Moreover, the Mahabharat Thrust (MT) running in almost east-west direction is located on top of the Krjshnabhir Landslide making the area more vulnerable. One of the main causes of occurrence of Krishnabhir landslide is the presence of thick pile of loose rock and soil deposit on top of the slope together with the occurrence of highly fractured,

sheared and highly weathered nature of the bedrock due to the influence of MT. an alternative is proposed from Benighat to Kurintar to avoid the problematic area of Krishnabhir.

From Galchhi to Benighat the road is aligned mainly either along the big terraces of Trishuli River and its tributaries or the Trishuli River bank slopes. Except the requirement for the correction of steeper gradient and for sharp curves at some places like in Chiraundi Khola bridge site, Gajuri, and Malekhu bends etc. not major slope cut will be required.

The road alignment from Naubise to Galchhi traverses mainly along the valley of Naubise Khola and Mahesh Khola along their left bank. The topography along this alignment is although mountainous but due to the presence of river valley alluvial terraces are encountered for considerable length of the road. Moreover, the Mahesh and Naubise river valleys are seasonal streams where it will not be difficult to work on the valley side. At Galchhi Mahesh Khola meets Trishuli River coming from north flows toward west. The road from Galchhi onward is also aligned along the left bank of Trishuli River. The rock types to be encountered along the road alignment from Naubise to Galchhi are of Kathmandu Complex the phyllite, meta-sandstone, carbonates and some metamorphic rocks like schist and gneiss. In general, the rocks are dipping into the hill slope or strikes of the rock are oblique to the road. Active landslides or rock slides are not visible throughout the length of the road from Naubise to Galchhi.

From Sisne Khola to Naubise the existing road section passes through very rugged and dissected topography consisting of the highly weathered rocks. Hence, the road in this section runs along steep downhill grade frequently encountering sharp hairpin bends, deeply incised gullies and narrow hilly spurs. There are sharp bends, narrow road sections, and high gradient at several locations in this road section. The rock types encountered in this road section is mainly highly weathered and fractured meta-sandstones and phyllites Complex. The bedding plane of the rock is varying considerably mainly due to tight folding nature of the rock. The Nagdhunga-Kalanki section comprises the lower four formations of the Phulchauki Group belonging to the Kathmandu Complex. The rock sequence is represented by metasandstones, phyllites, slates, limestone, and dolomites. In several places, the rocks are covered either by fluvio-lacustrine sediments or alluvial fan deposits of the Kathmandu basin. The fan deposits are confined mainly to the foothills of the Chandragiri Range.

5.1.7. Land slide hazard mapping and active landslide area

Active landslides areas were identified along the proposed road alignments of all the alternatives of the Nagdhunga Mugling road. Although, the status of landslide in almost all the unit slopes encountered by the road alignment were indicated in landslide hazard map, however area of existing active landslides and/or old landslides which were previously stabilized by various means are listed in the Table 5-14 presented below. As per the tabulated data the TRP section of the road from Nagdhunga to Naubise, consists of at least 6 locations of either active or previously stabilized landslides. Similarly, along the PRM section of the highway from Naubise to Mugling there are either high potential of landslide or the slope has already failed and stabilized at 6 locations including Krishnabhir and Jogimara. On the other hand, the proposed new alternative alignment from Sisnekhola to Dharke section consists of two locations where there are two potential sites for active landslide. At these locations scars of old

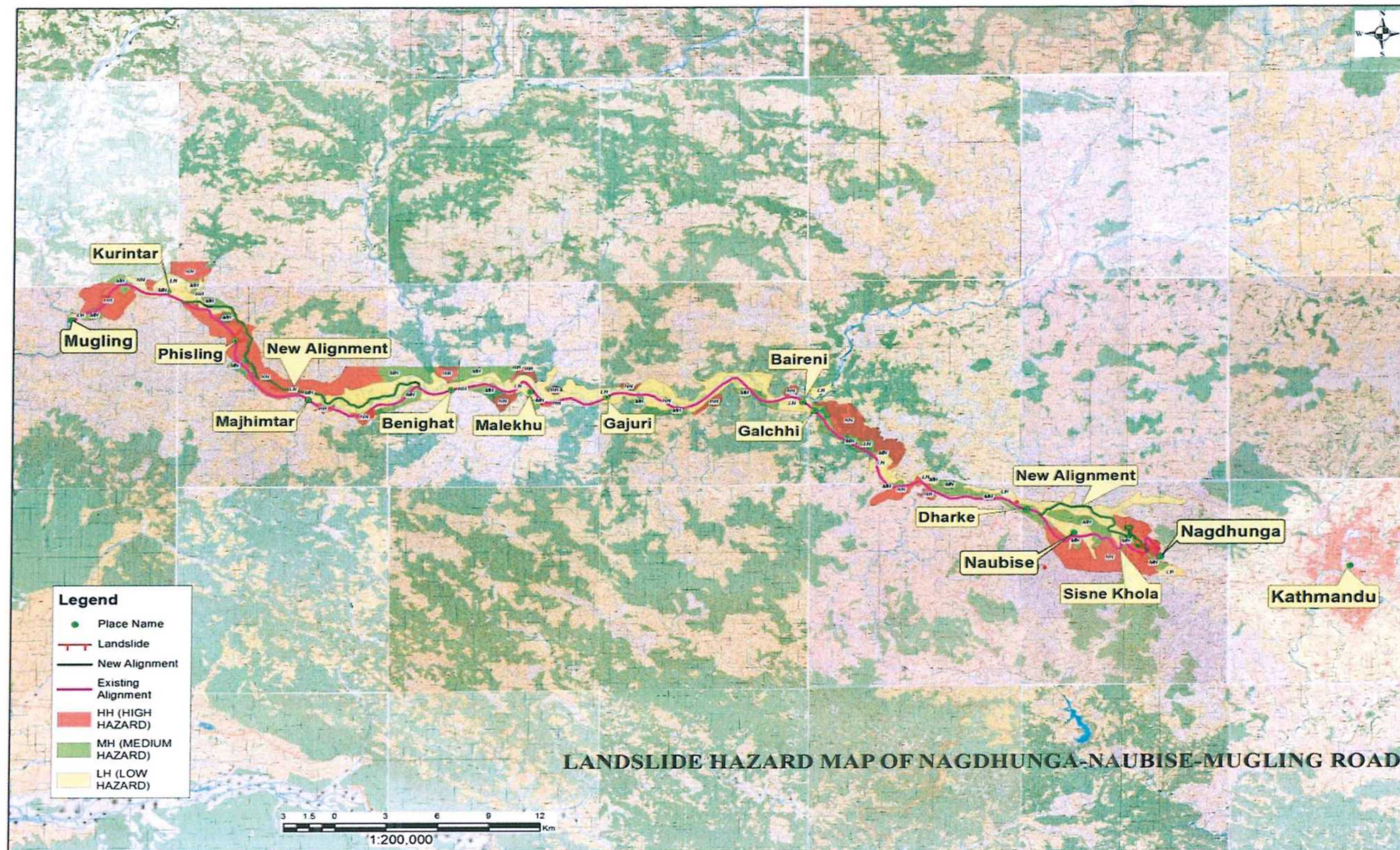
landslides can be seen. Along the proposed new alternative alignment from Benighat to Kurintar active landslides were neither observed nor viewed any sites of old landslide. However, considering the morphology of the area topographical features and geology of the alignment it can be concluded that landslides can be initiated at many locations while constructing road along this alignment.

Table 5-14: Active landslide areas in the proposed road alignment

From	To	Distance (m)	Name of the Place	Remarks
Nagdhunga Naubise				
0+050	0+200	150	Nagdhunga	Hillside
2+250	2+400	150	Jhakribas	Active L/S
2+790	2+830	40	Jhyaple Khola	Vally side L/S
3+950	4+075	125	Khatri pauwa	Hillside
4+125	4+175	50	Khatri pauwa	Active L/S
4+400	4+650	250	West of Khatripauwa	Stabilized L/S
Total		765		
Naubise Mugling				
13+350	13+550	200	Koiralagaon	Potential L/S
16+625	16+925	300	Eklephant	Deep Rock cut
42+540	42+600	60	Malekhu	
57+050	58+050	1000	Krisnabhir	Stabilized L/S still potential
66+800	66+925	125	Jogimara	Potential rock fall zone
69+000	69+200	200	Fisling	Slow and Active L/S
79+550	80+050	500	Mugling	
Total		2035		
Sisne Khola Dharke				
0+050	0+200	150	Chayudanda	Bedrock dip out of slope
0+450	0+740	290		Old L/S and Potential
1+100	1+500	400	Waglethok	Old landslide downslope
1+500	2+500	1000	Below Piplaamod	Deep cut in highly to completely weathered slope
3+200	3+800	600	Waglethok	
3+800	4+000	200	Waglethok	Potential landslide zone
Total		2640		
Bishaltar Phisling				
2+620	2+680	60	Dhobadighat	Steep soil slope
4+820	5+200	380	Chuwatar	Steep slope toe erosion by Trishuli River
7+260	8+820	1560	Jyamirghat	Steep unstable slope toe erosion by Trishuli River
9+780	10+820	1040	Thumka	Steep rocky slope
11+240	14+600	3360	Hulintar	Steep rocky slope fragile

Source: Field survey, 2017





Map 5-3: Landslide hazard map of Nagdhunga-Naubise-Mugling Road

5.1.8. Construction Material

Naturally occurring construction material like sand, gravel and aggregates are found in sufficient quantity with suitable quality within the vicinity of the road alignment. 1,792,613.46 cums of sand and aggregates will be required for the construction. The table below presents amount of construction material required for the project.

Table 5-15: Material required for the construction of the project (in cums)

Types of material	Gravel	Aggregate	Stone	Sand	Total
Quantity	250,666	1,132,206	232912	176,830	1,792,613

Source: Quantity Survey, 2017

Table below shows location of the construction material site together with available quantity.

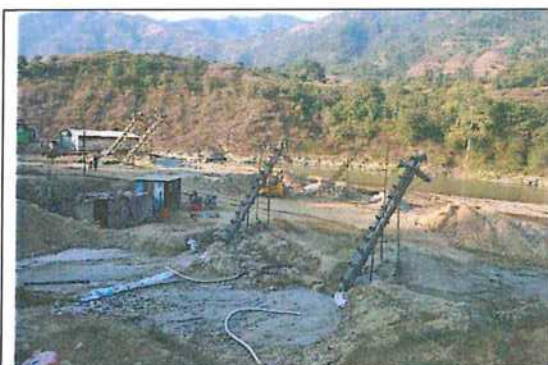
Table 5-16: Construction material availability

Sn.	Coordinate	Location	Available Quantity (m ³)	Distance/ Reference	Remarks
1	27°49'35.43"N, 85° 1'8.48"E	Trishuli River at Galchi-Trishuli Road, Keureni	238,000	4/22+600	River bed/ Crusher
2	27°44'39.21"N, 85° 6'22.12"E	Dharke, Dharke	As per Demand	0.2/6+100	Crusher
3	27°48'57.05"N, 84°40'7.24"E	Jabang Khola	288,000	2/66+100	Quarry
4	27°48'8.71"N, 84°50'5.31"E	Malekhu Khola, Malekhu	45,000	1.5/43+400	River bed
5	27°49'3.84"N, 84°46'2.85"E	Trishuli River at Siurenitar	42,000	2/51+300	
6	27°44'38.68"N, 85° 3'41.49"E	Agra Khola, Mahadev Besi	As per Demand	2/11+200	River bed
7	27°55'2.53"N, 84°32'15.36"E	Marsyangdi River, Anbu Khaireni	84,000	11/82+400	River bed
8	27°48'17.72"N, 84°44'49.52"E	Trishuli River, Charaundi	90,000	0.3/55+500	River Bed
9	27°48'18.13"N, 84°50'50.90"E	Trishuli River, Malekhu	74,000	1/42+300	River Bed

Source: Field survey, 2017

However, significant numbers of sand mining activities are existed along the Trishuli River and several sand cleaner are established along the existing Prithvi highway. Similarly, significant numbers of sand and soil excavation activities (quarry/borrow) has been found to be carried out by local people at southern side along the highway especially by local contractor for commercial purposed affecting existing landuse, landscape, and topography. Such activities are existed especially at soughern side of the existing highway within the Dhading district at Galchi, Baireni, Gajuri, Malekhu, Benighat and Majhimtar. These activities are intended to sell sand and soil as construction material and the excavated land area has been developed as land plotting for residential housing purposed. The operation of sand mining and sand cleaning activities close to the existing highway and close to the Trishuli River has affected river water quality significantly. Moreoever, such excavation activities are existed also at Dharke area and direct dispoal of muddy waste is still under practice along the Mahesh Khola (a tributary of Trishuli River) from Dharke area which also has significant contribution polluting Trishuli. The confluence of Mahesh Khola and Trishuli River is at Galchi. Some of the ongoing practices are presented in the following pictures.





Sand cleaners established along the Trishuli River bank; Dhading district.



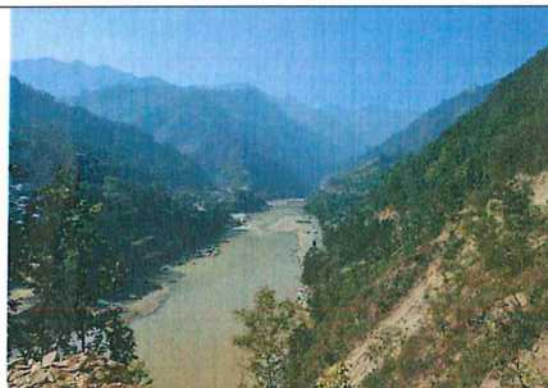
Illegal sand mining activities along the Trishuli River within Dhading district



Sand cleaners are established between highway and Trishuli



Direct disposal of waste from sand cleaning and mining activities along the Trishuli River banks



Polluted and muddy Trishuli river due to direct disposal



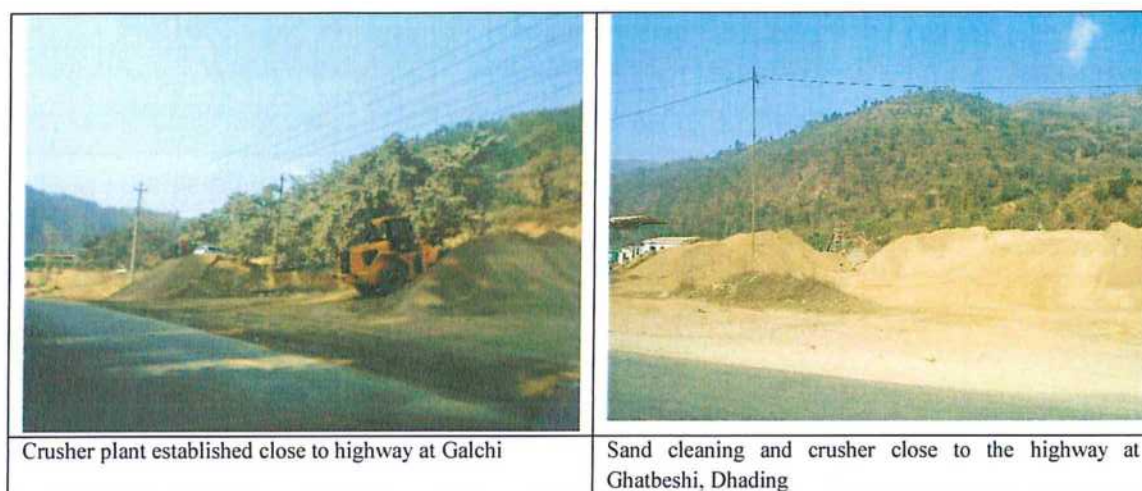
Quarry along the Trishuli River Right Bank at Bishaltar



Roadside sand mining close to the highway along KTM near Gajuri



Roadside sand and soil mining close to the highway



5.1.9. Air Quality

The study team carried out the air quality monitoring on different date at various spots (Table 5-17) to determine the quality of air around the project area. During the monitoring time, observed particulate matters of less and more than 10-micron size ambient air quality data were found above the National Noise Quality Standard Limit at Nagdhunga Checkpost Point. Other parameters are within the normal range as per National Ambient Air Quality Standard. (Table 5-18).

Table 5-17: Air Quality Monitoring Date and Location

Location	Monitoring Date	Code
Mungling (Near 3 sister restaurant)	27 - 28 September, 2016	1253-AA - 1
Malekhu (At Temple – Near Ambe petrol Pump)	28 - 29 September, 2016	1253 - AA - 2
Nagdhunga Checkpost (At Chndragiri Ward Office)	30 - 31 September, 2016	1253 - AA - 3

Table 5-18: Air Quality of Project Area

Location	PM ₁₀	*PM _{2.5}	TSP	*Lead	SO ₂	NO _x	*Benzene	CO (%)
	(ug/Nm ³)							
Mungling (Near 3 sister restaurants - 1253 - AA - 1)	122.0	28.0	150.0	<0.002	<0.01	2.4	<2.0	**ND (<1.0)
Malekhu (At Temple – Near Ambe petrol Pump - 1253 - AA - 2)	132.0	31.0	163.0	<0.002	<0.01	4.7	<2.0	**ND (<1.0)
Nagdhunga Checkpost (At Chndragiri Ward Office - 1253 - AA - 3)	326.0	38.0	364.0	<0.002	<0.01	3.3	<2.0	**ND (<1.0)
NAAQS	<120	<40	<230	<0.5	<70.0	<80	<5.0	<1.0

Source: Field Study 2017

Table 5-19: National Ambient Air Quality Standards for Nepal, 2012

Parameters	Units	Averaging Time	Concentration in Ambient Air, maximum	Test Methods
TSP (Total Suspended Particulates)	$\mu\text{g}/\text{m}^3$	Annual -	-	
		24-hours*	230	High Volume Sampling and Gravimetric Analysis
PM10	$\mu\text{g}/\text{m}^3$	Annual	-	High Volume Sampler and
		24-hours*	120	Gravimetric Analysis, TOEM, Beta Attenuation
Sulphur Dioxide	$\mu\text{g}/\text{m}^3$	Annual**	50	Ultraviolet Fluorescence, Waste and Geake method
		24-hours*	70	Same as annual
Nitrogen Dioxide	$\mu\text{g}/\text{m}^3$	Annual	40	Chemiluminescence
		24-hours*	80	Same as annual
Carbon Monoxide	$\mu\text{g}/\text{m}^3$	8 hours*	10,000	Non dispersive Infra Red spectrophotometer(NDIR)
Lead	$\mu\text{g}/\text{m}^3$	Annual**	0.5	High volume sampling, followed by atomic absorption spectrometry.
Benzene	$\mu\text{g}/\text{m}^3$	Annual **	5	Gas chromatographic Technique
PM 2.5	$\mu\text{g}/\text{m}^3$	24-hours*	40	PM2.5 sampling gravimetric analysis
Ozone	$\mu\text{g}/\text{m}^3$	8 hours*	157	UV spectrophotometer

*24 and 8 hourly values shall be met 95% of the time in a year. 18 days per calendar year, the standard may be exceeded but not on two consecutive days.

** The above indicators are prepared by the 104 data taken yearly average in a fixed location in one week by observing two times in 24 hours.

5.1.10. Noise Level

Different five spots were taken for the monitoring of noise level at project area. In overall, observed equivalent noise pressure level data were found above the National Noise Quality Standard Limit (NNQSL). The observed noise pressure levels were found still higher than OSHA TLV guideline.



Table 5-20: Noise Quality Level of Project Area

S. N.	Location Spots	Test Parameters								Range
		L _{max}	L _{min}	L _{eq}	L ₅	L ₁₀	L ₅₀	L ₉₀	L ₉₅	
1	Mugling (1253 - NM - 1)**	99.6	58.4	80.6	86.0	84.1	81.9	75.2	73.9	
2	Kuringhat (1253 - NM - 2) **	98.1	53.9	78.8	89.3	88.1	85.3	80.5	74.1	
3	Malekhu (1253 - NM - 3) **	109.3	53.9	90.1	91.4	89.8	84.1	70.8	64.8	*
4	Galchhi (1253 - NM - 4) **	104.4	54.8	85.4	89.3	88.5	82.5	64.6	61.8	*
5	Nagdhunga Checkpost (at VDC Ward Office - (1253 - NM - 5) **	105.6	59.5	86.5	96.8	96.2	82.8	60.0	59.9	*
NNQS for Industrial Area**				70						
Note: OSHA TLV Range acceptable at industrial workplace area for 8 working hours*				85						

Source: Field Study, 2017

Table 5-21: National Ambient Sound Quality Standard, 2012

S.N.	Land Use	Sound limit Leq (dBA)	
		Day	Night
1.	Industrial	75	70
2.	Commercial	65	55
3.	Rural Residential Area	45	40
4.	Urban Residential Area	55	50
5.	Mixed Residential Area	63	55
6.	Peace Area	50	40

Source: Ministry of Environment, Science and Technology

Note: Leq (24) = Equivalent Sound Level in decibels.

Table 5-22: Noise exposure limits for the work environment (adopted from Occupational Safety and Health Administration (OSHA))

S.N.	Noise Exposure (dBA)	Permissible exposure (Hours and Minutes)
1.	85	16 hrs.
2.	87	12 hrs. - 18 min.
3.	90	8 hrs.
4.	93	5 hrs - 18 min.
5.	96	3 hrs.-30 min.
6.	99	2 hrs. - 18 min.
7.	102	1 hr. - 30 min.
8.	105	1 hr.
9.	108	40 min.
10.	111	26 min.
11.	114	17 min.
12.	115	15 min.
13.	118	10 min.
14.	121	6.6 min.

S.N.	Noise Exposure (dBA)	Permissible exposure (Hours and Minutes)
15.	124	4 min.
16.	127	3 min.
17.	130	1 min.



5.1.11. Water Quality

Table 5-23: Water quality test results

Parameters	Units	NDWS	Result															Near Shree Chandrayan H. S. School at Trisuli River						
			Sisne Khola	Sikrey Khola	Khami Khola	Naubise Khola	100m Downstream of Dhumikhola	Manesh Khola	Agra Khola	Kheste Khola	Belkhu Khola	Galaudi Khola	Malekhu Khola	Charaadi Khola	Hagdi Khola	Mauna Khola	Barban Khola		Majhimtar Across at	Pang Khola	Paspanti Khola	Kaudi Khola	Dhaubadi Khola	Lamu Khola
pH	-	6.5-8.5*	6.8	6.5	6.6	7	6.8	7.3	7.4	7.5	7.1	6.7	7	7.1	7.1	7	6.5	6.5	6.5	6.2	6.7	7	7	6.7
Temp.	°C	-	24.7	24.5	24.4	24.4	24.5	24.7	24.9	24.7	24.6	24	24.7	24.8	25.2	25.3	25	25	25	24.9	25	24.9	24.9	24.9
TDS	mg/l	1000	81	78	106	148	155	154	128	116	35	127	176	193	160	258	65	72	65	57	184	223	221	74
CHEMICAL																								
Ammonia	mg/l	1.5	0.03	<0.02	0.16	0.05	<0.02	0.06	0.25	0.03	0.11	0.03	0.11	0.09	0.02	0.14	<0.02	0.3	<0.02	0.0	0.0	0.1	0.06	0.34
Nitrate	mg/l as NO ₃	50	2.17	4	4.2	2.1	1.9	1.2	1.6	<0.02	0.12	0.2	0.1	0.49	0.44	1.4	0.4	2.8	0.4	3.4	0.4	2	1.3	1.8
Phosphate	mg/l	-	0.22	0.37	0.2	0.09	0.19	0.15	0.4	0.19	1.7	0.27	0.16	0.32	0.15	0.1	0.3	0.25	0.35	1.3	0.15	0.15	0.18	0.16
Sulphate	mg/l	250	<5.0	<5.0	<5	<5	<5	<5.0	<5	<5	<5	<5	<5	<5	<5	60.97	<5	74.2	<5	28	57.7	57.7	63.5	<5.0
Sulphid	mg/l		1.5	1.5	0.75	1.5	1.8	1.1	1.8	1.8	2.6	1.1	2.6	3	1.5	2.2	1.5	1.8	1.5	2.2	1.8	1.8	1.1	2.6
DO	mg/l	-	7.1	7.4	7.2	7.5	7.2	7.3	7.6	7.1	7.1	7.3	7.1	7.3	7.2	7.1	7.4	7.2	7.1	7	7.4	7.1	7	7.2
BOD	mg/l	-	2.5	3	3.3	3.4	1.7	1.8	5.8	1.6	0.83	1.2	0.87	3	4.7	2.2	1.9	0.7	1.9	2.8	3	3.6	4.1	3.8
Total Hardnes	mg/l as CaCO ₃	500	68	100	126	136	136	130	102	100	30	102	154	182	152	250	50	70	50	44	180	208	200	70
Calcium	mg/l as Ca ²⁺⁺	200	17.6	27.2	35.2	36.8	38.4	33.6	22.4	32	8	28	36	36.8	31.4	51.2	12	16	12	10	40	43	40.8	20.8
Mg	mg/l	-	5.8	7.8	9.2	10.7	9.7	11.2	11.2	4.8	2.4	7.8	15.5	21.8	18.4	29.6	4.8	7.3	4.8	4.4	18	24	23.8	4.4
Chloride	mg/l	250	1	<1.0	1	3	2	3	2	<1.0	<1	<1	<1	1.98	0.9	1.9	<1	<1	<1	1	1.9	2.9	4.9	2

Parameters	Units	NDWS	Result																					
			Sine Khola	Sikrey Khola	Khani Khola	Naubise Khola	100m Downstream of Dhunikhola	Mahesh Khola	Agra Khola	Khaste Khola	Belkhu Khola	Galudi Khola	Malekhu Khola	Charaudi Khola	Hugdi Khola	Mauwa Khola	Barban Khola	Majhimtar Across at	Pang Khola	Paspauti Khola	Kandi Khola	Dhaubadi Khola	Lamu Khola	Near Shree H. S. School at Trisuli River
Iron	mg/l	0.3 (3)	0.13	0.21	1.5	0.4	0.5	0.8	31.9	0.03	0.27	0.62	0.91	0.12	0.08	0.12	0.0	8.9	0.0	0.0	0.0	0.7	0.25	4.3
Fluoride	mg/l	0.5	0.29	0.23	0.16	0.18	0.17	0.3	0.21	0.24	0.2	0.35	0.33	0.25	0.31	0.31	0.4	0.2	0.4	0.2	0.2	0.4	0.26	0.2
Chromium	mg/l	0.05	<0.05	<0.0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sodium	mg/l	-	3.8	3.3	3.1	2.1	2.2	6.7	5.8	6.8	4.5	8.7	3.9	3.3	2.2	3	8.6	3	8.6	7.3	3.4	5.5	3.7	3
Potassium	mg/l	-	1.6	1	1.1	1.2	1.33	2.8	4.5	2.7	1.6	2.7	3.5	3.06	1.7	3.7	1.6	6	1.6	1	1.7	2	1.6	4.1
Lead	mg/l	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.003
Copper	mg/l	1	<0.01	0.05	0.02	0.08	<0.01	0.3	0.08	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	0.03	<0.03	<0.03	<0.03	0.03	0.03	0.02
Mercury	mg/l	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1	<0.01	<0.01
Oil & Grease	mg/l	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

BACTERIOLOGICAL ANALYSIS

Total Coliform	CFU/100 ml	Nil	300	600	550	300	500	400	100	100	300	800	600	400	500	350	65	10	65	50	Nil	45	500	550
m									0	0						0	0	0	0	0	0			

Source: ESIA study, 2017

Source: ESIA study, 2017



In overall, fluoride level is lower than the NDWQS limit in all water samples. Iron is high in the water sample of Agra Khola, Majhimtar Across at Trisuli River and Near Shree Chandrodaya H. S. School at Trisuli River. Biologically, water is contaminated with Total Coliforms in all samples.

During the study, major contamination indicator is reported as *Total Coliforms*. *Iron and sediment* content were found high at *Agra Khola and Trishuli river water*. *Fluoride* content was found lower than NDWQS recommended limit in all of the samples. Aggregate (sand, etc) washing activities were found in few of the river such as Agra, Belkhu Khola as well as at the Baireni to Belkhu river zone mainly.

Table 5-24: National Drinking Water Quality standard 2006

Group	Parameter	Unit	Maximum Concentration Limits	Remarks
Physical	Turbidity	NTU	5(10)	
	pH	TCU	6.5-8.5*	
	Color		5(15)	
	Taste & Odor		No objectionable	
	Total Dissolved Solids	Milligram/Liter	1000	
	Electrical Conductivity	Micro-Siemens/Centimeter	1500	
Chemical	Iron	Milligram/Liter	0.3(3)	
	Manganese	Milligram/Liter	0.2	
	Arsenic	Milligram/Liter	0.05	
	Cadmium	Milligram/Liter	0.003	
	Chromium	Milligram/Liter	0.05	
	Cyanide	Milligram/Liter	0.07	
	Fluoride	Milligram/Liter	0.5-1.5*	
	Lead	Milligram/Liter	0.01	
	Ammonia	Milligram/Liter	1.5	
	Chloride	Milligram/Liter	250	
	Sulphate	Milligram/Liter	250	
	Nitrate	Milligram/Liter	50	
	Copper	Milligram/Liter	1	
	Total Hardness	Milligram/Liter	500	
	Calcium	Milligram/Liter	200	
	Zinc	Milligram/Liter	3	

Group	Parameter	Unit	Maximum Concentration Limits	Remarks
	Mercury	Milligram/Liter	0.001	
	Aluminum	Milligram/Liter	0.2	
	Residual Chlorine	Milligram/Liter	0.1-0.2*	In chlorination System Only
Microscopic Organism	E.coli	MPN/100ml	0	
	Total coli form	MPN/100ml	0(In 95% Sample)	

Note: (*) Value Given in the bracket is applicable only if no alternative is available * Indicates minimum and maximum limits. Source: Nepal Gazetted Ashad 12, 2063 B.S

Other Water and effluent quality guidelines of the country are as follows;

- Tolerance Limits for Different Industrial Effluents Discharged into Inland Surface Water; Source: Nepal Gazette , 30 April 2001 and 23 June 2003
- Generic Standard /Tolerance Limits for Different Industrial Effluents Discharged into Inland Surface Water; Nepal Gazette ,30 April 2001 and 23 June 2003
- Nepal Water Quality Guidelines for Irrigation Water; Department of Irrigation, Ground Water Project (Nepal Gazette (Number 10,16 June 2008))
- Nepal Water Quality Guidelines for Aquaculture; Department of Irrigation, Ground Water Project (Nepal Gazette (Number 10, 16 June 2008)).
- Nepal Water Quality Guidelines for Livestock Watering; Department of Irrigation, Ground Water Project (Nepal Gazette (Number 10, 16 June 2008)).
- Nepal Water Quality Guidelines for Recreation; Department of Irrigation, Ground Water Project (Nepal Gazette (Number 10, 16 June 2008)).
- Nepal Water Quality Guidelines for Industries; Department of Irrigation, Ground Water Project (Nepal Gazette (Number 10, 16 June 2008)).
- Nepal Water Quality Guidelines for the Protection of Aquatic Ecosystem; Department of Irrigation, Ground Water Project (Nepal Gazette (Number 10, 16 June 2008)).

All these guideline could be followed during the time of construction as per requirement.

5.1.12. Land Use

Land use pattern of the KNM project alignment was overlaid in digital topographical Maps and its patterns were analyzed. Preliminary study reveals that the major land use in the project area is covered by cultivated land mostly, followed by forest areas, settlement area and water-body area. The following Tables present land use patterns within three designated project areas: along existing road corridor from Kathmandu to Naubise – Mugling, then, for Sisnekhola-Dharke and Bishaltar – Phishling alignments. Land use calculation was conducted within Right of Way area (25 m buffer zone both sides of the road), in direct impact area (DIA) within the 300-meter corridor of the existing and proposed new alignments and in the indirect impact area



IIA within 2 km corridor along existing road and new alignments. Calculation of 7 main land use classes was done that to evaluate land use in the mentioned above sections and impact zones, including agricultural land, forest, grassland, shrubland and barren areas, built-up areas and waterbodies.

In the result of project implementation, 286.74 ha along existing highway, 58.76 ha in Sisnekhola -Dharke and 77.82 ha in Benighat-Phishling will be affected severely (more likely, cleared) for the upgrades and construction of new highway sections. As we can see from the table with land use in right-of-way area, the agricultural land is the main land use class along the existing highway, then, along both new alignments the agriculture occupies around 20%, and new alignments are planned through forest (39.8% and 14% of land use, respectively) and shrub-land (24.2 and 31.1% respectively). The new alignments also will cross the settlement area (15.6 and 10.6%, respectively). Land use in the right-of-way zone (ROW) of the existing and proposed new alignments is presented below:

Table 5-25: Land use within the ROW of KNM and new alignments (area in Ha.)

Land use type	KNM		Sisnekhola-Dharke		Benighat-Phishling	
	Ha	%	Ha	%	Ha	%
Agricultural land	156.74	54.7	12.31	20.9	16.58	21.3
Forest	57.43	20	23.37	39.8	10.89	14.0
Shrubland	0.62	0.2	7.67	13.1	24.2	31.1
Grassland	4.51	1.6	4.24	7.2	5.5	7.1
Built-up area	2.27	0.8	9.14	15.56	8.23	10.6
Barren land	14.19	4.9	2.03	3.44	2.33	3.0
Water-bodies	50.98	17.8	0	0	10.04	12.9
Total	286.74		58.76		77.82	

Source: GIS Map (ESIA Study Team)

Land use within the 300 m of Direct Impact Area (DIA) corridor of the existing and proposed new alignments is presented in the following table. Direct Impact Area (DIA) covers 2778 ha along existing highway, 321.45 ha in Sisne-Khola- Dharke and 551 ha in Benighat-Phishling section. Forest and agriculture are two main land cover classes along existing highway, residing 47.2 and 44.1 % respectively. Built-up area along the highway occupies around 5%. Other land cover classes together cover around 3% of the land. In Sisne-Khola-Dharke, natural habitats (forest and shrubland) cover 34.9% and 12.2% respectively, agricultural land occupies 20.9% in DIA and settlements are located on 17.8% of DIA. In Benighat –Phishling section, natural habitats also prevail with 14.7% of forest and 26.3% of shrubland, this alignment is going closely to the river and water-bodies represent 20.2% in DIA. Agricultural land occupies 13.4% in DIA and settlements present 11.9%. Barren land and grassland (5.8% and 7.6%, respectively), more likely, are associated with riverbanks.

Table 5-26: Land use within the 300m corridor of existing and new alignments of KNM (area in Ha.)

Land use type	KNM		Sisnekhola-Dharke		Benighat-Phisling	
	Ha	%	Ha	%	Ha	%
Agricultural land	1225.85	44.1	67.28	20.9	73.96	13.4
Forest	1309.9	47.2	112.15	34.9	81.27	14.7
Shrubland	22.81	0.8	39.27	12.2	145.03	26.3
Grassland	12.81	0.5	31.29	9.7	41.61	7.6
Built-up area	140.03	5.0	57.28	17.8	65.74	11.9
Barren land	14.63	0.5	14.18	4.4	32.04	5.8
Water-bodies	52.01	1.9	0	0	111.39	20.2
Total	2778.04		321.45		551.04	

Source: GIS Map (ESIA Study Team)

Land use analysis within the 2 km Indirect Impact Area (IIA) corridor of the existing and proposed new alignments follows below:

Table 5-27: Land use within the 2 km corridor of KNM and new alignments (area in Ha.)

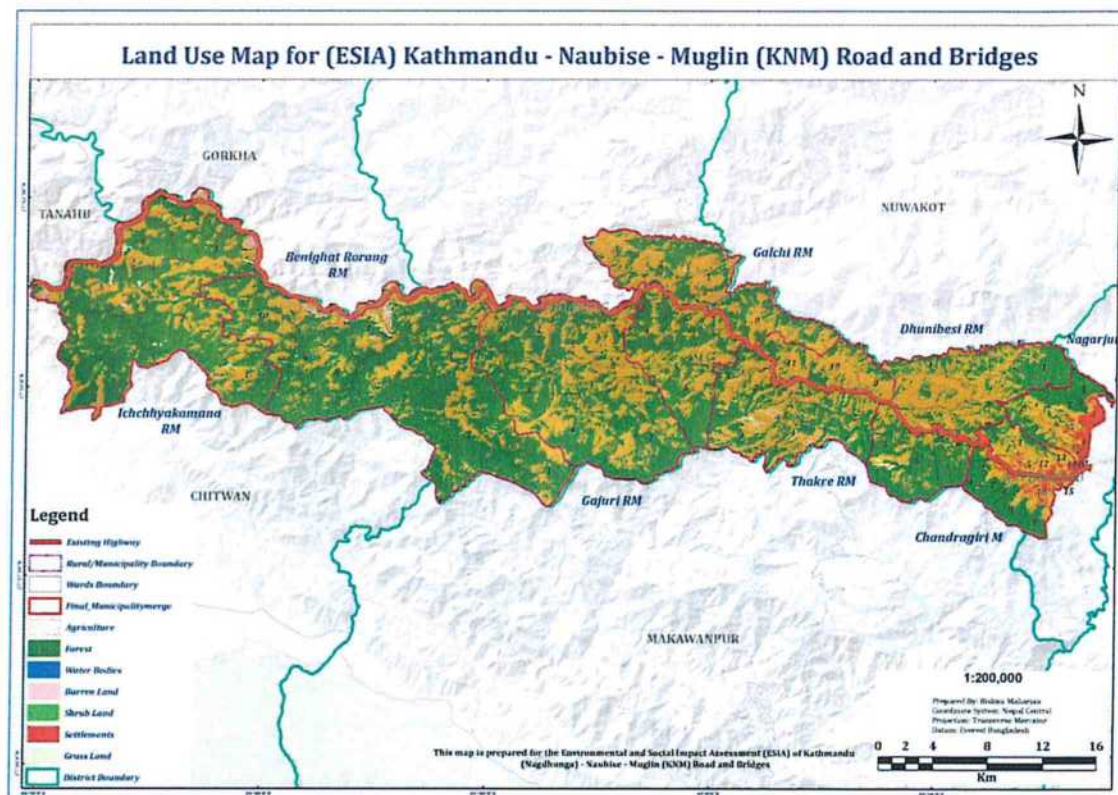
Land use type	KNM		Sisnekhola-Dharke		Benighat-Phisling	
	Ha	%	Ha	%	Ha	%
Agricultural land	6586.05	38.2	343.04	17.0	332.15	10.2
Forest	4654.01	27.0	504.47	25.0	992.98	30.3
Shrubland	450.1	2.6	710.54	35.1	848.03	25.9
Grassland	870.63	5.0	234.14	11.6	285.65	8.7
Built-up area	4496.93	26.1	186.73	9.2	358.5	11.0
Barren land	55.71	0.3	42.64	2.1	106.11	3.2
Water-bodies	135.4	0.8	0.21	0.01	348.97	10.7
Total	17248.83		2021.77		3272.39	

Source: GIS Map (ESIA Study Team)

Indirect impact area covers 17248.22 ha along existing highway, 2021.77 ha in Sisne-Khola – Dharke and 3272.39 ha in Benighat – Phishling. Land use along existing highway is mostly consisted of agriculture (38.2%), forest (27%), and settlements (26.1%). Grasslands and shrublands occupy together 7.6% of the area. In Sisne-Khola – Dharke, the natural land classes prevail, occupying 25% by forest, 35.1% by shrubland, and 11.6% by grassland. Agricultural areas and settlements cover 17% and 9.2% respectively. In Benighat-Phishling section, the natural habitats also prevail with 30.3% of forest, 25.9% of shrubland, and 8.7% of grassland.

This alignment is situated closely to Trishuly River, which occupies 10.7% of land in IIA. Agricultural area and settlements cover 10.2% and 11.0% of land in IIA, respectively.

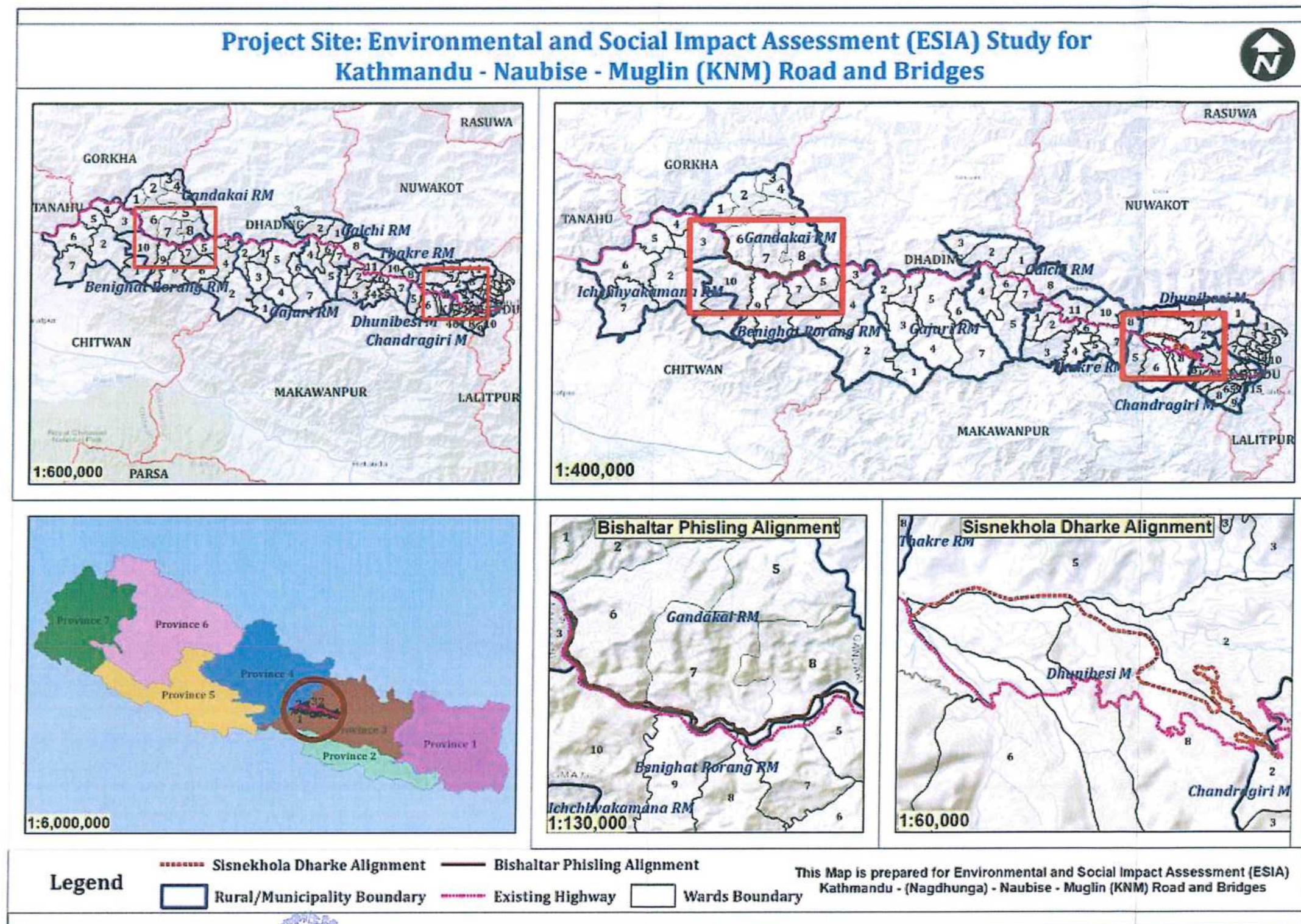
Therefore, the analysis of land use in the project area shows that the land, more likely, 423.32 ha of land will be cleared for Right of Way in three sections. The direct impact area presents 3650.53 ha in all three sections and indirect impact area covers 22542.99 ha of the area along existing highway and along new alignments.



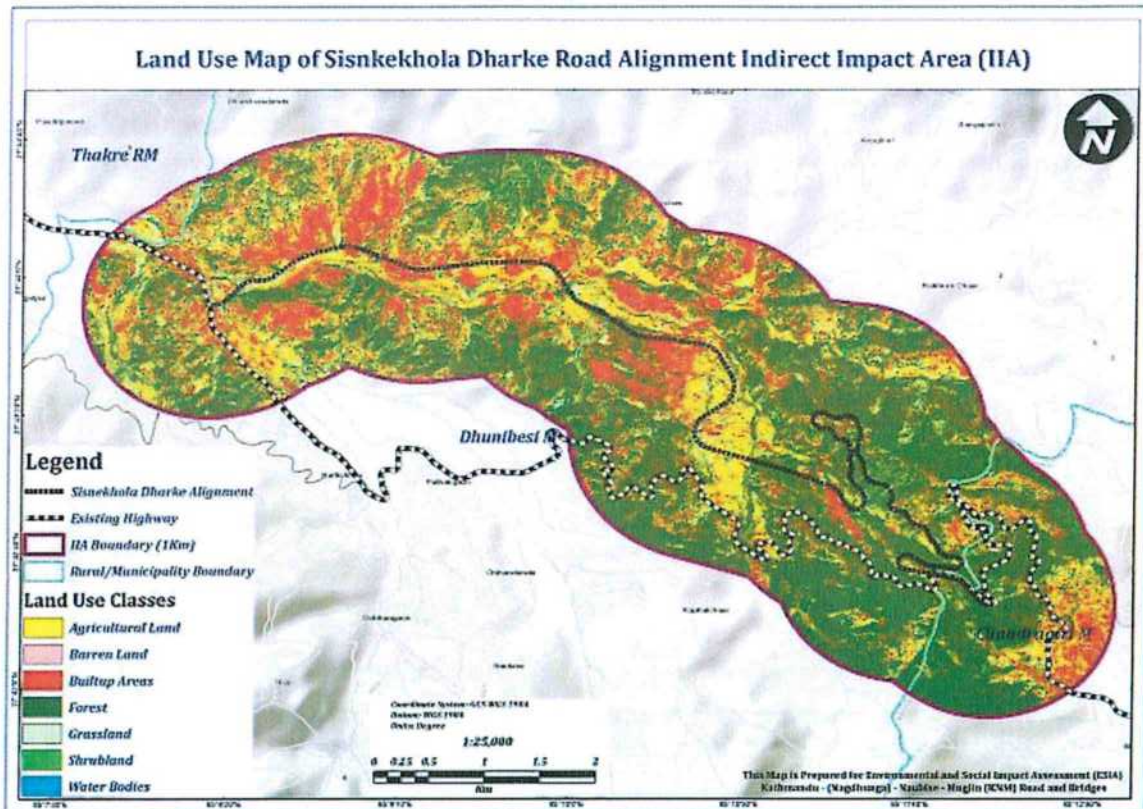
Map 5-4: Land use Map of KNM Section

As it follows from the tables, there is a difference in land use pattern between existing KNM highway and new alignments, where road construction is just planned. Agriculture is a main type of land use along existing highway with highest ration in ROW and gradually decreasing in direct and indirect impact areas. Forest and settlements are two other major land classes along existing highway, especially high percentage forest occupies in the direct impact area (47.2%), where special mitigation measures should be included in the EMP to minimize adverse impacts. The area along existing highway is highly populated, which is confirmed by analysis of land use in 2 km road corridor with 26.1% of total area, occupied by settlements (mostly villages and small towns located along highway).

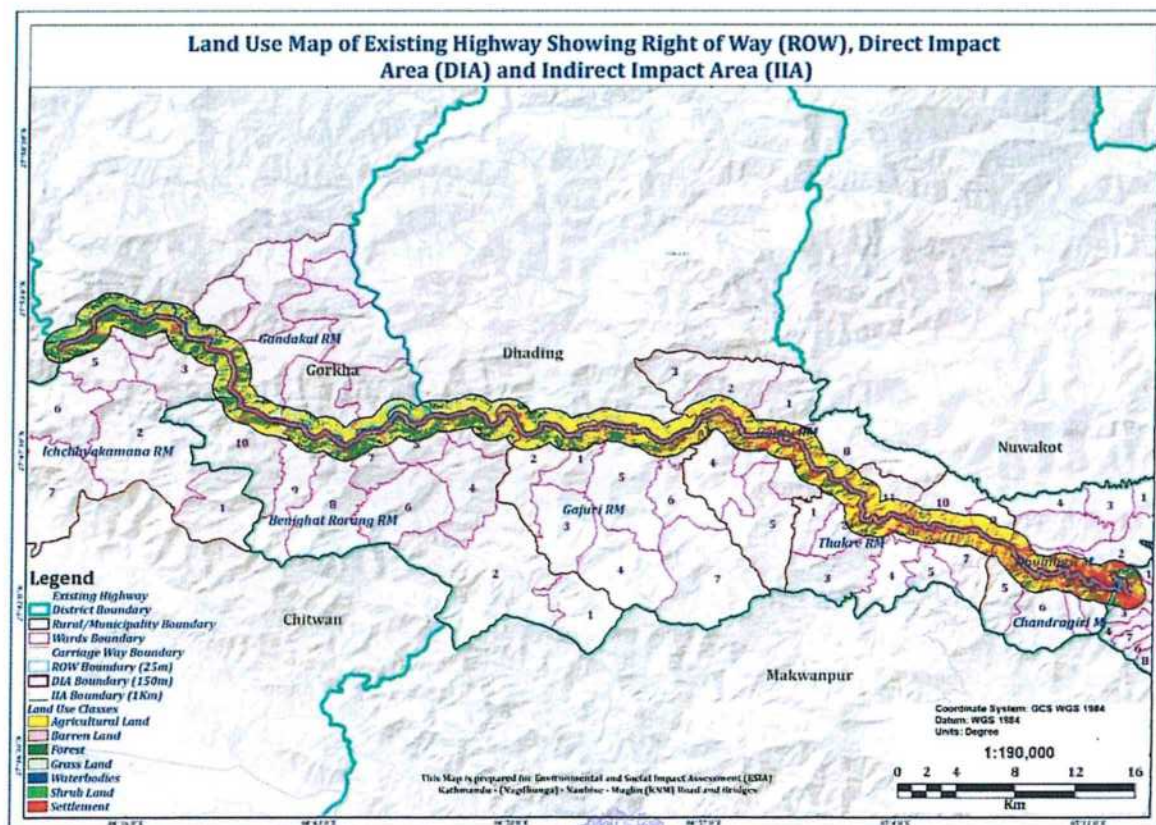




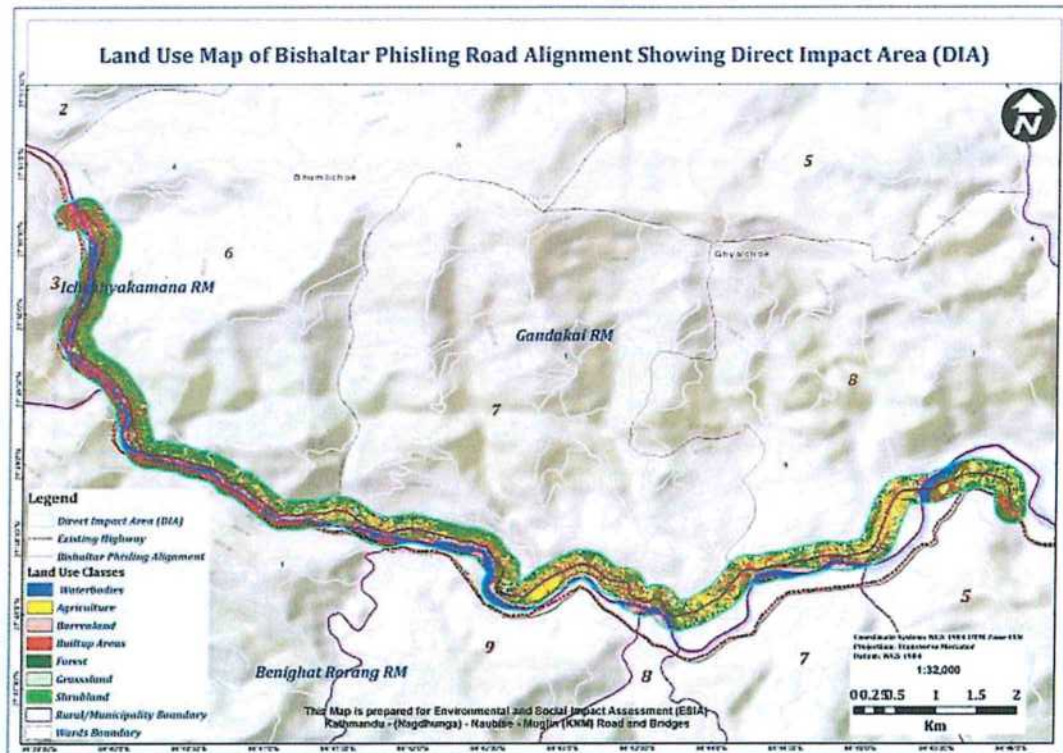
Map 5-5: Project Sites with alignments and wards



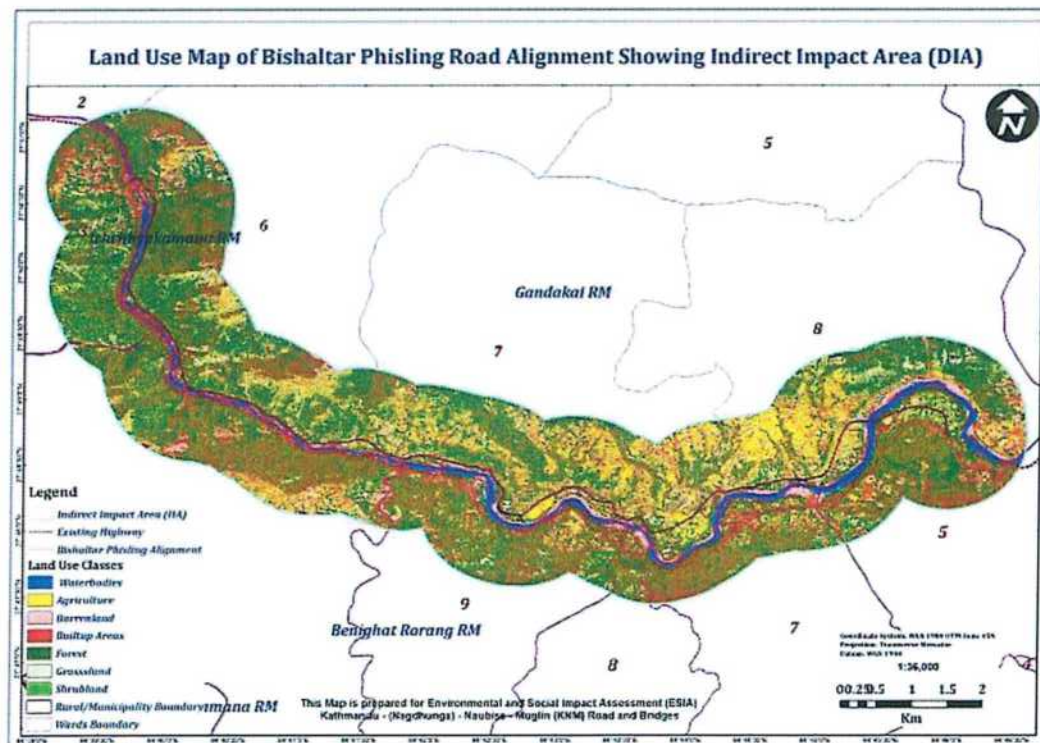
Map 5-7: Land Use Map in IIA of Sisnekhola – Dharke alignment



Map 5-8: Land Use Map in DIA of Bishaltar-Phisling alignment



Map 5-9: Land Use Map in DIA of Benighat – Phisling alignment



Map

5-10: Land Use Map in IIA of Benighat – Phisling alignment

In Benighat-Phishling section, the planned road will cross-forest, agricultural areas, shrublands and grasslands, it is also located closely to Trishuli River. Agricultural land presents 21% in ROW, 13% in DIA and 10% in indirect impact area. Natural habitats (forest, shrubland, and grasslands) together cover 52.2% in ROW, 48.6% in DIA and 64.9% in IIA. Closeness of river may create specific challenges along this alignment.

5.1.13. Solid Waste Management

Solid waste is the major challenges faced in the urban area of Nepal. It is estimated that waste from households in general contribute about 50%–75% of the total waste generated. The average waste generation is 317 g/capita/day. Household waste generation rate is 170 grams (g)/capita/day. Households in Terai municipalities generate nearly 80% more waste than those in mountain region municipalities (ADB, 2013).

Organic waste comprises 66%, followed by plastics (12%), paper and paper products (9%). The composition analysis of institutional wastes revealed 45% paper and paper products, 22% organic wastes, and 21% plastics. The commercial wastes comprised 43% organic wastes, 23% paper and paper products, and 22% plastics (ADB 2013).

Management of solid waste has become an essential and significant issue that requires substantial human and financial resources within the project area. However, often due to financial constraints, solid waste is being one of the major problem along the market area of roadside. The settlement along interior part of the roadside manages the degradable waste by local technology i.e. they make compost manure. However, non-biodegradable wastes are thrown either along the roadside, highway or directly disposed into river.

Although almost all municipalities and rural municipalities allocate budget for the management of solid waste, the breakdown of expenditures is rarely available. Roadside market, small shops, grocery, restaurants, and teashops are the major source of waste, which are seen along the roadside. Either side of the road is seen like a dumping site. The major challenge for its management is the behavioral part of the passengers. The owners of small market need to play pivot role for SWM. Roadside dustbins placement with regular monitoring from concerned municipalities or Rural Municipalities is essential. The major percentage of waste generated from the roadside market and hotels are organic wastes such as waste food materials, fruits and vegetables, wood pices, etc. whereas remaining percentage of waste are plastics, pet bottles, beer/whisky glass bottles, tin cans, broken pices of glasses, rubber, iron pices etc. No any institution, private organization working for the management of waste is existed along the existing highway as well as along the proposed new alignment area.

5.1.14. Infrastructure

Infrastructure such as electric poles, water supply pipelines, road tracks, irrigation canals etc. situated within the direct impact zone are presented in the following tables.



Table 5-28: Electric Poles existed within the direct impact zone (in Nos.)

Sn.	Road Section	Chainage	Type of Poles			Total
			Metal	Wooden	Cement	
Improvement of Existing Nagdhunga – Mugling Road						
1.	Nagdhunga - Naubise	0+000~ 12+200	35	6	41	82
2.	Naubise - Baireni	0+000~24+200	250	35	35	320
3.	Baireni - Bishaltar	24+200~3+000	300	41	62	403
4.	Bishaltar - Mugling	53+000~82+000	305	8	43	356
	Sub- Total		890	90	181	1161
New Alignment from Sisne Khola - Dharke and Benighat - Philsing						
5.	Sisne Khola - Dharke	0+00~11+200	80	25	-	105
6.	Bishaltar - Phisling	0+00~15+300	65	20	-	85
	Sub-Total		145	45	0	190
	Total		1035	135	181	1351

Source: Field Survey, 2017

Water Supply Pipe

Table 5-29: Water Supply Pipe Lines existed within the direct impact zone (in km)

Sn.	Road Section	Chainage	1" Dia. Pipe		0.5" Dia. Pipe		1.5" Dia. Pipe		2" Dia. Pipe	
			GI	PVC	GI	PVC	GI	PVC	GI	PVC
1.	Nagdhunga - Naubise	0+000~ 12+200	0.09	4.7	-	2.0	-	1.5	-	-
2.	Naubise - Baireni	0+000~24+200	0.55	11.0	-	-	-	-	-	1.8
3.	Baireni - Bishaltar	24+200~3+000	-	8	-	-	-	0.8	-	1.5
4.	Bishaltar - Mugling	53+000~82+000	-	11	-	-	-	-	-	2.32
Sub- Total			0.64	34.7	-	2.0	-	0.8	-	5.62
5.	Sisne Khola - Dharke	0+00~11+200	0.3	0.9	-	2.5	-	-	-	-
6.	Bishaltar - Phisling	0+00~15+300	-	-	-	2.56	-	0.8	-	-
Sub-Total			0.3	0.9	-	5.06	-	0.8	-	-
Total			0.3	0.9	-	7.06	-	3.1	-	5.62

Source: Field Survey, 2017

Irrigation Canal

Table 5-30: Irrigation Canal existed within the direct impact zone (in meters)

Sn.	Road Section	Temporary/Earthen	Cemented	Total
1.	Nagdhunga - Naubise	-	-	-
2.	Naubise - Baireni	-	-	-
3.	Baireni - Bishaltar	-	-	-
4.	Bishaltar - Mugling	-	-	-



Sn.	Road Section	Temporary/Earthen	Cemented	Total
Sub-Total				
5.	Sisne Khola-Dharke	300	100	400
6.	Bishaltar-Phisling	1200	200	1400
Sub-Total		1500	300	1800

Source: Field Survey, 2017

Existing Track

Table 5-31: Existing Tracks existed within the direct impact zone. (in meters)

Sn.	Road Section	Total Length
1.	Nagdhunga - Naubise	-
2.	Naubise - Baireni	-
3.	Baireni - Bishaltar	-
4.	Bishaltar - Mugling	-
5.	Sisne Khola-Dharke Road	980
6.	Bishaltar-Phisling Road	1500
	Total	2480

Source: Field Survey, 2017

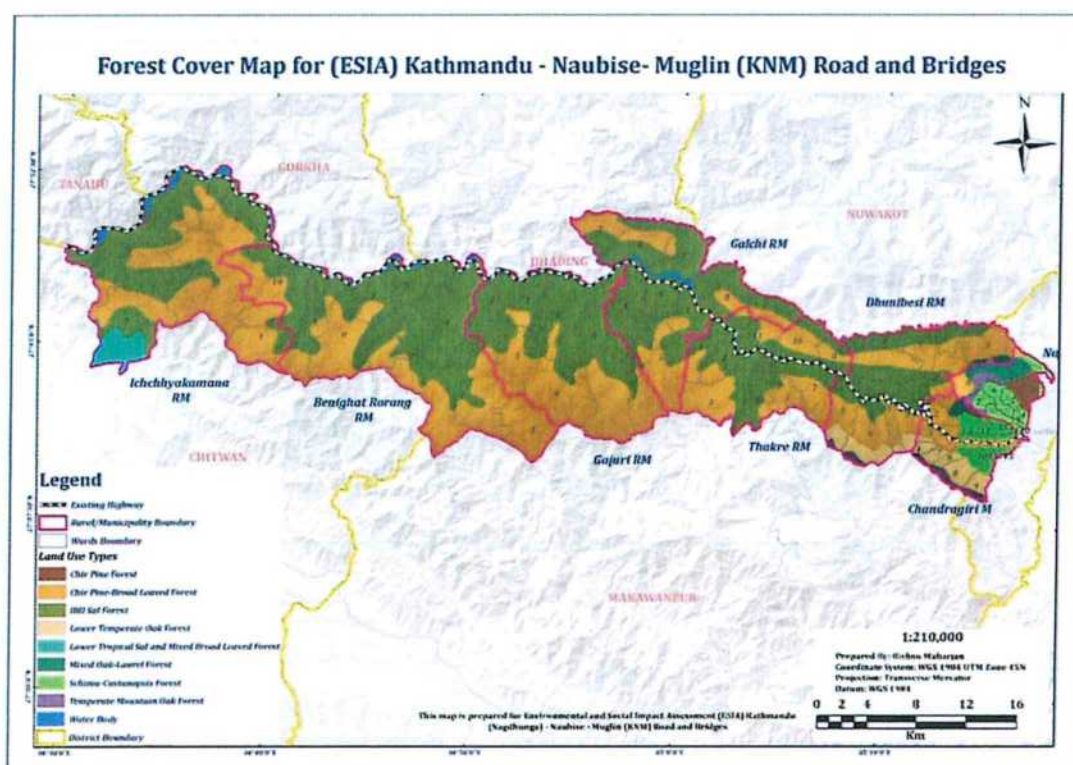
The list of existing tracks along the existing highway is presented in the Annex-5.



5.2. Biological Environment

5.2.1. General

Nepal has a wide range of habitats with rich biological diversity, supporting populations and sub-population of many species, isolated by mountain ridges and deep valleys with high diversity of endemism. Nepal has 5400 described vascular plants, including over 324 species of Nepalese endemic flowering plants distributed under 132 genera and 45 families (Rajbhandari *et al.* 2016) and 700 medicinal plant species. Over 175 species of mammals, 850 species of birds, 600 species of butterflies, 500 species of moths, 180 species of dragonflies, 170 species of fish, and other animals inhabit this country. With only 0.15% of the world's forest, Nepal has 2.2% of all known plants and 9.4% of all known bird species. However, at present time, these diversities face severe threat of extinction due to fast development and human population growth, causing soil and water pollution, rapid deforestation, land use change, habitat loss, unsustainable extraction and unplanned infrastructure development. Industrial growth, construction of dams for hydropower and irrigation and fast development of



Map 5-11: Forest Cover Map of Existing KNM-Road

road sector increase threats for ecosystems and biodiversity.

5.2.2. Forests in the Project Area

Forests in the project area are important to maintain quality and quantity of water in nearby streams. They attract foreign and domestic tourists. Forests are also sources of fuel wood for cooking and warming houses, timber for building and fodder and bedding materials for livestock, and manure for obtaining better productivity from agriculture crops. Non-timber

forest products (NTFPs), including fruits and vegetable, seeds, livestock and other valuable products play an important role in generating cash income and subsistence for local people. In the project area forests are managed through Community Forestry (CF), Leasehold Forestry (LHF) and Government managed forests (GF), which are solely managed by government alone. The Government managed forests are degraded due to high demand of fuel wood and timber by the people and weak control mechanisms. As a consequence, trees in governmental forests are sparsely distributed as well as inaccessible due to steep slopes.

5.2.3. Types of Forest by Vegetation

Five different pertinent forest types are found in the project area: *Schima-Castanopsis*, pine forests (*Pinus roxburghii* and *Pinus patula*), Hill sal, Khair Sissoo and upper Terai Mixed Hardwood Forest type. There are three types of designated above forests presented along existing and new alignments: Community Forests (CF), Governmental Forest (GF) and Leasehold Forests (LHF). As the forests do not exist in a single chunk, but distributed all along the project area and they are of different types, a mileage break down was not done.

i. Schima-Castanopsis forest



Figure 5-10: Schima-Castanopsis forest in Kathmandu district

The *Schima-castanopsis* forest is found along the old Kathmandu (Nagdhunga) - Naubise section. In the upper part, the dominant species is *Castanopsis tribulodies*. Other presented species include *Schima wallichii*, *Merica esculanta*, and several others. The Schima Castanopsis forest area at Nagdhunga is enriched with Utis (*Alnus nepalensis*) plantation. This forest is mostly presented in Kathmandu District. The majority of the forest is composed by *Schima Castanopsis* Forests from Kathmandu towards Naubise (12+000) of Dhading district. Species

distribution showed that the forest type starts with upper middle layer, which slowly changes to middle and to lower layer, including other tree species, toward Naubise, i.e., *Castanopsis indica*, *Schima wallichaii* domination. This is a forest type that has the diversity of woody and other species. Some other species are available in the forest are listed in Appendices.

ii. Hill Sal forest



Figure 5-11: Hill Sal Forest at KNM section

Both hill Sal forest and upper sub-tropical Sal forest are available along the lower end of the project area. Along the new alignment in Gorkha district, species available are those from hill sal in total and along the Mugling end in Chitwan district, the species domination is that of Terai mixed hardwood forest. Most of the Sal species is found in the community managed CF, hence, the quality of forest is good despite it is located closely to the

highway. However, unwanted harvesting is quite high in such forests, because outsiders (other than CF users) are involved in felling of trees (illegal harvesting). Hill sal forest has diverse type of woody and other tree species. Other potential species of the forest type are listed in **Annex**.

iii. Riverine Khair-Sissoo forest

This is a pioneer forest that appears on the bank of rivers and along landslide areas (movement or new land) in the sub-tropical zone. This forest exists on both banks of Mahesh Khola and Trishuli River from Naubise until Mugling and along the new Gorkha alignment. The forest represents a sizable distribution in the project area. The species composition of *Acacia catechu* (Khair), *Dalbergia sissoo* (Sissoo) is prominent in this type of forest as known. Due to the steep slope, majority of this forest is inaccessible.



Figure 5-12: Riverine forest in the Trishuli Valley

This is a pioneer forest that appears on the bank of rivers and along landslide areas (movement or new land) in the sub-tropical zone. This forest exists on both banks of Mahesh Khola and Trishuli River from Naubise until Mugling and along the new Gorkha alignment. The forest represents a sizable distribution in the project area. The species composition of *Acacia catechu* (Khair), *Dalbergia sissoo* (Sissoo) is prominent in this type of forest as known. Due to the steep slope, majority of this forest is inaccessible.

iv. Mixed forest

Along the alignment many patches are composed of mixed forest, resembling upper mixed hardwood, with species including *Mallatus philipinnes* (sindure), *Lagerstroemia parvifolia* (Bodhangero), *Schima wallichiana* (Chilaune), *Adina cordifolia* (Karma), *Melia azedarach* (Bakino), *Engelhardia spicata* (Mahuwa), *Castanopsis indica* (Dhale katus) and others. Other species available along the alignment with the Mixed forest type resemble the “Lower Tropical Sal and Mixed Broadleaved Forests”. Potentially occurring species in this forest type has been listed in **Annex**.

v. Pinus roxburghii forest



Figure 5-13: Pine forest in KNM section

This forest of native pine is distributed along the alignment in Dhading district only. This is a plantation forest found immediately after crossing along the new section in Sisnekhola-Dharke alternative, while moving from Sisnekhola to Dharke, in Nishakot VDC of Dhading district. Some scattered plantations of the species (not blocks) can be observed from Kathmandu (Nagdhunga) until Naubise in the existing alignment, providing

substantial living conditions for wildlife typical in coniferous forests. Along the Sisne Khola - Dharke alignment, it can also be observed in a scattered form of plantation all along. The home range of the species is elevation of 1200-1300 meter. Dominant number of *Alnus nepalensis* is also found in the newly exposed area along the fringe of this forest. Main species of this plantation forest is *Pinus roxburghii*; some *Alnus nepalensis* is also found along the fringes in the lower part where the location is moist comparatively.

5.2.4. Types of Forest by Ownerships and area being affected

On the basis of ownership, there are three types of forests in the project area. These are government managed forests (GF), community forests (CF) and leasehold forest (LHF). The ESIA team worked closely in acquiring the dimensions of affected linear distances and area of cut and field in the field. Pegging by the survey team have been the basis of the dimensions placed in Table 5-32.

i. Government Managed Forest: There are altogether 9 patches of GF being traversed by the proposed construction/improvement. GFs are located along the existing Kathmandu (Nagdhunga)–Naubise–Mugling section, Sisnekhola Dharke Section and Bishaltar Phisling Section of the project.

Nine patches of government-managed forest were found traversed by the alignment proposed and its span is 8.30 km. Among them, one with the length of 74 m, being the shortest patches of government managed forest along the new Sisnekhola Dharke Section, proposed in Dhading district. 7 patches of the forest lies in the existing Naubise Mugling Section. Remaining patch of GF is in the new Bishaltar Fisling Section following Salleri CF and is the longest among the GF (3680 m).

ii. Community Forest: The forest area those traversed by the alignment largely are community-managed forests. Altogether 30 patches of CFs within the project area. All the patches of CFs add up to 18.77 km. These forests are both natural and planted.

According to CF regulation management, responsibility to protect, harvest, regenerate and use such forests lies on the Community Forest User Groups (CFUGs). Detailed list of the CFs affected with its linear cut and field distance and forest area affected is presented in

Table 5-32. As depicted in table only two CF are found in existing Nagdhunga-Naubise section and they are unharmed. All together, there are four CFs in new alignments and 1 is in Sisnekhola Dharke Section and 3 in Bishaltar Fisling sections. Rest of the CFs are in the existing Naubise Mugling Section.

iii. Leasehold Forest: Leasehold approach is another important management option being followed in the country. These are largely degraded forest land, leased to poor household groups of 5-10 households (poor household hamlets), for income generating activities. Government has a focus of subsisting the livelihood of the poor people through this approach of forest management. Another agenda of LHF approach is to rehabilitate the degraded forest or prevent the degradation of forests. The area is leased for a specified period. Within the project alignment, there are 7 LHF with the affected length of 1.55 km and area of 4.54 ha as shown in Table 5-32 below. Among these only Madan Pakha LHF, Dhading district of the existing Naubise-Mugling section was found to have 22 poles.

Proposed project is the improvement of the existing road from Nagdhunga to Mugling to two lanes proper along with construction of Sisne Khola to Dharke (Dhading district) as well as Bishaltar to Phisling (right side of Trishuli River, Gorkha district). The highway passes through forest and agricultural land from temperate (Kathmandu) to subtropical region (Mugling). In addition, there are micro-climatic niches, which have offered different types of flora and fauna within the project sites of both districts.

The existing Kathmandu (Nagdhunga) Naubise Mugling Highway is to be maintained at two lane Highway, which already exists and the carriageway is 7 to 8m. New extensions were studied for a right of way (ROW) of 50m (25 m on either side from the center of the highway). However, the improvement of existing highway to 9m formation width (Figure 3-5) does not need to acquire the whole ROW and affected area being 1-2 m maximum on either side from the existing edge of the highway. The study estimated total affected forest area to be 37.44 ha and linear distance of all the affected forests adds up to 28.394 km.

Proposed new alignments, Sisnekhola Dharke Section and Bishaltar Phisling Section will traverse 0.76 Km and 28.15 Km of linear distances within the forests respectively. Distribution of length and area affected in different forests are presented in Table 5-26. Different owned forests contribute 29.2% (8.304 km), 62/8% (17.845 km) and 7.9% (2.245 km) respectively by Government managed, Community managed, and Leasehold group managed forests.

5.2.5. Estimated number of Trees along the Road Alignment

During the improvement of existing highway and construction of proposed new sections of highway; trees, poles and shrub will be removed. Largest number of trees and poles removed are from the Community Forest (CF), followed by Government managed forests (GF) and then the Leasehold Group managed forests (LHF).

A concept of not harvesting or harvesting minimal number of trees was the approach, especially in existing Kathmandu Naubise Mugling Highway (

Table 5-32). A close coordination was maintained with the survey engineers while inventorying the forests on either side of the existing highway. You can see that a neck to neck area was calculated and inventory carried. Review of the results show that, of the total trees harvested, 88.5% of the total trees

affected are from community forests, 11.32% of Government and 0.18% of Leasehold User Group Forests are impacted. A tree according to GON regulation is those with dbh 10 cm and above. Technically, 10cm to 29.99cm are poles and 30cm dbh and above are trees (Tamrakar



Figure 5-14: Community managed forest along existing highway

1999). Under this technical categorization, it is estimated that 11961 number of trees are to be harvested, of which 92% are poles and 8% only trees. More details are available in table below.

Table 5-32: Number of trees, wood volume, biomass and carbon along the project alignments

SN	District	Municipality/ RM	Forests under different management options	Forest area (ha)	Number of Trees		Total	Wood volume (m3)	Total biomass (ton)	Carbon (ton)	Remarks
					Trees	Poles					
Nagdhunga-Naubise											
1	KTM	Chandragiri	Near Subbako Ban - GF	0.04	1	16	17	2	2.6	1.46	The dimensions stated by Govt. of Nepal are diameter of breast height (dbh) 10cm and above. Technically, dbh 10-30 cm is pole and above 30 cm is tree. There are more poles (92%) in GoN categorized trees.
2	KTM	Chandragiri	Near Patle Ban CF - GF	0.02	1	9	10	1.12	1.46	0.81	
3	Dhading	Dhunibeshi	Naubise area - GF	0.03	1	13	14	1.56	2.03	1.13	
Naubise Mugling											
4	KTM	Chandragiri	Satiko Ban - CF	0.04	1	47	48	5.55	8.32	5.37	
5	Dhading	Galchi RM	Setidevi - CF	0.25	3	101	104	8.64	12.96	8.36	
6	Dhading		Thulodanda - CF	0.09	0	16	16	4.57	6.85	4.42	
7	Dhading		Balkumari - CF	0.13	0	235	235	12.6	18.91	12.2	
8	Dhading		Sutkeri Dhunga - CF	0.18	0	68	68	4.81	7.22	4.66	
9	Dhading		Chiraudi - CF	0.01	0	4	4	0.17	0.25	0.16	
10	Dhading		Indrayani - CF	0.04	3	42	45	3.76	5.64	3.64	
11	Dhading	Thakre RM	Bhasme - CF	0.02	0	9	9	0.17	0.26	0.17	
12	Dhading	Gajuri RM	Gauri Bhanjyang - CF	0.04	7	49	56	13.69	20.54	13.26	
13	Dhading		Indradevi - CF	0.08	0	92	92	4.16	6.24	4.03	
14	Dhading		Panchakanya - CF	0.09	1	71	72	5.94	8.91	5.75	
15	Dhading		Amaltari - CF	0.02	1	15	16	1.27	1.9	1.23	
16	Dhading		Mahadev Kholsi - CF	0.02	0	0	0	0	0	0	
17	Dhading		Kankali - CF	0.06	0	31	31	3.34	5.01	3.23	
18	Dhading		Kashi Khola - CF	0.15	2	83	85	9.95	14.93	9.64	
19	Dhading		Benighat Rorang RM	Phale Pakha - CF	0.08	4	89	93	9.56	14.35	
20	Dhading	Gomati Bhairab - CF		0.06	5	57	62	13.35	20.03	12.92	
21	Dhading	Bishal Samjhauta - CF		0.19	5	101	106	12.54	18.82	12.14	
22	Dhading	Jabang Mauwa Khola - CF		0.14	0	70	70	3.09	4.64	3	
23	Dhading	Jaldevi - CF		0.86	0	535	535	24.58	36.88	23.8	
24	Dhading	Bharyang Pakha - CF		0.16	0	0	0	0	0	0	
25	Dhading	Tapre - CF		0.16	12	109	121	19.64	29.47	19.02	

SN	District	Municipality/ RM	Forests under different management options	Forest area (ha)	Number of Trees		Total	Wood volume (m3)	Total biomass (ton)	Carbon (ton)	Remarks
					Trees	Poles					
26	Dhading		Galbandi - CF	0.06	0	16	16	1.29	1.94	1.25	
27	Chitawan	Ichhakamana RM	Chepang - CF	0.16	0	132	132	14.19	21.29	13.74	
28	Chitawan	Ichhakamana RM	Dharapani - CF	0.31	0	129	129	12.72	19.1	12.32	
29	Chitawan	Ichhakamana RM	Sirudanda - CF	0.17	0	64	64	3.89	5.84	3.77	
30	Dhading	Benighat Rorang RM	Before Majhimtar - GF	0.06	2	22	24	2.72	3.53	1.97	
31	Dhading	Benighat Rorang RM	Near Benighat - GF	0.08	2	30	32	3.64	4.73	2.65	
32	Dhading	Gajuri RM	At Pida - GF	0.02	1	9	10	1.06	1.37	0.77	
33	Dhading	Benighat Rorang RM	Near Malekhu - GF	0.01	0	5	5	0.63	0.82	0.46	
34	Dhading	Benighat Rorang RM	Jana bhabana - LHF	0.01	0	0	0	0	0	0	
35	Dhading	Benighat Rorang RM	Madan Pakha - LHF	0.05	0	22	22	2.02	2.62	1.47	
36	Chitawan	Ichhakamana RM	Kumbogaira - LHF	0.02	0	0	0	0	0	0	
37	Chitawan	Ichhakamana RM	Simle Gaira - LHF	0.02	0	0	0	0	0	0	
38	Chitawan	Ichhakamana RM	Dhap Pakha - LHF	0.03	0	0	0	0	0	0	
39	Chitawan	Ichhakamana RM	Bombay Aanp - LHF	0.03	0	0	0	0	0	0	
Sisne Khola-Dharke											
40	Dhading	Dhunibeshi	Nisakot CF	3.43	274	2367	2641	926.56	1390.5	597.92	
41	Dhading	Dhunibeshi	Dhading alternative GF	1.85	4	57	61	6.91	8.98	3.86	
Bishaltar-Phisling											
42	Gorkha	Gandaki RM	Salleri - CF	4.67	94	4734	4828	550.99	826.88	355.56	
43	Gorkha	Gandaki RM	Nibhare - CF	2.46	0	835	835	31.57	47.38	20.37	
44	Gorkha	Gandaki RM	Keraghari - CF	1.30	29	43	72	20.93	31.41	13.51	
45	Gorkha	Gandaki RM	After Salleri - GF	18.40	526	655	1181	366.5	550.06	236.5	
46	Gorkha	Gandaki RM	Surung Pakha - LHF	1.32	0	0	0	0	0	0	
			Grand Total	37.44	979	10982	11961	2111.68	3164.67	1425.78	

Source: Field survey, 2017

Table 5-32 shows that LHF contribute the least. There are very few scattered poles available, and that too in Madan pakha LHF only. On the other hand, these LHF were densely grown by seedlings and saplings. In Madan pakha LHF, total a total of 22 trees including Khair (*Acacia catechu*) and Sindhure (*Mallatus philippines*) were found. LHF is degraded forest area as the principle of the government is to lease degraded forests. However, other LHF have few sapling

of Sal, Khair, Kyamun, etc. and fruit trees and cash crops including Mango, Banana, Lemon, Pineapple, Bamboo, Cassia, Guava, etc., only.

Wood volume, biomass, and carbon conversion of the trees affected in the project area

Biomass and carbon was calculated for felled trees from community managed, government managed and Leasehold forests. Total biomass that will be harvested during the construction and upgrading of the Kathmandu Mugling highway was calculated to be 3164.67 tons. Carbon value of the wood biomass was 1360.65 tons. Wood/timber volume of the trees to be harvested was 2111.68 cubic meter.

Loss of forestland and effect on tree/vegetation diversity:

Proposed alignment traverses through a linear distance of 28.39 km from the forest, which clears an area of 37.44 ha of forests, during upgrading of the existing road and constructing of new Sisne Khola- Dharke section and Bishaltar – Fisling Sections. Linear distances traversed in forests by these new roads is 1.0 Km (Sisne Khola Dharke) and 4.489 Km in Bishaltar Fisling section. Rest of the effect is in the existing alignment. During the process, 37.4 ha of forestland will be converted into other landform. This natural forestland will be converted permanently into other landforms such as roads and bridges.

Tree Species diversity in CF

From all the three differently managed Forest management regimes, 24 different tree species will be affected. Among the most affected trees sal (*Shorea robusta*) is highest and is followed by Khair (*Acacia catechu*) and considered as protected species as per GoN.

It was observed that management of community forests being practiced was quite conservative and Sal focused. Of the 5-different forest type only Hill Sal and Terai mixed hardwood have Sal, but not to that domination as required by a forest type. It is clear that in community-managed forests there is higher presence of Sal species, which is the indication that the communities prefer Sal. Forest inventory enumerated that, of the total species composition, 47% was Sal and 22% Khair. Species details can be seen in Table 5-33.

Species like Sarpaganda (*Rauwolfia serpentina*), Tejpat (*Cinnamomum lamala*), Nundhike (*Osyris wightiana*), Rajbrikshya (*Cassia fistula*), Jamune (*Syzygium cumini*), and Amala (*Phyllanthus emblica*) were observed as regeneration crop and at a very low number, beyond the plots established, which were noted for record purpose. 2 seedlings of Sarpaganda wheeppy were seen in two inaccessible locations in Phisling, Chitwan. These government forests were in the process of being handed over as community forests. However, orchids and sarpaganda are considered as protected plant species as per GoN.

Table 5-33: Species wise summary of total tree to be felled

SN	Local Name	Latin name	Number			
			CF	GF	LHF	Total
1.	Asna	<i>Terminalia alata</i>	11	1		12
2.	Badkaule	<i>Casearia graveolens</i>	34	4		38
3.	Bakaino	<i>Melia azedarach</i>	77	9		86



SN	Local Name	Latin name	Number			
			CF	GF	LHF	Total
4.	Banjhi	<i>Quercus leucotrochophora</i>	58	7		65
5.	Bhalayo	<i>Rhus wallichii</i>	12	1		13
6.	Botdhairo	<i>Lagerstroemia parvifolia</i>	702	87		789
7.	Camuna	<i>Syzygium cerasoides</i>	54	7		61
8.	Chilaune	<i>Schima wallichiana</i>	239	29		268
9.	Karma	<i>Adina cardifolia</i>	9	1		10
10.	Katus	<i>Castanopsis indica</i>	8	1		9
11.	Khair	<i>Acacia catechu</i>	2359	294	22	2675
12.	Khanayo	<i>Ficus semicordata</i>	14	2		16
13.	Khirro	<i>Sapium insigne</i>	49	6		55
14.	Kholesalla	<i>Pinus roxburghii</i>	853	105		958
15.	Lapsi	<i>Choerospondias axillaris</i>	20	2		22
16.	Mauwa	<i>Engelhardia spicata</i>	111	14		125
17.	Others		22	3		25
18.	Padke	<i>Albizia gamblei</i>	51	6		57
19.	Patesalla	<i>Pinus Patula</i>	235	29		264
20.	Phalat	<i>Quercus glauca</i>	6	1		7
21.	Sal	<i>Shorea robusta</i>	4991	615		5606
22.	Sindhure	<i>Mallatus philippines</i>	353	44		397
23.	Sissoo	<i>Dalbergia sissoo</i>	198	25		223
24.	Utis	<i>Alnus nepalensis</i>	160	20		180
Grand Total			10626	1313	22	11961

Source: Field survey, 2017

Tree Species diversity in Leasehold Forest

In case of LHF, only few scattered trees and poles are available (only in Madanpakha LHF), however, these forests are densely populated with seedlings and saplings. In Madanpakha LHF a total of 22 trees, which included Khair (*Acacia catechu*) and Sindhure (*Mallatus philippines*) species. LHF are degraded forest area, which is handed over by the government to the LHF groups. Other LHF forests had only sapling of Sal, Khair, Cyamun, fruit trees and cash crops including Mango, Banana, Lemon, Pineapple, Bamboo, Cassia, Guava, etc.



Tree Species diversity in Government forest

Similarly, the Government forest patches found in alignment is also degraded because of over exploitation of the resources. On the other hand CF is strict for regular forest protection and forest product collection. Tree and pole species estimated to be felled in the government forest is presented in Table 5-34.

Table 5-34: Tree species diversity in the government forest

SN	Species	Latin name
1	Khair	<i>Acacia catechu</i>
2	Utis	<i>Alnus nepalensis</i>
3	Chilaune	<i>Schima wallichii</i>
4	Others	

Source: Field survey, 2017

Species diversity and their status

Some 23 tree species were recorded using sample plot data. According to forests types there are other species which were beyond the sample plot study. These species are listed in annex 5, according to forest type, as described in section 5.2.3, which are,

- A. *Schima Castanopsis* forest type
- B. Hill Sal forest type
- C. Riverine forest type
- D. *Pinus roxburghii* forest type
- E. Terai Mixed Hardwood forest type

Species details in the regeneration category was studied. It was found that the forests are still rich in the species diversity and can flourish and provide the diversity if a proper management regime is followed. There are 98 species of woody vegetation recorded regeneration category of the project area forests.

Protected, Rare or Endangered Species

Regarding the state of the forest trees, different studies and institution has identified to be of different state. Government of Nepal has provided a protection status to tree species, such as i) Champ (*Michelia charnpaka* var. *kisopa*), ii) Bijayasal (*Pterocarpus marsupium*) iii) Sal (*Shorea robusta*), iv) Satal (*Dalbergia latifolia*), and v) Okhar (*Juglans regia*).

The project area contains plants protected under the National Parks and Wildlife Conservation Act, 1973 and Forest Regulations, 1995 (amended in 2001) and those listed under various CITES appendices and IUCN category.



Table 5-35: List of Protected, Rare or Endangered species

SN	Local Name	Latin name	Protection Status		
			GoN	CITES codes	IUCN status
1.	Sal	<i>Shorea robusta</i>	P		
2.	Sungava (Orchids)	<i>Orchidaceae</i>		II	EN
3.	Sarpagandha	<i>Rauwolfia serpentina</i>	P	II	CR

Source: Field study 2017

Note : P= protected, GoN: Government of Nepal, CITES: NPWC Act: National Park and wild life conservation Act, Convention on International Trade on Endangered fauna and flora I=Appendix I: Species threatened with extinction, II=Appendix II: Not yet threatened but which could become endangered if trade is not controlled, III=Appendix III: Species identified by any party as being subject to regulation in that country and which require international co-operation control trade, IUCN World Conservation Union EN=Endangered, VU=Vulnerable, LR=Lower Risk/Near Threatend, CR: Critically Endangered

5.2.6. Ethno-Botanical Knowledge and Practices



Figure 5-15: Banana is one of the plants used in traditional medicine

Plants have always been an inexorable part of life and culture of Nepalese society. Locals use many plants according to indigenous knowledge and practices. The plants have been utilized for various purposes such as fooding, culture and religious purpose, medicinal use, livestock fodder and grazing areas, etc. The uses depend on the needs. Plants and plant products have augmented human and culture since time immemorial. The rural people have developed unique indigenous knowledge related to the uses

of plant resources due to constant association with the forests. The existing valuable knowledge is needed to be documented before it is lost or forgotten.

Below, selected 21 species found in the project direct and indirect impact area have been described as per their use by local communities. Many of them are grown by local people in their gardens and orchards.

1. दलिवन: *Achyranthes bidentata* Blume (Amaranthaceae);

A decoction of plant is applied for urinary problems. Juice of the root is used to cure asthma, indigestion, toothaches. The stem is used as a toothbrush. It is also considered as toothbrush in the religious purpose at 'Teej', Hindu festival.

2. उत्तीस: *Alnus nepalensis* (Betulaceae);

A decoction of roots is taken orally for the treatment of diarrhoea, dysentery and burns. Leaf paste is applied in cuts and wounds. Wood is used for furniture, other construction purposes and fuel.

3. रुखकटर: *Artocarpus heterophyllus* (Moraceae);



Leaf past is used to cure the skin diseases. A decoction of root is used to treat diarrhoea and dysentery. The latex of plants is applied to glandular swelling and abscesses to promote suppuration. Ripen fruits are eaten fresh. Unripe fruits are laxative and it is also cooked as vegetables and pickled. Roasted seeds are eaten. Leaves are lopped for fodder.

4. रामतोरिया: *Abelmoschus esculentus* (Malvaceae);

Juice of the plant is used to treat cuts and wounds, and urinary problems. It is also useful to cure an abdominal disorder, ease constipation, diarrhea and general debility. Tender fruits are cooked as vegetables.

5. कटुस: *Castanopsis indica* (Roxb.) Miquel

A decoction of the leaves applied to treat stomach disorder and skin diseases. Powdered leaves are given to cure indigestion. A plant resin is given to treat diarrhoea. A paste of leaves is applied for headache. The leaves are lopped for fodder and wood is used for fuel and house construction.

6. कागती: *Citrus aurantifolia*

Fruit juice is used to relieve rheumatism, dysentery, diarrhea and indigestion.

7. बर: *Ficus bengalensis*

A decoction of bark is used in dysentery, diarrhoea and diabetes. The milky latex is externally applied for pains and bruises and as an anodyne in rheumatism. It is also used as a remedy for toothache. The leaves are heated and applied as poultice to abscesses. Fruits are eaten fresh and seeds are considered cooling and tonic. Wood is suitable for furniture and other construction purposes. The leaves are looped for fodder. The plant is used for religious purpose.

8. बकाईनो: *Melia azedarach*

The juice of the bark is used to cure leprosy, scrofula and skin diseases. Decoction of leaves is administrated to hysteria. A past of the bark is applied to treat headaches and rheumatic pain. Fruits and flowers are boiled in water and applied for killing lice. Wood is used for furniture and fuel. Leaves are lopped for fodder.

9. अम्बा: *Psidium guajava*

Bark juice is administrated to cure dysentery. Leaves juice is taken to treat bowels, wounds and ulcers. A decoction of the leaves is applied in cholera, diarrhea and indigestion. A past of leaf is applied for rheumatism, cuts and wounds. Leaf buds are chewed to treat fever and headaches. Ripen fruits are eaten fresh.

10. लसून: *Allium sativum* (Amaryllidaceae);

Leaves and tubers powder are extensively used as a spice and stimulant. Leaves and tubers juice is used to cure fever and cough. Roasted tubers are eaten fresh and pickled. Fresh leaves are cooked as vegetables. Oil is administrated to cure rashes skin. It is also chewed raw for blood pressure.

11. पाषाणभेद: *Bergenia ciliata* (Saxifragaceae);

Juice of rhizome is applied to cure piles, tumor, urinary trouble, heart diseases, asthma and lung problems. Powdered rhizome is used to treat in fever, diarrhea, cough and dysentery. A past of the rhizome is applied to boils. The flowers are boiled and pickled.

12. तोरी: *Brassica napus* (Brassicaceae);



Seeds oil is put in the ear to relieve earaches and it is also used for cooking vegetables. Husks are used to plastering the housed and bamboo baskets. Tender green leaves are cooked as a vegetable.

13. घुसुल: *Colebrookea oppositifolia*

Root juice is given to treat the epilepsy. Leaf juice is used to relieve fever, headaches and wounds. The juice of the young inflorescence is given to treat gastric problems and is also put in the nose for sinusitis. The plant is lopped for fodder to cattle.

14. कर्कलो: *Colocasia esculanta*

The fresh shoots are dried for making 'masaura'.

15. बेसार: *Curcuma domestica* Valetton

A decoction of rhizome powder is used to relieve cough and colds and tonsillitis. A powdered rhizome mixed with lemon juice and is applied to treat swellings by inflammation. It is also used in cooking for flavor and colour.

16. बनतरुल: *Dioscorea bulbifera*

Juice of the root tubers is used to treat piles, dysentery, syphilis and ulcers. Tubers are boiled and eaten fresh. It is also cooked as a vegetable.

17. बनमारा: *Eupatorium adenophorum*

Juice of the plant is used to cuts and wounds. Juice of root is useful for fever treatment. A past of the leaf is applied to cure boils and it also used to treat eyes insomnia. It is used for green manure and bio-briquette.

18. बाबरी: *Mentha spicata* (Lamiaceae);

Leaf juice is given to treat nausea, diarrhoea, bloody dysentery, vomiting and gastric disorder. Leaves are also chewed for boils on the tongue. Leaves are used to prepare pickle.

19. केरा: *Musa paradisiaca*

Unripe fruit juice is given to treat diarrhoea and dysentery. Banana powder is applied to treat colic disease. It is also used for intestinal disorders in adults. Ripe fruits are eaten fresh and useful in diabetes, uremia, nephritis, gout, hypertension and cardiac disease. Juice of flowers is used in dysentery. Flowers are boiled and pickled. Green bananas are cooked as a vegetable. Leaves are used as plates. Plant is used as ritual and religious purposes.

20. भईअमला: *Phyllanthus urinaria*

The tubers juice of the plant is given to treat diarrhoea and dysentery. A past of the leaf is used in gonorrhea, urinary troubles and boils. Plants are also used for ornamental purposes.

21. अम्रिसो: *Thysanolaena maxima*

A past of the root is applied to cure boils. The villagers use bundle of the inflorescences to make brooms, which are the good sources of income generation. Tender portion of leaf base is eaten fresh. Plant is also the good sources of food for cattle. The traditional knowledge of the people in the project district have tremendous ethnobotanical importance. They use plants and their parts such as roots, rhizomes, tubers, leaves, steam, wood, bark, flowers, seeds, and fruits in various purposes in their daily life. It is evident that the local communities are dependent on a variety of plants to meet their requirements and beliefs to cure many diseases. The different plant parts are used for medicinal preparation, mode of administration, dosage and other human consumption. In some cases, the whole plant parts are utilized only for medicinal purposes. The plant parts are generally used by the ethnic communities to cure some important diseases

viz., diarrhea, dysentery, asthma, fever, stomach disorder, cuts and wounds, sore throat, rheumatism, blood pressure, urinary problems, ear diseases, headache, constipation and piles. Several species have been recorded to have more than one use. The elder people are familiar with the plant species and their use for common ailments, and the plant remedies being used regularly. Majorities of young generation do not know many plants and their medicinal values. Only few younger are followed the medicinal practices and traditional knowledge by the elders and healers as in the case in other areas of Nepal. Information that is related to women's health problems viz., urinary infections, bleeding and pregnancy are difficult to acquire and treat. Such curative information is kept secret, with the belief that the medicines would lose their effectiveness, if revealed to other people (Bhat and Jacobs, 1995). Therefore, scientific cultivation, conservation and sustainable use of plant species by ethnic communities would be highly advantageous for socioeconomic growth, in conservation of rare and endangered plant species and the indigenous knowledge for the future generations.

Regarding NTFP, there were very few significant species reported. Species reported were Kafal (*Myrica esculenta*), Mayal (*Pyrus pashia*), Jamun (*Syzygium cumuni*), Ainselu (*Rubus ellipticus* Sm.), etc. Grass/bamboo species like taru bans (*Bambusa nutans* sub-species nutans), ban negalo (*Drepanostachyum khasianum*), Choya/Tama Bans (*Bambusa nepalensis*), mal bans (*Bambusa nutans* subsp. *cupulata*), negalo (*Drepanostachyum khasianum*), khar (*Imperata cylindrical*), amriso (*Thysanolaena maxima*), titepati (*Artemisia vulgaris*) were found due to literature analysis. NTFP species found in the southern part of the project area are harro (*Terminalia chebula*), barro (*Terminalia chebula*), sindure (*Mallotus philippensis*), bael (*Aegle marmelos*), jamun (*Syzygium cumuni*), khiroro (*Sapium insigne*), etc. Products such as sal dhop (sal oleoresin) and khoto (resin) were reported to occur and to be collected in the area.

5.2.7. Fauna in the Project Area

Wildlife in the project area:

Most of the forests, by the side of the existing highway and proposed alternative alignments, have been handed over to local communities as community forests for management and utilization. Due to regular maneuvering of the vegetated area and increase in human population along the existing highway no animal habitat was available. During the field visits, CFUGs and CF user members were considered as the source of secondary information on wild species of fauna, found in and around the community forests that lies near the existing highway and within or near to the proposed alignment. For study location details and graphic evidences, please refer to Annex 14.

The forest throughout the project area within existing highway and proposed new alignments has been more or less disturbed. As a result of human interference, managing forests periodically, especially due to motorable road construction in and around forest areas, most of the existing forest areas are fragmented with human settlements and agricultural lands. Some



Figure 5-16: Common Leopard (*Panthera pardus*) is one of the globally threatened species (VU) occurring in the project area

remained community forests are small patches and lies along the existing road alignments, not very well suited to be called as the habitat of the major mammals.

No mega-vertebrates were identified in the project areas however one endangered and 3 threatened species were reported. According to local people threatened species like Common Leopard, Terai Grey Langur and Himalayan Ghoral and endangered species like Chinese Pangolin (*Manis pentadactyla*) is available within the IIA of the project area along the existing highway stretch of Nagdhunga-Naubise section (Bhandari, N and Chalise, M. 2013).

Besides above, other 15 common species were also recorded within the project area. Ghoral was mentioned only in new road section in Gorkha District only and Terai Gray langur in Naubise- Muglin section. Common leopard is a roaming species and reported to be available in Gorkha section.

Nagdhunga-Naubise section of existing road:

The movement of the wildlife along the proposed project alignments is negligible because of forest fragmentation and disturbances due to heavy traffic and increased human settlement and activities along the highway, which in combination significantly reduced continuous patch of forest. However, forest dependency for firewood and fodder has also decreased in recent years due to the availability of alternatives. Thus, the forest cover in remaining forest patches are improving in the mid DIA or little further and hence the concentration of the species.

Naubise-Mugling section of existing road:

This section has the highest number of wildlife species, but according to the local information, movement of the wildlife in the project area has decreased significantly in recent years, because of forest fragmentation and disturbances, associated with human encroachment along the road for business activities and reduced continuous patches of forest. Forest dependency for firewood and fodder also has decreased in this section due to alternate livelihoods. Thus, even in this section forest cover in remaining forest patches are improving also in the mid DIA or little further and hence the concentration of the species.

New road section in Bishaltar-Phishling section of Dhading district: This section mostly passes through the private property, therefore the impact on forest and wild fauna is minimal. The number of wild mammals, found in this section, is the minimal among four section studied. This section has maximum number of brick-kilns, which were shifted from Kathmandu valley and the exhausts from these brick kilns might have negative impacts on human health as well as on the environment. According to the local informants, the forest cover in this section has decreased significantly in recent years. However, forest dependency for firewood and fodder has decreased in recent years due to alternate livelihood sources. Thus, even in this section the forest cover has chance to be improved.

New road sections Sisnekhola-Dharke and Bishaltar-Phishling:

Wildlife species on this section is more or less similar with the wildlife species, found in the Naubise-Mugling section. Lots of movement of wildlife between these two sections are documented in this study by observing highest number of secondary evidences (by local communities) of wildlife species on the riverbanks that flows in between these two sections.

Table 5-36: Mammal species found in the project area, their global and national status

Sn.	Species Name	Occurrence in the project area			Status		Habitat	Threats
		Existing road	Sisne-Dharke	Bishaltar-Phishling	IUCN	Nepal		
1.	Chinese Pangolin – <i>Manis pentadactyla</i>	+	(NN)		CR	CR	Forest and grassland	Hunting and poaching
2.	Common Leopard – <i>Panthera pardus</i>	+	(NM)	+	VU	VU	Various	Reduction in prey, direct road impact, persecution and hunt
3.	Jungle cat - <i>Felis chaus</i>	+	(NM)	+	LC	VU	Forest, wetland	Hunting and poaching, habitat fragmentation and loss
4.	Leopard Cat - <i>Prionailurus bengalensis</i>	+	(NaM)	+	LC	VU	Forest	Habitat loss and hunting, direct road impact
5.	Bengal fox - <i>Vulpes bengalensis</i>	+	(NM)	+	LC	VU	Various	Hunting, direct road impact
6.	Golden Jackal - <i>Canis aureus</i>	+	(NM)	+	LC	LC	Various	Reduction in prey, direct road impact, persecution and hunt
7.	Grey Wolf - <i>Canis lupus</i>	+	(NaM)	+	LC	VU	Various	Reduction in prey, direct road impact, persecution and hunt
8.	Mongoose- <i>Herpestes spp</i>	+	(NM)	+	LC	LC	Various	Habitat fragmentation and loss, direct road impact
9.	Marten – <i>Martes spp.</i>	+	(NaM)	+			Forested areas	Habitat fragmentation and loss, direct road impact
10.	Rhesus Monkey - <i>Macaca mulatta</i>	+	(NM)	+	LC	LC	Various	Road mortality, habitat loss and fragmentation, human-wildlife conflict
11.	Terai Gray Langur – <i>Semnopithecus hector</i>	+	(NaM)	+	NT	LC	Forested areas	Road mortality, habitat loss and fragmentation, human-wildlife conflict
12.	Indian Porcupine - <i>Hystrix indica</i>	+	(NM)	+	LC	LC	Forested areas	Habitat loss and hunting, barrier effect
13.	Squirrel - <i>Funambulus spp.</i>	+	(NN)	+			Forested areas	Habitat fragmentation and loss, hunting

Sn.	Species Name	Occurrence in the project area			Status		Habitat	Threats
		Existing road	Sisne-Dharke	Bishaltar-Phishling	IUCN	Nepal		
14.	Himalayan Goral – <i>Naemorhedus goral</i>	+(NaM)		+	NT	NT	Mountain forest	Habitat loss and hunting, barrier effect, disturbance
15.	Wild Boar – <i>Sus scrofa</i>	+(NN)			LC	LC	Various	Habitat loss and hunting, barrier effect, disturbance
16.	Barking Deer - <i>Muntiacus vaginalis</i>	+(NM)		+	LC	VU	Forested areas	Habitat loss and hunting, barrier effect

Source: Field Survey, 2016/17

Legend: Species classification is done in accordance with IUCN categories and criteria: LC – Least Concern, VU – Vulnerable, EN- Endangered, CR - Critically Endangered, NT – Near Threatened. Areas: NN – Nagdhunga – Naubise Section, NaM – Naubise – Mugling Section; NM – Nagdhunga – Mugling Section.

Avian Fauna in the project area

Altogether, 276 species of birds have been recorded along the Nagdhunga-Mugling road alignments. Of which, 134 species were recorded during current survey and other species with the help of literature reviews and personal communications with bird experts who have been doing regular bird watching in the area. Higher number of species was recorded at Naubise-Mugling section and least in Sisnekhola-Dharke section.

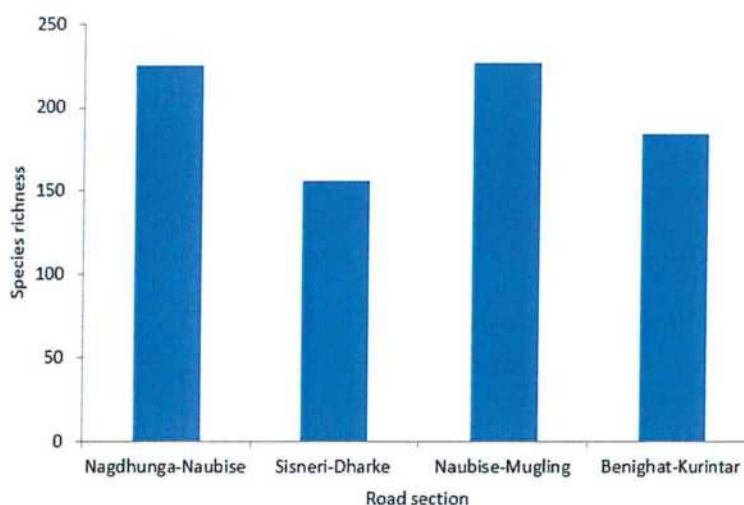


Figure 5-17: Species richness of birds along the road alignments

Of total recorded species, more than two third species were resident, while summer and winter visitors were presented by less number of species.



Based on literature review, 63% birds, probably, breed along the adjacent areas of the highway; few nests (12) were also observed along the highway during the survey period. Forest is the major habitats for birds; forest dwelling birds included 73.9%, while wetlands birds included 15.21%, birds in other habitats were few. Both globally and nationally threatened birds were recorded during the survey. 9 and 13 species were identified as globally and nationally threatened species respectively. The globally threatened species were more found in Naubise-Mugling section while some species in both sections. A total birds found in the project area is specified in detail in **Annex**. The list of threatened and endangered species recorded in the project area is presented in the Table 5-37.

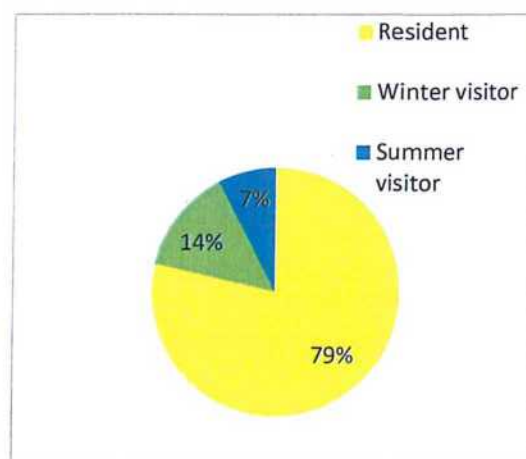


Figure 5-18: Migration status of birds found along road alignments

Table 5-37: Globally and nationally threatened birds found in the Road Alignments (project team observations and secondary data)

Sn.	Common Name	Scientific Name	Nepali Name	Road Section	Global Status	National Status
1.	Common Pochard	<i>Aythya ferina</i>	कैलोटाउके हाँस	Naubise-Mugling; Benighat-Phishling	VU	Protected
2.	Black-bellied Tern	<i>Sterna acuticauda</i>	उत्कोशी फ्यालफ्याल	Naubise-Mugling;	EN	Protected
3.	Egyptian Vulture	<i>Neophron percnopterus</i>	सेतो गिद्ध	Naubise-Mugling; Benighat-Kurintar	EN	Protected
4.	White-rumped Vulture	<i>Gyps bengalensis</i>	डंगर गिद्ध	Naubise-Mugling; Benighat-Kurintar	CR	Protected
5.	Red-headed Vulture	<i>Sarcogyps calvus</i>	सुन गिद्ध	Naubise-Mugling; Benighat-Kurintar	CR	Protected
6.	Greater Spotted Eagle	<i>Aquila clanga</i>	जीवाहार महाचील	Naubise-Mugling; Benighat-Kurintar	VU	Protected
7.	Steppe Eagle	<i>Aquila nipalensis</i>	गोमायु महाचील	All	EN	Protected
8.	Asian Woollyneck	<i>Ciconia episcopus</i>	लोभीपापी गरुड	All	VU	Protected
9.	Grey-crowned Prinia	<i>Prinia cinereocapilla</i>	घेघरी घाँसेफिस्टा	Naubise-Mugling	VU	Protected
10.	Ferruginous Pochard	<i>Aythya nyroca</i>	मालक हाँस	Naubise-Mugling; Benighat-Kurintar	NT	Protected
11.	Barn Owl	<i>Tyto alba</i>	गोठे लाटोकोसेरा	All	LC	Protected

Sn.	Common Name	Scientific Name	Nepali Name	Road Section	Global Status	National Status
12.	Brown Wood Owl	<i>Strix leptogrammica</i>	चशमे उलूक	All	LC	Protected
13.	Ibisbill	<i>Ibidorhyncha struthersii</i>	तिलहरी चरा	Naubise-Mugling; Benighat-Kurintar	LC	Protected
14.	Brahminy Kite	<i>Haliastur indus</i>	सेतोटाउके चील	Naubise-Mugling	LC	Protected
15.	Himalayan Griffon	<i>Gyps himalayensis</i>	हिमाली गिद्ध	All	NT	Protected
16.	Cinereous Vulture	<i>Aegypius monachus</i>	राजगिद्ध	Naubise-Mugling; Benighat-Kurintar	NT	Protected

Source: Field survey, 2017

Note: LC-Least Concern, NT-Near-threatened, VU-Vulnerable, EN-Endangered and CR-Critically Endangered (Pictures of some species in the project area were taken by executors and by team-leader, birds in the table occur in forest habitats, in wetlands and along river banks. Some of those species are seasonal migrants, others are resident species, breeding in local forests).

Birds along Nagdhunga to Naubise and Sisne Khola- Dharke sections

Mostly forest and few settlements present important habitats for birds in this section, while road along the Sisne-Khola-Darke section passes through the Mahesh Khola, farmland, settlements and little forest. So, both forest and wetland birds are found in this road section.

The most common birds, found along these road alignments, were represented by species adapted to live in highly altered anthropogenic landscapes. These are such “urban” species like Rock Pigeon, Oriental Turtle Dove, Black Kite, House Crow, Large-billed Crow, Black Drongo, Barn Swallow, Red-vented Bulbul, Oriental Magpie Robin, Common Myna, House Sparrow, White-rumped Munia, Cattle Egret, Indian Pond Heron, etc. Similarly many species of birds are also found in orchards or small forest patches or rivers along the road; Great Barbet, Blue-throated Barbet, Long-tailed Shrike, Blue Whistling Thrush, Grey-headed Canary Flycatcher, Black-lored Tit, Himalayan Bulbul, Spotted Forktail, Oriental White-eye, Common Tailorbird, Grey-hooded Warbler, Slaty-backed Forktail, Grey Wagtail, White-browed Wagtail, etc. Several other species such as Kalij Pheasant, Spotted Owlet, Steppe Eagle, and Himalayan Griffon were found also common in the area. Habitat for Steppe Eagle and Himalayan Vulture was found at about 500m down towards Naubise from Nagdhunga (Near Piplamode). These are threatened species and preservation of habitat for those species would be important.

Birds along Naubise - Mugling Road and Beshaltar to Phishling road sections

Both of these road sections run along Trishuli River and pass through the settlements, followed by forests with other tributaries like Budigandaki, small streams and rivers joining the Trishuli. Forest is composed by mature and intact trees, which lie along the Trishuli gorge mainly from Malekhu to Charaudi in Naubise-Mugling section, as well as forests on the side of the Phisling are important habitats for forest species including vultures and eagles. Trishuli itself is important habitat for migratory and resident wetland species. As in the previous section, the birds found may be mostly categorized as “urban” and “edge” generalist species: Great Barbet,

Blue-throated Barbet, Rock Pigeon, Oriental Turtle Dove, Black Kite, Long-tailed Shrike, Rufous Treepie, House Crow, Large-billed Crow, Black Drongo, Grey-headed Canary Flycatcher, Oriental Magpie Robin, Pied Bushchat, Common Myna, Black-lored Tit, Barn Swallow, Red-vented Bulbul, Himalayan Bulbul, Oriental White-eye, Common Tailorbird, Grey-hooded Warbler, Grey-breasted Prinia, Purple Sunbird, House Sparrow, White-rumped Munia, Crested Bunting, etc. At the same time, certain number

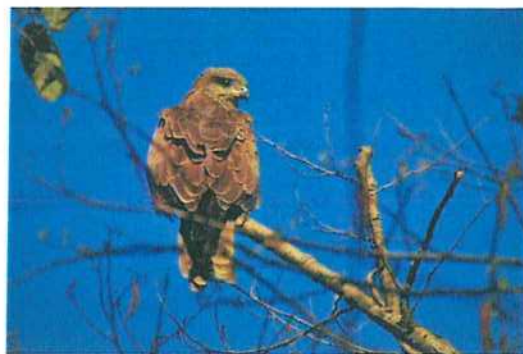


Figure 5-19: Black Kite is one of the most common scavengers, found near the road

of wetland bird species also was recorded closely to rivers and streams: Common Pochard, Mallard, Common Kingfisher, Blue Whistling Thrush, White Wagtail, White-browed Wagtail, Common Sandpiper, River Lapwing, Cattle Egret, Indian Pond Heron, etc. The Ibisbill, Great Cormorant, Woolly-necked Stork etc. migrate through the Trishuli river gorge. There were also found such species as Kalij Pheasant, Red Jungle Fowl, Plum-headed Parakeet, Spotted Owlet, Steppe Eagle, indicating the presence quite good forest habitats along the alignments.

5.2.8. Herpetofauna and Aquatic Fauna

The findings of study are based on one-time field visit, thus, lack of detailed quantitative study and seasonal variation of species due to time limitation. Due to time limitation and more complicated technics for data collection, the number of found fish and herpeto-fauna species was small. There is no much information in the literature about diversity of herpeto-fauna in the study area to incorporate in the findings. Fish diversity of the study area was mostly cited from the literature. However, fish diversity changed significantly since most studies were carried more than a decade before and study area is under severe influence of mining and excavation for construction materials along with plying of automobiles through springs/channels for transportation of construction materials, polluting water and desyroying fish habitats.

Herpetofauna and Aquatic fauna along Nagdhunga-Naubise Section

This section of road has five streams with alder as the dominant vegetation. Majority of streams have unconstrained channel form with open valley form. This section starts from Kathmandu valley thus it has higher influence of human activities and urbanization. Among five springs present in this section: Jhyaple Khola, Sisne Khola and Khatripauwa Khola were dry during the survey time in December 2016. This means that these springs are intermittent type. Jhyaple Khola and Sisne Khola is more as a drainage and filled with wastes, while Khatripauwa khola was under mining of gravel. Unlike these springs, Sikre Khola and Khani Khola is wet with low water flow, but these springs too filled with waste. Hence, no sign of fish presence in all the springs belonging to this section. However, local residents informed presence of frog and they have occasionally seen rat snake in the springs and in the periphery (i.e. within 2 Km alongside the existing highway).

Herpetofauna and Aquatic fauna along Naubise-Mugling Section

The existing road running along the Mahesh Khola from Naubise until Galchi, where the



Figure 5-20: Himalayan Agama is a lizard species found in the area along new alignments

Mahesh Khola confluence to the Trishuli River, then existing road runs along the Trishuli River. Among many feeder rivers of Mahesh khola flowing across the existing road from Naubise to Galchi, survey of five feeder rivers (i.e. Naubise Khola, Junga Khola, Agra Khola, Kheste Khola, Dangdhunge Khola) showed that the rivers were running with low flow contributing less than 30 percent of total flow of Mahesh Khola. The streams were unconstrained and are predominantly presented by single channel with open valley form. However,

Dangdunge River is constrained by hill slope while Mahesh Khola at Khayarghari area is constrained by landuse. Naubise Khola, Junga Khola and Agra Khola are under human influence. Dumping of waste in the banks of Naubise Khola and Junga Khola is highly polluting water, while vehicles transporting sand and gravel mined at the upstream of Agra Khola plying through the river course is increasing the turbidity and significantly affecting the aquatic fauna. There are no fishes nor other aquatic fauna observed. According to local residents, earlier they collect fish from these rivers, but they could hardly see any fish in the river. Polluted and turbid water from these feeder rivers mixes in Mahesh Khola causing turbid water in the Mahesh Khola. In addition, numerous mined sand refining activity and installed crushers found along the Mahesh Khola further enhance water turbidity and turbidity persist same in downstream till it confluence to the Trishuli river at Galchi. But, local residents informed that water is more clear during monsoon season, if no erosion or refining activity carried, and they collected some common fish species such as Barna baril (*Barilus barna*), Ring loach (*Schisturea sovana*) and Barb (*Punctius sp.*) in the monsoon. Along with these fish species, Copper Mahseer (*Nelissochilus hexagonolepis*) in Dangdunge Khola is collected from 700 meters upstream.

From Galchi, existing road run along the Trishuli river valley in few locations to approximately 800 meters distant. Numerous streams confluences to Trishuli River over which existing road run across. Majority of streams that flow intersecting existing highway are small, intermittent and were dry during the survey time. However, thirteen streams such as Chiraudi Khola, Belkhu Khola, Galaudi Khola, Soti Khola, Malekhu Khola, Kadam Khola, Khatauti Khola, Chiraudi Khola, Hugdi Khola, Mauwa Khola, Chum Khola, Kum Khola and Nagdi Khola were flowing and studied in detail. Water flow in all stream during the survey time was very low contributing less than 15 percent comparing with total flow in the Trishuli River at confluence point. There is residence in both side of highway in majority of area and, so, does in the sampling points. Thus, human inventions in the stream noted highly.

Neither fish species nor herpatofauna were seen in Chiraudi khola but in Belkhu Khola during the field survey, Skittering Frog (*Euphlyctis cynoplyctis*) and Barna baril (*Barilius Barna*) were

observed from the Trishuli River which at 500 m distance from existing highway and where Belkhu Khola confluence. Construction of bridges in Chiraudi Khola and Belkhu Khola during the construction phase might cause release turbid water to the Trishuli River but this is supposed to create minimal effect since the site of construction and the point of mixing is 500 meters apart. Turbidity might get lower due to mixing with water flow to Chiraudi Khola and Belkhu Khola before mixing to the Trishuli River. Putitor Mahseer (*Tor putitora*) categorized as an endangered fish species, noted from the Trishuli River that is at 200 m distance from the existing road at this site. Sand refining machines in Galaudi Khola riverbank are in operation. There is no sign of fishes in this khola. Similarly, there is no aquatic species observed in the Soti Khola. Moreover, this Khola is very small with very low flow. Whereas, Hamilton's Barila (*Barilius Bendelisis*) noted from Malekhu Khola. Fish species such as; Golden Snowtrout (*Schizothorax plagiostomus*), Gangetic Laita (*Crossocheilus latius latius*), Annandale Garra (*Garra annandalei*), Gotyla (*Garra Gotyla gotyla*), Asiatic Snakehead (*Channa orientalis*), in the Kadam Khola and the Trishuli River at Malinga. Kum Khola during the survey time was wet with significantly low flow (almost dry). Thus, no aquatic fauna availed in the stream. Bhante Khola, Budigandaki and Joltreap are other feeder stream of the Trishuli River flowing during survey time. These stream/river are in the zone of influence, but locating at opposite bank of the Trishuli River. Water flow in the Bhante Khola and Joltreap Khola is very low and no fish species observed while four species of fishes i.e. Sulcatus Cat fish (*Pseudechneis sulcatus*), Almorah loach (*Botia almorhea*), *Glyptothorax pectinopterus* and *Glyptothorax cavia* observed in Budigandaki River. Human influence is high in the Khatauti Khola and the Charaudi Khola. Mining of sand and stones is actively ongoing during the field survey. Trishuli River which at 300 meters distant existing highway and where Khatauti Khola and Charaudi khola confluence.

There was no aquatic fauna seen in Hugdi Khola, Mauwa Khola, Chum Khola, Nagdi Khola. However, some fish species observed in the Trishuli River that flows closed to existing road. Golden Snowtrout (*Schizothorax plagiostomus*), Gangetic Laita (*Crossocheilus latius latius*), Annandale Garra (*Garra annandalei*), Gotyla (*Garra Gotyla gotyla*), Asiatic Snakehead (*Channa orientalis*), Bata labeo (*Labeo bata*), Ring Loach (*Schistura sovana*) and Copper Mahseer (*Neolissochilus hexagonolepis*) are some fish species found in the Trishuli River. Moreover, River Rohu (*Labeo dero*), Stinging catfish (*Heteropneusteus fossilis*), Straited or Banded Snakehead (*Channa striatus*), Longfin Freshwater eel (*Anguilla bengalensis*) are some other fish species present in the river added by the local resident during social survey. The Golden Monitor Lizard (*Varanus flavescens*) was detected in Naubise – Mugling section during survey of mammals. Two other lizard species Common Garden Lizard (*Calotes versicolor*) and Himalayan Agama (*Paralaudakia himalayana*) were spotted by project team members during visit of the area.



Figure 5-21: Fish caught in Trishuli

Herpetofauna and Aquatic fauna along Sisnekhola-Dharke

Confluence point of Jhyaple, Sisne and Sikre Khola at the Devithan at the base of Nisakot Community forest, Dhuni Khola, Rupse Khola and Dhobi Khola are four sampling points. Water flow of these rivers are very low and the channel from Dhuni Khola, and tributary of Jhyaple, Sisne and Sikre at the Devithan is constrained by Hillslope while river valley form is open valley and steep valley respectively. Whereas Rupse Khola and Dhobi Khola is constrained bedrocks with medium river valley. There is no fish species observed however, Blacked Spined or Common Asian Toad (*Duttaphrynus melanostictus*) observed in Dhuni Khola and Skittering Frog (*Euphlyctis cynoplyctis*) and spirogyra algae observed in Rupse Khola. The Golden Monitor Lizard (*Varanus flavescens*) was detected in the Dhading area too during survey of mammals.

Herpetofauna and Aquatic fauna along Bishaltar-Phisling

Majority of Feeder Rivers in Gorkha side was dry during survey time. However, 4 (four) feeder streams i.e. Khani Khola, Barbang Khola, Juidi Khola and Pan Khola were flowing with very low current. The channel form of these streams is either constrained by bedrock or by hill slope. Instead of fish species during field survey there were observed some herpetofauna species, such as Common garden lizard (*Calotes versicolor*), Brahminy skink (*Mabuya carinata*) and Himalayan Agama (*Paralaudakia himalayana*). In addition, local people informed that they observed Cobra, Karait and Green pit viper snakes to be present in the area. The Golden Monitor Lizard (*Varanus flavescens*) was detected in Ghorka section as well during mammal survey.

Table 5-38: Fish Fauna of the Study Area (based on literature sources and survey)

S.N	Species	Common and Local Name	Family	Status		Remarks
				IUCN	Nepal	
1	<i>Acanthocobotis (Nemacheilus) botia</i> (Hamilton-Buchanan)	Sand Loach Pate gadela, Baghe	<i>Cobitidae</i>	LC	DD	Pristine Rare Decorative
2	<i>Anguilla bengalensis bengalensis</i> (Gray)	Indian mottled eel; Rajbam, Rem	<i>Anguillidae</i>	NT	VU	Cited
3	<i>Sperata (Mystus) aor</i> (Hamilton-Buchanan)	Long-whiskered catfish; Kanti	<i>Bagridae</i>	LC	LC	Uncommon
4	<i>Sperata (Mystus) seenghala</i>	Gaint river catfish, Sujah, Tengra	<i>Bagridae</i>	LC	LC	Uncommon
5	<i>Balitora brucei</i> (Gray)	Gray's stone loach Pathertata	<i>Balitoridae</i>	NT	CD	Rare
6	<i>Barilius barna</i> (Hamilton-Buchanan)	Barna baril; Titerkane faketa	<i>Cyprinidae</i>	LC	LC	Common Photo evidence



S.N	Species	Common and Local Name	Family	Status		Remarks
				IUCN	Nepal	
7	<i>Barilius bendelisis</i> (Hamilton-Buchanan)	Hamilton's barila; Chiple faketa, Gurder, Khasree chala	<i>Cyprinidae</i>	LC	LC	Common Photo evidence
8	<i>Barilius shacra</i> (Hamilton-Buchanan)	Shacre baril; Faketa	<i>Cyprinidae</i>	LC	LC	Uncommon
9	<i>Barilius vagra</i> (Hamilton-Buchanan)	Vagra baril; Lam faketa	<i>Cyprinidae</i>	LC	LC	Uncommon
10	<i>Botia almorhae</i> (Gray)	Yoyo; Baghi, Baghuwa	<i>Cobitidae</i>	LC	DD	Pristine Rare Ornamental Photo
11	<i>Botia lochachata</i> (Chaudhuri)	Y-loach, Tiger loach Baghi, Getu	<i>Cobitidae</i>	LC	LC	Uncommon
12	<i>Chagunius chagunio</i> (Hamilton-Buchanan)	Chaguni; Patharchatti, Kasree	<i>Cyprinidae</i>	LC	VU	Cited
13	<i>Channa gachua</i> (Hamilton-Buchanan)	Dwarf snakehead; Garahi, Bhoti	<i>Channidae</i>	LC	LC	Common; Photo evidence
14	<i>Channa striata</i> (Bloch)	Asian snakehead; Helae	<i>Channidae</i>	LC	LC	Common
15	<i>Tariqilabeo latius</i> <i>latius</i> (Hamilton-Buchanan)	Gangetic laita, Lohari, Mate buduna	<i>Cyprinidae</i>	LC	LC	Uncommon Photo evidence
16	<i>Cyprinion semiplotus</i> (McClelland)	Assamese kingfish; Khurpe, Chepti	<i>Cyprinidae</i>	NA	LC	Uncommon
17	<i>Parachilognis hodgarthi</i> (Hora)	<i>Torrent catfish</i> Telkapre	<i>Sisoridae</i>	LC	CD	Rare
18	<i>Eutropichthys vacha</i> (Hamilton-Buchanan)	Batchwa vacha Cherki, Bachawa	<i>Schilbeidae</i>	NA	LC	Uncommon
19	<i>Garra annandalei</i> (Hora)	Annandale garra; Lahare buduna	<i>Cyprinidae</i>	LC	LC	Photo evidence; common
20	<i>Garra gotyla gotyla</i> (Gray)	Gotyla; Dhumke buduna	<i>Cyprinidae</i>	LC	LC	Common; Photo
21	<i>Garra mullya</i> (Sykes)	Mullya garra, Khurpe buduna	<i>Cyprinidae</i>	LC	LC	Common

S.N	Species	Common and Local Name	Family	Status		Remarks
				IUCN	Nepal	
22	<i>Garra rupecula</i> (McClelland)	Mishmi Garra; Buduna	<i>Cyprinidae</i>	LC	LC	Common
23	<i>Glyptothorax telchitta</i> (Hamilton-Buchanan)	Telcapre	<i>Sisoridae</i>	LC	CD	Rare
24	<i>Glyptothorax trilineatus</i> (Blyth)	Three-lined catfish; Telcapre	<i>Sisoridae</i>	LC	CD	Rare
25	<i>Glyptothorax Cavia</i> (Hamilton-Buchanan)	Vedro	<i>Sisoridae</i>	LC	CD	Photo evidence; Rare
26	<i>Glyptothorax indicus</i> (Talwar)	Capre	<i>Sisoridae</i>	LC	CD	Rare
27	<i>Glyptothorax pectinopterus</i> (McClelland)	Capre	<i>Sisoridae</i>	LC	LC	Uncommon Photo evidence
28	<i>Heteropneustes fossilis</i> (Bloch)	Stinging catfish; Singhi	<i>Heteropneustidae</i>	LC	LC	Common
29	<i>Homaloptera bilineata</i> (Blyth)	Burmese loach; Patherchatti	<i>Balitoridae</i>	LC	DD	Pristine Rare Ornamental
30	<i>Labeo bata</i> (Hamilton-Buchanan)	Minor carp; Bata labeo	<i>Cyprinidae</i>	LC	LC	Common; Photo evidence
31	<i>Bangana dero</i> (Hamilton-Buchanan)	Kalabans, River Rohu; Gurdi	<i>Cyprinidae</i>	LC	LC	Common
32	<i>Labeo dew</i> (Hamilton-Buchanan)	Gardi	<i>Cyprinidae</i>	NA	LC	Common
33	<i>Monopterusuchia</i>	Chuchia, Gangetic mud eel; Andhbam, Anahi, Anali	<i>Synbranchidae</i>	LC	LC	Uncommon
34	<i>Nemacheilus corica</i> (Hamilton-Buchanan)	Stone loach; Raigadero	<i>Cobitidae</i>	LC	DD	Pristine Rare Ornamental
35	<i>Neolissochilus hexagonalepis</i> (McClelland)	Copper mahseer; Katle, Vadalke	<i>Cyprinidae</i>	NT	VU	Photo evidence

S.N	Species	Common and Local Name	Family	Status		Remarks
				IUCN	Nepal	
36	<i>Pseudecheneis eddsi</i> (Ng)	Gotel, Kabre	<i>Sisoridae</i>	DD	DD	Rare Ornamental Pristine
37	<i>Pseudecheneis serratula</i> (Ng & Edds)		<i>Sisoridae</i>	LC	DD	Pristine Rare Ornamental
38	<i>Pseudecheneis sulcata</i> (McClelland)	Sulcatus catfish; Kabre	<i>Sisoridae</i>	LC	CD	Rare; Photo evidence
39	<i>Psilorhynchus balitora</i> (Hamilton-Buchanan)	Balitora minnow; Titari	<i>Psilorhynchidae</i>	LC	DD	Pristine Rare Ornamental
40	<i>Puntius terio</i> (Hamilton-Buchanan)	One-spot barb; Pothi	<i>Cyprinidae</i>	LC	LC	Uncommon Photo evidence
41	<i>Schistura beavani</i> (Gunther) <i>Nemacheilus beavani</i>	Dharkee gadero, Kholse gadero	<i>Balitoridae</i>	LC	DD	Pristine Rare Ornamental
42	<i>Schistura multifaciata</i> (Day)	Gadelo, Kachhinya (Newari language)	<i>Balitoridae</i>	LC	DD	Pristine Rare Ornamental
43	<i>Schistura savona</i> (McClelland) <i>Nemacheilus sovana</i>	Ring loach; Gadela	<i>Balitoridae</i>	LC	LC	Uncommon Photo evidence
44	<i>Schizopyger niger</i> (Heckel)	Snowtrout; Kalo tilke	<i>Cyprinidae</i>	NA	NT	Rare
45	<i>Schizothorax progasus</i> (McClelland)	Dinnawah snowtrout, Pointed-snout snowtrout Chuche asla	<i>Cyprinidae</i>	LC	VU	Cited
46	<i>Schizothorax plagiostomus</i> (Heckel)	Golden snowtrout/ spotted snowtrout; Sun asla	<i>Cyprinidae</i>	NA	VU	Photo evidence
47	<i>Schizothorax richardsonii</i> (Gray)	Blunt-nosed snowtrout, Buche asla	<i>Cyprinidae</i>	VU	LC	Common
48	<i>Naziritor chelynoides</i> (McClelland)	Dark mahseer; Halundae	<i>Cyprinidae</i>	VU	LC	Uncommon
49	<i>Tor putitora</i> (Hamilton-Buchanan)	Putitor mahseer, Golden Pahale sahar, Mahseer, Ratar	<i>Cyprinidae</i>	EN	EN	Photo evidence

S.N	Species	Common and Local Name	Family	Status		Remarks
				IUCN	Nepal	
50	<i>Tor tor</i> (Hamilton-Buchanan)	Falame sahar; Deep bodied mahseer	<i>Cyprinidae</i>	NT	EN	Cited

Source: Literature review, 2017

Table 5-39: Herpetofauna Species Observed During the Field Survey

S N	Species	Common Name	Local name	Family	Status (Nepal, IUCN)	Remarks
Amphibia						
1	<i>Duttaphrynus melanostictus</i> (Schneider, 1799)	Black spined toad/ Common Asian toad	Khasre bhyaguto	Bufonidae	Most common toad; LC	Photo evidence
2	<i>Euphlyctis cynoplyctis</i> (Schneider, 1799)	Skittering frog	Dholbaje paha/Tik-tike paha	Ranidae	Common frog; LC	Photo evidence
Reptiles						
1	<i>Calotes versicolor</i> (Daudin, 1802)	Common garden lizard	Chheparo	Agamidae	Most common lizard; LC	Photo evidence
2	<i>Paralaudakia himalayana</i>	Himalayan agama		Agamidae	Very common; LC	Photo evidence
3	<i>Mabuya carinata</i> (Schneider, 1801)	Brahminy skink/Common Indian skink	Bhanemungro	Scincidae	Very common; LC	Photo evidence
4	<i>Varanus flavescens</i>	Golden Monitor Lizard/ Bengal Monitor		Varanidae	Rare in Nepal; LC	Observations during mammal survey

Source: Field survey, 2017

Table 5-40: Some Macroinvertebrates of the Study Area

S.N	Species	Common Name	Family	Remarks
1	<i>Nepa sp.</i>	Water scorpion	Nepidae	Photo evidence
2	Dragonfly nymphs		Odonata	Photo evidence
3	<i>Lymnea sp.</i>		Lymnaeidae	Photo evidence
4	Water Beetle	Water Beetle	Hydrophilidae	Photo evidence

Source: Field survey, 2017



Status of Herpetofauna, Fish and Macroinvertebrates: Summary

In total 6 species of herpetofauna, 16 species of fishes and few macro-invertebrates were observed during the field survey. This is the minimal number of species observed since the survey conducted in March and the cool blooded animals remain dormant and undergo in hibernation during winter season. There was no opportunity and resources for additional studies. In practice, seasonal study is required for detailed information on fish fauna and herpetofauna diversity. However, the species diversity of the area listed through the citation from relevant literatures. Shrestha, T.K. (1990) has recorded 34 fish species from the Trishuli River. Dhital, R.R. and Jha, D.K., (2002) collected fourteen species of fishes from Trisuli River at Kuringhat and Trisuli-Marsyangdi confluence at Muglin during their study of Fish fauna of the Narayani River system and their impact on the fishermen community in Chitwan, Nepal.

Besides three large reptilian species (*Gavialis gangeticus*, *Varanus flavescens*, *Python molurus*), there are no other reptilian and amphibian protected by Government of Nepal. Many species of study area- amphibian, reptile, and fish species are under category of common, least concern and data deficient. Two species of fish (*Tor putitora*, *T. tor*) found in the study are reported as endangered and five species of fishes (*Anguilla bengalensis bengalensis* (Gray), *Chagunius chagunio* (Hamilton-Buchanan), *Neolissocheilus hexagonalepis* (McClelland), *Schizothorax plagiostomus* (Heckel), *Schizothorachthys progastus* (McClelland), are reported as vulnerable.

Table 5-41: Status of Herpetofauna, Fish and Macroinvertebrates of the Study Area

Status	Species
Amphibian	
Common	2
Reptile	
Common	3
Rare or Near Threatened	1
Fish	
Common	13
Conservation Dependent and Rare	7
Data Deficient Pristine Rare Ornamental	9
Endangered	2
Rare or Near Threatened	1
Uncommon or Lower Risk/ Least Concern	13
Vulnerable	5
Macroinvertebrates	
Status Unknown	4



Status	Species
Status based on: Shah, K.B. & Tiwari, S. (2004) for Herpetofauna; Shrestha, T.K. (2008) for Fish	

Source: Field survey, 2017

5.2.9. Protected, Rare or Endangered Flora and Fauna Species

Endangered fauna species in the project area are represented by 16 globally and nationally threatened bird species (Table 14), by 5 globally threatened mammal species (Table 5-42) and 1 threatened reptile species (Golden Monitor Lizard).



Figure 5-22: Threatened Tarai Gray Langur (left) and Himalayan Vulture (right) in the project area

Table 5-42: Globally and nationally threatened birds found in the project area

Common Name	Scientific Name	Nepali Name	Road Section	Global Status	National Status	CITES Appendix
Common Pochard	<i>Aythya ferina</i>	कैलोटाउके हाँस	NM; BK	VU	NT	-
Black-bellied Tern	<i>Sterna acuticauda</i>	उत्कोशी फ्यालफ्याल	NM	EN	CR	-
Egyptian Vulture	<i>Neophron percnopterus</i>	सेतो गिद्ध	NM; BK	EN	VU	II
White-rumped Vulture	<i>Gyps bengalensis</i>	डंगर गिद्ध	NM; BK	CR	CR	II
Red-headed Vulture	<i>Sarcogyps calvus</i>	सुन गिद्ध	NM; BK	CR	EN	II
Greater Spotted Eagle	<i>Aquila clanga</i>	जीवाहार महाचील	NM; BK	VU	VU	II
Steppe Eagle	<i>Aquila nipalensis</i>	गोमायु महाचील	All	EN	LC	II
Asian Woollyneck	<i>Ciconia episcopus</i>	लोभीपापी गरुड	All	VU	NT	-
Grey-crowned Prinia	<i>Prinia cinereocapilla</i>	घेघरी घांसेफिस्टा	NM	VU	VU	-
Ferruginous Pochard	<i>Aythya nyroca</i>	मालक हाँस	NM; BK	NT	VU	-
Barn Owl	<i>Tyto alba</i>	गोठे लाटोकोसेरा	All	LC	VU	II
Brown Wood Owl	<i>Strix leptogrammica</i>	चश्मे उलूक	All	LC	VU	II
Ibisbill	<i>Ibidorhyncha struthersii</i>	तिलहरी चरा	NM; BK	LC	EN	-
Brahminy Kite	<i>Haliastur indus</i>	सेतोटाउके चील	NM	LC	CR	II
Himalayan Griffon	<i>Gyps himalayensis</i>	हिमाली गिद्ध	All	NT	VU	II

Common Name	Scientific Name	Nepali Name	Road Section	Global Status	National Status	CITES Appendix
Cinereous Vulture	<i>Aegypius monachus</i>	राजगिद्ध	NM; BK	NT	VU	II

Source: Field survey, 2017

Note: NM-Naubise-Mugling; BK - Benighat Kurintar

LC-Least Concern, NT-Near-threatened, VU-Vulnerable, EN-Endangered and CR-Critically Endangered (Birds in the table occur in forest habitats, in wetlands and along river banks. Some of those species are seasonal migrants, others are resident species, breeding in local forests)

List of threatened mammal species is presented in Annex 2. Some listed threatened and endangered species will be affected by road upgrades and construction of new road alignments directly through disturbances, road mortality, loss of habitats, barrier effect and habitat fragmentation. However, expected cumulative impacts associated with increased human encroachment along the roads will affect them even more. Chinese Pangolin (CR) and was reported to occur in the forests little beyond the mid DIZ as reported by local people and literature review. Common Leopard occurs in many areas and observed by local villagers and project staff on the signs. Terai Gray Langur and Himalayan Goral were observed in the area of Bishaltar-Phishling and in southern part of existing highway on the way to Mugling.

5.3. Socio-economic and Cultural Environment

The project area is very rich in ethnic and cultural diversity. People belonging to different ethnic and caste group are found and have been following different culture and tradition. Most of people celebrate Dashai, Tihar, and other festivals commonly, but some specific festivals are only celebrated by respective social groups. The Loshar, Push Pandhra, Bhumi Puja, etc. are major local festivals celebrating in the project area. Even Eid and Christmas are also celebrated as one of the major festivals in project area. The temples of Shiva, Krishna, Siddha baba, Siddheswor Mahadev, Bhimsen, Bishnu and several others are the major temples of the project area. The different culture and traditions are followed by people in project area; however, the social solidarity and harmony in common social practices are found there as well.

5.3.1. Demography of the Project Area

The proposed project covers Kathmandu, Dhading, Gorkha and Chitwan district. Population count of 2011 reveals that the total population of project district is 2931352 with 709163 households. The population of male and female of the district is found to be 1470963 and 1460389, respectively, with average household size of 4.3. The households and population of Municipality/Rural municipality (Municipalities) along the existing and proposed new alignment is presented in the following tables.

Table 5-43: Households and Population within the Zone of Influence (ZoI)

District	VDC/ Municipality	Municipality/ Rural Municipality(RM)	House holds	Male	Female	Total Population	Average HH Size
Kathmandu	Chandragiri Municipality	Chandragiri Municipality	20,532	42,881	42,317	85,198	4.15
Dhading	Chhatreaurali		1,655	3,665	4,022	7,687	4.64



District	VDC/ Municipality	Municipality/ Rural Municipality(RM)	House holds	Male	Female	Total Population	Average HH Size
	Jeewanpur	Dhunibeshi Municipality	1,920	4,329	4,460	8,789	4.58
	Naubise		3,184	7,203	7,350	14,553	4.57
	Thakre	Tharke RM	2,141	4,781	5,057	9,838	4.60
	Bhumesthan		2,145	5,323	5,463	10,786	5.03
	Baireni	Galchi RM	2,795	6,630	6,739	13,369	4.78
	Pida	Gajuri RM	2,214	5,415	5,628	11,043	4.99
	Gajuri		2,223	4,968	5,067	10,035	4.51
	Benighat	Benighat Rorang RM	2,123	4,854	4,863	9,717	4.58
	Dhussa		1,361	3,548	3,642	7,190	5.28
	Jogimara		1,442	3,842	3,902	7,744	5.37
Gorkha	Ghyalchok	Gandaki RM	1,298	2,759	3,193	5,952	4.59
	Bhumlichok		685	1,653	1,892	3,545	5.18
	Tanglichok		802	1,525	1,844	3,369	4.20
	Makaising		552	1,094	1,213	2,307	4.18
	Taklung	Sahid Lakhan RM	1,121	2,232	2,796	5,028	4.49
Chitwan	Darechok	Ichakamana RM	2,029	4,836	4,771	9,607	4.73
Total			50,222	111,538	114,219	225,757	4.3

Source: National Population and Housing Census 2011

Table 5-44: Households and Population within the Direct Impact Area (DIA)

District	VDC / Municipality	Municipality/Rural Municipality(RM)	Houses	Male	Female	Total Population
Kathman du	Chandragiri Municipality	Chandragiri Municipality-2	40	84	82	166
	Jeewanpur	Dhunibeshi Municipality-5	119	268	276	545
	Naubise	Dhunibeshi Municipality-6,7,8 & 9	645	1,459	1,489	2,948
	Thakre	Thakre RM- 6,7&8	284	634	671	1,305
	Bhumesthan	Thakre RM-1&2	220	546	560	1,106
	Baireni	Galchi RM-4,6&7	451	1,070	1,087	2,157
	Pida	Gajuri RM-5&6	249	609	633	1,242
	Gajuri	Gajuri RM-1&2	319	713	727	1,440
	Benighat	Benighat Rorang RM-3 & 5	559	1,278	1,280	2,559

	Dhussa	Benighat Rorang RM-7 & 8	94	245	252	497
	Jogimara	Benighat Rorang RM-9&10	159	424	430	854
Gorkha	Ghyalchok	Gandaki RM-7 & 8	294	625	723	1,348
	Bhumlichok	Gandaki RM-6	61	147	168	316
	Tanglichok	Gandaki RM-2	28	53	64	118
	Makaising	Gandaki RM-1	24	48	53	100
Chitwan	Darechok	Ichakamana RM- 3,4 & 5	452	1,077	1,063	2,140
Total			3,998	9,280	9,560	18,840

Source: Field survey 2016

Table 5-45: Households and Population of the Indirect Impact Area (IIA)

District	Then VDC / Municipality	Municipality/ Rural Municipality (RM)	House holds	Male	Female	Total Population	Average HH Size
Kathmandu	Chandragiri Municipality-3	Chandragiri Municipality – 2	817	1,873	1,906	3,779	4.6
Dhading	Chhatredeurali-1,3 Jiwanpur-9 & Naubise- 3,5,6,4,7,8,2,1	Dhunibeshi Municipality - 2,5,6,7,8 & 9	4,343	9,870	10,188	20,058	4.6
	Thakre-2,8,5,4,3,6 & Bhumisthan-4,6,7,8,9;	Thakre RM - 1,2,6,7&8	3,231	7,587	7,933	15,520	4.8
	Baireni-8,9,7	Galchi RM - 4,6&7	2,109	4,914	4,876	9,790	4.6
	Pida-1,3,2 & Gajuri-1,2	Gajuri RM - 1,2,5&6	3,626	8,070	8,347	16,417	4.5
	Benighat-1,9,8,7,2; Dhusa-1,3 & Jogimara- 8,9,1,2	Benighat Rorang RM - 3,5,7,8,9 & 10	3,780	9,067	9,416	18,483	4.9
	Ghyalchok-9,5,6; Bhumlichok-8,9,2,4; Tanglichok-9; & Makaising-1,2,3	Gandaki RM - 1,2,6,7 & 8	3,310	7,031	8,142	15,173	4.6
Gorkha	Taklung-3	Sahid Lakhana RM – 4	629	1,225	1,561	2,786	4.4
	Darechok -9,1,2,7,3,4,5 & Chandi Bhanjyang-5	Ichakamana RM- 3,4 & 5	2,205	5,329	5,328	10,657	4.8
Total			24,050	54,966	57,697	112,663	

Source: National Population and Housing Census 2011

5.3.2. Caste, Ethnicity, Religion and Language

Ethnic composition in the district is very diverse, local peoples follows different types of culture and traditions. In terms of ethnic composition, the road alignment inhibited with multi



caste/ethnic groups. Among them Brahmin, Chhetri, Dalit and other indigenous groups (Janajati) Chepang/Praja, Magar, Newar, Tamang, Gurung, Bhujel/Gharti were found in the project area. CBS 2011 shows that the Chandragiri Municipality, Chhatradeurali, Jeewanpur, Naubise, Thakre, Bhumesthan, Baireni, Pida, Gajuri, Benighat, Ghyachok and Darechok are dominated by Brahmin/Chhetri where as Dhussa, Jogimara, Bhumlichok, Tanglichok, Makaising and Taklung are dominated by indigenous groups in project area.

The Chepang/Praja are mostly located in Dhading, Gorkha, Chitwan, Makwanpur and Tanahu district of Nepal. In the proposed project area viz. Naubise, Thakre, Pida, Gajuri, Benighat, Dhussa, Jogimara, Ghyachok, Bhumlichok, Tanglichok, Makaising, Taklung and Darechok, the Chepang/Praja were found. The details of caste and ethnic group of proposed project area is as below.

Hindu, Buddha, Islam, Christianity and Kirat are the major religions of the project area district. Different types of temples, ancient monasteries, traditional villages with diverse culture, Gumba and Chorten, significant to both Hinduism and Buddhism religions followed by project district people. It reflects diversity in culture. The diverse of cultural norms and values has made the road alignment route very rich. Most of people celebrate Dashai, Tihar, and other festivals commonly, but some specific festivals are only celebrated by respective social groups. Loshar / Poush 15, Maghe & Shawaune skranti, Nepal Sambat, Janaipurnima, Naag Panchami, Buddha Jayanti, Thulo Ekadashi, Holi, Shivaratri etc are locally celebrated and major festivals in the road alignment route. Especially the Chepang are celebrate Bhui Jhyasa (Bhumi Puja).

The population following Hindu religion has been dwell primarily in all project districts and, secondarily, the people following Buddha religion. The population of district in terms of religion is presented in the table below.

Table 5-46: Population of the district by Religion

District	Total Population	Hindu	Buddha	Islam	Kirati	Christ ianity	Sikha	Jain	Ba hai	Other
Kathmandu	1744240	1395538	268479	21866	13379	40592	63	829	55	3439
Dhading	336067	243384	69113	1034	26	21243	0	2	45	1220
Gorkha	271061	203702	51766	3056	22	8860	2	1	15	3637
Chitwan	579984	472103	75509	6741	225	19682	7	5	10	5702
Total	2931352	2314727	464867	32697	13652	90377	72	837	125	13998

Source: National Population and Housing Census 2011

The Nepali language is spoken as a major language by the majority of population in all project districts, where the Gurung language in Gorkha & Chitwan district and the Newari language in Kathmandu are spoken secondly.

5.3.3 Settlement Pattern and Housing Structures

Most of the existing roadside settlements are semi-clustered and clustered. Beside this, in proposed new alignment the settlements are semi-clustered and scattered type. There are



several settlements and market centers along the existing KNM highway starting from Naghdhunga to Mugling. The major settlements along the existing KNM are Khanikhola, Naubise, Dharke, Mahadevbesi, Galchi, Gajuri, Baireni, Majhimatar, Malekhu, Benighat, Charaudi, Kurintar, Ramailo Danda, and Mugling. Therefore, Chhatrapati, Phauraule, Aryaltar, Barabise, Amalechaur, Dadadihi, Purano Dharke, Benibei, Siruwatar, Dhobadighat, Jyamireghat, Itar, Gorditar, Buttar and Rainas are the main settlements in proposed new alignment.



Figure 5-23: Clustered settlements along existing highway

Structures.

The field data shows that seven types of houses/structures are found comprising 1194, 865, 643, 505, 389, 30 and 5 as RCC, cement block, Stone and Mud wall, cement and brick wall, stone & Cement wall, Mud & Brick wall, and wood & Tin in the project area respectively. Nearly thirty-three percent (32.9%) of total households of project affected houses with the foundation having RCC, 23.8 percent households with foundation made up of cement block, 17.7 . percent in stone & mud wall, 10.7 percent in stone & cement wall, 0.8 percent in mud and brick wall and 0.1 in wood and tin type of foundations. According to preliminary findings; it is found that 43.3 percent of the structures have one store. Similarly, 39.0 percent, 13.3 percent, 2.8 percent, 0.6 percent, 0.6 percent, 0.5 percent, 0.1 percent structures have Two & half, Three & half, Four & half, Three, Four, Five & half, Five, and Six store respectively. The details are presented below.



Table 5-47: Caste and Ethnic groups along the proposed project Zol

VDC/ Municipality	Chandragiri Municipality	Chhatradeur Municipality	Jeevanpur	Naubise	Thakre	Bhumessthan	Baireni	Pida	Gajuri	Benighat	Dhussa	Jogimara	Ghyachok	Bhumlichok	Tanglichok	Makaising	Taklung	Darechok	Total
Tamang	9361	3157	1458	4111	1926	5029	4509	1645	2229	487	39	35	18					161	34165
Brahmin Hill	13198	1973	2434	3121	1633	1855	2394	1403	1776	2224	640	512	1260	21	394	245	198	1128	36409
Chhetree	19929	1437	1856	3303	3960	1386	2700	1813	1301	1758	650	708	621		37		293	664	42416
Newar	24884	313	666	1010	272	53	701	623	646	669	868	524	768	365	69	288	233	622	33574
Magar	5150	111	691	137	262	188	482	692	525	611	569	837	373	1418	1002	253	3091	1825	18217
Gurung	937			44	68		54	77	101	296	162	572	780	443	777	504		2525	7340
sherpa	14																		14
Rai	971																		971
Sharki		206	758	420	40	16	590	360	591	691	139		755		108		295	12	4981
Chepang/Parja				68	382			2499	1405	804	3416	3223	330	1112	822	755	406	1305	16527
Kami	1107	65	146	451	269	579	738	519	597	860	312	248	330	93	37	181	163	323	7018
Damai/Dholi	853	88	182	225	188	275	322	289	375	546	152	102	215	90	98	59	160	284	4503
Ghale					13			29	181	332	25	180							760
Kumal																		11	11
Sanyashi/Dasnami	1590	222	13	223	30	142	64		74		78	170							2606
Gharti/Bhujel			140	152	307	91	435	491	44	49								32	1741
Musalman	909												89				15	151	1164

VDC/ Municipality	Chandragiri Municipality	Chhatradeur ali	Jeevanpur	Naubise	Thakre	Bhumesthan	Baireni	Pida	Gajuri	Benighat	Dhussa	Jogimara	Ghyachok	Bhumlichok	Tanglichok	Makasing	Taklung	Darechok	Total
Thakuri	519	18	188	20	90	145	43		18	26	15	507							1589
Marwadi	69																		69
Tharu	755																	49	804
Others	4880	97	257	1268	398	1027	337	603	172	364	125	126	413	3	25	22	174	515	10806
Total	85126	7687	8789	14553	9838	10786	13369	11043	10035	9717	7190	7744	5952	3545	3369	2307	5028	9607	22568

Source: National Population and Housing Census 2011

VDC/ Municipality	Chandragiri Municipality	Chhatradeur ali	Jeevanpur	Naubise	Thakre	Bhumesthan	Baireni	Pida	Gajuri	Benighat	Dhussa	Jogimara	Ghyachok	Bhumlichok	Tanglichok	Makasing	Taklung	Darechok	Total
Tamang	9361	3157	1458	4111	1926	5029	4509	1645	2229	487	39	35	18					161	34165
Brahmin Hill	13198	1973	2434	3121	1633	1855	2394	1403	1776	2224	640	512	1260	21	394	245	198	1128	36409
Chhetree	19929	1437	1856	3303	3960	1386	2700	1813	1301	1758	650	708	621		37		293	664	42416
Newar	24884	313	666	1010	272	53	701	623	646	669	868	524	768	365	69	288	233	622	33574
Magar	5150	111	691	137	262	188	482	692	525	611	569	837	373	1418	1002	253	3091	1825	18217
Gurung	937			44	68		54	77	101	296	162	572	780	443	777	504		2525	7340
sherpa	14																		14

VDC/ Municipality	Chandragiri Municipality	Chhatradeur ali	Jeevanpur	Naubise	Thakre	Bhumesthan	Baireni	Pida	Gajuri	Benghat	Dhussa	Jogimara	Ghyachok	Bhumlichok	Tanglichok	Maakasing	Taklung	Darechok	Total
Rai	971																		971
Sharki		206	758	420	40	16	590	360	591	691	139		755		108		295	12	4981
Chepang/Parja				68	382			2499	1405	804	3416	3223	330	1112	822	755	406	1305	16527
Kami	1107	65	146	451	269	579	738	519	597	860	312	248	330	93	37	181	163	323	7018
Damai/Dholi	853	88	182	225	188	275	322	289	375	546	152	102	215	90	98	59	160	284	4503
Ghale					13			29	181	332	25	180							760
Kumal																		11	11
Sanyashi/Dasnami	1590	222	13	223	30	142	64		74		78	170							2606
Gharti/Bhujel			140	152	307	91	435	491	44	49								32	1741
Musalman	909												89				15	151	1164
Thakuri	519	18	188	20	90	145	43		18	26	15	507							1589
Marwadi	69																		69
Tharu	755																	49	804
Others	4880	97	257	1268	398	1027	337	603	172	364	125	126	413	3	25	22	174	515	10806
Total	85126	7687	8789	14553	9838	10786	13369	11043	10035	9717	7190	7744	5952	3545	3369	2307	5028	9607	22568

Source: National Population and Housing Census 2011

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Department of Roads
Development Cooperation Implementation
Jhagat, Lalitpur

Table 5-48: Composition of project affected structures in proposed project area

District	VDC	Municipality/Rural Municipality(RM)	Composition of affected number of structure							Total
			Stone & Mud wall	Mud & Brick wall	Stone & Cement wall	Brick & Cement wall	RCC	Cement Block	Wood & Tin	
Kathmandu	Chandragiri	Chandragiri Municipality-2	10	2	4	15	9	3		43
	Jiwanpur	Dhunibeshi Municipality-5	18		2	3	1	1		25
	Naubise	Dhunibeshi M-6,7,8 & 9	116	13	45	145	93	88	1	501
	Tharke	Thakre RM- 6,7&8	43	2	22	88	99	44		298
	Bhumisthan	Thakre RM-1&2	34	1	33	39	62	61		230
	Baireni	Galchi RM-4,6&7	74	6	63	61	125	130		459
	Pida	Gajuri RM-5&6	33	3	48	35	64	76		259
	Gajuri	Gajuri RM-1&2	23	1	33	50	126	91		324
	Benighat	Benighat Rorang RM-3 & 5	68	1	76	30	256	135		566
	Dhusa	Benighat Rorang RM-7 & 8	12		7	7	39	32		97
	Jogimara	Benighat Rorang RM-9&10	19		20	6	75	48		168
	Ghyalchowk	Gandaki RM-7 & 8	92		3		14	15	2	126
	Bhumlichowk	Gandaki RM-6	21				4	11		36
	Tanglichowk	Gandaki RM-2	11							11
Chitwan	Makaisingh	Gandaki RM-1	9			4	1	7		21
	Darechowk	Ichakamana RM- 3,4 & 5	60	1	33	22	226	123	2	467

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 Development Cooperation Implementation
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District	VDC	Municipality/Rural Municipality(RM)	Composition of affected number of structure							Total
			Stone & Mud wall	Mud & Brick wall	Stone & Cement wall	Brick & Cement wall	RCC	Cement Block	Wood & Tin	
			643	30	389	505	1194	865	5	3631
Total										

Table 5-49: Types of floor of project affected structures in proposed project area

District	VDC	Municipality/Rural Municipality(RM)	Types of store of affected structures							Total
			one	Two & Half	Three	Three & Half	Four	Four & Half	Five	
Kathmandu	Chandragiri	Chandragiri Municipality-2	31	9		3				43
	Jiwanpur	Dhunibeshi Municipality-5	10	12		3				25
Dhading	Naubise	Dhunibeshi Municipality-6,7,8 & 9	286	151	2	53	2	7		501
	Tharke	Thakre RM- 6,7&8	134	136	3	18		6	1	298
	Bhumisthan	Thakre RM-1&2	80	104		43		1	1	230
	Baireni	Galchi RM-4,6&7	242	163	2	46		4	1	459
	Pida	Gajuri RM-5&6	131	85	2	31	1	5	3	259

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District	VDC	Municipality/Rural Municipality(RM)	Types of store of affected structures									Total
			one	Two & Half	Three	Three & Half	Four	Four & Half	Five	Five & Half	Six	
	Gajuri	Gajuri RM-1&2	118	116	1	54	3	27	1	4		324
	Benighat	Benighat Rorang RM-3 & 5	170	226	4	116	8	36		7		566
	Dhusa	Benighat Rorang RM-7 & 8	36	42	3	11	1	4				97
	Jogimara	Benighat Rorang RM-9&10	50	91	1	24		2				168
	Gorkha	Gandaki RM-7 & 8	53	72		1						126
	Bhumlichowk	Gandaki RM-6	24	12								36
	Tanglichowk	Gandaki RM-2	2	9								11
	Makaisingh	Gandaki RM-1	14	7								21
Chitwan	Darechowk	Ichakamana RM- 3,4 & 5	190	180	2	81	5	8		1		467
Total			1571	1415	20	484	20	100	2	18	1	3631

Source: Field survey 2017



Table 5-50: Caste and Ethnic groups along the proposed project affected area (Direct Impact Area (DIA))

District	VDC/ Municipality	Municipality/RM	Brahmin	Sanyal	Che	Dalit	Janjati	Mus	Mad	Other	Total
Kathmandu	Chandragiri Municipality	Chandragiri Municipality-2	28				10			2	40
Dhading	Jeewanpur	Dhunibeshi Municipality-5	75	1			41			2	119
	Naubise	Dhunibeshi Municipality-6,7,8 & 9	444	14		3	175		1	8	645
	Thakre	Thakre RM-6,7&8	199			3	70	4		8	284
	Bhumesthan	Thakre RM-1&2	150			1	57	5		7	220
	Baireni	Galchi RM-4,6&7	279	4	1	6	143	2	1	15	451
	Pida	Gajuri RM-5&6	127	3	1	9	103	1		5	249
	Gajuri	Gajuri RM-1&2	166	2		3	129	1	2	16	319
	Benighat	Benighat Rorang RM-3 & 5	423	1	5	9	97	9	2	13	559
	Dhussa	Benighat Rorang RM-7 & 8	68	1	2	1	14	3		5	94
	Jogimara	Benighat Rorang RM-9&10	71	5	6	7	68	2			159
Gorkha	Ghyalchok	Gandaki RM-7 & 8	193	1	13	44	33			10	294
	Bhumlichok	Gandaki RM-6	1		42		18				61
	Tanglichok	Gandaki RM-2	0		5		23				28
	Makaising	Gandaki RM-1	1		1	12	10				24
Chitwan	Darechok	Ichakamana RM-3,4 & 5	162	1	7	9	251	7		15	452
Total			2387	33	83	107	1242	349	62	106	3998
Percent			59.7	0.8	2.1	2.7	31.1	0.9	0.2	2.7	100.0

Source: Field survey 2017



5.3.3. Profile of Project Affected Families

The field study shows that about 3998 houses with 18840 populations are situated within the 50-meter road corridor along the KNM and proposed new alignments within the project-affected area. The highest with 645 numbers of houses in Dhunibeshi Municipality-6, 7, 8 & 9 and lowest number (24) of HHs in Gandaki RM-I situated close to the proposed highway alignment.

The field study shows that the Brahmin/Chhetri is the largest caste/ethnic groups having 59.7% (2387) of the total HHs followed by Janjati 31.1% (1242), Dalit 2.7%(107), Others 2.7(106), Chepang/Parja 2.1%(83), Muslim 0.9(34), Sanysi 0.8%(33) and Madheshi 0.2%(6).

Moreover, Government of Nepal has envisaged of developing modern, green and information technology-friendly smart cities. It has plans to develop 20 modern cities besides three existing towns each as green cities and smart cities. Amid increasing use of information and communication technology (ICT), this is the first time that the government has set a national agenda to develop smart cities. Generally, a city is known as 'smart', if it uses ICT to enhance the quality and performance of urban services, reduce costs and resource consumption, and to engage more effectively and actively with its citizens.

The government has a plan to expand broadband internet service to municipality level and make them ICT based utilizing resources. To develop such smart towns in other parts of the country, the government has announced work would start on laying the optical fibre along the Mid-Hill Highway. The government has been preparing to implement a project with a target to develop 10 modern towns along the Mid-Hill Highway. Among the ten selected location; Baireni Galchhi (Dhading) is one of the location that has been selected by the government to establish as modern town. The development of ribbon settlement and market along the existing highway at Baireni is increasing day by day.

The plan to develop the towns into smart cities is yet to come up with a proper implementation. Even though there has been slow progress in the project. The proposed KNM improvement project will coordinate with the "New Town Project Coordination Office (NTPCO) under Department of Urban Development and Building Construction (DUDBC) during the time of construction.

5.3.4. Gender Situation



Figure 5-24: Local woman in a fruit market

According to 2011 Census, more than 51 percent of the total populations of Nepal are women. As Nepali society is patriarchal, women as a whole are lagging much behind than men in the overall socioeconomic development. There is a tendency to lump all women of Nepal into one group. Gender norms and practices vary among different cultural groups of women in Nepal. Indigenous (Adibasi/ Janajati) women are generally known to have greater freedom and

decision-making at the household level than the 'high caste' Hindu women. However, in terms of accessing state resources like education and employment, Indigenous women lag behind 'high caste' women. The literacy and health status of Dalit women is very worse in condition. Dalit women also suffer from social and sexual violence, including caste discrimination and prostitution practices.

It is widely reported that women are discriminated and exploited by their own family members. Due to seasonal absence of males who out-migrate temporarily to other parts of the county or India in search of job, women carry out both household and outside farm related works. Many women of the area have no property in their name. The educational status of women is lower comparing to males.

The participation of women is higher in traditional type of works such as fetching water, collection of fodder, preparing food for the family members and taking care of children. The role of women in decision-making is non-significant in comparison to male.

Household Head

Female-headed households in the country has increased by about 11 percent from 14.87% in 2001 to 25.73% in 2011. Similarly, on the proposed project district Dhading, Gorkha and Chitwan the percent of female household head is higher than the male. The household head details of proposed district are presented in the following table.

Table 5-51: Household head status of the project district

District	Male	Male %	Female	Female %	Total
Kathmandu	913,001	52.3	831,239	47.7	1,744,240
Dhading	157,834	47.0	178,233	53.0	336,067
Gorkha	121,041	44.7	150,020	55.3	271,061
Chitwan	279,087	48.1	300,897	51.9	579,984
Total	1,470,963	50.2	1,460,389	49.8	2,931,352

Source: National Population and Housing Census 2011

Female ownership of fixed assets

Altogether, 19.71 percent of households reported the ownership of land or house or both in the name of female member of the household. In urban areas, 26.77 percent of the households show female-ownership of fixed assets while the percentage stands at 18.02 in rural areas.

In project-affected districts, 28.9, 22.4, 17.2 and 14.3 percent of female household heads have fixed assets in Chitwan, Kathmandu, Gorkha and Dhading district respectively. Out of total 85.2, 82.1, 76.8, and 70.5 percent of female household heads do not have fixed assets in Dhading, Gorkha, Kathmandu, and Chitwan district respectively. The detail is presented in the following table.



Table 5-52: Households by female ownership of fixed assets

District	Total HHs	Female ownership in			
		Both house & land	Land only	Neither house nor land	Not stated
Kathmandu	435,544	59,119	38,247	334,699	3,479
Dhading	73,842	5,323	5,248	62,932	339
Gorkha	66,458	5,818	5,622	54,566	452
Chitwan	132,345	22,655	15,407	93,354	929
Total	708,189	92,915	64,524	545,551	5,199

Source: National Population and Housing Census 2011

Literacy Status

The overall literacy status of project-affected districts is presented in the Table below.

Table 5-53: District Population aged 5 years and above by Literacy status

District	Population aged 5 years and above	Able to read & write		Read only		Unable to read & write		Not stated	
		Male	Female	Male	Female	Male	Female	Male	Female
Kathmandu	1632640	786704	621495	11471	14135	55116	143109	195	415
Dhading	305985	101240	91097	3765	3980	37348	68333	80	142
Gorkha	247857	82054	82370	2622	3371	24558	52765	39	78
Chitwan	537183	215282	198244	4946	5633	36351	76434	115	178
Total	2723665	1185280	993206	22804	27119	153373	340641	429	813

Source: National Population and Housing Census 2011

The population below 5 years is not accounted in literacy status. In proposed project area Municipality/VDCs the literacy percent range is in 55 % to 85%. Among the proposed project area, the highest literacy rate is in Ichakamana RM (Darechok VDC) 77.4% and lowest in Gajuri RM (Pida VDC) 55.5%. The literacy rate of Chandragiri Municipality is in range of 73 to 85 percent. The literacy rate of women is low as compared to men.

Table 5-54: Literacy percent of proposed project area

District	VDC/ Municipality	Municipality/ Rural Municipality(RM)	Literacy %
Kathmandu	Chandragiri Municipality	Chandragiri Municipality	73% to 85%
Dhading	Chhatredeurali	Dhunibeshi Municipality	65.3
	Jeewanpur	Dhunibeshi Municipality	62.8
	Naubise	Dhunibeshi Municipality	64.9
	Thakre	Thakre RM	69.3

District	VDC/ Municipality	Municipality/ Rural Municipality(RM)	Literacy %
	Bhumesthan	Thakre RM	61.4
	Baireni	Galchi RM	66.7
	Pida	Gajuri RM	55.5
	Gajuri	Gajuri RM	64.3
	Benighat	Benighat Rorang RM	72.0
	Dhussa	Benighat Rorang RM	59.7
	Jogimara	Benighat Rorang RM	61.4
Gorkha	Ghyalchok	Gandaki RM	73.6
	Bhumlichok	Gandaki RM	59.0
	Tanglichok	Gandaki RM	65.8
	Makaising	Gandaki RM	61.2
	Taklung	SahidLakhan RM	71.9
Chitwan	Darechok	Ichakamana RM	77.4

Source: National Population and Housing Census 2011

5.3.6 Profiles of Service Providing Institutions

Different sectors, i.e. Industrial, Trade, Service, Social, Public utilities, Financial, have been providing the services in project area. Such sector viz. Bal Kalyan Samaj, Stopes Center, Nagdhubnga Yuba club, Krish Tatha Tarkai Sahakari Sanstha, Ahati Yuba Club, Indreni Club, Navajoyti Bachat Taha Rin Sahakari Santstha, Ban Samiti Club, Amar Jyoti Yuwa Club, Sagarmatha Club, Jaibik Biu Bijan Sanstha, Nabjyoti Bal Tatha Yuba Club, Gajuri Bachat Tatha Rin Sahakari, Sanakishan Sahakari, Krishi Sahakari, Tarkari Sahakari, Dudh Bikash Sahakari, Janabhawana Sahakari financial institutions are actively involved in project area.

5.3.5. Access to GoN Service facilities

The government has been providing health service facility through primary health center, health post and sub-health post in proposed project area. Seventeen different types of government lead health service center are in proposed project area. In Gajuri RM (Gajuri) and Gandaki RM (Makaising) each have a Primary Health Center; Naubise of Dhunibesi Municipality, Chhatredeurali of Dhunibesi Municipality, Baireni of Galchi RM, Pida of Gajri RM, Benighat of Benighat Rorang RM, Dhussa of Benighat Rorang RM, and Jogimara of Benighat Rorang RM each have one Health Post; and Jiwanpur of Dhunibesi Municipality, Thakre of Thakre RM, Bhumesthan of Thakre RM, Ghyalchok of Gandaki RM, Takulung of Sahid Lakhan RM, Tanglichwok of Gandaki RM, Bhumlichowk of Gandaki RM, and Darechwok of Ichakamana RM each have one Sub Health Post.



Expect this Postal service, Agriculture service center, Livestock service center, Nepal Telecom, Nepal Electricity Authority facilities has been provided by government in project area.

Access to Private Service facilities



Figure 5-25: Manakamana cable car station near Kurintar

Private schools, health service provider institutions, commercial finance institutions, cooperatives, agro vet, fuel centers, construction materials (hardware) and sanitary shops etc. service facilities can be accessed within the project area. Both private and government lead different means of communication and media facilities, i.e. newspaper, telephone, cell phone, television and internet etc. are available in the project area.

5.3.6. Occupational Status

The main occupation of the people along the existing road are agriculture, animal husbandry (goat, cow, etc.), small business and cottage industry work. According to CBS 2011, about 35 percent of total population are based on agriculture, forestry & fishery related work around the proposed road district. So, on the about 18 percent of total population are based on Service & sale work. Out of total population, the craft and related trades worker population in Dhading, Gorkha and Chitwan district are 5%, 5% and 11% respectively.

Table 5-55: Major occupation status of proposed project districts

District	Total	Major occupation										
		Armed forces	Managers	Professionals	Technicians and associate professional	Office assistance	Service & sale workers	Agri., forestry & fishery workers	Craft and related trades workers	Plant & machine operators & assemblers	Elementary occupations	Not stated
Kathmandu	624745	8114	36844	63219	52238	30085	160391	57054	108313	33814	48302	26371
Dhading	150220	185	1341	4902	1205	1148	7354	115462	7570	3051	6819	1181
Gorkha	122201	59	920	4169	1081	827	4957	98757	5938	867	4014	611
Chitwan	227104	494	5371	10080	6042	2808	25044	117197	24608	9028	23340	3,093
Total	1124270	8852	44476	82370	60566	34868	197746	388470	146429	46760	82475	31256

Source: National Population and Housing Census 2011, CBS 2014

5.3.7. Work Force and Employment

According to CBS 2011, in project district the maximum (34.6%) of 10 yrs. and above population is engaged in Agriculture, forestry & fishery works and followed by Service & sale workers (17.6%), Craft & related trades workers (13.0%), Professionals and Elementary

occupations 7.3% in each and minimum 0.8% of population is engaged in Armed forces. The details are presented in Table 5-56.

Table 5-56: Usually active population 10 yrs. of age & over by major industry and major occupation in project district

Occupation in project district																									
District	Kathman	Dhading	Gorkha	Chitwan	Major occupation								Major Industry												
					Total	Armed forces	Managers	Professionals	Technicians and	Office assistance	Service & sale workers	Agri., fore stry & fishery workers		Craft and related	Plant & machine operators & assemblers	Elementary occupations	Not Stated								
0.8	624745	150220	122201	227104	0.8	8114	185	59	495	5371	10080	6042	2807	25044	117197	24608	9027	23340	3093	Agriculture, forestry and fishing, Mining and quarrying, Manufacturing, Electricity, gas, steam and air conditioning supply, Water supply; sewerage, waste mgmt. & remediation activities, Construction, Wholesale and retail trade; repair of vehicles & motorcycles, Transportation and storage, Accommodation and food service activities, Information and communication, Financial and insurance activities, Real estate activities, Professional, scientific and technical activities, Administrative and support service activities, Public admn. and defence; compulsory social security, Education, Human health and social work activities, Arts, entertainment and recreation, Other service activities, Activities of households as employers, Activities of extraterritorial org. and bodies, Not Stated					
4.0	8114	185	59	495	5371	10080	6042	2807	25044	117197	24608	9027	23340	3093	1181	611	4015	867	5938		7571	3051	33814	48302	26371
7.3	36844	1341	920	5371	5371	10080	6042	2807	25044	117197	24608	9027	23340	3093	1181	611	4015	867	5938		7571	3051	33814	48302	26371
5.4	63219	4902	4169	10080	10080	6042	2807	25044	117197	24608	9027	23340	3093	1181	611	4015	867	5938	7571		3051	33814	48302	26371	26371
3.1	52238	1206	1082	6042	6042	2807	25044	117197	24608	9027	23340	3093	1181	611	4015	867	5938	7571	3051		33814	48302	26371	26371	26371
17.6	30085	1148	827	2807	2807	25044	117197	24608	9027	23340	3093	1181	611	4015	867	5938	7571	3051	33814	48302	26371	26371	26371	26371	
34.6	160391	7354	4957	25044	25044	117197	24608	9027	23340	3093	1181	611	4015	867	5938	7571	3051	33814	48302	26371	26371	26371	26371	26371	
13.0	57054	115462	98757	117197	117197	24608	9027	23340	3093	1181	611	4015	867	5938	7571	3051	33814	48302	26371	26371	26371	26371	26371	26371	
4.2	108313	7571	5938	24608	24608	9027	23340	3093	1181	611	4015	867	5938	7571	3051	33814	48302	26371	26371	26371	26371	26371	26371	26371	
7.3	33814	3051	867	9027	9027	23340	3093	1181	611	4015	867	5938	7571	3051	33814	48302	26371	26371	26371	26371	26371	26371	26371	26371	
2.8	48302	6819	4015	23340	23340	3093	1181	611	4015	867	5938	7571	3051	33814	48302	26371	26371	26371	26371	26371	26371	26371	26371	26371	
0.8	26371	1181	611	3093	3093	1181	611	4015	867	5938	7571	3051	33814	48302	26371	26371	26371	26371	26371	26371	26371	26371	26371	26371	

Source: National Population and Housing Census 2011

5.3.8. In and Out Migration Pattern



Figure 5-26: Migration for job or business opportunity from rural to urban conditions is common in the area

Migration from hill to Terai and rural area to urban area is a common demographic feature in our country. The main cause of migration to urban area is for seeking the better economic opportunities and social services. For employment, service and education are major purposes of out-migration in the project area. Out of total project area population (2931352), 200867 persons were found to have gone outside the home. Among outside going population (200867), 80.2 percent belong to male and 19.8 percent female was found to

have gone out for different purpose of works.

Table 5-57: Absentee population and household.

Project district	Total HHS	Absent household	Sex of absentees			
			Total	Male	Female	Not stated
Kathmandu	435,544	69,521	99,805	71,837	27,967	1
Dhading	73,842	17,055	22,537	20,207	2,330	0
Gorkha	66,458	21,258	28,104	25,375	2,729	0
Chitwan	132,345	38,423	50,421	43,728	6,693	0
Total	708,189	146,257	200,867	161,147	39,719	1
%		20.7		80.2	19.8	

Source: National Population and Housing Census 2011

5.3.9. Land Holding Pattern

The type of ownership of land is another variable for assessing the vulnerability and socio-economic condition of any groups and communities.

Agriculture is the major source of income and livelihood of the people in the project area. The land in the area is irrigated Khet-land, un-irrigated Khet land, un-irrigated upland (Pakho/Bari), and grass land at slope (Kharbari). People grow paddy in irrigated land where irrigation system is employed and in un-irrigated paddy land where the monsoon is only the source of irrigation, the un-irrigated upland is an untterraced outward slope land where dry crops are grown. Majority of the land owners have irrigated as well as un-irrigated and Pakho or Bari land. The use of Pakho is for grass, thatch for roofing of houses, firewood and grazing.

The proposed new alignments Sisnekhola-Dharke and Benighat-Kurintar follows significant cultivated land of more than 100 hectares. The field based preliminary findings shows that in Galchhi RM (earlier Baireni VDC), Gajuri RM (earlier Pida VDC), Benighat Rorang RM (earlier Benighat VDC), Benighat Rorang RM (earlier Dhussa VDC), Benighat Rorang RM (earlier Jogimara VDC) of Dhading district; Gandaki RM (earlier Ghyalchok VDC), Gandaki RM (earlier Bhumlichok VDC) of Gorkha district; and Ichakamana RM (earlier Darechok VDC) of Chitwan districts have likely impact on land and structures of Chepang community by the proposed project. The

cultivated land along with locally established earthen tracks meandering around the cultivated land situated along the proposed new alignments will be affected severely. Cultivated land along the Sisnekhola-Dharke alignment are Khatripauwa, Kanakot, Lapsikhola, Kafle settlement cultivated land, Gajurelgaun, Arjelgaun, Purano-Dharke will be affected. Similarly, fertile cultivated land situated along the Benighat-Kurintar alignment such as at Benibesi, Beldanda, Ghyalchowktar, Dhobadighat, Sukumbasibasti, Chuwatar, Pudaliphat, Jyamerighat, Itar, Kautikhet and Buttar cultivated land will be fragmented.



Figure 5-27: Agricultural area and cement plant in Sisnekhola – Dharke alignment

5.3.10. Land Use Pattern

Land use within the two-kilometer corridor of the existing and proposed new alignments is presented in the following table.

Table 5-58: Land use within the 2-kilometer corridor of KNM and new alignments (area in Ha.)

Land use type	KNM	Sisnekhola-Dharke	Beshaltar-Phisling
Built up Area	4496.93	186.73	358.5
Forest/Bush	4654.01	504.47	992.98
Agricultural land	6586.05	343.04	332.15
Other	1511.84	987.53	1588.76
Total	17248.83	2021.77	3272.9

Source: GIS Map (ESIA Study Team)

Further, land use within the 300-meter DIA of existing highway KNM and proposed new alignments such as Sisnekhola-Dharke and Benighat-Phisling has been calculated from the available topographic map. The land use calculated along the proposed alignments has been presented in the Table 5-59 below.

Table 5-59: Land use within the 300 meter corridor (DIA) of KNM and new alignments (area in Ha.)

Land use type	KNM existing	Sisnekhola-Dharke	Benighat-Phisling
Built up Area	140.03		1.29
Barren land	14.63	0.28	0.32
Forest/Bush and Grassland/ Orchard	1345.52	98.92	215.86
Agricultural land	1225.85	276.8	221.12
Other	52.01	4.08	16.13
Total	2778.04	380.08	454.72

Source: GIS Map (ESIA Study Team)

It is anticipated that the land use pattern presented in the **Table 5-59** along the proposed new alignment Sisnekhola-Dharke and Benighat-Kurintar will be changed significantly.

5.3.11. Land Value

The value of land will increase due to the project implementation in the project areas. It brought a change in land use pattern. The agriculture land will be converted to commercial land and it induced the new urban centers and shanty towns. After fixed the road alignment, people will start to buy the land in a small plot to use for residential and business purposes in future. During the field survey the current land price was also collected, which is presented in below.

Table 5-60: Location Based Land Price Analysis for Affected Land

Road Section	Location	Current Market Rate (NRs.)/Meter Sq.
Naubise-Mugling	Dharke	12,580
Naubise-Mugling	Gomati	12,580
Sisnekhola-Dharke	Khatripauwa	6,290
Sisnekhola-Dharke	Jhakriban	4,720
Sisnekhola-Dharke	Chapagaithok	9,435
Sisnekhola-Dharke	Laklungphedi. Khadkagau	4,720
Sisnekhola-Dharke	Jugedi	7,865
Sisnekhola-Dharke	Aryaltar	6,290
Sisnekhola-Dharke	Bahrabise	9,435
Sisnekhola-Dharke	Purandihi	6,290
Sisnekhola-Dharke	Dharke	11,010
Bishaltar-Phisling	Bishaltar	11,010
Bishaltar-Phisling	Chinaghat	4,720
Bishaltar-Phisling	Dhabadighat, Govindatar	6,290

Road Section	Location	Current Market Rate (NRs.)/Meter Sq.
Bishaltar-Phisling	Jyamireghat	4,720
Bishaltar-Phisling	Itar, Kaudi, Pallotar	3,145

Source: Field Study, 2017/2018

5.3.12. Agriculture Practices

The major crops grown in the project area are paddy, maize, millet, wheat, oilseed, potato, lentil etc. Similarly, vegetables (cauliflower, cabbage, radish, onion, tomato, carrot, pumpkin, cucumber, brinjal, capsicum, green vegetables etc), mango, pineapple, sugarcane, Litchi, jackfruit, papaya, guava and citrus etc are produce in the project area. Naubise, Dhunibeshi, Chhatreaurali, Jiwanpur, Thakre, Bhumesthan, Gajuri, Benighat, Makaising, Bhumlchok and Ghyalchok are the major green vegetable production area of the proposed project area. No any industrial agricultural is being practiced by the locals in the project area. The area has been cultivated either by tenants or by land owners for their subsistence. Local farmers also use to sell the agricultural products at the local market existed along the highway.



Figure 5-28: Vegetables are often grown near the road

The cropping pattern varies from site to site depending on land quality and availability of irrigation. More fertile and year-round irrigated lands are cultivated three times a year where as non-irrigated lands are cultivated twice a year. The selection of crops is based on the land quality and irrigation facility available. The cash crops of the project district constitute maize, potato, lentil, ginger, green vegetables, honey, silkworm and milk.

5.3.13. Food Sufficiency Level

The food sufficiency level is one of the most important indicators and tools of mapping poverty and assessing vulnerability. So as to assess the food sufficiency level, it was purposively categorized into 6 different levels such as surplus, sufficient for 9-12 months, sufficient for 6-8 months, sufficient for 3-5 months, sufficient for less than 3 months and no production. As revealed by the study, only 13.9% HHs were found to have surplus amount of production of food grains along the road corridor. 9.1%, 10.3%, 13.9%, and 52.3% HHs was found to have food sufficiency gradually for 9-12 months, 6-8 months, 3-5 months and less than 3 months. 0.5% HHs were responded of no production. From this analysis, we can conclude that overwhelming majority of the sampled HHs had food deficit problems.

5.3.14. Off-farm Activities

Off-farm income-generating activities provided an important source of capital and help finance social services that the households consume in proposed project area.

Preliminary findings indicate that foreign work continues to be the source of highest off-farm income of the project districts. This is followed by salary and wages, pension, self-employment in trade, handicraft, and business income.



Figure 5-29: Tourism and services, like small restaurant, are developed along the road

5.3.15. Non-Timber Forest Products

The agricultural commodities, their coverage, production, sales and incomes are important variables for assessing the socio-economic condition. As revealed by the study, 101.53 Ha. of lands were covered by various types of crop species. They included cereals (Food grains), vegetables (Cauliflower, Cabbage, broccoli, capsicum, Tomato, Peas etc.), cash crops, NTFPs and fruits. There is tremendous scope of these crops in the markets. The traditional/conventional farming of cereal crops could be important only for subsistence.

Regarding NTFP, there were very few significant species reported. Species reported were Kafal (*Myrica esculenta*), Mayal (*Pyrus pashia*), Jamun (*Syzygium cumuni*), Ainselu (*Rubus ellipticus* Sm.), etc. Grass/bamboo species like taru bans (*Bambusa nutans* sub-species *nutans*), ban negalo (*Drepanostachyum khasianum*), Choya/Tama Bans (*Bambusa nepalensis*), mal bans (*Bambusa nutans* subsp. *cupulata*), negalo (*Drepanostachyum khasianum*), khar (*Imperata cylindrical*), amriso (*Thysanolaena maxima*), titepati (*Artemisia vulgaris*) etc. were reported growing.

NTFP species found in the lower part of the project area are with other values and are harro (*Terminalia chebula*), barro (*Terminalia chebula*), sindure (*Mallotus philippensis*), bael (*Aegle marmelos*), jamun (*Syzygium cumuni*), khiroro (*Sapium insigne*), etc. Products such as sal dhoop (sal oleoresin) and khoto (resin) were reported to occur and to be collected in the area.

5.3.16. Household Income and Expenditure

Pension, wage employment, non-farm enterprises, remittances, house/land rental, agriculture production, livestock production etc. are the major sources of income in project area. So on food, housing, clothing, health care, children's schooling, utilities and amenities, agricultural

input (including seeds/seedlings, fertilizers, pesticides, and hired labour) etc. are the main field of expenditure in project area.

5.3.17. Cottage and Small Industries

As reported by the respondents, there were not found small scale cottage industries. The traditional skills of weaving DOKO NAMLO are in practice, but the product is being used by self.

5.3.18. Market Centre and Marketing



Figure 5-30: Small banana market near banana plantations

There are several settlement and market centers along the existing KNM highway starting from Nagdhunga to Mugling. The major settlements along the existing KNM are Khanikhola, Naubise, Dharke, Mahadevbesi, Galchi, Gajuri, Baireni, Majhimatar, Malekhu, Benighat, Charaudi, Kurintar, Ramailo Danda, Mugling will have great potentiality to be developed as a main business centre in the future. These market centers supply daily commodities to people of its nearby settlements.

Households are built close to existing road alignment along the existing KNM alignment. The trend of ribbon development of settlements and market areas along the existing highway is still continued at the immediate ROW of the highway.

5.3.19. Mode of Transportation

Sale of HH products is one of the important variable for assessing the vulnerability and socio-economic condition of a particular group or community. In this context, the information was collected about the HH production, their sales, market places, means of transportation and time factors. About 41.4% of sample surveyed HHs used vehicle as means of transport to go to major market but 58.6% HHs walking on foot to go to market. As revealed by the study, it is found that the average distance to reach the all weather road is minimum 0.6 km to maximum 4.2 km. Average travel time to reach all weather road service is minimum 5 minutes to maximum 15 minutes. Gorkha district based project area HHs spend more travel time than



Figure 5-31: Motorbike is one of the transportation means used in households more often

others project area district HHs for access to all weather road. People of the study area have access to transportation facilities. Still, significant number of people are using walking mode of transportation for the social services except to district headquarters and hospital. This indicates that most of the social services are located adjoining area of the settlements.

In project area, about 24 percent of sample HHs are engaged in agriculture-based occupations. It is in practice that most of the HHs transported their agriculture product through head load carrying to the near vegetable collection center.

Sources of Energy

Electricity facility is available for lighting in proposed project district however, 90.1% households in the have access to electricity. Remaining 4.9%, 2.6%, 0.3% of Households are using Kerosene, Solar, and Bio-gas for electricity facility respectively. About 1.3% percent of households are depending upon other sources for lighting and 0.6% HHs have not stated about usually used for lighting. Households of the proposed project district using source of lighting are presented in Table 5-61 below.

Table 5-61: Households by usual source of lighting.

District	Total households	Fuel usually used for lighting					
		Electricity	Kerosene	Bio gas	Solar	Others	Not Stated
Kathmandu	435,544	427,363	2,330	1,815	200	407	3429
Dhading	73,842	46,257	14,282	38	8,196	4,804	265
Gorkha	66,458	50,788	11,131	113	2,890	1,275	261
Chitwan	132,345	113,728	7,211	333	7,468	3,066	539
Total	708,189	638,136	34,954	2,299	18,754	9,552	4,494
%	100.0	90.1	4.9	0.3	2.6	1.3	0.6

Source: National Population and Housing Census 2011

Similarly, majority 63.9% of households of the project district is depending upon LP Gas and 30.6% of households depending on wood/firewood for cooking purpose. Minimum 2.5%, and 2.0% HHs depending upon Biogas, and Kerosene use for cooking purpose respectively. So on less than 1% of HHs use electricity, others, and Santhi/ guitha (cow dung) for cooking purpose. Households of the proposed project area using type of fuel used for cooking are presented in Table 5-62.

Table 5-62: Households by usual type of fuel used for cooking

District	Total households	Fuel usually used for cooking							Not Stated
		Wood / firewood	Kerosene	LP gas	Santhi / guitha	Bio Gas	Electricity	Others	
Kathmandu	435544	33,223	12,213	385,136	160	214	224	940	3434
Dhading	73,842	62,367	618	7,517	8	2,940	52	76	264

Gorkha	66,458	56,049	268	7,214	20	2,558	37	53	259
Chitwan	132,345	64,933	997	52,545	211	12,238	234	669	518
Total	708,189	216,572	14096	452412	399	17950	547	1738	4475
%	100.0	30.6	2.0	63.9	0.1	2.5	0.1	0.2	0.6

Source: National Population and Housing Census 2011

5.3.20. Historical, Cultural, Religious and Aesthetic Sites and Values

Significant numbers of cultural structures such as temples and resting place with religious trees (Bar/Pipal Chautaro) occur along the existing highway within a significant distance from the road alignment. The improvement of existing highway into two lane including construction of Sisenkhola-Dharke section will not have significant impact upon such existing cultural sites. There is only one cultural structure at 9+430 that will be affected directly due to construction of Sisenkhola-Dharke and there are 4 culture structures along the existing highway that are likely to be affected. A Shiva Temple situated close to the alignment at 3+400 along the Sisenkhola-Dharke alignment will need protection during the time of construction. Only one cultural sites of local significance is existed along the Bishaltar-Phisling proposed alignment. Several cultural structures such as religious trees, small temples etc. existed along the existing highway will be affected directly with the upgrading. All the cultural sites existed along the proposed project area is of local significance. Where local people are worshipping daily considering some as holy diety. However, the entire project area does not comprise cultural and historical sites with archaeological and historical importance. The list of temples and other structures situated near to the existing and proposed alignment is presented in the Table 5-63.

Table 5-63: List of existing cultural sites situated near to the alignment

S. No	Type Of Sites	District	VDC	Municipality/ RM	Area (sq.m)	Distance from alignment (m)
1.	Ganesh Mandir	Kathmandu	Naagdhunga-4	Chandragiri Municipality	9	15
2.	Shiv Mandir	Kathmandu	Naagdhunga-4		12	15
3.	Shiv Mandir	Kathmandu	Naagdhunga-4		25	2
4.	Shiv Mandir	Kathmandu	Naagdhunga-4		1	1
5.	Shiv Mandir	Kathmandu	Naagdhunga-4		4	5
6.	Ganesh Mandir	Dhading	Naubise	Dhunibesi Municipality	9	5
7.	Shree Krishna Mandir	Dhading			16	6
8.	Shiv Mandir	Dhading	Naubise-5		16	4
9.	Muktinath Mandir	Dhading	Naubise-2		80	10
10.	Lakeswor mahadev mandir	Dhading	Naubise-6		100	10
11.	Santosi Mata Mandir	Dhading	Naubise-6		9	7
12.	Buddhako Pratima	Dhading	Naubise-1		6	8

S. No	Type Of Sites	District	VDC	Municipality/ RM	Area (sq.m)	Distance from alignment (m)
13.	Krishna Mandir	Dhading	Naubise-1		8	7
14.	Radha Krishna Mandir	Dhading	Tharke-3		30	8
15.	Radha Krishna+Shivparbati Mandir	Dhading	Bhumesthan-4		75	7
16.	Shiv Mandir	Dhading	Bhumesthan-6		25	8
17.	Shiv Mandir	Dhading	8, Dhade		25	5
18.	Kalpeswor mahadev Mandir	Dhading	8, Dhade		36	8
19.	Shiv Mandir	Dhading	Bhumesthan-9		50	10
20.	Shiv mandir	Dhading	Baireni-8	Galchhi RM	16	10
21.	Krishna Mandir	Dhading	Baireni-8		20	10
22.	Ramjanaki mandir	Dhading	Baireni-8		100	20
23.	Shiv mandir	Dhading	Baireni-8		49	15
24.	Bhimsen Mandir	Dhading	Baireni-9		16	5
25.	Shiv Mandir	Dhading	Pida-1		100	20
26.	Shiv Mandir	Dhading	Pida-3		25	15
27.	Shiv Mandir	Dhading	Pida-2		16	3
28.	Krishna Mandir	Dhading	Pida-2		50	8
29.	Shiv + Krishna Mandir	Dhading	Pida-2		16	10
30.	Shiv Mandir	Dhading	Pida-2		120	5
31.	Siddeswor Mahadev	Dhading	Gajuri-1	Gajuri RM	100	5
32.	Shree Krishna Mandir	Dhading	Gajuri-1		16	10
33.	Ganesh Mandir	Dhading	Gajuri-1		12	8
34.	Shiv mandir	Dhading	Gajuri-1		12	8
35.	Ganesh Mandir	Dhading	Gajuri-1		64	5
36.	Ganesh Mandir	Dhading	Gajuri-1		24	5
37.	Shiv mandir	Dhading	Gajuri-1		30	6
38.	Shiv Mandir	Dhading	Gajuri-2		25	7
39.	Ganesh Mandir	Dhading	Benighat-1	Benighat Rorang RM	15	9
40.	Mandir					
41.	Shree Pabitra Shivalaya Mandir	Dhading	Benighat-9		25	6
42.	Shiv Mandir	Dhading	Benighat-9		40	7

S. No	Type Of Sites	District	VDC	Municipality/ RM	Area (sq.m)	Distance from alignment (m)
43.	Bachhako Chidan Mathi banayeko Mandir	Dhading	Benighat-8		16	5
44.	Shiv Parbati Mandir	Dhading	Benighat-8		16	5
45.	Shiv Mandir	Dhading	Benighat-8		20	7
46.	Bisnu Mandir	Dhading	Dhusa-1		25	8
47.	Shivalaya	Dhading	Jogimara-9		12	6
48.	Shiv Mandir	Dhading	Jogimara-9		64	8
49.	Shiv Mandir	Chitwan	Darechowk-3, Pipal Chautara		50	8
50.	Shiv Parbati Mandir	Chitwan	Darechowk-3		25	8
51.	Siddha Baba mandir	Chitwan	Darechowk-4		75	4
Benighat-Narshimhatar Section						
52.	Regmi Kul Devata mandir		Ghyalchowk-5	Ganda ki RM	72	4
Sisnekhola-Dharke Section						
53.	Shiv Mandir + Krishna Mandir	Dhading	Jeevanpur-9	Dhuni Besi Municipality	64	6
54.	Mane Cultural Structure	Dhading	Jeevanpur		16	1
55.	Bhubaneshwor Mandir	Dhading	Jeevanpur-9, Dharke		600	5
56.	Krishna/Mahadev Mandir	Dhading	Jeevanpur-9, Dharkebas		600	20
57.	Siddeswor Mahadev Mandir	Dhading	Naubise-3		400	15

Source: Field Survey, 2016 (Detail table in Annex)

5.3.21. Tourism

Nepal Tourism Policy (2009) identifies tourism sector as an important vehicle for economic and social development. According to Tourism Development Board, around half of the tourist arrived in Nepal with purpose of holiday celebration and pleasure.

To boost the revenue generation the government has emphasis on improvement in tourism industry all over the country. So, that the government has committed to develop all major tourist destinations (Pilgrimages site, Heritage & Historical sites, Natural beauty & scenery destinations etc.) to enhance their attraction and provide opportunities for visitor's easy access.



In project area tourism related business, i.e. Hotels, Cottages, Home stay, etc. has been conducted by local and outer people. According to Tourism Statistic Data (2015) it is shown that 100 HHs (221 rooms with 398 beds) has been registered for home stay services for local and foreigners in project districts. Water sports (Rafting in Trishuli River), Hiking & Tracking/mountaineering, Manakaman temple & Cable car, Gorkha Durbar, Chitwan national park, Cultural programmes etc. are the main attractions for domestic and international tourist of the project district.



Figure 5-32: Rafting is one of the tourism development opportunities along the KNM section

Table 5-64: Registered home stay management by types, affiliated house, room and bed 2015

District	No. of Affiliated House	Type	2015 Total	
			No. of Room	No. of Bed
Kathmandu	52	Community	80	148
	34	Private	114	198
Total	86		194	346
Dhading	5	Community	9	18
	0	Private	0	0
Total	5		9	18
Chitwan	7	Community	14	28
	2	Private	4	6
Total	9		18	34
Gorkha	NA	Community	NA	NA
	NA	Private	NA	NA
Total	NA		NA	NA
Grand Total	100		221	398

Source: Nepal Tourism Statistics 2015, Department of Tourism

5.3.26 Identification of Potential Economic Activities

Preliminary findings show that bricks/tiles production, handmade paper manufacturing, handicraft production, construction materials production, food processing, vegetable farming, livestock farming, dairy production, hotel/lodge business, water adventure (rafting) business etc. related economic activities have been practiced in the project area.

Tourism sector (home stay, hotel/lodge, tracking/hiking, rafting) business, Agro-business (vegetable farming, livestock farming), Milk production, Handicraft production, etc. have been recognized as potential economic generating activities in project area.

5.3.22. Local NGOs and Community Based Organizations

Some NGOs and clubs are working in the field of Water supply (Drinking water and Irrigation), Health & Sanitation, Sports, Women awareness, and support for Income generating activities in project area.

5.3.23. Identification of Vulnerable Groups

There is few HHs of vulnerable groups like, ethnic minorities (Chepang, Danuwar, Majhi), religious minority (Muslim), women headed households and aged member households in the project area. Dalits, ethnic minorities, women headed households, below poverty level income households and aged member households are categorized under vulnerable. Some special support assistance will be provisioned to the project affected vulnerable people.

5.3.24. Vulnerability of Project Affected Families

The preliminary field study shows that the Brahmin/Chhetri is the largest caste/ethnic groups having 59.7% (2387) of the total HHs followed by Janjati 31.1% (1242), Dalit 2.7% (107), Others 2.7% (106), Chepang/Parja 2.1% (83), Muslim 0.9% (34), Sanysi 0.8% (33) and Madheshi 0.2% (6) HHs are identified in the different settlement of project affected area.



CHAPTER 6: Consultations and Public Hearing

6.1 Consultations with local communities and stakeholders

Public consultation and involvement is important part of the EIA process. At the stage of field studies, the meetings, consultations, interviews and workshops were organized to collect opinions of various stakeholders about upgrading of existing road and construction of two new alignments. At each meeting, an introduction of the project was briefed, making stakeholders fully aware of the purpose of the project implementation. While preparing the EIA Study and according to Rule 7 of EPR, the concern people and institutions has been informed regarding the Proposal, the EIA Study has been conducted and on possible impacts of implementation of the proposal on the socio-economic and cultural, physical, chemical and biological environment. Matters included in the Recommendation Letters from affected municipalities and rural municipalities.

- Impacts on local schools, Health posts, community infrastructures due to project and proposed mitigation measures;
- Other impacts on local environment due to the project and mitigation measures proposed;
- Impact on Community Forests and its users, and mitigation measures proposed. Any subject matter that is not concerned with the project has been clearly indicated.

Interaction meetings:

Several meetings were held as a part of the study. The objective was to a) inform interested stakeholders about the project and b) acquire information on available forest biology in the PA and ZOI and discuss issues on potential impact in the result of project implementation on the forest biology and user/local lifestyle during construction and operations of the road. The various stakeholders were invited to participate in the meetings, including DFO staff, Community Forest User Groups, local elites, local representatives from political parties and other stakeholders from affected and nearby Villages, affected and nearby community Forest user groups of Kathmandu, Dhading, Gorkha and Chitwan districts in the field. Concerned stakeholders from the Department of Forests and Ministry of Forests and Environment were also informed and involved in the consultation process.

At those meetings, anticipated environmental impacts that likely may occur during construction and operation phases were shared and discussed. Alignment maps, project materials and other information were also shared and presented during the meetings. Consultant and relevant experts delivered all aspects of forest biology and its interrelation to the project, proposed actions and their potential negative and positive impacts in an open and transparent manner and without any pressure. Through these meetings, concerned participants were requested to provide their comments and suggestions, foreseen impact on the forests resources and their own lifestyles and issues on the development.



Focus Group Discussion and Key Informant Interview:

The meetings and discussions were organized to acquire information, for which Focus Group Discussions and Key Informant Interviews were carried out. In the results, information on biological environment, management issues of community forests and their public concerns were acquired. Community Forest User Groups (CFUG), other local committee (CC, as available), representatives of political party (PP) and Ward office representatives, and DFO staff were consulted. It was ensured that not only those who directly affected by road construction, but also other concerned groups from the adjoining Community Forests attained the meetings.

6.2 Public Notice and Public consultation

15 days Public Notice seeking the written opinions from the concerned stakeholders has been also published in a national newspaper. Similarly, Public Notice has been affixed at the offices of Rural Municipality, Municipality, School, Health Post and other local bodies as far as possible of the concerned District, and a public deed of act (*Muchulka*) has been collected confirming the pasting of such notice. Any comments or suggestions from the concerned stakeholders and affected peoples has been collected.

Interaction meetings have been carried out in order to disclose the outline during scoping stage and informed all interested stakeholders of the project area. Study team also discussed with DDC (Now District Coordination Committee, DCC) in order to carry out consultation process and requested to summon all the stakeholders like Ward chairman, District Forest Office, District Coordination Committee Office (earlier DDC), District Administration Office, local NGOs working in the area, etc. The DCC were of the view that the consultation shall be carried out at the project affected VDCs (Now Rural Municipalities) along the alignment. Hence, prior to public consultation; study team requested DCC by sending formal letter to invite all the relevant stakeholders, ward chairman and other representatives, and representatives from the political parties etc.

Public consultation was carried out in two stages. One; by the walkover survey team with the local inhabitants and another by the study team at respective Rural Municipal offices in presence of secretary of Municipality and DCC representatives including local representatives from the major political parties, teachers, indigenous Chepangs, business persons, representatives from citizen forum, local journalists, local NGOs, social mobilizers, local farmers and locals, etc. Further, DDC (Now DCC) office Dhading and Gorkha were visited in order to conduct informal meeting and to fix proper date and location for DDC (Now DCC) level meeting along the alignment as well as in the respective ward chairman. The DDC (Now DCC) staffs requested us to carry out such interaction meetings near to the proposed alignment, and it was not necessary to carry out such meetings at DDC (Now DCC) headquarters. Hence, letters of invitation were issued to project affected DDCs (Now DCC) and also requested to invite all the representatives from the project affected Rural Municipalities (earlier VDCs) in the meeting. Invitation letters were distributed at least 15 days prior the meetings.



Public consultation/interaction meetings were carried out at 5 locations along the project alignment dividing all the project VDCs (Now RM) and Municipality into clusters with each cluster comprising 4 to 5 projects affected VDCs (Now RM). The consultant made a brief presentation of the findings of the preliminary assessment, key environmental and social issues of the project and plan of the EIA and other environmental and social planning studies. The key stakeholders from RM representatives, and representatives from the political parties etc. participated in the meeting. The comments and suggestions received from the participants had been collected and incorporated in scoping and TOR documents. Consultation process has been documented, including feedbacks received, and outline updated in order to take the feedback into account. All the collected information has been analyzed and incorporated while preparing this Scoping document. The schedule of public consultation is presented in the following table.

Table 6-1: Date and Venue of the Public Consultation

Sn.	District	Municipality/VDCs	Venue for Public Consultation	Public Consultation Date
1.	Kathmandu	Chandragiri municipality	Naubise VDC office, Khanikhola, Naubise, Dhading	13 th Margha, 2073 (26 th January, 2017)
	Dhading	Chhatreaurali VDC		
	Dhading	Naubise VDC		
	Dhading	Thakre VDC		
	Dhading	Bhumisthan VDC		
	Dhading	Jiwanpur VDC		
2.	Dhading	Baireni VDC	Pida VDC office, Ghatbesi, Dhading	14 th Margha, 2073 (27 th January, 2017)
	Dhading	Pida VDC		
	Dhading	Gajuri VDC		
	Dhading	Benighat VDC		
3.	Dhading	Dhusa VDC	Jogimara VDC office, Majhimtar, Dhading	17 th Margha, 2073 (30 th January, 2017)
	Dhading	Jogimara VDC		
	Gorkha	Bhumlichok VDC		
4.	Gorkha	Ghyalchok VDC	Siurenitar, Ghyalchowk, Dhading	17 th Margha, 2073 (30 th January, 2017)
5.	Gorkha	Tanglichok VDC	Janajagriti Primary School, Buttar, Makaising VDC, Gorkha	18 th Margha, 2073 (31 st January, 2017)
	Gorkha	Makaising VDC		
	Gorkha	Taklung VDC		
	Chitawan	Darechok VDC		

Table 6-2: Numbers of Participants in the Interaction Meetings

Sn.	Date	Interaction Location	Number of Participants			Participants From
			Male	Female	Total	
1.	26 January, 2017	Naubise VDC office, Khanikhola, Naubise, Dhading	32	3	35	Dharke, Jivanpur, Bhumesthan, Naubise
2.	27 January, 2017	Pida VDC office, Ghatbesi, Dhading	26	4	30	Pida, Benighat, Gajuri, Adamghat, Baireni, Kiranchok
3.	30 January, 2017	Gogimara VDC Office, Majhimtar, Dhading	32	4	36	Dhusa, Jogimara,

Sn.	Date	Interaction Location	Number of Participants			Participants From
			Male	Female	Total	
4.	30 January, 2017	Jogimara, Majhimtar (With chepang community)	14	-	14	Jogimara VDC- 1,2,3, 6,7and 8 no. wards
5.	31 January, 2017	Siurenitar Market Area, Gorkha	17	2	19	Siurenitar, Ghyalchok
6.	31 January, 2017	Buttar, Makaising VDC, Gorkha	39	5	44	Makaising, Tanglichok

Source: Field Survey, 2016

6.3 Public Hearing

Public hearing has been carried out at four locations along the entire stretch of road alignment, covering all project affected Rural Municipalities and Municipalities. Public hearings have been carried out after preparing the draft of EIA. For Public Hearing, a leaflet has been prepared in Nepali language with major findings, potential impacts and suggestions as well as suggested mitigation measures and has been distributed to all concerned stakeholders during Public Hearing Programme. The program has been conducted with participation of representatives of DoR, DFO, DDC, CDO, NGOs, CBOs, political parties and other public representatives. Further, the recommendation letters have been collected from all project affected rural and urban municipalities and has been attached to the final EIA report.

Table 6-3: Location of public hearing

Sn.	Venue of public hearing	Date of public hearing	Number of participants	Gender	
				Male	Female
1.	New Activities Youth Club, Ward 9, Khatripauwa, Dhunibesi Municipality.	April 9 2018 (२०७४/१२/२६)	52	41	11
2.	RIMS Hall, Jintetar, Bairani Ward 6, Galchhi Rural Municipality	April 10 2018 (२०७४/१२/२७)	57	52	5
3.	Ward office of Bishaltar Ward 5, Benighat-Rorang Rural Municipality	April 11 2018 (२०७४/१२/२८)	95	88	7
4.	Agricultural Hall, Phisling, Gandaki Rural Municipality	April 12 2018 (२०७४/१२/२९)	55	47	8

6.4 Public Consultation and Disclosure Plan

Disclosure of project

The scoping process for this project has been carried out publishing public notice and affixing notice on the notice board of local bodies under Environmental Protection Rules 1997 (EPR



1997) and the TOR for the EIA were approved on 13 March 2018 (2074/10/29) by Ministry of Forests and Environment (MoFE) during the scoping process. The new road corridor along the Sisnekhola-Dharke has many affected premises on either side of the ROW and there is a requirement for the compensation of private lands and resettlement of affected people (AP). The preliminary design has been disclosed to the public and Public Hearings have been conducted (as required under EPR 1997) on 9, 10 11, 12 April 2018 based on the designs prepared by detail design consultant.

There were no major objections to the alignment during the scoping phase of public disclosure. During the scoping processes, some additional administrative units just outside the ROW were included in the formal disclosure in order to anticipate any minor adjustment to alignment that might take place in the detailed design stage.

General issues raised during hearing are as follows;

- Right of Way should be 30 m instead of 50;
- Appropriate compensation for loss of property and land
- Replacement of affected infrastructure
- Proper disposal of soil and wastes
- Public participation in decision making should be guaranteed
- Avoiding/minimizing impact on environment and land

Specific issues raised during hearing are as follows;

- Suggestions for construction of new alignments;
- Cumulative impacts due to construction of several highways in Dhunibeshi municipality
- Mitigation of landslide risks during construction of Bishaltar-Phishling
- Establishment of ward level Grievance Redress Mechanism
- Ensuring priority for local employment during road upgrades/ construction

Translation of Minutes from Public Hearing attached in Annex 11

Dhunibeshi Municipality

1. The proposed alignment should be rerouted to avoid the meadows and cultivated areas owned by locals of ward No. 9 and 5 of Dhunibeshi Municipality.
2. There are 3 National Highways proposed within the span of 1 KM in Dhunibeshi Municipality, which will cause a significant loss of cultivable lands and private properties. So, the proposed Sisnekhola-Dharke alignment is questionable and thus the alignment is deemed to be unnecessary.
3. All the public infrastructures such as canals, local water supply pipelines and taps should be rebuilt.
4. In the course of road expansion, new recreation facilities and parks should be build.



5. Some locals haven't yet received the compensation for the loss of the properties incurred during the construction of Tribhuvan Highway. So, people are doubtful about the appropriate compensations they ought to receive. Therefore, locals should be assured about the compensation for any loss of properties resulting from the expansion of road.
6. The right of way should be reduced to 30 m from 50 m.
7. Another public hearing should be conducted in presence of locals, stakeholders and the proponents.

Galchhi Rural Municipality

1. The road expansion should be done keeping the center as it is in the existing road. The center-line of the road should be fixed before commencing any construction activities.
2. The spoil and the waste generated during construction should be disposed off properly and should not be dumped in the river.
3. The road expansion should be carried in both sides rather than encroaching a particular side. Similar consideration should be given while constructing bridges and installing culverts drainage and other structures.
4. Locals with unregistered landholdings, whose properties fall in Right of Way of the road should also be provided with proper compensation.
5. Rather than upgrading the existing road alignment, new alignment should be constructed on the opposite side of the Trishuli River.
6. Bishaltar-Phisling road alignment should be upgraded and constructed where necessary.

Benighat-Rorang

1. There should be uniformity in the expansion of road all along from Naubishe to Mugling.
2. Construction of new alignment "Bishaltar-Fisling" should be justified and the risks of landslides in that section should be mitigated.
3. There should be the presence of the proponents and the engineers from the design team in the public hearing.
4. Any expansion work that will be carried out beyond 30 m Right of Way should be done with proper compensation to the affected locals.
5. The confusion prevalent regarding Right of Way (RoW) should be made clear.
6. Despite having the alternatives for road construction in Bishaltar- Phisling section to avoid cultivable land, current proposition passes through the cultivable areas. This must be justified.
7. All the compensations necessary should be provided as per the current market rates prior to commencing any construction activities.
8. Public participation in decision making should be given due consideration.
9. Resettlement and rehabilitation plans for those displaced by road expansion must be done.
10. Tree plantation should be carried out on both sides of the road.

11. Grievance redress mechanism should be developed in every ward in coordination with ward chiefs while carrying out the project activities.
12. Locals do not have any opposition regarding the expansion of road, however, the locals must be pre-informed well about all the activities and the role of state in such matters should be made clear to the public.

Gandaki Rural Municipality

1. The Right of Way should be 30 m as demanded by local stakeholders.
2. The road construction should begin as soon as possible as the people are in a dire need of the road.
3. All the affected households during the road construction and expansion should be provided with compensation as per the existing market rates.
4. The households which lose all their properties due to the road construction and expansion should be provided with resettlement alternatives.
5. Family members of affected households as mention in point No. 4 should be assured of employment opportunities and income generating sources by the project.
6. Ward level Grievance redress mechanism should be developed while implementing the project.
7. Proper disposal of spoil and waste generated during construction activities should be ensured so as not to harm the local environment
8. Tree replantation should be done to compensate for the loss of trees during construction of road.
9. Measures shall be taken to minimize the impact on environment, and proper structures to avoid soil erosion and landslides such as retaining wall, gabion wall etc. should be constructed.
10. The priority should be given to locals for employment as per their skills during the project implementation.
11. The construction of culverts, canals and drainage should be done properly so as to avoid impact on water bodies.
12. Existing public infrastructures such as schools, temples, resting places, public water supply should be rebuilt if they incur any losses or the loss of such infrastructures should be minimized as much as possible.

Further, supplementary consultation was conducted according to suggestion provided by the participants during public hearing. The supplementary consultation was aim to acquire consensus from locals about the proposed mitigations measures and facilities proposed along the alignment such as flyover bridges and its prosed locaation, and establishment of public toilets etc. The minutes of supplementary consultation is presented in Annex 12. The supplementary consultation was conducted at 23 locations along the existing KNM alignment and proposed two new alignments. The response provided during the consultation was positive. All the participants expressed willingness to provide protection for the implemented infrastructure during operation.



Table 6-4: Supplementary public consultation

Sn.	Date	Interaction Location	Number of Participants			Participants From
			Female	Male	Total	
1.	2075/03/12 June 26 2018	Dhunibesi Municipality-9	4	9	13	Dhunibesi-9
2.	2075/03/12	Dhunibesi Municipality-8	2	13	15	Dhunibesi-8
3.	2075/03/12	Dhunibesi Municipality-6	1	13	14	Dhunibesi-6
4.	2075/03/13 June 27 2018	Thakre Rural Municipality-6	3	10	13	Thakre-6
5.	2075/03/13	Thakre Rural Municipality-2	3	9	12	Thakre-2
6.	2075/03/13	Thakre Rural Municipality-1	6	7	13	Thakre-1
7.	2075/03/14 June 28 2018	Galchi Rural Municipality-6	16	10	26	Galchi-6
8.	2075/03/14	Gajuri Rural Municipality-5	4	19	23	Galchi-5
9.	2075/03/14	Gajuri Rural Municipality-6	6	3	9	Gajuri-6
10.	2075/03/14	Gajuri Rural Municipality-1 (Market area 37+600)	4	27	31	Gajuri-1
11.	2075/03/15 June 29 2018	Gajuri Rural Municipality-1 (Near traffic post 37+850)	3	11	14	Gajuri-1
12.	2075/03/15	Gajuri Rural Municipality-2 Malekhu	-	14	14	Gajuri-2
13.	2075/03/15	Benighat Rorang Rural Municipality-3	6	9	15	Benighat Rorang-3
14.	2075/03/15	Benighat Rorang Rural Municipality-3 Malekhu Petrol Pump	1	13	14	Benighat Rorang-3
15.	2075/03/16 June 30 2018	Benighat Rorang Rural Municipality-5 Benighat	2	10	12	Benighat Rorang-5
16.	2075/03/16	Benighat Rorang Rural Municipality-5 Bishaltar	5	11	16	Benighat Rorang-5
17.	2075/03/16	Benighat Rorang Rural Municipality-7 Charaundi	3	12	15	Benighat Rorang-7
18.	2075/03/16	Benighat Rorang Rural Municipality-9 Majhimtar	4	9	13	Benighat Rorang-9
19.	2075/03/17 June 31 2018	Ichchakamana Rural Municipality-4 Kurintar	2	9	11	Ichchakamana-4
20.	2075/03/17	Ichchakamana Rural Municipality-4 Ramailodanda	6	7	13	Ichchakamana-4
21.	2075/03/17	Ichchakamana Rural Municipality-5 Mugling	3	9	12	Ichchakamana-5
22.	2075/03/12 June 26 2018	Dhunibesi Municipality-5	1	16	17	Dhunibesi-5
23.	2075/03/16 June 30 2018	Gandhaki Rural Municipality-7 Jyamirghat	36	1	37	Gandhaki Rural Municipality-7 Jyamirghat



Table 6-5: Issues raised during consultation at scoping stage

S.No	VDC/Municipality	Settlement	Date	Participants			Issues raised in consultation
				Male	Female	Total	
1	Naubise-4	Lapshi Khola	2073/5/6	9	5	14	➤ Reasonable compensation should be provided for affected property (fall within 25 m) ➤ Appropriate wall construction in steep slope area along the roadside. ➤ Zebra crossing spot should be marked in Bazar area and dense settlement areas. ➤ Road expansion work should be conducted equally in each side.
2	Naubise-1	Dharke	2073/5/8	10	6	16	➤ Prior to road extension work, compensation should be provided to affected structures (fall within 25 m). ➤ Appropriate structures like Gabion works, wall etc. should be constructed according to geography conditions. ➤ During the construction period employment opportunity should be provided for project affected household families. ➤ Skill based training should be provided for project affected household families.
3	Naubise-3	Dharke	2073/5/9	10	3	13	➤ Reasonable compensation should be provided for affected property (fall within 25 m) ➤ Road affect households should be sifted according to resettlement plan before construction work. ➤ Road safety sign and structures i.e. overhead bridge, Zebra crossing should be design in Mahadev Besi bazar area.
4	Bhumesthan-6	Simle Bazar	2073/5/10	17	1	18	➤ Reasonable compensation should be provided to affected property (fall within 25 m) ➤ To prevent landslide, appropriate structures like Gabion works, wall etc. should be constructed according to geography conditions.
5	Baireni-9	Baireni Bazar	2073/5/10	7	5	12	➤ Reasonable compensation should be provided for loss of private property (fall within 25 m) ➤ Road safety sign i.e. Zebra crossing sign in Baireni bazar area.
6	Pida-1	Adhamghat	2073/5/11	9	3	12	➤ Road improvement/widening works should start rapidly. ➤ Skill based training should be provided for project affected household families. ➤ Road safety sign i.e. Zebra crossing sign in Adhamghat bazar area.
7	Gajuri-1	Gajuri Bazar	2073/5/12	10	5	15	➤ Only 75 fit structures clear during the road improvement/widening ➤ Frequently changed ROW rule create confusion in local level

S.No	VDC/Municipality	Settlement	Date	Participants			Issues raised in consultation
				Male	Female	Total	
8	Benighat-1	Malekhu Bazar	2073/5/13	5	4	9	➤ Road safety sign i.e. Zebra crossing sign in Gajuri bazar area ➤ Reasonable compensation should be provided to affected property (fall within 25 m) ➤ Road safety sign i.e. Zebra crossing sign in 3/4 spot of Malekhu bazar area. ➤ To prevent landslide, appropriate structures like Gabion works, wall etc. should be constructed according to geography conditions.
10	Benighat-8	Benighat Bazar	2073/5/14	13	6	19	➤ Reasonable compensation should be provided to affected property (fall within 25 m) ➤ There is not any losses and compensation needed if the ROW will be fixed on 30 m. So, requested for revise the ROW to 30 m.
11	Dhusha-1	Charaudi Bazar	2073/5/15	8	5	13	➤ Reasonable compensation should be provided to affected property (fall within 25 m) ➤ Road safety sign i.e. Zebra crossing sign in Charaudi bazar area.
12	Jogimara-1	Hugdi Khol	2073/5/15	9	6	15	➤ Reasonable compensation should be provided to affected property (fall within 25 m) ➤ Highway should not be affected during rural road construction. Most of rural road link points have damaged the highway.
13	Darechok-7	Darechok	2073/5/17	16	8	24	➤ Reasonable compensation should be provided to affected property (fall within 25 m)
14	Darechok-4	Mugling Bazar	2073/5/18	12	5	17	➤ Reasonable compensation should be provided to affected property (fall within 25 m) ➤ Business hold households should be resettled within commercial location within the road alignment. ➤ Constructed new road should be 4 lane wide. ➤ In Darechok VDC there is still 15 m land are being selling and buying in practice, so the compensation amount should be equal with AILAYANI land.
15	Makaising -2	Makaising	2073/5/18	16	3	19	➤ New alignment should be fixed through public land in possible place. ➤ Reasonable compensation should be provided to affected property and agricultural land (fall within 25 m) ➤ The proposed alignment will be support to seal agro based production and easy in transportation good. ➤ Entire sector will be developed if the proposed alignment approved. ➤ It will help to easy access in health and education sector.



S.No	VDC/Municipality	Settlement	Date	Participants			Issues raised in consultation
				Male	Female	Total	
16	Tanglichok -9	Gorditar	2073/5/19	10	2	12	➤ Reasonable compensation and resettlement programme should be provided to affected property and agricultural land (fall within 25 m) ➤ The proposed alignment will be support to seal agro based production and easy in transportation good. ➤ Entire sector will be developed if the proposed alignment approved. ➤ It will help to easy access in health and education sector.
17	Bhumlichok - 8	Kaudiphant	2073/5/20	7	2	9	➤ Reasonable compensation and resettlement programme should be provided to affected property and agricultural land (fall within 25 m) ➤ The life of local people will be easy if the proposed road pass through the Bhumlichok of Kaudiphant settlement. ➤ Skill based training should be provided for project affected household families.
18	Ghyalchok-5	Baltar	2073/5/20	17	5	22	➤ Reasonable compensation and resettlement programme should be provided to affected property and agricultural land (fall within 25 m) ➤ Local should use in construction work. ➤ Skill based training should be provided for project affected household families.
19	Jiwanput-9	Jiwanpur	2073/5/21	8	2	10	➤ Reasonable compensation should be provided to affected property (fall within 25 m) ➤ To prevent landslide, appropriate structures like Gabion works, wall etc. should be constructed according to geography conditions ➤ Public land and river bank should be followed to protect productive agricultural land.



CHAPTER 7: Alternatives of the Proposal

7.1 Proposal Design, Location and Implementation Methods

7.1.1 Basis of Selection of the Road Alignment

Different alternative routes identified and prioritized by feasibility consultant have been analyzed. The alternative routes identified and studied focuses on major two options as Two-Lane Option and Four-Lane Option, including existing road upgrading and new road. Summary of the options are:

A. Two Lane Road Options

1. Kathmandu (Nagdhunga) – Naubise Road
 - a. Minor Improvement of Existing Road
 - b. Improvement of Existing Road with Tunnel and Bypass
 - c. New Road Alignment from Sisne Khola to Dharke
2. Naubise-Mugling Road
 - a. Improvement of Existing Road to Two Lane except at Difficult Area
 - b. Improvement of Existing Road to Two Lane
 - c. Two Lane New Alignment from Benighat to Phisling

B. Four Lane Road Options

1. Kathmandu (Nagdhunga) – Naubise Road
 - a. Minor Improvement of Existing Road plus Two-Lane New Road
 - b. Improvement of Existing Road with Tunnel and Bypass plus Two-Lane New Road
 - c. Four-Lane New Road.
2. Naubise – Mugling Road
 - a. Upgrading of Existing Road to Four-Lane with Two-Lane Split-Level Road at Difficult Areas
 - b. Upgrading of Existing Road to Four-Lane Plus Partial Two-Lane New Alignment at Difficult Areas.

The studies to assess the environmental and social impacts were conducted in the full stretch of Kathmandu-Naubise-Mugling road section and the alternative alignments considered in the feasibility study. Six options, considered in the feasibility study by the feasibility consultant, are presented below in the following **Table 7-1**

Table 7-1: Alternative Alignments Considered

Alternative 1	Improvement of existing road to 2-Lane standards with curve improvement and additional 2 bridges at Khatripauwa and Naubise and 4-lanes in Urban Areas.
Alternative 2	Improvement of existing road to 2-Lane standards with curve improvement and Tunnel Bypass and 4-lanes in Selected Urban Areas.
Alternative 3	Improvement of existing road to 2-Lane standards with curvment improvement and construction of additional 2-lane new alignment from Sisnekhola-Dharke and 4-lanes in Selected Urban Areas.
Alternative 4	Minor improvement and 2-Lane standards new lane Sisnekhola-Dharke; construction of 4-lanes from Dharke to Benighat; improvement of existing road from Benighat to Mugling into 2-lanes and 2-lane new alignment on right bank of Trishuli River from Benighat to Kurintar.



Alternative 5	Improvement of existing road from Nagdhunga to Dharke into 2-Lane standards with curvment improvement and Tunnel Bypass and construction of additional 2-lane new alignment from Sisnekhola-Dharke; 4-lanes from Dharke to Benighat; improvement of existing road from Benighat to Mugling into 2-lanes and 2-lane new alignment on right bank of Trishuli River from Benighat to Kurintar.
Alternative 6	Improvement of existing road from Nagdhunga to Mugling into 2-Lane standards with additional 2 bridges at Khatripauwa and Naubise and construction of additional 2-lane new alignment from Sisnekhola-Dharke and 2-lane new alignment on right bank of Trishuli River from Benighat to Phisling.

Alternative Alignment-6

Improvement of Nagdhunga – Naubise part to 2-lanes and providing additional 2-lanes by the new alignment from Sisnekhola to Dharke has been proposed. The existing Nagdhunga-Naubise section has been improved into 2-lane standards; whereas the proposed new alignment (Sisnekhola-Dharke) starts from Sisnekhola and passes through the Nisakot Community forest situated at Naubise-3. Approximately, 5500 meters of the section starting from the Sisnekhola has been proposed on the hilly terrain. The alignment proposed through the Waglethok and Rupakot of the Naubise and gradually declines towards the flat cultivated land and has been proposed through the left bank of Dhuni Khola at the northern border of United Cement Factory compound. Approximately 180 m tunnel has also been proposed at Waglethok settlement area in order to pierce the hill and reach to other side before it decline towards flat cultivated land. The alignment then proposed through the undulation landscapes, where most part of land has been used for cultivation. The alignment crosses existing river (Mahesh Khola) at chainage 8+600 near the confluence of Dhuni Khola and Rupse Khola and proposed alignment crosses several small natural drainages, cultivated lands before it reaches to Dharke to meet the existing highway.

Existing road section between Dharke and Benighat has been proposed to improve into 2 lanes (82.64 Km); the Benighat to Kurintar section will be improved to 2 lanes by improving existing 2-lane standard highway.

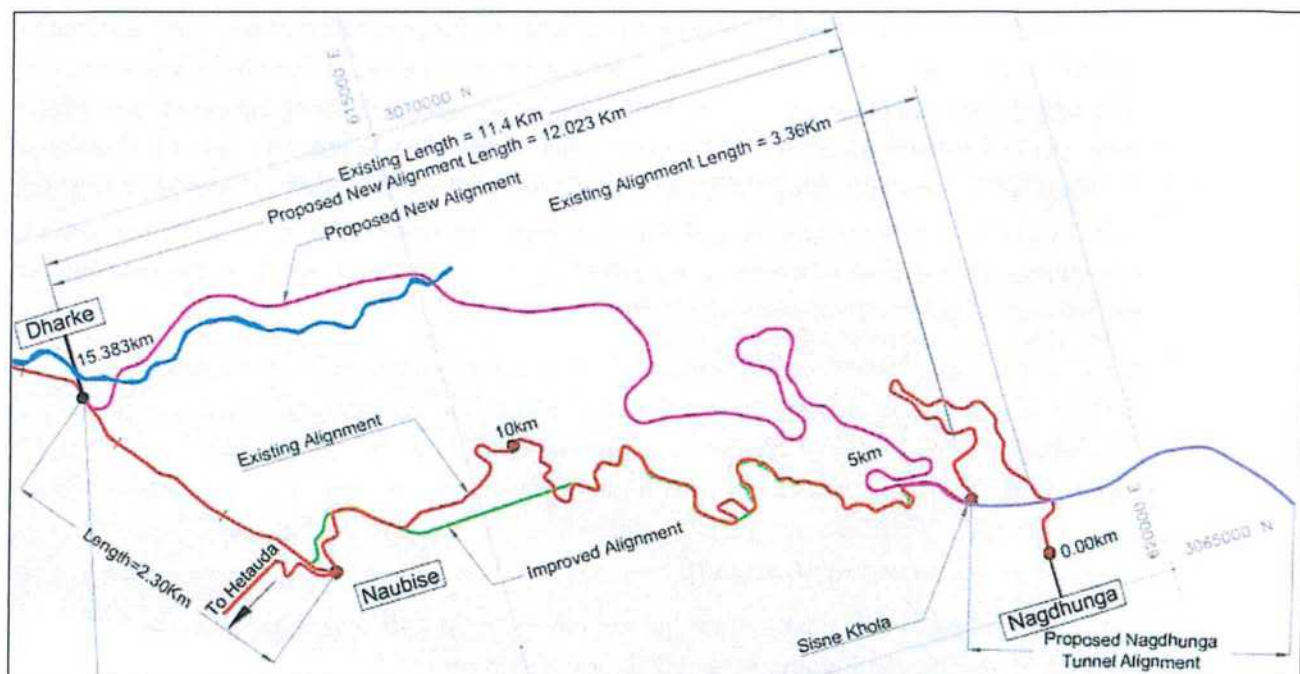
Further, new lane from Benighat has been proposed on the right bank of the Trishuli River and it lies in the Gorkha District. Approximately, 15 km of the new alignment from Benighat to Phisling on the right bank of the Trishuli River is proposed on cultivated land. Moreover, new alignment has also been proposed from Benighat to Phisling through the right bank of Trishuli River which is approximately 15 km. The proposed alignment starts near the settlement area of Benighat and traverse through cultivated land before it reaches to Trishuli River. The proposed alignment then switches to the right bank of the river and traverse through cultivated lands and settlements, undulation terraces and steep and fragile mountain comprising community forests before it reaches to the Phisling. The first one-third of the alignment comprises flat cultivated land, whereas second one-third of the alignment comprises cultivated terraces with undulation planes and last one-third of the section comprises steep hilly area with vegetation cover. Approximately, 8 Km of the proposed new Benighat to Phisling alignment will pass through the community forest area on the right bank of Trishuli River. Finally, existing 2-lane from Kurintar to Mugling section has been improved (12.71 Km) into acceptable highway condition.



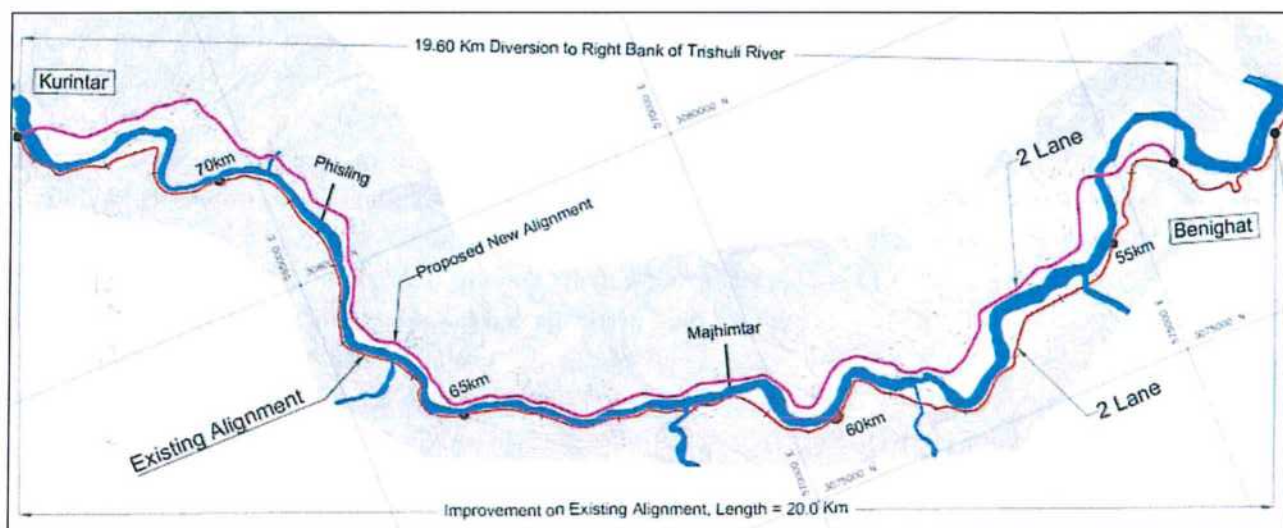
Table 7-2: Road Improvement Options

Lane	Option	Brief Description of Option	Brief Description of Sub-option		Brief Description of Sub-option	
			Option 1-a	Option 1-b	Option 1-a	Option 1-b
2 Lane option	Option 1	Section 1 : Minor Improvement of Nagdhunga – Naubise Road	• No new alignment	• No new alignment	• No new alignment	• No new alignment
		Section 2 : Improvement of Naubise – Mugling Road to 2 Lane.	• New Bridge 1 at Khatripauwa	• New Bridge 1 at Khatripauwa	• New Bridge 2 at Naubise	• New Bridge 2 at Naubise
	Option 2	Section 1 : Improvement of Nagdhunga – Naubise Road with Tunnel/Bypass	• New Bridge 2 at Naubise	• No new alignment	• No new alignment	• No new alignment
			• Narrow Carriageway width at steep areas	• 7m carriageway width throughout length	• 7m carriageway width throughout length	• 7m carriageway width throughout length
		Section 2 : Improvement of Naubise – Mugling Road to 2 Lane.	• No new alignment	• No new alignment	• No new alignment	• No new alignment
			• Tunnel 1 = 100m Cut&Cover	• Tunnel 1 = 100m Cut&Cover	• Tunnel 2 = 410m	• Tunnel 2 = 410m
4 Lane option	Option 3	Section 1 : New Alignment from Sisne Khola to Dharke	• Bypass 1 = 770m Khani Khola	• Bypass 1 = 770m Khani Khola	• Bypass 2 = 596m, Naubise	• Bypass 2 = 596m, Naubise
			• Bypass 2 = 596m, Naubise	• No new alignment	• No new alignment	• No new alignment
	Option 4	Section 1 : Minor Improvement of Existing Nagdhunga – Naubise Road and 2 lane new Road from Sisne Khola to Dharke	• Narrow Carriageway width at steep areas	• Narrow Carriageway width at steep areas	• 2 Lane, New align. L= 11.97 km	• 2 Lane, New align. L= 11.97 km
			• Tunnel L = 140m	• Tunnel L = 140m	• Tunnel L = 140m	• Tunnel L = 140m
		Section 2 : Improvement of Naubise – Benighat to 4 Lane, Benighat to Mugling to 2 lane and New Alignment from Benighat to Kurintar 2 lane	• No new alignment	• No new alignment	• No new alignment	• No new alignment
			• New Bridge 1 at Khatripauwa	• New Bridge 1 at Khatripauwa	• New Bridge 2 at Naubise	• New Bridge 2 at Naubise
2 Lane option	Option 5	Section 1 : Improvement of Naubise – Benighat to 4 Lane, Benighat to Mugling to 2 lane and New Alignment from Benighat to Kurintar 2 lane	• 2 Lane, New align. L= 11.97 km, Tunnel L = 140m	• Naubise ~ Benighat - 4 Lane, L=52.92 km, except at difficult areas	• Benighat ~ Kurintar - 2 Lane, New align. L= 19.87 km, Rt. Bank of Trishuli River	• Benighat ~ Kurintar - 2 Lane, New align. L= 19.87 km, Rt. Bank of Trishuli River
			• Benighat ~ Kurintar - 2 Lane, New align. L= 19.87 km, Rt. Bank of Trishuli River	• No new alignment	• No new alignment	• No new alignment
	Option 6	Section 1 : Improvement of Naubise – Benighat to 4 Lane, Benighat to Mugling to 2 lane and New Alignment from Benighat to Kurintar 2 lane	• Tunnel 1 = 100m Cut&Cover, Bypass 1 = 770m Khani Khola, Naubise ~ Benighat - 4 Lane, L=52.92 km, except at difficult areas	• Tunnel 2 = 410m	• Tunnel 2 = 410m	• Tunnel 2 = 410m
			• Benighat ~ Kurintar - 2 Lane, New align. L= 19.87 km, Rt. Bank of Trishuli River	• Benighat ~ Kurintar - 2 Lane, New align. L= 19.87 km, Rt. Bank of Trishuli River	• Benighat ~ Kurintar - 2 Lane, New align. L= 19.87 km, Rt. Bank of Trishuli River	• Benighat ~ Kurintar - 2 Lane, New align. L= 19.87 km, Rt. Bank of Trishuli River
		Section 2 : New Alignment from Benighat to Kurintar 2 lane	• No new alignment	• No new alignment	• No new alignment	• No new alignment
			• 7m carriageway width throughout length	• 7m carriageway width throughout length	• 7m carriageway width throughout length	• 7m carriageway width throughout length





Map 7-2: Existing alignment with proposed new Sisnekhola-Dharke alternative



Map 7-1: Existing alignment with proposed new assessed alignment on right bank of Trishuli River starting from Bishaltar.

7.1.2 Comparative Assessment of Alternative Alignments

The consultant coordinated and interfaced with the separately contracted consulting team under the NIRTTP project, carrying out feasibility study for improvement works to the Kathmandu Naubise Mugling road and bridges and Detailed design of improvement of Kathmandu Naubise Mugling Road and Bridges during the alternative assessment. The consultant studied all possible alternative alignments, identified by Detail Design Consultant. Walkover surveys were carried out and topographical maps were studied.

The consultant has reviewed environmental and social screening and initial alternatives analysis sections of the feasibility report and has provided an independent assessment of the adequacy of consideration of environmental and social aspects in the selection of the preferred road and bridge improvement alternative. This further led to an analysis of alternatives proposed in the feasibility study, focusing on the areas where alternatives have been proposed. Public consultation was carried out at different locations to understand the views of the local community on social and environmental benefits and adverse impacts of improving the road section with due consideration to all alternatives.

Field survey was carried out to conduct the inventory of all affected structures along the existing alignment and other proposed new sections. Environmental and Social Checklists were developed prior to carrying out the inventory survey. Observations were collected regarding the existing environmental features including drainage system, land stability, landslide prone area, and other environment aspects. Checklists were used for the collection of existing physical structures and infrastructures.

Analysis has been carried out by first incorporating all the anticipated impacts on the Physical, Biological and Socio-Economic and Cultural environment in a Matrix. All impacts were assessed considering the Magnitude, Extent and Duration of the impact and assigning rating score, as per the National EIA Guideline, 1993. Respective specialists assigned the rating as per guideline using the expert's judgment. The aspects considered for the analysis of alternatives included Topography, Destabilization of slopes, Hydrological conditions, Road Safety, Availability of construction materials, Type and number of bridges, Seismic Hazard, Resources required, Physical Structures and Infrastructures in the Physical aspects, Loss of Forest Trees, Forest Land, Grazing areas, Habitat loss and fragmentation, Impact on Wildlife, Damage to Aquatic Habitat, Increase in Poaching, Forest dependents and forest users, Impact on Buffer zone, GHG in Biological aspects and Total Households affected, Total Population affected, HHs of indigenous people, Market places and urban areas, Cultural and Community Resources, Land acquisition, Land required for the construction, Agricultural land, Public acceptance in the Social and Cultural aspects. Mitigation hierarchy principles were applied to explore predicted impacts and suggest the most suitable solutions including avoiding of adverse impacts of landslides in the case of widening highway, minimizing adverse impacts of linear structures during construction and operation stages, rehabilitating wildlife habitats through establishment of new forest plantations and compensating lost land and property through associated plans and programs.



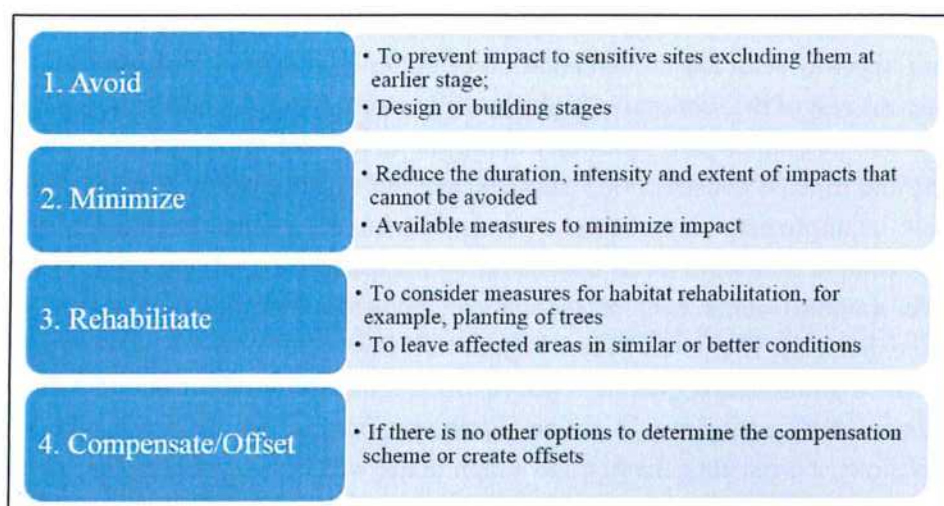


Figure 7.1. Mitigation Hierarchy in the Environmental Impact Assessment Process.

Analysis of alternatives, using mitigation hierarchy principles, indicated that in the case of implementation the first three alternatives, impact on the environment will be less and costs of construction also will be less. However, implementation of those alternatives will solve the problems of road congestions only partly. Alternatives 4 and 5 were recognized as environmentally and socially risky with many predicted environmental threats, first of all, relevant to physical issues such as landslides and slope instability. The alternative 6 decrease such risks through splitting highway into two roads in the most dangerous areas or avoiding road widening in the landslide prone areas. Alternative analysis was conducted at the feasibility (design) stage, which allowed to prevent impact on environmentally sensitive areas adjusted to the road. Besides, construction of new alignment on the right bank of Trishuli River also providing multiple benefits to local communities. Therefore, the most attractive alignment based on this analysis was identified as alternative 6, which has been taken up for detail environmental assessment.

7.1.3 Route of Road Alignment

Alternative 1 and 2

The first 2 alternative options 1 and 2 are improvement of existing highway with additional bridges and improvements in selected urban areas and tunnel with 410 m and bypass with 770m has also been found to be proposed. The proposed tunnel and bypasses is found to be proposed along the existing highway within short distance of 13 km between Nagdhunga and Naubise. Bypasses and a tunnel is found to be proposed in order to minimize curves and avoid time duration. However, the proposal of avoiding curves and time limit within the short distance does not reduce travel time significantly. Whereas, the compensation cost will be high to the affected cultivated land after the alignment egress from tunnel at Khanikhola. Approximately 3206 private structures, 107 public structures, 3356 public & private land owners will be affected by alternative 1 and 2. Compensation for such structures must be provided. In overall scenario, the implementation of option 1 and 2 will have very less significant environment and social impact upon topography, unstable slopes, and existing hydrology.

Following to mitigation hierarchy, road safety will be enhanced especially in urban areas along the existing highway with the implementation of option 1 and 2 during operations. Whereas, safety along the rest of the sections of highway will not be changed significantly. However, the road safety will be challenging especially along the urban and settlement area and along the area during the time of construction, when excavation to achieve the construction materials required for the implementation of these options. The impact for the extraction of construction materials will have minimal effects that could be mitigated by applying mitigation measures such as river draining works, bank protection, etc. along the Trishuli River, Mahesh Khola and other small tributaries. There will be less impact on infrastructures and cultural structures. Loss of forest will be minimal and there will not be any fragmentation of forest and habitats as well as buffer zone. GHG emission will not be significant, because loss of forest will be low. The population along the existing market and urban areas will be less affected in comparison to other options. No any significant land acquisition will be required, except in some bypass proposed and along the proposed tunnel bypass alignment, which is only within the first 13 km of the existing highway. Separate grazing area along the existing alignment does not exist. The practice of grazing by the inhabitants is only within the community forest existing along the highway. No any remarkable impact on HHs of indigenous people as there is very small population of indigenous people, inhabiting areas along the existing highway. Further, the land required for the construction will be within the existing right of way and there will not be required any acquisition of new land along the existing highway. There will be minimal loss or no loss of public structures and land. Further, the existing urban and rural settlements will be benefited directly with the upgrading of the highway, hence the public acceptance is high.

Alternative 3

Implementation of alternative option 3 will have more or less the same impact as mentioned for alternative options 1 and 2. But the construction of additional 2-lane new alignment of approximately 11 km from Sisnekhola-Dharke will have additional impact with its implementation. Compensation of private lands along the alignment will be required. Approximately 3288 private structures, 110 public structures, 3614 public & private land owners will be affected by alternative 3. Besides, approximately 52 hectares of cultivated land area is existed with the 50 m ROW along the proposed Sisnekhola-Dharke alignment. Compensation of standing crops will also be required for the affected cultivated land. Moreover, compensation will be required for the affected number of trees; as 3500-meter length of Nisakot community forest existing along the alignment. The alignment is found to be proposed in order to avoid steep gradient of Naubise-Nagdhunga section, where a maximum numbers of loaded freight vehicles use to stick while traveling towards Kathmandu. The proposed section will further require slope protection works as a mitigation measure along the Nisakot community forest area; the area is situated with the first 5 km along the proposed alignment from Sisnekhola. Further, measures for the disposal of excavated materials will be required avoiding significant environment impact upon hill slopes and adjacent cultivated and private lands. Likely, landslide along the Nisakot community forest shall also be avoided. Further, excavated material from a short tunnel proposed along the new alignment will also require to be disposed safely in identified spoil disposal site. Moreover, the proposed disposal site shall also be rehabilitated after its closure.



Alternative 4 and 5

Proposed both 4 and 5 alternatives are 4-lane options, requiring more excavations of existing highway especially from Dharke to Benighat, existing two-lane requiring mitigation measures for stabilization of hill slopes and disposal of excavated materials including substantial loss of forest area and also requiring compensation for the acquisition of land and structures. Further, excavation of proposed new 20 km 2-lane road from Benighat to Kurintar will have severe impact on environment and society, requiring compensation to cultivated land, mitigation for the stabilization of hill slopes, avoiding fragmentation of forest and cultivation land, compensation to physical cultural structures and infrastructures along the proposed alignment. Extraction of construction materials to meet the demand for the construction of these options might go beyond the river corridor, especially for the construction of proposed new Sisnekhola-Dharke and Benighat-Kurintar road alignment. Construction materials should be acquired only from the approved quarry sites, which have received environmental clearance certificate from authorized agency. Substantial number of small and big bridges will be required along the both proposed new alignments, which could not be avoided as the proposed alignments pass through several natural drainages. Bank protection along the river banks, both at upstream and downstream, will be required at the location of proposed bridges as preventive mitigation measure. These new alignments were found to be proposed at the other bank of river in order to avoid disturbance to traffic movement on existing highway during excavation for expansion; further to avoid devastating landslide areas those are likely to be occurred if excavated along the existing road alignment where historical landslides at as Kirshnavir and Jogimara were existed. Numbers of community forests along the Benighat-Kurintar new proposed alignment shall also be required. Further, substantial disposal sites will also be required for the implementation of these proposed options as there will be 2 tunnels proposed, one along Sisnekhola-Dharke section and another is at Khanikhola section along existing highway will generate substantial number of tipping materials to be disposed. Approximately 3494 private structures, 137 public structures, 4089 public & private land owners within the 25 meters of ROW are likely to be affected by proposed alternative.

Alternative 6

Improvement of existing road from Nagdhunga to Mugling into 2-lane standards with additional 2 bridges at Khatripauwa and Naubise and construction of additional 2-lane new alignment from Sisnekhola-Dharke and 2-lane new alignment on right bank of Trishuli River from Benighat to Phisling has been proposed as 6th alternative options. As the option is to upgrade the existing highway into 2 lane standards, impact upon each and every aspect will be less in comparison to alternative option 4 and 5. Because splitting of the road into two in the landslide prone area, the expansion along the historical land slide area will be minimal and limited avoiding landslide and devastation impact. Whereas, upgrading of existing highway along with improvement in rural settlement and urban areas will enhance safety measures during operations. Implementation of two new sections along the highway also provides development and easy access to the inhabitants on the other banks of the rivers. The, options 1, 2, 3 does provide least impact, but comparatively meets lesser demand. 4-lane alternative options 4 and 5 gives a greater leeway, but will have significant impact on environment and society with difficulty in avoid, minimize, mitigate or compensate impacts. Therefore, with an

intermediate impact on environment, option 6 gives the best output of meeting the traffic demand as well as impacts will be in between the 2-lane and 4-lane options. However, application of mitigation hierarchy is needed at the design (preconstruction) construction and operation stages to predict and prevent adverse environmental and social impacts, including avoiding of road construction or widening in the environmentally sensitive areas (landslide prone areas), minimizing of environmental and social impacts during construction and operation through integrated safety issues, improved road permeability for people, livestock and wildlife, incorporated rehabilitation measures (such as planiting of 25 trees across the road instead of 1 cut tree) and application of transparent compensation and resettlement plans for people, lost their houses and land. Approximately 456 private structures, 70 public structures, 748 land owners will be affected by proposed alternatives and improvement of existing alignment. Those affected structures shall be compensated with the implementation of the alternative option 6.

7.2 No Action Alternative/Do Nothing Scenario

No action scenario just will accelerate existing environmental and social problems along the road. Adverse environmental and social effects of operations have been permanently increased with growing traffic, congestions and other associated impacts. The existing highway is only the highway for the freight transportation linking capital city Kathmandu with Indian border at Birgunj. The frequency of freight transportation will be increased significantly with the increasing population of Kathmandu valley in coming years. Hence; no any upgrading of existing highway is no more significant in order to sustain capital city maintaining good transportation to and from the capital city. Transportation; especially freight transportation will be affected significantly in coming days ahead with heavy traffic jam along the existing highway and will have significant loss of time and energy resources, consuming more petroleum products in transportation of goods and services. Further, the difference in terms of development is clearly visible between the left bank and right bank of the Trishuli River; as the existing highway is situated only along the left bank of the river where significant economic activities including urbanized market places have been established. Gorkha district including its RMs will not be the additional district along the highway and the inhabitants will not be benefited directly without implementation of the proposed project along the right bank of the Trishuli River. Gradual excavation of tracks and earthen roads from the local level as well as from the RM level are identified along the new proposed alignments Sisnekhola-Dharke and Bishaltar-Phisling on the right bank of Trishuli River and such activities will be increased haphazardly in near future. However, there is no any black topped road along those areas and inhabitants are still deprive from easy access to national highway. Haphazard construction and excavation of earthen road will have significant environmental impacts such as landslide, depletion of forest and land, soil erosion, instability of excavated slopes, rendering impact upon existing physical and cultural properties, etc. along the proposed new sections. Further, there are only twin ropes and suspension bridges in several locations along the river bank to access the highway from right bank, especially along the Bishaltar-Phisling section. People inhabiting areas within right bank of Trishuli River along the Bishaltar-Phisling section have been underprivileged from the easy accessibility and economic development in comparison to the people inhabiting left bank of the highway. Without construction, the situation will remain the

same. The area between Bishaltar-Phisling comprises of notorious landslide areas such as Krishnavir, Jogimara and several small landslide areas along the existing highway alignment, which could be very challenging environmentally as well as technically in order to upgrade the existing section even into 2-lane standards. Sharp bendings, blind corners, horizontal and vertical broken-back curves; posing both navigational and stability problems to vehicles; bridges and culvert either unprotected/ inadequately protected laterally; risk of angular collision between conflicting traffic movements and overshooting problem from the numerous side approach of junctions; narrow at bridges, culverts including hazard at numerous bridges, high risk of accidents, risk of falling of vehicles into Trishuli River and risk of toppling of vehicles due to slides, if even the slides are now stable. These are the major factors of risk and challenge that will remain same if no upgrade and improvement of the highway section will occur.

Indigenous Chepang would not be benefited directly if the constriction of road along the right bank of Trishuli River (through Taklung and Makaising of Gorkha district) and would not be carried out. Those indigenous people will not have direct access to national highway that will prevent enhancing their socio-economic status if the project will not be implemented. Tourism development along the right bank will not be flourished; as substantial resorts and homestay facilities are being established along the bank that has to be accessed either by twin rope or by existing suspension bridges. Local inhabitants along the right bank of Trishuli highway will not have easy access for the selling of their agricultural products and will not have gradual economic development and enhanced living standard.

7.3 Alternative Time Schedule for construction

During rainy season, the earthworks and excavation of fragile area will be strictly restricted. Construction works will be executed employing local people as far as possible, whereas population dependent on agriculture will not be affected with the highway construction. Seasonal calendar will be taken into account to manage construction works avoiding implication for agricultural practices at local level. Bridge foundation works at Mahesh-khola and Trishuli Rivers will be avoided during rainy season, especially from June to September when high flood and inundation at the riverbanks are likely. Such foundation excavation work will be carried out in dry seasons only. Site clearance works and affected tree felling will be carried out during dry seasons also. The maximum temperature of the district is ranges between 25 to 35°C and minimum temperature ranges between 0 to 3°C. Therefore, surface pavement will be carried out during warmest period of the year, in August and September, rainy days will be avoided to perform such work.

The overall construction and excavation period will be scheduled from May to September, which could be the most favourable period for project area to provide substantial contribution by the local inhabitants as well.



CHAPTER 8: Specific Impacts of the Proposal on the Environment

Taking into account the difference in the planning work between existing highway and new alignments as well as bridges construction, first of all, relevant to nature of works such as upgrades and improvement of existing road fragments and construction of new alignments and bridges, potential beneficial and adverse impacts were predicted and assessed by several relevant sections or packages as follows below:

- Kathmandu (Nagdhunga) - Naubise – Mugling sections of existing highway (planned upgrades and improvements) (12 km + 83 km);
- New Sisnekhola-Dharke alignment (construction of new road) (11.2 km);
- New Bishaltar - Phishling alignment (construction of new road) (15.3 km);
- Bridges construction.

Below the analysis of predicted environmental and social impacts has been conducted by defined sections. The general impacts, including beneficial and adverse, for KNM section also have been considered.

8.1 General Impacts of Road Development in KNM Section

Improvement of the Kathmandu (Nagdhunga) – Naubise – Mugling Road and Bridges is supposed two types of road works and construction of new bridges. Road works are consisted of upgrades of existing road (from Kathmandu to Naubise and from Naubise to Mugling) and new road construction in new alignments (Sisnekhola – Dharke and Bishaltar – Phishling). Both types of road work are associated with different impacts, therefore after the review of predicted general impacts in the KNM section, the analysis of the specific impacts has been done by separate packages.

The identification and assessment of impacts has been carried out by considering the proposed proposal activities in terms of construction and operation phases. The impacts have been predicted in terms of their magnitude of significance (minor, moderate and high), extent (site specific, local and regional) and duration (short, medium and long term). Most of the identified impacts have been quantified to the extent possible. The possible impacts from the proposal during the construction and operation phases are presented in the succeeding sections.

8.2 Beneficial Impacts of KNM Road Improvement

Strategic value of the KNM section development has been defined at the feasibility stage. The improvement of the existing road is highly beneficial for country economic development and transport efficiency, providing multiple services to local communities and industries, contributing to safety issues and allowing solving the environmental problems, associated with road inefficiency and traffic congestions.

Potential beneficial impacts due to implementation of the proposal during construction and operation phase were assessed and further enhancement measures were suggested. Beneficial impacts of the KNM improvement include facilitated economic development, covering generation of employment and arising opportunities for businesses, access to services and markets, improved road infrastructure contributing to safety issues and better transportation, etc. Beneficial impacts are related to improvement of road infrastructure and its technical efficiency, economic development and livelihoods of the local people. Beneficial impacts also



have been measured by their magnitude, extent and duration. The likely beneficial issues, envisaged during construction and operation stages, are:

– **Improved Road Infrastructure**

Current conditions of the KNM section do not respond to any technical standards, motorists and passengers spend in the way many hours that to pass the section of the road, which length is less than 100 km. The most significant benefit of road construction is improved road infrastructure responding to modern Nepal road standards, including width of the road, pedestrian walks, bus stops, transportation public and gas stations, proper traffic lights (especially in urban sections), underpasses/overpasses and other crossing structures for pedestrians, wildlife and livestock, improvement of sidebars for safety issues, mirrors at thudding points, etc. *The nature of impact will be direct with high magnitude, regional in extent and long-term in duration.*

– **Generation of Employment**

There will be potential for local employment along the settlements in the project area, including settlements such as Siurenitar and Ghyalchoktar of Gorkha district, especially where new highway alignments will be constructed. This would be direct employment for construction-related work for the inhabitants all along the existing and new proposed alignments, or indirect employment on project-support activities such as construction activities, food supply and transport. In total, 1,112,452.50 man-days of skilled labour and 5,567,448.00 man-days of unskilled labour will be generated during the time of construction. 741,635.00 man-days of skilled labour and 3,711,632.00 man-days of unskilled labour will be generated for the improvement and upgrading existing KNM. 184,398.75 and 847,968.00 man-days for skilled and unskilled labour respectively will be generated for Sisnekhola-Dharke alignment during the time of construction. Similarly, 186,418.75 and 1,007,848.00 man-days of skilled and unskilled labour respectively will be generated during the time of construction for Bishaltar-Phisling alignment.

It is also likely to increase in commercial agriculture/increase in trade business after road upgrading. Creation of service centres along the road will provide opportunities for local employment on small markets, cafeteria and service stations. *The nature of impact will be direct, medium in magnitude, site-specific in extent and medium -term in duration.*

– **Opportunities of New Income Generating Activities**

It is anticipated that more numbers of local enterprises will be developed such as cottage and small-scale industries, increase in import and export of goods and commodities. Large population of project municipalities will have chance to be involved into economic activities once the project comes into operation. Trade and business of local products, business of forest products, establishment of small-scale and medium industries, agro-businesses, etc., will generate long-term opportunities for local people to be involved into economic activities. Various educational institutions are likely will be established along the road after starting of its operation. New market areas will be developed especially adjoining link roads along the new proposed alignments enhancing more income generation activities and livelihood at local level.



The nature of impact will be indirect with high in magnitude, regional in extent and long-term in duration.

– **Enhancement of Technical Skill and Know-How**

KNM Road development project will adequately use the local people for construction works, facilitating the unique chances for the transfer of skills and technical know-how in construction and related construction technical sectors.

Considerable number employed work forces will convert themselves into fully skilled laborers in works such as masonry, gabion wires weaving, construction of dry and foundation walls, slope cutting and stabilization, rock cutting, bio-engineering works and other open opportunities. These skills will not only benefit to locals by providing long-term employment opportunity, but also contribute to local human resource development in project areas that otherwise have restricted opportunities. *The nature of impact will be direct with high in magnitude, site specific in extent and long-term in duration.*

– **Development of new local infrastructure and easement of former environment problems**

Implementation of the proposed project will enhance the development of new infrastructures. Moreover, the project will benefit to improvement of adjoining road networks, irrigation facilities, electricity supply lines, water supply and sanitation, sewerage and drainage within the project areas. Further, the implementation of proposed project will address the existing environmental problems along the proposed alignments such as landslides and degradation of forest, dust pollution and waste management, etc.

The project will promote best practices and establish the mitigation measures for landslides, compensatory replantation of native trees along the proposed new alignments, selected places for waste management, wildlife/livestock cross-road structures, etc. *The nature of impact will be direct with high in magnitude, site specific in extent and long-term in duration.*

– **Improved Access to Services and Transportation**

Freight transportation between Birgunj and Kathmandu will be substantially increased reducing travelling time and cost. Accident due to freight transportation and freight related vehicles, such as large trucks, will be reduced significantly. Health and safety of road users including drivers of freight transportation will be enhanced with the implementation the good road conditions and other additional roadside facilities. Transportation facilities will save time and energy of locals, improving their economic activities along the route. Paved roads will provide all-weather transportation service to the local people to cash these services and facilities. Quick access to, for example, health posts may be crucial in everyday life.

The improved access will bring improved quality of life in the project rural municipalities. Moreover, the operation of road will also provide benefits to local people of the adjacent rural municipalities. Once the road comes into operation, people will have improved access to many goods such as seeds, fertilizers, irrigation and technology leading to increased agricultural production and diversification. *The nature of impact will be direct, high in magnitude, regional in extent and long-term in duration.*



– **Opportunities for tourism development and enhancement of local economy**

Although the project does not consist any important area of the world heritage sites; there are still some pilgrimage sites holding great historical and cultural importance such as Manakamana at Gorkha District. The cable car station to the temple is situated to the close distance with existing KNM at Kurintar. Operation of highway will have more national and international tourist visiting to this cultural site and other interesting natural and cultural places, including improved access to well-known tourist destination place such as Pokhara.

Locals will have opportunity to demonstrate their traditional and religious cultural activities and traditions together with the opportunity to uplift the local economy with the development of Regional Tourism Industry within the region. The area along Trishuli River is known by its attraction for rafting and improved road will contribute to growing of this touristic activity. *The nature of impact will be direct with high in magnitude, regional in extent and long-term in duration.*

– **Enhance in living standard and lifestyle of local communities alleviating poverty**

The operation of KNM with two new alignments will improve the road connectivity with Gorkha district and enhance freight transportation with Birgunj via Mugling and will bring adequate opportunities for the promotion of trade and business to locals and other entrepreneurs. All-weather road facilities will enhance the trade and business of local businessmen and local farmers. Activities such as road construction, forest harvesting to clear the alignment and replenishment plantations and its management will bring in a sizable units of employment. It will be ensured, wherever possible, that LHFG will be encouraged to participate, as they are groups of poor people. *The nature of impact will be direct, high in magnitude, regional in extent and long-term in duration.*

– **Facilitated Industrial Development along the proposed alignment.**

The value of local products, i.e. agriculture and livestock production in the project municipalities, will be increased, especially along the proposed two new alignments Sisnekhola-Dharke and Bishaltar-Phisling due to better access to markets for producers. Moreover, the increasing demand of products from the adjacent municipalities and headquarters of Gorkha and Dhading district will also enhance the trade in these areas. Also, the established local enterprises will get the chance to foster their trade, increasing the production of goods. During operation, the improved road connectivity will bring about opportunities for the promotion of trade and business.

All-weather road facilities developed will enhance the trade and business with the easy access and reduced transportation cost. The flow of goods from and to the project influence area will be continued. Local products could be transported outside markets at suitable cost, thereby benefiting the producers as well as consumers. The local agricultural and horticulture products (citrus fruits, vegetables etc.) can be processed into new products and transported. Thus, an improved road linkage with the establishment of other markets opens potential opportunities for the production of off-season fruits and vegetables. *The nature of impact will be direct, high in magnitude, regional in extent and long-term in duration.*



– **Increase in Land Value**

Price of land will be increased especially along the proposed two new highway alignment with the implementation of the project. The price of adjacent lands after the operation of the highway will be increased significantly, especially in the places with fertile soils and scenic landscapes. The land owners will be benefited directly with the increment in the price of land. More shops, hotels and other economic activities will be developed along the new proposed highway alignment. *The nature of impact will be direct with high in magnitude, regional in extent and long-term in duration.*

– **Opportunities for women and gender specific benefits**

Local women will have direct benefit with the widening of existing highway and construction and operation of two new alignments. Local women will have more chances for education and training and relevant enterprise development; they will have opportunity to establish shops, hotels and resorts all along existing and new link lines from the proposed new highway alignments and to generate employment opportunities by selling local products all along the new highway. *The nature of impact will be direct with high in magnitude, regional in extent and long-term in duration.*

– **Access to social services for local people**

Locals will have easy access to the social services such as health posts, hospitals, schools and other education institutions, offices of local authorities, municipalities, district coordination committees, etc. with the implementation of project. *The nature of impact will be direct, high in magnitude, regional in extent and long-term in duration.*

– **Opportunities for diversification of local economy and Exploitation of Untapped Potentials**

Local economy especially along the project affected municipalities will be enhanced with the implementation of the project. Economic activities will be increased significantly with the operation of new alignments. As the several municipalities of Gorkha district will have direct linkage with the KNM highway; more inhabitants of adjacent municipalities of the district will also be benefited with the establishment of new link roads after the operation of new highway. As the Dhading and Gorkha districts are spread up to the high mountainous area on the northern side and linked with the Terai district Chitwan at the south; the improvement and establishment of new highways will provide better opportunities and potential in exploring and exploiting untapped potentials of natural and human resources.

– **Improve linkage to other districts and enhanced market cooperation opportunities**

The local communities along the new alignments will have better access to other districts, providing them with cooperation opportunities, exchange of goods and services, better chances to find job, obtain education and better mobility. The nature of impact will be indirect, moderate in magnitude, regional in extent and long-term in duration. More likely that all listed beneficial impacts are applicable in the most scenarios of road upgrades and improvement or construction of new alignments. That to avoid duplication, only site specific beneficial impacts will be listed below in the site-specific packages.



8.3 Adverse Impacts

The project activities during construction and in subsequent operation and maintenance stages will create also a number of adverse issues and affect environment directly, indirectly or in the result of cumulative effects and interactions between various impacts. Adverse impacts like positive effects also have been measured by their magnitude, extent and duration.

The possible general adverse impacts have been considered below for various components of environment (physical and biological) and for socio-economic and cultural environment during pre-construction, construction and operation phases. In general, more than 70 adverse impacts were predicted and found by the team after visits to the project area and consultations with local people. Adverse impacts have been appeared as effects on physical environment: topography, geology, meteorology, hydrology, air and water quality, noise and pollution; effects on biological environment, including forest and aquatic habitats, terrestrial and aquatic biotic communities, species and ecosystems; and effect on socio-economic environment such as safety, health and sanitation, water and land use, cultural resources and practices, etc. After analysis, all impacts were grouped to several clusters for physical environment, for biological environment and for socio-cultural environment.

8.3.1 Physical and Chemical Environment

Such valued environmental components (VECs) as atmosphere and meteorology, physiography and geology, soils, surface waters and watersheds were considered for physical environment. Below the general possible impacts on VECs for pre-construction, construction and operation stages along existing and new sections have been described.

Impact at the Preconstruction Stage

At the preconstruction stage, the adverse impacts are mostly associated with several issues relevant to landscape features in the project area and existing physical infrastructures, which is linked to preparation of sites for clearance, removal and relocation of physical and cultural structures. In both cases, upgrading of existing road and construction of new alignments, it is expected that the general impacts will appear as:

- Loss of physical and cultural structures and infrastructure;
- Temporary disruption and relocation of existing services and public utilities

The impact on physical and cultural structures, existing services and public utilities will be direct in nature, low in magnitude, site-specific in extent and short-term in duration.

Impact at the Construction Stage

It is expected that the most direct impacts on physical environment will be observed at the stage of road construction and upgrades. The most adverse effects will be on atmosphere and meteorology with effects on air quality, GHGs emissions, and waste management. Upgrading of existing road and construction of new alignments may significantly impact fragile landscapes in the project area, especially affecting slope stability, triggering new landslides and soil erosion. The construction of highway will further acquire lands adjacent to proposed highway alignment for temporary purposes such as establishment of labour camps, crusher

sites, worker camp site, spoil disposal, etc. (For example, 16 labour camps have been proposed during road upgrades and construction of new alignments in KNM road section). Besides, road construction may significantly disrupt hydrological processes, because erosion, pollution and contamination of fertile agricultural lands, provoke process of watershed degradation with loss of many important services such as clean water for communal needs and irrigation. Impact on soil and hydrology will be most notable during pre-construction and construction stages. Current practices of illegal quarrying, production of sand, gravel and boulders along the existing road already cause adverse hydrological and environmental impacts, polluting rivers and contributing to severe soil erosion, threatening safety and triggering landslides in adjacent areas. Blockage of natural drainage path during construction (for example, by environmentally hazardous disposal of spoil material) may generate water depletion and water logging, a concentration of water flow as well as increase the speed of flow, which will be erosive in nature.



Figure 8-1: Illegal quarrying for construction industry along KNM section

Haphazard disposal of spoil and other construction materials into the natural drainage may cause interruption of natural flow of the drainage, triggering landslide and mass wasting at the downstream. Hazard management and spoil disposal issues are most important during construction stage and immediately after construction. Spoil materials can adversely impact atmosphere and air quality, affect soils and landscape features, pollute water streams and affect health of local people. Disposals and hazards

in the project area are expected from the construction of the tunnel, spoil disposal and waste generation during construction, and from used chemical substances. Expected impacts are following:

- Hazards related to noise pollution;
- Stone crushing plants;
- Land use change;
- Landslides, slope destabilization and soil erosion;
- Quarrying of construction materials;
- Stockpiling and transportation of materials;
- Issues related to establishment of labour camps and contractor's camps;
- Issues of landscape aesthetic;
- Disruption and blockage upon natural drainage, runoff water;
- Pollution of water resources;
- Contamination of soil and loss of topsoil;
- Water logging;
- Water flow disruption and erosion of river banks during bridge construction;
- Potential hazards due to blasting for tunnel;
- Hazardds due to spoil disposal and construction wastes;

- Potential hazards caused by bitumen and other toxic chemicals;
- Impact on water sources such as river due to vehicle washing, fuel leakage, poor sanitation practices, increased human activities/settlement/market center expansions/hotel operations to the nearby water sources.

The impacts will be mostly direct in nature, ranging in magnitude from very high to low, can be local or site-specific in extent and, mostly, short-term or medium-term in duration.

Impact due to possible use of child labour

Mobilization and utilization of child labour is likely during the time of construction in each construction package. It is likely that children from outside the valley will be engaged in road construction. However, construction contractor will be responsible to avoid child labour. Contractor will be penalized as per Labour Act 2074, and Children Act 2018 reviewed in Chapter 0. *The impacts will be mostly direct in nature, ranging in magnitude from very high to low, can be local or site-specific in extent and, mostly, short-term or medium-term in duration.*

Impact at the Operation Stage

During operation stage the road will affect atmosphere and meteorology with typical effects of air and noise pollution. New landslides are likely to develop along the proposed new Sisnekhola-Dharke and Bishaltar-Phisling alignment during the time of operation; the previous landslide areas also may be activated. Besides, road operations may significantly disrupt hydrological processes, cause erosion, pollution and contamination of fertile agricultural lands, provoke process of watershed degradation. Impact on watershed might be most significant during operation stage. Substantial number of culverts and river crossing structures will be required to maintain natural drainages, from which the proposed alignment passes through. Diversion as well as overloading existing drains will result in water flowing, where it normally would not, e.g. on vulnerable soils where frequent effects are scouring, gully, bank cutting and soil erosion. The dramatic final effect of these incremental impacts usually cumulates in massive landslides, which in turn can cause slope instability and landslides. Expected impacts are following:

- Air and noise pollution during operation stage;
- Slope stability along proposed new sections and updated existing sections during operation stage;
- Solid Waste Management;
- Pollution of water resources during road operations;
- Cross drainage outfall and gullies formation.

The impacts will be direct or indirect in nature, low, medium or high in magnitude, site-specific, local or regional in extent and long-term in duration. More likely, those cumulative impacts also will appear at this stage.

8.3.2 Biological Environment

Valued environmental components (VECs) for biological environment in KNM section are presented by terrestrial and aquatic habitats, threatened and endangered species, and ecological processes. Terrestrial wildlife habitat is mostly presented by forests, affected in the result of human encroachment, infrastructure and agriculture development. More likely forests of the

area will be affected directly and indirectly during road upgrades and construction of new alignments. Aquatic habitats also may be affected, especially during bridge construction. Ecological processes along the road are mostly described as ability of wildlife populations to move through landscapes for species dispersal and colonization of new habitats, gene flow, ability to move without specific barriers through habitats for food, shelter, breeding and seasonal needs. Indicators of impact can be characterized as alternated movement corridors, affected critical habitats, impacted wildlife crossing areas, etc. Existing sections of the road, operating during many decades, already altered ability of species for movement; therefore, there is no specific critical habitat in the road proximity. However, in the sections with new planned alignments, there are areas, which can be affected by altering ecological processes. Conducted biological surveys indicated presence of 6 nationally and globally threatened mammal species and 16 nationally and globally threatened bird species. Some of these animals may be attracted to road for scavenging (like vultures) or can be affected by disturbances during road construction or persecution by labors. Impact of the road construction on threatened and endangered species may be assessed through selection of indicator species, such as Common Leopard (globally vulnerable), Hispid Hare or Chinese Pangolin (both species are globally endangered). The indicators of the impact on VECs are described below for each VEC.

Impact at the Preconstruction Stage:

Upgrading of the existing road and especially construction of new alignments will affect terrestrial habitats by many ways. During pre-construction stage, this is a direct effect of forest clearance for construction work. Other effects at the preconstruction stage are associated with disturbances due to clearing work as follows:

- Loss of vegetation and scattered trees due to site clearance;
- Disturbance to natural habitats and critical natural habitats;
- Wildlife disturbance.

Impact of site clearance and change of terrestrial habitats will be direct in nature, medium in magnitude, local in extent and long-term in duration.

Impact at the Construction Stage

Road constructions have the direct impact on the wildlife habitat, affecting the occurrences of wild species. Anthropogenic noises and disturbances created during construction may reduce wildlife composition and richness in adjacent habitats. Road construction deteriorates large number of forests as well as wetlands systems, which ultimately affects the existing biodiversity of the area, forest and aquatic habitats, fragmenting rivers and other water-bodies, polluting water-courses, destructing fish and wildlife habitats. The major environmental impact from the implementation of this road extension project is on



Figure 8-2: Nisakot Community forest at Sisnekhola-Dharke alignment will be severely impacted

forests. Adjacent forests will be easily accessible to anybody during the time of construction as well as during operation of the road.

Forest resources during the time of construction will be vulnerable and might be degraded from the haphazard utilization by construction workers, including outside migrants. Many streams, rivers and rivulets along existing road are already highly polluted and aquatic wildlife and local population damages fish habitats in the result of sand and gravel mining in the riverbeds. Dumping of extract from road construction will increase vulnerability of aquatic organisms, directly and indirectly. Clearing excavation, grading and filling activities and continuous vehicular movement along the road would kill less mobile, frequently moving small species such as frogs, lizards and snakes. Labor camps during construction phase is likely to increase impacts, generating solid wastes and effluent, causing forest fire in dry season due to haphazard disposal of cigarettes, disturbing wildlife or providing illegal hunting, trapping, fishing and trading. Possible general impacts on biodiversity during construction stage have been described below:

- Clearing of forest and loss of vegetation and grazing areas;
- Loss of biomass and carbon from the felled trees and poles;
- Disturbance to natural habitats and critical natural habitats;
- Use of forest products and fuel wood by the construction workers during construction activities;
- Damage of aquatic habitats with the construction of bridge foundation;
- Impact on herpeto-fauna and fish species along existing road and new alignments;
- Forest fire;
- Wildlife disturbance & hunting and poaching of wildlife by labourers.

Table 8-1: Summary of Impact on the forests in KNM section

SN	Forests under different management options	Linear cut and field distance (m)	Affected number of trees, wood volume, biomass and Carbon						
			Forest area (ha)	Number of Trees			Wood volume (m3)	Total biomass (ton)	Carbon (ton)
Trees	Poles	Total							
	Nagdhunga-Naubise	950	0.1	3	38	41	4.68	6.09	3.4
	Naubise Mugling	20609	3.91	49	2253	2302	203.54	303.37	194.66
	Sisne Khola Dharke	760	3.61	278	2424	2702	933.47	1399.48	601.78
	Bishaltar Phisling	6075	28.15	649	6267	6916	969.99	1455.73	625.94
Grand Total		28.39	37.44	979	10982	11961	2111.68	3164.67	1425.78

Field survey 2017

Bishaltar Fisling Section of the new road construction will have the most affect in the forests. Of the total of 37.44 ha of forests being cleared, this section alone shared 75.2%. The contribution is followed by the existing Kathmandu Naubise Mugling with a contribution of 10.7% and remaining 9.1% by Sisnekhola Dharke Section.

Impact on terrestrial and aquatic habitats, threatened species and ecological processes during road construction will direct in nature, high or medium in magnitude, local or site-specific in extent and medium-term or long-term in duration.

Impact at the Operation Stage:

Direct impacts of road upgrades and extension are relevant to decrease forest areas, reduced wildlife habitats, some of which will be lost forever. Indirect impacts are relevant to gradual

encroachment of people along the road with land use change and increased pressure on natural resources such as tree felling, woodcutting, illegal export of fuel wood and other forest products. The roads bisect also forest and wetlands, fragmenting wildlife habitats and creating barriers for many common wildlife species in the area. With increased traffic and speed during road operations, there is a risk of increased wildlife road mortality and wildlife-vehicle collisions. Chances of road mortality will increase in the environmentally sensitive areas or in proximity of critical wildlife habitats as well as chances of wildlife disturbances near the road, sometimes leading to human-wildlife conflicts. The expected impacts on wildlife, terrestrial and aquatic habitats during operation include:

- Disturbance to natural habitats and critical natural habitats;
- Illegal felling of trees;
- Impact on herpeto-fauna and fish species present in streams along existing road and new alignments;
- Damage of aquatic habitats during road operations in the results of technical accidents or spillage of chemical substances near bridges;
- Habitat fragmentation and barrier effect for wildlife movement;
- Forest fire;
- Road safety concerns in wildlife crossing areas;
- Wildlife disturbance;
- Ribbon human encroachment along the road, affecting wildlife and its habitats;
- Increased hunting and poaching of birds and wildlife in road access zones.

The impacts will be direct, indirect or cumulative with medium to high magnitude, medium in extent and, mostly, long-term in duration.

8.3.3 Socio-economic and Cultural Environment

Valued social components (VSCs) for socio-economic and cultural environment were identified as land and resource use, population infrastructure and services, economy and well-being and community life. Road construction and upgrades facilitate the development of local and national economy as well as contribute to improved well-being of local populations as it was mentioned above. Improvement of road infrastructure in KNM section will provide new opportunities for income generation to local communities. At the same time, there are some risks for traditional marginalized communities and the most vulnerable low-income part of the population, which can be affected with threat to lose their income and livelihoods. Land is one



Figure 8-3: Fertile land in Bishaltar – Phishling alignment area

of the most important resources in the mid-hill area used for agriculture, industry and other businesses. Fertile land along new developed alignments is valuable resource for local rural communities. Local peasants depend on the land productivity and loss of any part of such land can cause loss of income and poverty of people, especially taken into account that area along highway and new alignments highly populated by agricultural communities. The road

of the most important resources in the mid-hill area used for agriculture, industry and other businesses. Fertile land along new developed alignments is valuable resource for local rural communities. Local peasants depend on the land productivity and loss of any part of such land can cause loss of income and poverty of people, especially taken into account that area along highway and new alignments highly populated by agricultural communities. The road

construction also will bring the issues of competition of traditional communities with outsiders, changes in existing traditional practices and culture, damages to existing practices, etc. Below, the analysis of general impacts has been provided for each selected valued social component at the pre-construction, construction and operation stages.

Impact at the Preconstruction Stage:

Upgrading of existing road and construction the new alignments can impact land, private property and other assets. Households depend on agriculture for their livelihood and loss of their private property due to road upgrades and construction will affect families severely; they will be considered as Severely Project Affected Families (SPAFA) who require compensation. Grievances raised by the locals and labours during pre-construction stage might delay site clearance and construction works. The amount of land affected, public and private properties acquired serve as indicators of impact at the preconstruction stage:

- Land and property acquisition, compensation, resettlement and rehabilitation;
- Grievances raised by the locals and labours, if any.

The impact will be direct in nature, high in magnitude, local in extent and long-term in duration.

Impact at the Construction Stage:

Impact upon private property and acquisition of cultivated land for project implementation will be the major concern of local people, especially low-income population. In the results of road upgrades and construction, local farmers will lose cultivated land permanently, which will decrease the production of agricultural products. At the same time, the local population may be affected by influx of labour workers from other places, increased threat of disease transmission and safety issues, increased road accidents during construction stage, lack of waste management and sanitary issues. Local road users' safety may be an issue, when large numbers of construction vehicles ply on local roads during construction works, especially along the existing urban areas. Accidents and health hazards are likely during excavation of new roads, operation of construction vehicles such as excavators and dump trucks, crusher plants, quarry sites. The outside workforce may also introduce transmissible unknown diseases to the communities, increasing the risk of STD and HIV/AIDS. Poor sanitation practice of the outside workforce in camps and construction sites is also potential to generate pollution issues, affecting community health. Consumption and import of alcoholic products are expected to be increased with associated impacts. Pressure on existing natural resources such as water, existing food availability, etc. are likely with conflicts between workers and local people during time of construction for same commodity and natural resources. The outside construction workforce, coming from different parts, is envisaged to influence the local cultural and traditional values with potential of the exploitation of the female members, during the construction and post construction period. Workers tend to leave their wives behind and as a result may be tempted to engage in sexual relationships with women and young girls in the project area. In addition, prostitutes may be attracted to the area due to the presence of workers, possessing a lot of money. The road project is likely to increase the prostitution as a profession. Immigration of people from other areas and influx of workers are inevitable during the time of

construction of any project. The expected adverse impacts during construction stage are following:

- Loss of private property and assets;
- Loss of productive land;
- Road safety issues;
- Occupational health and safety of labours, accidents;
- HIV/AIDs and other diseases;
- Increase in sale and use of alcoholic products along the new proposed sections;
- Livelihood issues;
- Potential issues associated with road construction work forces;
- Conflict in or with nearby community;
- Impact due to damage of community infrastructures;
- Issues related to cultural assets;
- Increase in prostitution;
- Migration and immigration

The impact will be direct in nature, high or medium in magnitude, site specific or local in extent and medium-term or long-term in duration.

Impact at the Operation Stage

In general, the upgrading of existing road and construction of two new alignments will benefit to local communities through access to market, many beneficial services, and other typical features of modern society. Road safety will be the major issue within the ROW of the proposed and existing new alignments during the time of operation. Existing urban areas along the KNM will be more vulnerable to traffic safety as accident-prone areas, especially in busy sections such as schools and trading centers. Better transportation will benefit to local farmers, traders, prospective visitors and tourists, who would wish to raft in Trishuli River, which is a major tourist attraction in the area, local communities. At the same time, encroachment of ROW for the establishment of shops and residences with ribbon settlements are likely with the gradual development. The increase in competition for existing resources, likely, can put the indigenous people at a disadvantage, especially when the settlers introduce ecologically inappropriate and unsustainable production systems. Physical conflicts are possible between settlers and host communities, changing social, cultural and religious practices of local community. The presence of an immigrant labour force and additional disposable income may result in undesirable interactions between the local communities (particularly youth) and the workforce, contributing to the spread of HIV/AIDS to both workers and the communities. Girl trafficking and prostitution could be one of the potential problem during operation and maintenance period, especially at existing settlement areas, where people gatherings with increase in facilities such as hotels, restaurants and lodges. Accumulation of water in borrow pits and quarries and improperly designed drainage structures may encourage the breeding of malaria-transmitting mosquitoes and other water-borne diseases. Various socio-economic changes are likely in the project areas and adjacent municipalities, because the overall inter-regional connections will also expect to bring changes in the local life style. Immigration has been

envisaged especially during the time of operation stage with the availability of good services and facilities.

- Road safety issues;
- Traffic safety and increase in accidents;
- Development of settlements and market places along the proposed new sections;
- Possible ribbon development along the road alignment;
- Disruption of community structure;
- Issues related to vulnerable indigenous people;
- Girl trafficking;
- HIV/AIDs and other diseases.

8.4 Site-specific Adverse Impacts

8.4.1 Site-Specific adverse impact of KNM improvement (existing sections of Kathmandu – Mugling road)

Physical environment

Impact at the Pre-construction stage

(i) Review of impact assessment, mitigation and EMP

Construction contractor will be responsible to review all environment assessment reports in order to update EMP prior to start of construction work. Any changes in project scope or alignment these will be disclosed to MoFE and World Bank and the ESIA, RAP, VDCP and EMAP will be revised and updated as required. The updated EMAP will be implemented by the construction contractor. *The impact can be considered as low in magnitude, site specific in extent and short term in duration.*

(ii) Planning for erosion control

The hill slopes along the existing KNM is prone to significant erosion and landslides. Removal of existing protection walls for further widening along the highway likely to aggravate landslides situation. Hence, erosion control plan should be in place prior to the construction. *The impact can be considered as low in magnitude, site specific in extent and short term in duration.*

(iii) Planning materials management and spoil disposal

Contractor will plan in advance in managing stockpiling areas for construction materials and disposal of excavated materials. The identified spoil disposal area is presented in the Annex 7. *The impact can be considered as low in magnitude, site specific in extent and short term in duration.*

(iv) Traffic Management

Management of traffic along the existing highway will be most challenging task during the time of widening of road width and excavation. Complete blockage of highway or just a section

during construction will not be possible. The impact during the construction could be considered as high in nature and long-term in duration if traffic management plan is not in place prior to the construction. Coordination with traffic will be required prior to the construction and contractors representing each construction packages shall also be coordinated with each other for the management and control of existing traffic. *The impact can be considered as low in magnitude, site specific in extent and short term in duration during preconstruction.*

(v) Preparing the Contractor(s) to Address Mitigation Measures

The contractor will be well-informed by including the EMAP and environmental assessments outcomes in the bidding and contract document. The contractor(s) will be informed that they will be required to produce method statements and plans in advance as required in the EMAP for, temporary pedestrian and Traffic Management Plan, Drainage Plan, Erosion Control Plan, Materials Management Plan, Waste Management Plan, Spoil Disposal Plan, and Noise and Dust Control Plan. *The impact can be considered as low in magnitude, site specific in extent and short term in duration.*

Impact at the construction stage

i. Disruption and relocation of existing services and public utilities

Substantial number of infrastructures are existed along the Kathmandu (Nagdhunga)-Naubise-Mugling Highway. The highway also links several villages situated close to it with gravel road and earthen tracks. The list of likely affected track length is presented in the Table 8-2. Similarly, the highway comprises major junctions existing along the highway linking other districts. Those junctions are also likely to be affected during the time of construction. The other infrastructures which are likely to be affected along the existing highway such as electric poles, water supply pipelines and taps which are likely to be affected are presented in the tables below as well as in the Annex. Further, the physical structures situated close to the existing highway that are likely to be affected are presented in the Annex.

Table 8-2: Likely affected road length.

Sn.	Road category	Length of the road	Average width of the affected road
1.	Black Topped	104	6.6
2.	Gravel	22	4.5
3.	Earthen	216	3
	Total length	342	

Source: Field Survey, 2017

Major junction

Table 8-3: Impact upon existing major road junctions

Sn.	Location	Existing major junctions
1.	Naubise	Junction to Hetauda (TRP)
2.	Galchhi	Junction to Nuwakot
3.	Malekhu	Junction to Dhadingbesi



Sn.	Location	Existing major junctions
4.	Benighatat	Junction to Gorkha District
5.	Darechaur	Junction to Manakamana Cable Car Gate
6.	Mugling	Junction to Narayanghat and Pokhara

Table 8-4: List of directly affected electric poles situated along the Nagdhunga-Naubise-Mugling alignment

Sn.	Road Section	Chainage	Type of Poles			Total
			Metal	Wooden	Cement	
Improvement of Existing Nagdhunga – Mugling Road						
1.	Nagdhunga - Naubise	0+000~ 12+200	35	6	41	82
2.	Naubise - Baireni	0+000~24+200	250	35	35	320
3.	Baireni - Bishaltar	24+200~3+000	300	41	62	403
4.	Bishaltar - Mugling	53+000~82+000	305	8	43	356
	Sub- Total		890	90	181	1161

Source: Field Survey, 2017

Table 8-5: Drinking Water Supply along the Nagdhunga-Naubise-Mugling Section (in meter)

Sn.	Road Section	Chainage	1" Dia. Pipe		0.5" Dia.Pipe		1.5" Dia.Pipe		2" Dia. Pipe	
			GI	PVC	GI	PVC	GI	PVC	GI	PVC
1.	Nagdhunga - Naubise	0+000~ 12+200	0.09	4.7	-	2.0	-	1.5	-	-
2.	Naubise - Baireni	0+000~24+200	0.55	11.0	-	-	-	-	-	1.8
3.	Baireni - Bishaltar	24+200~3+000	-	8	-	-	-	0.8	-	1.5
4.	Bishaltar - Mugling	53+000~82+000	-	11	-	-	-	-	-	2.32
Sub- Total			0.64	34.7	-	2.0	-	0.8	-	5.62

Source: Field Survey, 2017

ii. Change in Land use and loss of productive topsoil

Improvement and upgrading of the existing highway will have minor change in land use. Improvement of existing KNM comprises agricultural land, forest land, water bodies, barren, grass land, settlement, and shrub land of 156.7 ha, 57.43 ha, 50.98 ha, 14.19 ha, 4.51 ha, 2.27 ha and 0.62 ha respectively within the 50-meter ROW are likely to be affected. It is further anticipated that the construction of carriage width will affect land use beyond 7m carriage width within some sections. However, the construction width will not exceed beyond 25m ROW. Massive amount of cutting and filling will affect existing terrains changing its land use type is likely during construction. Moreover, the construction of highway will further acquire lands adjacent to proposed highway alignment for temporary purposes. Lands such as barren land, flood plain, plateau etc., are likely to be acquired for the establishment of labour camp, crusher sites, worker camp site, for the disposal of spoil etc. Land use pattern of identified labour camp site, crusher sites, and spoil disposal sites will be utilized during the time of construction and

will be changed temporarily. *The overall impact of land use change will be direct in nature, high in magnitude with site specific in extent and long term in duration.*

iii. Landslides, Slope Destabilization and Soil Erosion

Krishnabhir and Jogimara are the area prone to landslide along the existed alignment. Major mass movements along the road alignment have been found at Krishnabhir (69+000), Jogimara (75+500), between Phurke Khola and Malekhu (54+500) and in other locations. These slides were activated 10 to 20 years ago; currently, slides are passive, however, there is no guarantee that they can be reactivated again any time due to activation of the thrust, heavy precipitation or earthquake. Activation of the slides blocked the road traffic many times in the past also. The Krishnabhir landslide is occurred in slate of the Galyang Formation; the Jogimara slide is seen in the rocks of the Lakharpata Formation; whereas the Malekhu slide is found in the quartzite. The Malekhu slide is occurred due to slope, weathering and fractured rocks and activation of the MT. The stereo net of the rock mass shows that wedges are safe, but the joint (J2) has high possibility for failure occurring (toppling failure). Along the road alignment, the failures of joint are controlled by construction of wall on hillside. However, there is possibility of meeting slides during extension of the road alignment into the wider lanes. After extension of the road, there is high possibility to meet the cut slope failures in the rocks as well as soil erosion. New protection walls should be provided immediately after widening of the existing road to maintain stability and this will be the best mitigation measures. Other mitigation measure required is to manage the surface drain immediately after dismantled existing measures and widening of the road alignment. Surface drain is needed to control the slope stability, especially in the soil. Landslide and soil erosion will be triggered due to excavation work, first, in previously detected landslides and erosion prone areas like Krishna Bhir, Jogimara and Kurintar to Mugling area of this road alignment. *Impact of landslides and erosion of fresh cut hillside slopes will be direct in nature with high in magnitude, local in extent and mid-term in duration.*

iv. Impact due to disposal of spoil

Unmanaged disposal of spoil may cause blockage of natural drainage systems, loss of organic fertile top soil and farmlands, loss of crops and forest, and water logging. It is estimated that a total of 1,534,908 cums of spoil material will be generated and 633,143 cums will be reused whereas 901,765 cums of spoil material required to be disposed safely. If this spoil is not properly disposed significant negative impacts are anticipated on public health and safety, landslide and slope stability and scenic beauty along the proposed alignment. *Impacts from spoil disposal during the upgrading of the proposed road will be direct, of high magnitude, site-specific and long-term in nature.*

Table 8-6: Estimated volume of spoil for the disposal

Sn.	Road Section	Length (Km)	Cut Vol. (Cu.m.)	Fill Vol. (Cu.m.)	Cumulative Vol. (Cu.m.)	Reusable Vol. (Cu.m.)	Disposable Vol. (Cu.m.)
1.	Nagdhunga - Naubise (0+00~12+400)	12.4	31,994	9,330	22,664	5,651	17,013



Sn.	Road Section	Length (Km)	Cut Vol. (Cu.m.)	Fill Vol. (Cu.m.)	Cumulative Vol. (Cu.m.)	Reusable Vol. (Cu.m.)	Disposable Vol. (Cu.m.)
2.	Naubise - Baireni (0+00~24+200)	24.2	91,901	31,635	60,266	15,067	45,199
3.	Baireni -Bishaltar (24.20~53+00)	28.8	139,174	17,872	121,302	30,326	90,976
4.	Bishaltar -Mugling (53+00~82+400)	29.4	102,899	19,300	83,599	20,900	62,699
Sub Total		94.8	365,968	78,137	287,831	71,944	215,887
5.	Sisne Khola - Dharke Section (0+00~11+200)	11.15	808,597	257,753	550,844	247,895	302,949
6.	Bishaltar - Phisling Section (0+00 ~ 15+300)	15.35	981,476	285,243	696,233	313,304	382,929
Sub Total		26.503	1,790,073	542,996	1,247,077	561,199	685,878
TOTAL		121.3	2,156,041	621,133	1,534,908	633,143	901,765

Source: Detail design for the improvement of Kathmandu (Nagdhunga)-Naubise-Mugling Road and Bridges. Draft Design Report (Volume I-Main Report).

v. Obstruction to natural drainage pattern

Haphazard disposal of spoil and other construction materials into the natural drainage will prevent the natural flow of the drainage-triggering landslide and mass wasting at the downstream. Blockage of natural drainage path during construction or maintenance, for example, by environmentally hazardous disposal of spoil materials, may generate water depletion, water logging, a concentration of water flow as well as increase the speed of flow, which will be erosive in nature. Water channels, side drains, and culverts will be disturbed or filled with construction debris and silt during the time of construction.

Diversion as well as overloading existing drains results change in water flowing rendering scouring, gullyng, bank cutting and soil erosion along the banks of natural drainages within the highway. The dramatic final effect of these incremental impacts usually cumulates in massive landslides, which in turn can cause slope instability and landslides. In absence of proper water management, a concentrated flow can lead to scouring, gullyng and soil erosion at downstream land, which in turn can cause slope instability and trigger landslides. *The effects of disruption can extend well beyond the immediate vicinity of a road or point sources of any immediate impact. Impact of disposal upon natural drainage will be direct in nature with high in magnitude, local in extent and mid-term in duration.*

Table 8-7: List of existing bridges along the KNM highway

Sn.	Name of Bridge	Chainage
1.	Khatripauwa	4+139
2.	Naubise Khola Bridge	12+449
3.	Ganesh khola Bridge	15+465



Sn.	Name of Bridge	Chainage
4.	Sopyang Khola Bridge	17+596
5.	Juge khola bridge	
6.	Agara khola	23+380
7.	Khahare Khola	24+876
8.	Fedi Khola	26+953
9.	Dangdunge Khola bridge	27+235
10.	Kheste Khola Bridge	30+665
11.	Machedi Khola Bridge	31+984
12.	Gardo Khola Bridge	35+628
13.	Jundi Khola Bridge	37+489
14.	Charaundi Khola Bridge	38+988
15.	Belkhu khola Bridge (Photo)	41+303
16.	Pokhare khola Bridge (Photo)	45+655
17.	Galaudi Khola Bridge	48+816
18.	Soti Khola Bridge	50+884
19.	Malekhu Khola Bridge	55+879
20.	Gomati Khola Bridge	62+442
21.	Charaundi Bridge (Photo- Soil and Sand extraction)	67+746
22.	Khatauti Bridge	70+686
23.	Hugdi Khola Bridge	74+206
24.	Mowa Khola Bridge (Photo)	78+387
25.	Dahaki Khola Bridge	84+844
26.	Bargang Khola Bridge	85+775
27.	Nagdi Khola Bridge	92+682

Source: Field Survey, 2017

vi. Pollution of Water Resources

Degradation of water quality of existing Rivers such as Mahesh khola, and Trishuli River is likely, especially during the time of construction. As the proposed new alignment proposed close proximity to those rivers. The disposal of soil and chemical wastes from construction works and from camps is possible along the above stated Rivers. Further, impact upon small stream along the existing KNM is expected due to likely disposal of wastes. Existing Trishuli and Mahesh khola is muddy, due to local activity like extraction of sand for the river, operation of crusher plants and sand cleaning plants along the Trishuli riverbanks. The major natural drainages along the existing alignment is presented in the Table above. *The nature of impact will be direct with high in magnitude, site specific in extent and short-term in duration.*

vii. Impact due to operation of borrow pits and quarries

Operation of borrows areas and quarries will cause some adverse impacts if left unrehabilitated. It may pose risk to people, particularly children and animals of accidentally falling into it as well as become potential breeding ground for mosquitoes and vector born disease with the accumulation of stagnant water into it. Illegal quarrying will lead to unstable soil condition; destroy the landscape of the terrain, air and noise pollution. Quarry material will be sourced from existing licensed quarries (whose IEE/EIA has been approved). The dredging and use of dredged material, if involved, may have its impact in terms of localized sedimentation level increase and dispersion of pollutants present in the dredged material in the river water. Probable

sources for construction materials are located along the road alignment (borrow pits -Ch. 9+500, 14+200, 19+300, 27+400 31+200, 37+100, 42+500, 47+800, 53+400, 58+300, 64+300, 69+200, 74+500, 79+700, 85+500, 92+300, 99+700, 104+500, 109+800, X=565760, Y=3080662; X=575092, Y=3175020; X=616575, Y=3067747; X=568277, Y=3077149. X=617857, Y=3066820).

Quarry of hill slopes is also likely during the time of construction; where further landslide may trigger due to over excavation of hill slopes. Such quarry sites are within the scope of project. Hence, the nature of impact due to operation of quarry will be direct with high in magnitude, site specific in extent and short-term in duration.

Table 8-8: Quarry along KNM

Sl. No.	Chainage	Clay %	Silt %	Sand %	Grave l %	NMC	SG	MDD	OMC %	CBR %
1	9+500	0	9.4	18.6	72	23.64	2.62	21.6	7.3	7.1
2	14+200	0	20	20.6	59.4	9.13	2.66	21.5	5.5	35.5
3	19+300	0	55	14.9	30.1	18.93	2.64	18.9	7.9	7.7
4	27+400	0	71.2	19.9	8.9	10.99	2.68	19.1	10.9	8.5
5	31+200	0	37.3	59.5	3.2	14	2.65	21.5	5.9	13.3
6	37+100	2	22.3	33.6	42.1	21.1	2.54	18.8	11.5	5.8
7	42+500	0	21.6	23.7	54.7	4.01	2.67	21.3	6.2	16
8	47+800	0	13.2	51.2	35.6	4.63	2.67	21.4	7.4	11.4
9	53+400	0	33.6	59.2	7.2	6.75	2.67	21.6	5.3	12.4
10	58+300	0	41.2	57.4	1.3	9.07	2.68	20.9	7.3	8.7
11	64+300	0	28.2	54.5	17.2	11.28	2.68	21.4	6.4	11.3
12	69+200	0	15.2	31.7	53.1	5.02	2.69	21.9	6.5	34.2
13	74+500	0	6.9	92.2	0.9	12.25	2.66	19.1	10.8	8.6
14	79+700	0	30.1	62	7.9	6.45	2.68	19.9	9.2	12.2
15	85+500	0	17.1	36.5	46.4	5.36	2.67	21.9	7.7	10.2
16	92+300	0	22	40.5	37.5	6.22	2.67	21.7	6.5	23.2
17	99+700	0	23.2	57.4	19.5	6.11	2.69	21.4	6.4	13
18	104+500	0	10.8	33.2	56	2.56	2.67	21.9	5.6	31
19	109+800	0	25.3	39.2	35.5	7.89	2.69	21.8	6.7	23.4
20	X=565760, Y=3080662	0	24.3	33.6	42.1	2.99	2.67	21.7	7.1	7.2
21	X=575092, Y=3175020	0	38.6	29	32.2	11.88	2.68	19.5	11.1	8.1
22	X=616575, Y=3067747	0	81.5	17.9	0.6	34.79	2.6	20.6	8.4	11.8
23	X=568277, Y=3077149	0	73.5	13.7	12.7	29.82	2.62	18.5	11.6	10
24	X=617857, Y=3066820	0	57.8	24.4	17.8	33.74	2.61	18.8	11.8	12

Source: Detail design for the improvement of Kathmandu (Nagdhunga)-Naubise-Mugling Road and Bridges. Draft Design Report (Volume I-Main Report).



viii. Stone Crushing Plants

Operation of Stone crushing plant will have noise pollution at vicinity. Number of crusher plant location has been identified within the direct impact area; however, the operation of such plants will have dust, air, noise pollution at the vicinity of the proposed location (Section 10.3.2). Excessive noise and dust from the plant will create disturbance to nearby settlements, school, health posts etc. is likely during the construction. Significant number of stone crushing plants are established all along the Trishuli River and are under operation, making Trishuli River water muddy with the direct disposal of effluent from such plants, operating at the banks of the river. *The nature of impact due to operation of crusher plant will be direct with medium in magnitude, site specific in extent and medium-term in duration.*

ix. Stockpiling and transportation of construction materials

Stockpiling of construction materials and aggregates as well as excavated material if piled haphazardly along the existing alignment as well as at the valley side will be washout affecting downhill and along the Trishuli River and cultivated lands. It is likely that significant amount of construction materials will be collected from the Trishuli river bank. Stockpiling along the existing road and near settlement and urban areas will provide discomfort to the local inhabitants with the dust pollution.

Further, haphazard storage along the urban settlements may also lead to accidents. Such impact is likely all along the highway alignment and especially along the existing urban settlements such as at Khanikhola, Naubise, Dharke, Mahadevbesi, Galchi, Baireni, Majhimtar, Malekhu, Chumlingtar, Phisling, Ramailodanda, Kurintar, and Mugling. These materials may be washed away by monsoon rain, causing water pollution to existing natural drainages and along the Trishuli River. The unnecessary piling of construction materials would disturb the scenic beauty and topography of the local environment. Similarly, surrounding crops and ground vegetation may be damaged due to haphazard disposal of these materials. *Impact of likely future washout during heavy rains will be direct in nature with high in magnitude, local in extent and mid-term in duration.*

x. Air pollution

Excavations for road width opening will be carried out by operating drill machines, excavators, load and unload heavy vehicles. Air pollution due to operation of such machines is likely in the vicinity of the project alignment situated within the mountainous area of Dhading and Gorkha district and majority of the alignment passes through undulated and vegetated land; mountains and hill slopes such as Krishabhir and Jogimara considered as unstable area. Excavation for the improvement along such area may lead severe destruction with massive air pollution during construction. Influence of dust and noise pollution on settlement areas due to operation of crusher plants, batching and bitumen-mixing plant close to such area might cause air and noise pollution.

Excessive noise and dust from such plants will create disturbance to nearby settlements, school, and health posts. Further, during transportation of construction materials, operation of dump trucks and excavation activities dust pollution along the existing highway is likely. Physical impact on air, noise and water due to operation of quarry is also anticipated during construction

phase of the project. Possible quarry locations have also been identified for their establishment. Local people, including construction labours, construction contractors, engineers as well as road users will be the major dust victims during the time of construction. *The impact will be direct in nature, high in magnitude, regional in extent and medium-term in duration.*

xi. Potential hazards caused by bitumen and other toxic chemicals

The use of chemicals such as epoxy, gypsum, additives, admixtures, cements, bitumen etc. is inevitable during the time of construction. All these chemicals are hazardous materials used for road construction and maintenance activities. The storage of such chemical might be an environmental problem that can only be met by special precautionary measures. Containers of such chemicals such as bitumen drums often are damaged during transit, leading to a leakage in storage places that often are not or not adequately cleaned up afterwards.

It is likely that the bitumen could remain at the boiling area and decanter sites for many years after the completion of road construction if it is not properly rehabilitated along the existing natural drainages and Trishuli River Corridor. *The impact will be direct in nature with medium in magnitude, site specific in extent and short-term in duration.*

xii. Noise pollution

Noise pollution is likely due to operation of excavators and excavation activities with the widening of existing highway to maintain Asian Highway Standard. Noise will impact the urban settlements, schools and other public places. There are several hotels, shops, resorts and eatery shops, along the highway where road users will be the victims of noise during construction. Crusher plants, batching and bitumen mixing plant, concret-mixing plants, close to such areas might cause inconvenience to nearby settlements in terms of air and noise pollution, creating disturbance to nearby settlements, school, health posts etc.

Establishment of labour camps close to settlement with significant number of labours will also disturb local communities. During transportation of construction materials, operation of dump trucks and excavation activities dust pollution along the existing highway is likely. *The impact will be direct in nature with medium in magnitude, site specific in extent and short-term in duration.*

xiii. Impact related to Road Safety during construction

There are about 15 spots along the Naghdunga-Mugling highway, where very high traffic accidents occur. The major locations account Naubise, Baireni, Pida, Gajuri, Benighat, Jogimara and Darechowk. The major safety issues are visibility at the various blind corners, horizontal and vertical broken-back curves; steep gradients, posing both navigational and stability problems to vehicles; presence of numerous deep valleys, bridges and culvert either unprotected/ inadequately protected laterally; risk of angular collision between conflicting traffic movements and overshooting problem from the numerous side approach of junctions; narrow at bridges, culverts including hazard at numerous bridges etc.



Traffic accidents are likely during the time of road excavation and construction of side facilities along the running highway. The accident prone clusters and their records of accident, from Jan 2013 to Dec 2015 are as under.

Table 8-9: Accidents Clusters in Nagdhunga – Mugling Highway

Sn.	Accident Clusters	Fatalities	Injury
1.	Naubise-4	2	19
2.	Naubise-1	7	24
3.	Baireni-9	4	16
4.	Baireni-8	4	14
5.	Pida-1	2	40
6.	Pida-2	6	82
7.	Gajuri-1	3	10
8.	Gajuri-2	7	53
9.	Benighat-1	3	20
10.	Benighat-9	5	27
11.	Benighat-8	5	88
12.	Jogimara-9	7	41
13.	Dharechowk-7	4	1
14.	Dharechowk-3	16	18
15.	Dharechowk-4	9	58

Source: RSA Report, 2016 (Accident record of Jan 2013 to Dec 2015)

As the existing KNM traverses through hilly area and some forest section along the Trishuli River; cutting of hill slopes may trigger landslides and slope instability, rendering increase in safety of labour workers and road users. Improvement of existing KNM will have road safety issue especially along the existing urban areas. Road safety will be the major issue within the ROW of the existing alignment. *The overall impact of road safety will be direct in nature, high in magnitude with site specific in extent and short term in duration.*

xiv. Occupational Health and Safety of Labour and accidents

Occupational health and Safety of the labour worker will be the major issue during the time of construction. More than 2000 labour worker will be involved during the time of construction and excavation of the new road alignment including improvement of existing KNM. Accidents and health hazards are likely during excavation of new roads, operation of construction vehicles such as excavators and dump trucks, operation of crusher plants, operation of quarry sites likely to have impact upon health and safety. *The impact will be direct in nature, high in magnitude with site specific in extent and short-term in duration.*

xv. Loss of physical and cultural structures and infrastructures

Substantial number of physical and cultural structures and other infrastructure are existed within the 25 meters of ROW along the existing KNM. Numbers of such structures related culture are likely to be affected directly or indirectly during the improvement of existing KNM. The list of physical and cultural structures along the alignment are presented in the Table 5-63. The physical and cultural resources comprise, temples, religious trees (Bar-pipal Chautara),

and in some location such structures are existed together. *The impact will be direct in nature with medium in magnitude, site specific in extent and short-term in duration.*

xvi. Impact due to establishment of construction camps

Approximately, 5 ha of land will be acquired for the establishment of labour camps and Contractor's camp at the vicinity of the project area. However, the land acquired for the establishment of labour camp and camp for Contractor will not be acquired for the overall duration of project construction period. Siting of camp will cause encroachment of agriculture land and alteration of drainage, solid waste and waste water problems. Impacts anticipated from construction camp establishment and operation include disposal of solid waste (organic waste, plastic and metal scrap, domestic effluent, etc.), competition on public facilities (drinking water sources, health facilities, schools, etc.), impairment of aesthetic value of the landscape (loss of vegetation, compaction and contamination of soil and land), poor sanitation (unhygienic latrine, poor drainage facility), transmission of communicable diseases (sexually transmitted diseases, vector borne diseases, etc.), poor water supply, use of alcohols, gambling and conflict with local communities.

Probable locations for campsite are Ch. 01+900, 03+400, 07+100, 09+200, 10+950, 14+800, 28+500 and 35+900. Camp-site results in change of land use due to setting up of construction camp and waste generation during the construction. Contractor is required to properly remove all temporary structures built for operation of construction and workers camps. While doing so, the land will be brought back to original state. *The impact of temporary loss of land will be direct in nature with medium in magnitude, site specific in extent and short-term in duration.*

xvii. Impact due to possible use of child labour

Mobilization and utilization of child labour is likely during the time of construction in each construction package. It is likely that children from outside the valley will be engaged in road construction. However, construction contractor will be responsible to avoid child labour. Contractor will be penalized as per Labour Act 2074, and Children Act 2018 reviewed in Chapter 0. *The impacts will be mostly direct in nature, ranging in magnitude from very high to low, can be local or site-specific in extent and, mostly, short-term or medium-term in duration.*

Impact at the operation stage

i. Instability of the hill slopes

Operation of highway after improvement and upgrading will result instability and landslide are likely at Krishnabhir and Jogimara area. Other impact area along the alignment are Simle, after Belkhu khola at Adamghat vegetated area of 850 meters, 1300m at Phurke khola at Dhading bridge junction, about 1200 meters along the Huilingtar area which is right after Jogimara, 2 kilometers of hill slopes between Phisling and Chumlingtar, about 1-kilometer Chumkhola, 4.5 kilometers road length from Kurintar to Mugling. Whereas such impact is less likely especially along the Nagdhunga to Naubise as the road width has already been widened along this first section. The destabilization of slope may also be expedited due to human activities in the road neighborhood such as quarrying stones or soil, animal grazing, irrigated cultivation. This can cause damage to road section, disruption to transportation and other social impacts in the nearby areas. *The impact is direct, high magnitude, local and long-term in nature.*



ii. Right of Way encroachment

Encroachment of RoW of National Roads might occur any time after completion of construction works and this practice is common in the country, mainly for income generation activities. The permanent or temporary structures built by encroachers within existing reservation cause impact to the pavements and roadside drains. They also obstruct maintenance activities of the roads, view range of travelers and impact to the movement of pedestrian. Parking of vehicles opposite to these locations for buying foods (vegetable, fruits), as well as for other services will increase accidental damage to vehicles and other road users. *The impact will be direct, medium magnitude, local and long term in nature.*

iii. Impacts due to Poor Drainage

During operation phase, sediments could block drain and culverts, improper disposal of debris or disposing garbage into side drain will create overflow of drains and alter surface runoff paths causing soil erosion and health hazards. This will induce siltation in nearby stream which can trigger floods as well as affect aquatic flora and fauna. The inadequate maintenance of the road due to the blockage of drains damages the road surface that can lead to slides and slope failure. *Impacts will be indirect, of medium magnitude, local and short-term in nature.*

iv. Air and Noise Pollution

The source of air pollution in this area will be the exhaust from the vehicles using fossil fuels and vehicle fumes from any other fuel powered mechanical equipment. This will result in the degradation of air quality. It is common practice in Nepal for pressure horns to be used. This is likely to increase the noise level and it may affect people and livestock. *The impacts associated with this will be of direct nature, medium in magnitude, locally confined and long term in nature.*

v. Traffic safety and accident

Existing urban areas along the KNM will be more vulnerable to traffic safety and often accidents with 15 prone areas along the existing KNM. Safety will be the major issue during the time of operation of existing during the time of operation. *The operation of proposed alignment will have impact direct in nature with high in magnitude, site specific in extent and long-term in duration.*

vi. Waste Management

Pollution and waste hazards is likely during the time of operation due to haphazard disposal of wastes by road users all along the existing alignment. Bad odour, blockage and obstruction of road side drain, traffic cogestion, contamination of ground and river water and soil close to the highway is likely due direct disposal of waste from the income generation activities such as operation of eatery shops, hotels and restaurants etc. existed along the highway. Moreover, impact on water sources such as river crossing area due to vehicle washing, fuel leakage, poor sanitation practices, increased human activities/settlement/market center expansions/hotel operations to the nearby water sources is very likely. *The operation of proposed alignment will have impact due to solid waste will be direct in nature with high in magnitude, site specific in extent and long-term in duration.*

Biological Environment

Impacts at the pre-construction stage

i. Dissemination of information to CFUGs and DFO for acquisition of forest land

The project office will send letter to DFO and Community Forest User Groups (CFUG) informing the date of implementation of project and seeking permission for the cutting of the affected trees along the proposed alignment. *The anticipated impact will be direct, of medium magnitude, local and long-term in nature.*

ii. Approval for tree cut

The forest area will be lost permanently and number of trees will be cut during construction period. Project office will acquire permission for the cutting of affected trees from Ministry of Forests and Environment after decision from cabinet. The summary of total tree to be felled in the community according to species is presented in the Table 5-32. *The anticipated impact will be direct, of medium magnitude, local and long-term in nature.*

iii. Hammering of affected trees

There will not be significant impact on forest resources during the pre-construction phase of the proposed road upgrading works. Forest officer, community forest user groups, and project office/contractor representative will identify all affected trees and will hammer for the tree cut. *The impact will be medium, local, and long term in nature.*

Impacts at the construction stage

i. Clearing of shrubs and herbs of the forest areas

The existing road has a width of about 5-6 m, which will be extended to about 7m within a RoW of 50m. During the widening and construction of the proposed road, establishment of campsites, borrow pit / quarry areas and construction of access routes there will be need to clear all vegetation within the designed project area along the entire stretch of the proposed road. *The impact will be direct, low, local, and long term in nature.*

ii. Disturbance, Hunting and Poaching of wildlife

Although the wildlife population is reported low in the project area, illegal hunting and poaching can take place in natural forests by road workers. *The impact will be confined to the road alignment and thus is local, direct, medium magnitude and of short term in nature.*

iii. Use of forest product by the construction workers and construction activities

Labor force and workforce unless their energy needs for their meal cooking is met from fossil fuel, may exert pressure on the local forests of the surrounding areas. *The impact will be indirect, of medium magnitude, local and short term in nature.*

iv. Disturbances on aquatic lives and fishing activities

Erosion from poorly constructed and rehabilitated sites can lead to downstream siltation, ruining spawning beds for fish. Construction can affect flows affecting aquatic wildlife. Roads may also serve as barrier to movement of migratory aquatic species, especially where culverts

are used. Disposal of excavated materials in water bodies may increase turbidity of water and result in reduction in dissolved oxygen content.

It is also common to see the inappropriate driver practices connected with vehicle washing in streams and rivers that can cause local water pollution by leakage of fuel that may not only affect the aesthetic value of the water body, but also put hazards on people and animals using these as drinking sources. Continual water pollution will also affect the aquatic biota, with subsequent negative consequences for fisheries and the economic return. *Such impact on aquatic life and fishes along the road alignment will be of low magnitude and local and medium term in nature.*

v. Disturbances on the corridor of the wildlife movement

Increase in traffic flow and speeds may cause wildlife population disturbance and decline due to vehicle-wildlife collisions, more likely in Ch. 21+400 – 21+500, 33+340 – 33+600, 35+000 – 35+400. *The impact is indirect, medium in magnitude, local and long-term in nature.*

Impact at the operation stage

i. Possible impact on forest resources and extraction of firewood and timber

Road opening to public transportation and others upgrading works may exert indirect pressure on forests and forest resources through illegal extraction of firewood and timber. Good trafficable road conditions may motivate people to earn money illegally. *Impact is indirect, medium magnitude, local, and long-term in nature.*

ii. Increased wildlife disturbance, hunting and poaching

Where the road stretch is crossed by forests concealing wildlife including game value, it may become a good ground for the locals for hunting and poaching of wildlife of game value due to open public transportation. *Impact is indirect, low magnitude, local, and short - medium - term in nature.*

iii. Disturbances for the wildlife movement

Increased traffic flow may cause disturbance to wildlife and their movements on road stretch crossed by natural forests. This in combination with fast driving (especially during nighttime) may pose risks of traffic-wildlife collisions leading to population decline and extirpation. *Impact is indirect, low magnitude, local, and long-term in nature.*

Socio-economic and Cultural Environment

Impacts at the pre-construction stage

Loss of private property and assets

Approx. 30, 100 and 80 market sheds providing services of tea and lunch, grocery, medicine, respectively for highway passengers and to people inhabiting nearby villages in Nagdhunga, Baadbjangyang, Chisapani, Pipalmode, Khatripauwa, Kanakot, Khanikhola and Naubise area. Such temporary shade will be affected within construction width with the implementation of Kathmandu (Nagdhunga)-Naubise road section. In this option, a total 76 private structures will be affected by the road project. Private structures comprises residential structure, residential



cum trade, trade related structure, other structures including kitchen, toilet, water tap, water tank, bio-gas plant, animal shed etc. Most of the affected structures are semi-modern and hut types. Dharke, Mahadevbesi, Galchhi, Baireni, Gajuri, Malekhu, Benighat, Bishaltar, Charaudi, Majhitar, Phisling, Chumlingtar, Kurintar, Ramilo Danda, Manakaman cable car entrance point and Mugling are the major market and settlement area of the Naubise-Mugling section. For the road extension works, previously acquired ROW is sufficient for the improvement of existing road to 2 lanes. Therefore, additional land acquisition will not be required for the road extension and construction within the row of 30m. For the construction of 4 bridges approx. 0.21 ha additional land area belongs to 3 HHs will be required. No new additional land will be acquired for road improvement works. *The impact of loss of private properties is low in magnitude, site specific in extent and short term in duration.*

Grievances raised by the locals and labours

Impact upon private property and acquisition of cultivated land for project implementation will be the major concern of local people. Locals will have deep interest and concern about the compensation of affected structures and affected private lands. Moreover, households depending upon agriculture for their livelihood will be loss their private property due to implementation of Kathmandu (Nagdhunga)-Naubise-Mugling Road and are categorized as severely affected families and has been considered as Severely Project Affected Families (SPAFA) who require compensation. Grievances raised by the locals and labours during pre-construction stage might delay the start of site clearance and construction works. *The impact is low in magnitude, site specific in extent and short term in duration.*

Impacts at the construction stage

Loss of productive land

The road improvement work will be limited within previously acquired ROW (right-of-way), therefore, additional land acquisition will not be required. Some agricultural land will be utilized temporarily during the construction activities, i.e. for construction materials storage, labour camps, construction equipment, temporary passing zones etc. Local farmers of Dharke, Jugekhula, Belkhu, Benighat, Charaudi, and Chumlingtar along Bishaltar-Phisling will lose about 0.21 ha of cultivated land permanently, which will decrease the production of agricultural products with estimated loss of approximately, 1.2 tons along the Naubise-Mugling road section. Although, it will be insignificant in terms of overall project benefit as well as to the development of agricultural sector of the district. *The impact will be direct in nature, medium in magnitude, local in extent and long term in duration.*

Land and property acquisition, compensation, resettlement and rehabilitation

76 private and 9 public structures will be affected in Nagdhunga –Naubise-Mugling section. Among the affected households, Brahmin (54.5%), Chhetri (18.2%), Janajati (18.2%), and Newar (9.1%). The road improvement work will be limited within previously acquired ROW (right-of-way). Hence, additional land acquisition will not be required in this option. Temporary use of land will be needed during road construction for contractor's campsites, labor force campsites, quarry sites, crusher plant and stock piling yard, etc. *The impact of land*

acquisition will be direct in nature, high in magnitude, local in extent and long term in duration.

Disruption of community structure

The increase in competition for existing resources are likely that can put the indigenous people at a disadvantage, especially when the settlers introduce ecologically inappropriate and unsustainable production systems. Physical conflicts are likely between settlers and the host communities, when the latter try to reclaim their heritage and traditional rights. This sort of conflict might change social, cultural and religious practices of local community. 9 public structures are affected by improvement and upgrading along the Nagdhunga-Naubise-Mugling section, including 1 public sheds (*Pratikhalaya*), 2 toilet, 3 temples, 2 public taps and 1 community building. The list of temples situated along the existing KNM is presented in Annex 7. *The impact will be indirect in nature, low in magnitude, site specific in extent and short term in duration.*

Livelihood issues

Substantial population along the Kathmandu (Nagdhunga)-Naubise-Mugling alignment are considered as low-income. Their major livelihood depends on agricultural production, livestock and small shop business. Low-income level population will be severely affected with permanent acquisition of their land and property.

Temporary shades along the Nagdhunga, Sisnekhola, Sikrekhola, Khatripauwa, Khanikhola and Nausie, Dharke, Mahadevbesi, Galchhi, Baireni, Gajuri, Malekhu, Benighat, Bishaltar, Charaudi, Majhitar, Phisling, Chumlingtar, Kurintar, Ramilo Danda, Manakaman cable car entrance point and Mugling area during the project construction and implementation works will be severely affected that will lead to loss of business due to excavation and construction activities. *The impact will be direct in nature, low in magnitude, site specific in extent and short-term in duration.*

Conflict in or with nearby host community

Conflict between workers and local people is likely during the time of construction as there could be a struggle between local people and labour workers for same commodity and natural resources. Such impacts are likely within Kathmandu (Nagdhunga)-Naubise-Mugling road during time of construction, especially at market places, i.e. Nagdhunga, Khanikhola, Naubise Dharke, Mahadevbesi, Galchhi, Baireni, Gajuri, Malekhu, Benighat, Bishaltar, Charaudi, Majhitar, Phisling, Chumlingtar, Kurintar, Ramilo Danda, Manakaman cable car entrance point and Mugling and at community forest areas. *The impact will be indirect in nature, medium in magnitude, site specific in extent and short term in duration.*

Issues related to vulnerable indigenous people

There are vulnerable groups in every social setting and these include, women, children, the elderly and people with disabilities. According to assets loss inventory of the project affected household, only 2 women headed households were identified as vulnerable in the Kathmandu -Naubise road section. In addition, six households of ethnic minorities (Chepang), 5 Dalits households, 10 women headed households, and 2 aged member households were identified in

the Naubise-Mugling road section. *The magnitude of the impact is evaluated as Medium Negative as it can be prevented.*

Impact due to damages of community infrastructures

The KNM alignment passes through locally important cultural and religious sites, including temple area and Chautaro (Religious tree) existed along the hillside and valley of the road and beyond RoW of the project. Approximately, 96 cultural sites are located along the existing highway. No any chautaro will be affected severely. *The impact of loss of such religious sites will be direct in nature, medium in magnitude, site specific in extent and short-term in duration.*

Potential issues of conflicts associated with road construction work forces

Influx of people is anticipated during the time of construction. Pressure on existing natural resources such as water, existing food availability, existing educational facilities are likely with the increase outside workers and utilization of such resources. Such impacts might occur existing markets and settlement, i.e. Nagdhunga, Khanikhol, Naubise, Dharke, Mahadevbesi, Galchhi, Baireni, Gajuri, Malekhu, Benighat, Bishaltar, Charaudi, Majhitar, Phisling, Chumlingtar, Kurintar, Ramilo Danda, Manakaman cable car entrance point and Mugling areas. *The impact will be direct in nature, medium in magnitude, site specific in extent and short term in duration.*

Road safety issues

Locals and other vehicles plying the road during construction will likely to face difficulty due to dust, noise and stability of the slopes. Improvement of existing Kathmandu-Naubise-Mugling will cause road safety issue along the existing urban areas i.e. Khanikhola, Naubise, Dharke, Mahadevbesi, Galchhi, Baireni, Gajuri, Malekhu, Benighat, Bishaltar, Charaudi, Majhitar, Phisling, Chumlingtar, Kurintar, Ramilo Danda, Manakaman cable car entrance point and Mugling. Further, Road safety will be the major issue within the ROW of the existing alignments. *The impact will be direct in nature, high in magnitude, local in extent and short-term in duration.*

Issues related to cultural assets

The outside construction workforce coming from places with different cultural and traditional values is envisaged to influence the local cultural and traditional values. The extent of such influence is difficult to predict. Project area is a co-existing ground of different ethnic groups with diverse sets of traditions and values since ages. It is predicted that the outside workforce and the local community will come together without any cultural and traditional conflicts. Moreover, the number of the workers involved is small. Further, 3 temples and worship places are existed close to the existing KNM road alignment are likely to be affected directly or indirectly. The number of likely affected cultural and worship places including such sites situated close to the existing highway are presented in the Table 5-63 and Annex-7 All the cultural sites existed along the proposed project area is of local significance. Where local people are worshipping daily considering some as holy diety. However, the entire project area does not comprise cultural and historical sites with archaeological and historical importance. *The envisaged impacts on local culture and tradition is short period, site specific and of low magnitude.*

Issues on landscape aesthetics

The stockpiling of materials, construction excavation for structures and clearance of vegetation are some of the issues related to the general aesthetics. Except for the vegetation clearance, rest of the works is site specific, short term and low magnitude. *The vegetation clearance is an impact of long-term, site specific, moderate magnitude along the ROW.*

HIV/AIDS and other diseases

The issue if community health is related to the outside workforce. The outside workforce may introduce transmissible disease of unknown nature to the communities. The outside workforce can get sexually involved with the local community individuals increasing the risk of STD and HIV/AIDS in the community. Poor sanitation practice of the outside workforce in the mark shift camps and construction sites is also potential to generate pollution issues affecting community health. *The envisaged risk is site specific, short duration and of low magnitude.*

Impacts at the operation stage

Possible ribbon development along the road alignment

Encroachment of ROW for the establishment of shops and residences are likely with gradual development of ribbon settlement. This sort of impact is envisaged along the entire road alignment area. Bus stops and indented bus bays at 11+300 and 11+430 and ch: 12+207 to 12+650 area will be possible ribbon development area due to construction. Similarly, Benighat, Galchhi, Mankamana cable car driveway junction, Furke Khola (Ch: 54+787 EB and 54+906 WB), Malekhu Bazar, Charaudi Bazar, Lewatar, Ch: 15+195, Ch: 23+222, Ch: 50+080, Ch: 50+432, Ch: 90+496, and Ch: 94+759 area will be possible ribbon development area due to construction of indent bus bays. *The impact of encroachment will be direct in nature with high in magnitude, regional extent and long term in duration.*

Increase in accidents

With an improved road, there is likely increase of vehicular traffic and over speeding in busy sections of the road thereby increasing risks of road traffic accidents to communities along the KNM road. The effect of accident will be likely and long term. *The magnitude of the impact will be medium in magnitude, local extent and long term in duration.*

Development of settlements and market places

After construction, the condition of the road will improve and transportation of commodities to and from the project area will be easier. More vehicle owners will operate on improved road surface, which will result in more vehicles on the road, thus, leading to low transport costs, savings on general fuel consumption and reduction in travel time. Farming communities will be easily accessed to evacuate farm production (paddy, wheat, maize, bananas, beans, vegetables, and fruits among others), which will be easily and quickly transported to different destinations. More traders will prefer to buy directly from farmers and this will encourage them to produce more production for the market. In addition, transportation will be eased for prospective visitors and tourists who would wish rafting in Trishuli River, which is a major tourist attraction in the area. Given the current state of this road, it is expected that the project will have high positive impact. as the improved road will facilitate inter and intra community

communication and transport. Bus stops and indented bus bays at 11+300 and 11+430; from chainage 12+207 to 12+650 has been proposed, which will be possible location of development settlement and market area. Moreover, bus bays at Benighat, Galchhi, Mankamana cable car driveway junction, Phurke Khola (Ch: 54+787 EB and 54+906 WB), Malekhu Bazar, Charaudi Bazar, Lewatar, Ch: 15+195, Ch: 23+222, Ch: 50+080, Ch: 50+432, Ch: 90+496, and Ch: 94+759 has been proposed, which will be possible location of development settlement and market area. *The magnitude of the impact will be medium, local, and long term in nature.*

Sexual violence on female workers and Girl trafficking

There is potential of the exploitation of the female members by the construction workforce, mostly the outside workforce, during the construction and post construction period. Girl trafficking could be one of the potential problem during operation and maintenance period. Girl trafficking, prostitution is expected to be increased especially at existing (Nagdhunga, Tileghar, Khanikhola, Naubise) and emerging (Khatripauwa) settlement areas, where people gatherings are likely to be increased with increase in other facilities such as hotels, restaurants and lodges. *The impact will be direct in nature with medium magnitude, regional extent and long term in duration.*

Migration and immigration

Immigration of people from other areas and influx of workers are inevitable during the time of construction of any project. Project implementation is difficult without skilled workers and labourers introduced from outside the project area. As local people may reluctant to involve into labour work. Some industries i.e. a cement factory and few gas bottling plants and brick factories establishment in nearby areas has commercialized the Khanikhola territory, will cause of the influx people in the area. Immigration has been envisaged into the project especially during the time of operation stage with the availability of good jobs, services and facilities. Some industries/finance institutions i.e. Gas bottling plants, Petrol pump, Hotels, Banks, Cooperatives, Sand processor factory and aggregate crosser establishment in nearby areas will be another cause of increase of the influx people in the area. *The impact will be indirect in nature, low in magnitude, site specific in extent and short term in duration.*

Increasing in prostitution

Increase in prostitute likely due to influx of many people and operation of hotels adjacent to link roads from the highway. This impact might continue into the operation phase, especially with predicted increase of small trading centres, i.e Khanikhola, Naubise, Dharke, Mahadevbesi, Galchhi, Baireni, Benighat, Bishaltar, Phisling, and Chumlingtar. In addition, the new/improve bitumen road will increase the number of mobile workers on the road such as truck and trailer drivers and mobility of workers, associated with risky behaviour. *The impact will be direct in nature with medium magnitude, regional extent and long term in duration.*

HIV/AIDS and other diseases

The presence of an immigrant labour force and additional disposable income may result in undesirable interactions between the local communities (particularly youth) and the workforce, contributing to the spread of HIV/AIDS to both workers and the communities. This impact is likely to continue into the operation phase, when small trading centres will turn into bigger

towns. Accumulation of water in borrow pits and quarries and improperly designed drainage structures (the latter particularly in urban areas) may encourage the breeding of malaria-transmitting mosquitoes and other water-borne diseases. *The impact will be direct in nature with medium magnitude, regional extent and long term in duration.*

8.4.2 Impacts in the Sisnekhola-Dharke Alignment

Physical Environment

Impact at the preconstruction stage

Impacts during detailed design and pre-construction phase

The construction of the proposed Sisnekhola-Dharke will be a new two-lane carriageway road built to Asian Highway standards. The new alignment of the road is critical in determining the environmental impacts and route selection and the related impacts of various alignments are discussed in Chapter 8. There are also a number of other matters that detailed design consultant engineers will prepare and it is assumed that the detailed designs will avoid construction impacts by good design and to minimize operational environmental pollution impacts as far as practicable. Opportunities to provide environmental enhancements have been identified and included in the detailed designs. Routine matters such as avoiding unnecessary removing of trees and compensatory and enhancement planting has been attended in the detailed design and preconstruction stages.

Other routine matters such as design and construction of the pedestrian and road underpasses, over passes, lead off drains and maintenance of the works (protection works) during construction has also be addressed in the detailed design stage. Opportunities for enhancements during detailed design, construction and operation, which are envisaged at this stage, have also been included in the Environmental Management Plan (EMP) and these has been reviewed at the detailed design team.

Review of impact assessment, mitigation and EMP

Construction contractor will be responsible to review all the environment assessment reports in order to update EMP prior to start of construction work and will get approval from engineer prior to the construction. If there are changes in project scope or alignment these will be disclosed to MoFE and World Bank and the ESIA, RAP, VDCP and EMAP will be revised. The revised ESIA/EIA, RAP and EMAP will be resubmitted to DOR and WB, incorporating any recommendations and requirements from MoFE. The EMAP is a working document and will need to be reviewed in due course at inception and throughout construction in order to feed back any significant unpredicted impacts. *The impact can be considered as low in magnitude, site specific in extent and short term in duration.*

Review of alignment to improve project acceptability

The main alignment has avoided most of the sensitive receivers by at least 50m and there will be sufficient buffer distance between the works and the community in the settlements such that major significant impacts can be avoided in order to maintain the new highway construction to meet Asian Highway Standards. Nonetheless, some significant construction impacts can be expected from the works, particularly in terms of noise, vibration, dust and waste disposal and

mitigation measures and public consultation are proposed to be undertaken at the implementation stage to ensure unavoidable nuisances are controlled and not allowed to escalate. Due to the locality and the nature of the terrain some losses of agricultural land and public land for the main road alignment are inevitable such as from chainage 8+500 to 9+400 where the proposed alignment is proposed more or less superimpose with existing earthen track of Sitapaila-Dharke alignment. *The impact can be considered as low in magnitude, site specific in extent and short term in duration.*

Access roads

The access to the existing settlements, schools during the time of construction has not been proposed in the detail design. Alternative diversions to local roads that access Waglethok, Rupakot settlement, local schools and access to Gajurelgaun and Purano Dharke settlements has not been designed and hence should discussed in advance with the local authorities such as with ward office and municipality.

Further, signposted and other necessary information will be disseminated and will be provisioned before the start of construction. No access roads have been designed during the preparation but the ESIA consultants gave an indication of the likely approach based on observation and professional judgement. *The impact can be considered as low in magnitude, site specific in extent and short term in duration.*

Planning for erosion control

The hill slopes especially at Nisakot community forest, tunnel portal including tunnel outlet area is prone to significant erosion, and landslides and the construction works will aggravate this situation. However, *the impact can be considered as low in magnitude, site specific in extent and short term in duration.*

Planning materials management and spoil disposal

Construction of new alignment and tunnel excavation at Waglethok community will generate 17,741.00 cubic meters of spoil to be dispose. Significant public consultation will again be required for the plying of dump trucks and construction vehicles along the existing road and communities. Contractor will plan in managing stockpiling areas for construction materials and disposal of excavated spoil materials. *The impact can be considered as low in magnitude, site specific in extent and short term in duration.*

Traffic Management

There are also concerns about blocking existing roads such as the track connecting existing highway from Waglethok and Rupakot settlement and many other foot trails that connecting schools, settlement areas at Gajurelgaun and Purano Dharke area. *The impact can be considered as low in magnitude, site specific in extent and short term in duration.*

Preparing the Contractor(s) to Address Mitigation Measures

The contractor will be well-informed by including the EMAP of Sisnekhola-Dharke and environmental assessments in the bidding and contract document. The contractor(s) will be informed that they will be required to produce method statements and plans in advance as



required in the EMAP for, temporary pedestrian and Traffic Management Plan, Drainage Plan, Erosion Control Plan, Materials Management Plan, Waste Management Plan, Spoil Disposal Plan, and Noise and Dust Control Plan. *The impact can be considered as low in magnitude, site specific in extent and short term in duration.*

Impact at the construction stage

Disruption and relocation of existing services and public utilities

Existing earthen track at Waglethok will be affected severely with the opening of proposed new track and excavation of tunnel portal. The portal area will be severely affected with the establishment of heavy equipment, parking lots, movement of labour workers, establishment of camps etc. Excess cutting will be required near Buddha Vision Secondary School at 5+600-5+800 will lower the level of proposed highway than the existing ground level affecting existing earthen track and small stream Sikre-khola. Sikre-khola junction at the chainage 6+760 the track in front of United cement compound will be affected severely due to construction. The track is connecting exist Tribhuvan Highway with local tracks and Sitapaila-Dharke connection. Other infrastructures that are likely to be affected due to construction of proposed Sisne khola-Dharke alignment are presented in the following tables.

Table 8-10: List of existing tracks along the Sisne-Dharke alignment that are likely to be affected

Sn.	Chainage along the KNM	Affected width length (m)	Road Type	Linkage between
1.	2+700-3+000	250	Earthen track	Piplamod-Waglethok (track connecting Shiva temple) road
2.	2+650-2+800	65	Earthen track	Waglethok-Rupakot Rod (track along the outlet of tunnel portal)
3.	3+100	65	Earthen track	Track road at Rupakot that goes to Cement factory
4.	3+100-3+300	60	Earthen track	Track at Waglethok that goes to Dillisabritri School
5.	5+740	120	Earthen track	Tracks connecting Buddha Vision Secondary School
6.	6+760	110	Earthen track	Sikrekhol junction, track in front of United cement factory compound
7.	8+100	55	Earthen track	Earthen track after Mahesh khola crossing at 8+100
8.	8+460	110	Earthen track	Earthen track connecting both bank of Mahesh khola at chainage 8+460
9.	8+400-9+550	1150	Earthen track	Existing motorable earthen track at Gajurelgaun
10.	11+100	60	Earthen track	Track connecting highway
11.	11+150-11+252	100	Black topped	Prithvi Highway

Source: Field Survey, 2017

Table 8-11: List of Irrigation Canals to be affected within the proposed Sisne khola-Dharke alignment

Sn.	Chainage	Canal Type	Approx. Length Affected (m.)
1.	10+300-10+400	Earthen	100

Sn.	Chainage	Canal Type	Approx. Length Affected (m.)
2.	10+600~10+800	Earthen	200
3.	10+500~10+600	Cemented	100
4.	Total		400

Table 8-12: Drinking Water Supply along the Sisne khola-Dharke Section (in meter)

Sn.	Road Section	Chainage	1" Dia. Pipe		0.5" Dia. Pipe		1.5" Dia. Pipe		2" Dia. Pipe	
			GI	PVC	GI	PVC	GI	PVC	GI	PVC
1.	Sisne Khola - Dharke	0+00~11+200	0.3	0.9	-	2.5	-	-	-	-

Table 8-13: List of affected electric poles situated along the proposed Sisne khola-Dharke alignment

Sn.	Road Section	Chainage	Type of Poles			Total
			Metal	Wooden	Cement	
New Alignment from Sisne Khola - Dharke						
5.	Sisne Khola - Dharke	0+00~11+200	80	25	-	105

The impact due to disruption and relocation of existing services and public utilities will high in magnitude, local in extent and short term in duration.

Change in Land use and loss of productive topsoil

The total area of land use cover within the proposed new alignments Sisnekhola-Dharke Road length is 58.76 ha. In which; approximately, 2.03 ha of barren land, 4.24 ha of grassland, 23.37 ha of forest, 7.67 ha. of shrub land, 9.14 ha. of built-up areas, and about 12.31 ha of cultivated land situated within the ROW will be acquired permanently during the construction of road alignment. However, all the land area acquired within the 50m ROW will not be changed or destroyed permanently for the construction of alignment. Only the land use cover within the 10 meters will be changed permanently into the carriage width of proposed Sisnekhola-Dharke. The proposed alignment traverse through Nisakot Community Forest at the chainage 1+800 to 2+400 and 3+600 to 4+000 will be severely affected where substantial number of mature pine trees required to be removed. The removal of those trees will render hill collapse and significant landslides are likely with the destruction with severe impact upon existing infrastructure such as approximately 3 km of existing earthen track road linking Piplamod to Waglethok will be affected severely. Similarly, the Waglethok and Rupakot communities will be affected during the time of construction. Direct transportation from the Piplamod of Tribhuvan Highway to Waglethok and Rupakot community settlement through existing earthen track will be affected with the change in land use during construction.

Approximately, 67.28 ha. of cultivated land will be destroyed along the Sisnekhola-Dharke road alignment. The area within the 12 meters of carriage width covering the cultivated land will be completely changed into road. Top soil of the fertile cultivated land will be affected during the time of construction. Fertile cultivated land between Nisakot Community forest and United Cement Factory will be destroyed with the construction of proposed new alignment. The adjacent cultivated lands between Dillishabitri Secondary School and Buddha Vision Secondary Schools of Dunibeshi RM-9 will be affected severely during construction activities

and change its land use pattern. The natural drainage flow from one cultivated terrace to another terrace in this area will be discontinued. Cultivated lands situated in between chainage 5+000 to 6+5000 is likely to be affected due to discontinuity of natural drainages. The cultivated lands situated along the Dhuni khola, Mahesh Khola and Naubise Khola River will also be affected severely as the proposed alignment traverses through the banks of the river from United Cement Factory area till the alignment reaches Dharke. However, there is no any remarkable forest and vegetated area between united cement factory areas up to Dharke to be affected. Moreover, the existing agricultural production will also be affected with the implementation of the Sisnekhola-Dharke.

It is further anticipated that the construction of carriage width will affect land use with the construction of 10 m carriage width; however, the construction width will not exceed beyond 25 m ROW. Massive amount of cutting and filling will affect existing terrains changing its land use type is likely during construction. Moreover, the construction of highway will further acquire lands adjacent to proposed highway alignment for temporary purposes. Lands such as barren land, flood plain, plateau etc., are likely to be acquired for the establishment of labour camp, crusher sites, worker campsite, for the disposal of spoil etc. Land use pattern of identified labour campsite, crusher sites, and spoil disposal sites will be utilized during the time of construction and will be changed temporarily. *The overall impact of land use change will be direct in nature, high in magnitude with site specific in extent and long term in duration.*

Landslides, Slope Destabilization and Soil Erosion

Nisakot Community forest area where landslide is likely with the construction of new alignment and excavation for the proposed tunnel. Landslide and soil erosion will also be triggered due to excavation activities of proposed tunnel at Waglethok settlement along the Sisnekhola-Dharke alignment. Landslide and slope destabilization and soil erosion will also be the major issue for the first 5 km of the Sisnekhola-Dharke alignment at Khatripauwa, Nisakot Community forest area and at the proposed tunnel location along the Sisnekhola-Dharke and the impact will be very high with the excavation of stable slopes. Tunnel portal excavation activities are likely to produce landslide hazards and soil erosion at the portal area and it's adjacent during the time of portal excavation. Impact of landslide along the Rupakot settlement after tunnel outlet is likely, as the new highway after tunnel outlet will also affect existing earthen track and settlement.

Road construction and excavation in Waglethok hill will be more difficult during the rainy season due to the area comprises clayey soil around the area. After the hill slope of Nisakot community forest, the proposed alignment passes through the bank of Maheshkhola; where the impact of landslide and slope stabilization is low. However, soil erosion along the Maheshkhola riverbank is likely during the construction and excavation of propose road. *The overall impact of landslide will be direct in nature, high in magnitude with site specific in extent and long term in duration.*

Impact due to tunnel excavation

Excavation of the proposed tunnel likely to have severe impact upon the adjacent Rupakot and Waglethok settlement. Further, access to the locals will be affected with the excavation of the

proposed tunnel. Existing earthen tracks connecting from Piplamod to the Waglethok settlement will be affected during the time of excavation. Approximately 3 km of the local tracks and the settlement including local inhabitants will be affected during the time of 180m tunnel excavation due to inaccessibility, dust pollution, noise and vibration, fly rocks up to several kilometres during the opening of tunnel portal and blasting, safety issues, and degradation of existing local road tracks. Drill and Blast (soft ground tunnelling) method will be carried out for the tunnel excavation. 17,741.00 cubic meters of spoil will be excavated from 180m tunnel. *Impact of excavation and blasting of the proposed tunnel will be direct in nature with high in magnitude, local in extent and mid-term in duration.*

Spoil disposal

Approximately, 302,949 cums of excess rock and soil materials will be required to dispose safely with the excavation of Sisnekhola-Dharke new proposed alignment. It is estimated that 808,597 cums of excavated materials will be generated from the excavation and construction of Sisnekhola-Dharke alignment. It could be difficult to keep balance between cut and fill, and haulage to disposal site might be expensive. About 550,844 cums of excavated material will be reused in back filling. Thus, the side tipping of excavated material is very likely during the time of construction. Direct disposal of excavated material during the time of construction will affect adjacent private and cultivated lands. Such disposal of spoil especially at the valley side of the alignment will trigger landslide, causing soil erosion, destroy vegetation, cause hazard to settlement at downhill side, disrupt natural drainages and pollute water sources existed along the alignment.

Natural drainages such as Sisnekhola, Dhuni khola, Sikre Khola existed along the alignment will be affected due to haphazard disposal of the spoil. 17,741.00 cubic meters of spoil will be excavated from 180m tunnel proposed at Waglethok settlement area where three earthen houses are situated at the hilltop. Approximately, 3 km of Dhunikhola riverbank is likely to be affected with the excavation of new alignment along the Nisakot Community Forest and along the cultivated land area at Dillishabitri Secondary School and Buddha Vision Secondary Schools of Dunibeshi RM-9. *Impact of disposal landslides and erosion of fresh cut hillside slopes will be direct in nature with high in magnitude, local in extent and mid-term in duration.*

Disruption and blockage upon natural drainage

The proposed Sisnekhola-Dharke alignment crosses 39 big and small natural drainages; construction and excavation of proposed new alignment will have severe impact upon such natural drainages. The major natural drainages along the alignment are Sisnekhola, Dhuni khola, Sikre Khola, Mahesh Khola and Naubise Khola. Blockage to these natural drainages especially during rainy season will trigger landslide and mass wasting at the downstream. The impact is more likely at the Nisakot community forest area and tunnel excavation area at Waglethok and Rupakot settlement area. As the alignment traverse towards downhill and proposed through flat cultivated land, such impact is very less likely after the United Cement Factory area along the Sisnekhola-Dharke area.

Direct disposal of spoil material will generate water depletion, water logging, a concentration of water flow as well as increase the speed of flow, which will be erosive in nature. Natural

drainages along the Nisakot community forest will be vulnerable where frequent effects of scouring, gullying, bank cutting and soil erosion are likely. These impacts may cumulate massive landslides, which in turn can cause slope instability and landslides. Such impact is also likely at the tunnel outlet at the Rupakot settlement area. In absence of proper water management, a concentrated flow can lead to scouring, gullying and soil erosion at downstream land, which in turn can cause slope instability and trigger landslides along the Nisakot community forest area, Waglethok settlement and Rupakot Settlement area. The effects of disruption can extend well beyond the immediate vicinity of a road or point sources of any immediate impact. *Impact of disposal upon natural drainage will be direct in nature with high in magnitude, local in extent and mid-term in duration.*

Water Pollution

Degradation of water quality of existing Rivers such as Sisne khola, Sikre khola, Dhuni khola, Mahesh khola, and Naubise Khola (River) is likely especially during the time of construction. As the new alignment proposed close proximity to those rivers, the disposal of soil and chemical wastes from construction works and from camps is likely along the above stated Rivers. Further, impact upon small streams along the Sisnekhola-Dharke are also likely due to direct disposal of wastes generated from the construction activities. *The nature of impact will be direct with medium in magnitude, site specific in extent and short-term in duration.*

Soil Contamination

Contamination of soil is likely with the implementation of proposed Sisne khola-Dharke road project and likely deficit in agricultural production along the proposed new alignments. With the direct impact upon 12.31 ha of cultivated land; top soil of cultivated land and agricultural products from the area within the proposed road carriage width will be lost permanently with the implementation. Further, the soil adjacent to the proposed alignment will be affected with temporary utilization such as establishment of labour camps, workshop area, construction vehicle parking and piling of construction materials. Cultivated land along the project area are likely to be affected with the disposal of chemical wastes and other construction wastes into natural drainages as locals down streams have been utilizing water from such natural drainage for irrigation purposes along the fertile land of the project area. Particularly, the locals have been utilizing natural water from Dhuni khola, Sikre khola, and Mahesh khola for the irrigation. *The cumulative impact of loss of top soil and agricultural products along the proposed alignment will be direct in nature, medium in magnitude with site specific in extent and long term in duration.*

Water logging

Water logging especially along the cultivated land will be likely during the time of construction along the proposed new Sisnekhola-Dharke alignments. Severe impact of water logging is likely along the Nisakot community forest area and near Rupakot community, cultivated land along the Dillishabitri Secondary School and near to Bhuwaneshwori Primary School playground at Purano Dharke due to haphazard disposal of spoil and destruction of natural drainages. *The impact of water logging of land will be direct in nature with medium in magnitude, site specific in extent and short-term in duration.*

Quarrying of Construction Materials

Quarry for the construction materials is more likely especially from the Mahesh khola and its other tributaries such as Dhuni khola, Rupse khola for the proposed new Sisnekhola-Dharke alignment. Quarry of hill slopes near Nisakot community forest is also likely during the time of construction; where further landslide may trigger due to over excavation of hill slopes. Illegal excavation of hill slopes anywhere within the 2 kilometres from the project alignment by the contractor is very likely in order to acquire stones required for slope stabilization activities for hill slope along the Nisakot community forest, stone required for river training works along the Mahesh khola and other small stream along the proposed new alignment. *The nature of impact due to operation of quarry will be direct with high in magnitude, site specific in extent and long-term in duration.*

Stone Crushing Plants

Operation of Stone crushing plant will have noise pollution at the vicinity. However, the operation of such plants by contractor will have dust, air, noise pollution at the vicinity of the proposed location. Excessive noise and dust from the plant will create disturbance to nearby settlements, school, health posts etc. is likely during the construction. The project area comprises five schools situated close proximity along the proposed alignment. The project area also comprises significant numbers brick kilns along the proposed alignment. Most of the brick kilns are established along the Mahesh khola riverbanks. Further, the United Cement Factory occupying huge area at the left bank of Mahesh khola at Jugedi is also into operation. A crushing plant for the Sisnekhola-Dharke section is proposed at 27 43' 57.40" N and 85 10' 54.15" E. The location is situated 670m north from United Cement factory or from proposed Sisnekhola-Dharke chainage 7+200. *The nature of impact due to operation of crusher plant will be direct with medium in magnitude, site specific in extent and medium-term in duration.*

Stockpiling and transportation of materials

Stock piling of construction materials and aggregates as well as excavated material if deposited haphazardly along the alignment as well as at the valley side will be washout affecting downhill settlements and cultivated lands. Damage to fresh cutting outer slopes throughout the alignment is also likely due to high velocity of wind resulting erosion and landslides due to piling at the outward slopes is likely. Especially; at section 0+000 to 5+000 of Sisnekhola-Dharke section where the existing hill slopes are steep and likely to be vulnerable to landslide with the storage of construction materials. Impact upon adjacent cultivated lands and private property including schools are also likely with the haphazard stockpiling of construction materials on cultivated lands and private lands along the alignment. Stockpiling along the Maheshkhola stream is also likely and will have severe impact of dust and impact upon aquatic life along the river. *Impact of likely future washout of piled materials during heavy rains will be direct in nature with high in magnitude, local in extent and mid-term in duration.*

Air Pollution

Excavations for road width opening will be carried out operating drill machines, excavators, load and unload heavy vehicles etc. Air pollution due to operation of such machines is likely throughout the vicinity of the project alignment; as the overall alignment of the proposed new

Sisnekhola-Dharke traverse through terrace-cultivated lands, Nisakot Community forest, Waglethok, Rupakot, Gajurelgaun and Purano Dharke as major settlements. Operation of construction vehicles will have significant impact upon local inhabitants, upon cultivated lands, upon forest and natural habitat.

Impact of dust and noise pollution upon settlement areas due to operation of crusher plants, batching and bitumen mixing plant as well as excavation of tunnel portal proposed at Waglethok area is likely to causes inconvenience to nearby settlements in terms of air and noise pollution. Excessive noise and dust from the operated machines and vehicles will also create disturbance to nearby settlements, school, health posts etc. is likely during the construction. Severe impact upon agricultural is also likely due to construction activity. Generation of dust is likely and dust cover on cultivated farmlands during the construction will have severe impact upon production of agricultural products. Physical impact upon air, and noise due to operation of quarry was anticipated during construction phase of the project. Umpteen amounts of stones and boulders and quarry locations have been identified along the road alignment and its adjacent areas. *The impact will be direct in nature with high in magnitude, regional in extent and medium-term in duration.*

Impact of chemicals on environment

The proposed section passes through cultivated land, forests, settlements, natural drainages, schools, and local cultural sites etc. where impact of chemicals is likely with its haphazard use. Chemicals such as epoxy, gypsum, additives, admixtures, cements, bitumen etc. is inevitable during the time of construction. All these chemicals are hazardous materials used for road construction and maintenance activities. The storage of such chemical might be an environmental problem that can only be met by special precautionary measures. Containers of such chemicals such as bitumen drums often get damaged during transit, leading to a leakage in storage places, spillage of diesel and lubricants which often are not adequately cleaned up. It is likely that the bitumen could remain at the boiling area and decanter sites for many years after the completion of road construction if it is not properly rehabilitated along the river corridors of Mahesh khola, Naubise khola. The impact of chemicals upon cultivated lands forest, drinking water resources, and natural drainage as well as to local inhabitants is very likely during the time of construction. *The impact will be direct in nature with high in magnitude, regional in extent and medium-term in duration.*

Noise pollution

Noise pollution is likely along the alignment especially at the school areas and settlements along the proposed alignment. Severe impact of noise is likely at Khatripauwa near to Sisnekhola starting point due to road excavation and operation of heavy equipment. Similarly, excavation of tunnel portal, mobilization of construction vehicles, establishment of labour camps and mobilization etc. will generate significant noise and will have impact upon Waglethok and Rupakot settlement. Locals along with students of Dillishabitri Secondary School and Buddha Vision Secondary Schools of Dunibeshi RM-9 will be affected severely. There are several scattered houses after the alignment crosses Mahesh khola. The Gajurelgaun and Purano Dharke settlement from chainage 8+000 to 11+200 along the right bank of Mahesh khola will also be affected severely due to noise pollution. Sharada Primary School at

Gajurelgaun and Bhuwaneshwori Secondary School of Purano Dharke, Dhunibesi-5 are likely to be affected due noise from construction works. Noise for the operation of machines, excavators, vehicle movements on unpaved roads during the time of construction are likely along the proposed highway alignment. *The impact will be direct in nature with high in magnitude, site specific in extent and short-term in duration.*

Water flow disruption and erosion of riverbanks

Nine small seasonal drainages existed along the Nisakot community forest area. These small drainages are lies along the proposed alignment and will have disruption in water flow and erosion of topsoil due to felling of pine trees, excavation for the new road and other construction activities. Dhuni khola riverbanks from 6+200 to 6+600 is likely to be affected with the construction activities. Similarly, riverbank erosion is likely along the banks of 6 numbers of major bridges proposed along the Sisnekhola-Dharke alignment during construction.

Construction of bridges generally carried out with the temporary flow diversion of river through narrow channel. However, the flow diversion likely to modify the natural flow of river water by concentrating flows at certain periods increasing the speed of flow and likely to have erosion of river banks near bridge construction sites. *The impact will be direct in nature, high in magnitude with site specific in extent and short-term in duration.*

Impact related to Road Safety and traffic during construction

Road safety along the proposed new alignment Sisnekhla-Dharke section traverse through hilly area and forest section; cutting of hill slopes may trigger landslides and slope instability rendering increase in safety of labour workers and road users.

Open and construction of new alignment will have significant road safety issue especially along the existing urban areas where existing earthen track connecting those areas. Altogether, 2.04 km of existing tracks will be affected with the construction of new 11.2 km Sisnekhola-Dharke. Track connecting Waglethok from Piplamod and from Shiva temple to Dillishabitri Secondary School and Buddha Vision Secondary School will also be affected. Further the track connecting Rupakot to United cement factory will also be affected and the safety of locals will be the major issue.

Plying of heavy construction vehicles along the existing earthen track in order to access the proposed new track will have concern of safety to locals and others plying the road. Further, Road safety will be the major issue within the ROW of the proposed and existing new alignments. Locals including school going children will be affected; as there are 4 schools situated and operated along the proposed alignment.

The road safety along the other existing earthen tracks such as road connecting Sitapaila Dharke junction and existing earthen track along the Mahesh khola up to Dharke (chainage 8+100 to 9+400) will have severe safety issue. The area along Gajurelgaun and Purano Dharke comprises scattered houses will have severe safety issue due to construction work. Road junction in front of United Cement Factory and Dhunikhola river crossing will also have severe safety issue. *The impact will be direct in nature, high in magnitude with site specific in extent and short-term in duration.*



Occupational Health and Safety of Labour and accidents

Occupational health and Safety of the labour worker will be the major issue during the time of construction. More than 700 labour workers will be involved during the time of construction and excavation of the new road alignment. Accidents and health hazards are likely during excavation of new roads, operation of construction vehicles such as excavators and dump trucks, operation of crusher plants, operation of quarry sites likely to have impact upon health and safety. *The impact will be direct in nature, high in magnitude with site specific in extent and short-term in duration.*

Loss of physical and cultural structures and infrastructures

Very few physical and cultural structures and other infrastructure exist within the 25 meters of ROW along the proposed Sisnekhola-Dharke. Numbers of such structures related culture are likely to be affected directly or indirectly during the construction. A small Shiva temple with religious trees at Waglethok settlement is very close to the proposed alignment and are likely to be affected. A cremation site is existed close to the alignment at Gajurelgaun and is likely to be affected. *The impact will be direct in nature with medium in magnitude, site specific in extent and short-term in duration.*

Impact due to establishment of construction camps

Approximately, 5 ha of land will be acquired for the establishment of labour camps and Contractor's camp at the vicinity of the project area. However, the land acquired for the establishment of labour camp and camp for Contractor will not be acquired for the overall duration of project construction period. Siting of camp will cause encroachment of agriculture land and alteration of drainage, solidwaste, and wastewater problems.

Impacts anticipated from construction camp establishment and operation include disposal of solid waste (organic waste, plastic and metal scrap, domestic effluent, etc.), competition on public facilities (drinking water sources, health facilities, schools, etc.), impairment of aesthetic value of the landscape (loss of vegetation, compaction and contamination of soil and land), poor sanitation (unhygienic latrine, poor drainage facility), transmission of communicable diseases (sexually transmitted diseases, vector borne diseases, etc.), poor water supply, use of alcohols, gambling and conflict with local communities. Camp-site results change in land use temporarily due to setting up of construction camp and waste generation during the construction. *The impact of temporary loss of land will be direct in nature with medium in magnitude, site specific in extent and short-term in duration.*

Impact due to possible use of child labour

Mobilization and utilization of child labour is likely during the time of construction in each construction package. It is likely that children from outside the valley will be engaged in road construction. However, construction contractor will be responsible to avoid child labour. Contractor will be penalized as per Labour Act 2074, and Children Act 2018 reviewed in Chapter 11. *The impacts will be mostly direct in nature, ranging in magnitude from very high to low, can be local or site-specific in extent and, mostly, short-term or medium-term in duration.*

Impact at the operation stage

Landslide and slope stability

New areas of landslides vulnerability are likely to be emerge along the proposed new Sisnekhola-Dharke alignment during the time of operation. Landslides are more likely at the first 5 kilometers of the proposed alignment after excavation for the new road construction and operation. Further, all previous landslide areas along the existing alignment are likely to be vulnerable with the excavation for widening and improvement if proper toe walls have not been established during the time of construction. It is further anticipated that direct disposal of excavated material from the proposed tunnel portal at the immediate valley sides private lands will be affected. Lands at the downhill side are likely to be affected triggering landslides due to direct disposal of excavated materials from the tunnel portals. *However, the impact of landslide and slope stability along the proposed new sections will be direct in nature with high in magnitude, local in extent and long-term in duration especially along the new cutting and along the Nisakot Community forest and tunnel portal areas of Sisnekhola-Dharke alignment.*

Air pollution

Air pollution is likely with the plying of substantial number of vehicle along the new alignment. Existing settlements, schools, health posts, and people plying the existing and operated new proposed highway alignment will be the major receivers of Sisne khola-Dharke alignment. *The impact upon air due to plying of significant number of vehicles will be high in magnitude, local in extent and long term in duration due to operation.*

Noise

Noise will be generated with the operation of proposed project along the proposed new alignments. Movement of vehicles, establishment of market areas at the link roads connecting to the new highways, mobility of locals, including establishment of industries and its operation within the project vicinity will be the major sources of noise during the time of operation. Local residences of Waglethok community, Rupakot community, Dillisabitri Secondary School and Buddha Vision School, Dhunibesi, Sharada Primary School at Gajurelgaun and Bhuwaneshwori Secondary School of Purano Dharke, Dhunibesi-5 will be the major noise receivers with the operation of the project. *The impact of noise due to operation will be high in magnitude, site-specific in extent and long term in duration due to operation.*

Cross drainage outfall and gullies

Significant number of private cultivated land and settlement are existed along the proposed Sisnekhola-Dharke alignment and hence those cultivated private land will be affected directly if cross drainage is disposed directly to such land. Gully erosion is likely along the Nisakot Community forest area along the alignment as the area already comprises small natural gullies and are now protected due to existing Pine forest. Over excavation during construction and excavation may trigger such existing gullies. There are about 39 natural drainages along the Sisnekhola-Dharke alignment where either culverts or cause-ways are required together with roadside cross drainage which shall be disposed properly. *However, the magnitude of impact due to cross drainage outfall and gullies will be medium, low in extent and site specific in duration with the operation of proposed project.*



Traffic safety and accident

Existing settlement areas along the alignment will be more vulnerable to traffic safety and are likely to be the accident-prone area. Waglethok and Rupakot settlement will be surrounded by the proposed highway and locals will be more vulnerable to every day traffic and accident.

Safety will be the major issue during the time of operation proposed new Sisnekhola-Dharke alignment. *The operation of proposed alignment will have impact direct in nature with high in magnitude, site specific in extent and long-term in duration.*

Waste Management

Pollution and waste hazards is likely during the time of operation due to haphazard disposal of solid wastes by road users all along the existing and proposed new Sisnekhola-Dharke alignment. Moreover, impact on water sources is likely such as at river crossing area due to vehicle washing, fuel leakage, poor sanitation practices, increased human activities/settlement/market center expansions/hotel operations to the nearby such water sources. *The operation of proposed alignment will have impact due to solid waste will be direct in nature with high in magnitude, site specific in extent and short-term in duration.*

Biological Environment

Impacts at the pre-construction stage;

Preparation for felling of trees

Estimated 278 trees with dbh greater than 30 cm will be affected and 2424 number of pole size trees will be affected along the Nisakot Community forest and other forests while implementing Sisnekhola-Dharke section.

Approved consent from community forest user's group and Department of Forest will be required prior to invasion into the forest area for cutting of trees. *The magnitude of the impact is high with site specific extent and long term in duration.*

Protecting wildlife and habitat

Vegetated area and woods are habitat of wildlife and birds even though no any critical habitat and protected forest area is situated along the proposed Sisnekhola-Dharke alignment. Nerby this alignment, Kathmandu (Nagdhunga)-Naubise Alignment provides habitat not only for common birds, but also threatened species like Steppe eagle, Himalayan griffon, and some Owlets, Tits, Warbler, Thrushes species as well as other raptors in winter season. This habitat is spread over a kilometre eider side of mileage 1+500 of the Kathmandu (Nagdhunga)-Naubise alignment. *The magnitude of the impact is high with site specific extent and long term in duration.*

Impacts at the construction stage

Clearing of Forest and loss of vegetation and grazing area

Total length of the Sisnekhola-Dharke Alignment is 11.2 km and it traverses through Nishakot community forest and a government forest. A total traversed distance will be 0.760km of forests and an area of 3.61 ha.



Table 8-14: Forest length and area affected

Sn.	Alignment	Affected length (m)	Affected area (ha)	Remarks
1	Nishakot CF	686	3.43	
2	Government forest	74	0.18	
	Total	760	3.61	

Source: Field Survey, 2017

Loss of trees and their wood volume

Nisakot is the only CF along the alignment. A total of 2702 trees will be felled from this alignment. These trees have a wood volume of 933.47 m³. *The magnitude of the impact is high with site specific extent and long term in duration.*

Table 8-15: Loss of trees

Sn.	Alignment	No of trees	Wood volume (m3)	Remarks
1	Nishakot CF	2641	926.56	
2	Government forest	61	6.91	
	Total	2702	933.47	

Source: Field Survey, 2017

Loss of biomass and carbon from the felled trees

A total biomass (root and above ground biomass) loss along the alignment is 1399.48 tons and carbon value is 601.78 tons. This data is besides the private forests that it traverses. *The magnitude of the impact is high with site-specific extent and long term in duration.* Details are presented in table below.

Table 8-16: Loss of wood volume, total biomass, and carbon

Sn.	Alignment	Wood volume (m3)	Biomass (tons)	Carbon (tons)	Remarks
1	Nishakot CF	926.56	1390.5	597.92	
2	Government forest	6.91	8.98	3.86	
	Total	933.47	1399.48	601.78	

Source: Field Survey, 2017

Disturbance to natural habitats and critical natural habitats

The project area does not comprise any critical habitat of wildlife and birds. Affected CF along the alignment has *Pinus roxburghii* and *Pinus patula* growing with some *Alnus nepalensis* in the fringe (lower part of the CF). The other forests situated along the alignment is not significant in comparison to Nisakot CF as some private managed forest are situated along the alignment. *The magnitude of the impact is medium with site-specific extent and long term in duration.*

Habitat fragmentation and barrier effect for wildlife movement

Sisnekhola-Dharke proposed road alignment does not pass through any specific and critical habitat of wildlife. However, road mortality is the leading source of many wildlife populations along the other existing highways and quite a size of vertebrates dies on roads every day in Nepal, which go pass by without being noticed. Fragmentation of habitat and barrier effect for wildlife movement will be very less due to construction of the project. *The magnitude of the impact is low with site-specific extent and long term in duration.*

Disturbance to biodiversity and wildlife

Cutting down of Pine trees lies within the Nishakot community forest situated along Sisne khola –Dharke section also affects some birds like Owlets, Tits, Warbler, and Thrush species. The movement of people and vehicles affects these resident birds, which breed in this area. *The magnitude of the impact is low with site-specific extent and long term in duration.*

Impacts on Herpeto-fauna and Fish species

The section has higher influence of human activities and urbanization. Of the total springs present in this section, such as, Jhayple Khola, Sisne Khola and Sikre Khola, Dhuni Khola, Rupse Khola and Dhobi Khola and Khatripauwa Khola. Khatripauwa Khola was dry during the survey time implying intermittent type. Jhyaple Khola and Sisne Khola was filled with wastes while mining of gravel in Khatripauwa khola was highly active. Water flow in the Sikre Khola and Khani Khola was very low and filled with waste. These springs are devoid of fish species. Local people informed about presence of frogs and rat snake in the springs and in the periphery (i.e. within 2 Km alongside the existing highway). Nevertheless, they are very common species; therefore the effect on herpetofauna will be insignificant. The section had Jhayple Khola, Sisne Khola and Sikre Khola, Dhuni Khola, Rupse Khola and Dhobi Khola. Water flow during winter and dry season in these rivers were very low. No fish species was observed however, Blacked Spined or Common Asian Toad (*Duttaphrynus melanostictus*) in Dhuni Khola and Skittering Frog (*Euphlyctis cynoplyctis*) and spirogyra algae observed in Rupse Khola. Species seen are common species and the proposed project have minimal impact on these species. *Impact due to construction of the proposed alignment is low in magnitude, local in extent and medium term in duration.*

Use of forest products and fuel wood by the construction workers during construction activities

Existing forest situated at the vicinity of the proposed alignment are likely to be affected during construction due to pressure laid by construction labour for fuel wood in labour camps. Labours will have easy accessibility upon existing forests situated at the project vicinity. Forest resources adjacent to the proposed alignment is Nisakot Community Forest and during the time of construction will be vulnerable from the haphazard utilization by construction workers including outside migrants are likely. Adjacent forests are likely to be degraded during the time of construction. *The impact will be direct in nature, medium in magnitude, local in extent and short-term in duration.*

Hunting and poaching of wild animals by labourers

Hunting and poaching of wild animals by labourers is unlikely along this section. As no critical habitat and wild animals are identified along the Nisakot Community forest area. *The impact upon wild animals along this section will be low in magnitude, site specific in extent and short term in duration.*

Illegal felling of trees

Gradual encroachment into accessible parts of Nisakot community forest area and periphery to the project area is likely. As the forest is open in access, chances remain that a slow

encroachment in the project area and periphery is possible. Tree felling, wood cutting, illegal export of timber wood is likely during the construction of proposed highway. Impact upon community forest will also affect directly to the user groups of 263 numbers of households as well as to the adjacent communities. Government managed forests are open and the dependent households are not known. *The impact will be indirect in nature with low magnitude, site specific in extent and short term in duration.*

Forest fire

Forest fire are likely due to haphazard put out of cigarettes and match sticks by labour forces and are likely during construction period. Such impacts are likely along the Nisakot Community forest area and adjacent vegetated area. Forest fire is common in Nishakot CF and area adjacent to the United Cement Factory where private forest is existed. Similarly, forest fire is also likely at the chainage 11+100 near Dharke where 50 meters of section has vegetation cover (private forest). However, this section comprises maximum number of brick kilns and exhausts from these brick kilns might have negative impacts on human health as well as to the environment. The CFUG has been repeatedly reporting of the fire from the kiln causing the forest fire. Several reports have been made to the DFO for removal of the kiln from the area nearby the CF. According to the local people, forest cover in this section has decreased significantly in recent years. However, forest dependency for firewood and fodder has been decreased in recent years also due to alternate livelihoods. Thus, even in this section the forest cover in remaining forest patches are improving. *The impact will be indirect in nature, medium in magnitude, site specific in extent and short term in duration.*

Impact at the operation stage

Illegal felling of trees

As the forest management is regulated by CFUG, encroachment most probably will be checked, if it is from outsiders. However, cases are there, when the users themselves have encroached, situation have been difficult. Similar is the case with tree felling, woodcutting, and illegal export of timber wood. However, in case of government managed forest encroachment and illegal felling is common and could increase after the highway access has improved the access to the forest, during the operation of the forests. *The impact will be indirect in nature with low magnitude, site specific in extent and short term in duration.*

Damage of aquatic habitats

Direct impact upon aquatic habitats during the time of operation is minimal. Road and bridge side accident and vehicle drop, direct disposal of waste into the river will have impact upon aquatic habitat. The proposed Sisne khola-Dharke Section comprises about 39 natural drainages whereas the major streams along the alignment are Dhunikhola, Mahesh khola and Naubise khola where such impact is likely. *The impact will be direct in nature with medium magnitude, local in extent and short term in duration.*

Road safety concerns in wildlife crossing area

In this section majority of the road section passes through the private property, therefore this section has the minimum impact on the forest and wild fauna. The number of wild mammals

found in this section is the least among four sections studied. *The impact will be direct in nature with low magnitude, local in extent and short term in duration.*

Spillage of oil, diesel in the river due to accident

Aquatic environment along the Mahesh khola river corridor is likely to be affected due to roadside accident during the time of operation. Such impact has been envisaged especially at the bridge locations along the proposed Sisne khola-Dharke new alignments. *The impact will be direct, medium significance, local and short-term.*

Forest fire

Forest fire are likely due to haphazard put out of cigarettes and match sticks by the persons travelling during the operation period. Such impacts are likely as Nisakot Community forest is pine forest. Transferring of fire to this pine forest will remain the same if the brick kilns is not removed from the area. *The impact will be indirect in nature, low in magnitude, site specific in extent and short term in duration.*

Socio-economic and Cultural Environment

Impacts at the pre-construction stage

Loss of private property and assets

Chhatrapati, Phauraule, Aryaltar, Bahrabise, Amalechaur, Dadadihi, Khatripauwa, Kanakot, Lapsikhola, Kafle, Gajurelgaun, Arjelgaun, Purano-Dharke are the major settlement area of the Sisne Khola-Dharke section. Few number of market sheds providing services of tea and lunch for people of nearby villages in Sisnekhola-Dharke section area. 58 private structures and 384 HHs will be affected by the road project. Out of 58 private structures; 29 residential structure, 3 trades, 26 are other structures including kitchen, toilet, water tap, water tank, biogas plant, animal shed etc. Most of the affected structures are semi-modern and hut types. Due to be a new section, significant amount of land will be affected by road project. 25.40 hectares of (Belongs to 384 HHs) private land need to be acquired for the ROW of 50-meter road width along the new alignment. *The impact of loss of private properties is low in magnitude, site specific in extent and short term in duration.*

Grievances raised by the locals and labours if any

Impact upon private property and acquisition of cultivated land for project implementation will be the major concern of local people. Locals will have deep interest and concern about the compensation of affected structures and affected private lands. Moreover, households dependent on agriculture for their livelihood and will lose their private property due to implementation of Sisnekhola-Dharke Road Section are categorized as Severely Project Affected Families (SPAFs) who require compensation.

Grievances raised by the locals and labours during pre-construction stage might influence the time to start site clearance and construction works.

Grievance issues of 384 HHs will be needed to be addressed. Adequate provisions and compensation arrangement will be obtained in the Resettlement and Rehabilitation Action Plan. Further at least one family member of project affected family and severely project

affected families will be provided income generating training. *The impact is low in magnitude, site specific in extent and short term in duration.*

Impacts at the construction stage

Loss of productive land

Due to the new road construction the local farmers of Khatripauwa, Kanakot, Lapsikhola, Kafle, Gajurelgaun, Arjelgaun, Purano-Dharke will lose about 25.40 ha. of cultivated land permanently, which will decrease the production of agricultural products. Approximately, 177.9 tons of agricultural products will be lost yearly with the loss of cultivated area along the Sisnekhola-Dharke road section. Although, it will be insignificant in terms of overall project benefit as well as to the development of agricultural sector of the district. *The impact will be direct in nature, medium in magnitude, local in extent and long term in duration.*

Land and property acquisition, compensation, resettlement and rehabilitation

58 private and 1 public structures will be affected by the road project. Approximately about 25.40 ha land will be required for acquisition for the construction of road alignment. Temporary use of land will be required during road construction for contractor's campsites, labor force campsites, quarry sites, crusher plant and stock piling yard etc. Among the affected households, Brahmin (41.5%), Chhetri (14.2%), Dalits (0.5%), Newar (8.5 %), Gurung (9.0%), Tamang (4.2%), Magar (3.8%), Danuwar (9.4%), Sanyasi (1.9%), and Gharti (7.1%). *The impact of land acquisition will be direct in nature, high in magnitude, local in extent and long term in duration.*

Disruption of community structure

The increase in competition for existing resources are likely that can put the indigenous people at a disadvantage, especially when the settlers introduce ecologically inappropriate and unsustainable production systems. Physical conflicts are likely to break out between settlers and the host communities when the latter try to reclaim their heritage and traditional rights. This sort of conflict is likely to change social, cultural and religious practices of local community. A total 4 public structures are affected by road project. The affected public structures include 1 public waiting shed (*Pratikhalaya*), 1 temple (cultural structure at 9+430), and 1 public tap. *The impact will be indirect in nature, low in magnitude, site specific in extent and short term in duration.*

Livelihood issues

Substantial population along the Sisnekhola-Dharke alignment are considered as low-income population. Their major livelihood depends upon agricultural, livestock and small shop business. Low-income level population will be severely affected with the permanent acquisition of their land and property.

It is further anticipated the Khatripauwa, Kanakot, Lapsikhola, Kafle, Gajurelgaun, Arjelgaun, and Purano-Dharke area likely obstruction in project construction and implementation works by such severely affected groups with the loss of their cultivated lands, business during the time of excavation and construction of alignment. The local farmers of these area will be directly affected with the acquisition of those Khet and Bari land and will further loss in

agricultural products and their livelihoods. *The impact will be direct in nature, low in magnitude, site specific in extent and short-term in duration.*

Conflict in or with nearby host community

Conflict between workers and local people is likely during the time of construction. Such impacts are likely through the Sisnekhola-Dharke road length during the time of construction, especially at market places i.e. Khatripauwa, Kanakot, Lapsikhola, Kafle, Gajurelgaun, Arjelgaun, and Purano-Dharke and at community forest area where workers and local will be interacted directly. *The impact will be indirect in nature, medium in magnitude, site specific in extent and short term in duration.*

Issues related to vulnerable indigenous people

There are vulnerable groups in every social setting and these include, women, children, the elderly, and people with disabilities. However, the actual number of vulnerable indigenous people and their levels of vulnerability will be ascertained during the Resettlement Action Plan process. The assets loss inventory of the project-affected household identified 33 households of ethnic minorities (Danuwar Rai), 2 Dalits households, 5 women headed households, and 6 aged member households were identified in the Sisnekhola-Dharke road section. *The magnitude of the impact is evaluated as Medium Negative as it can be prevented.*

Impact due to damages of community infrastructures

The Sisnekhola-Dharke alignment also passes through locally important cultural and religious sites and some of those religious sites such as Shiva temple at Ch: 3+400, Devthan at 8+975 and Chautaro (Religious tree) at Ch: 5+850 are likely to be affected with the construction of road alignment. There is only one cultural structure at 9+430 that will be affected directly due to construction of Sisnekhola-Dharke proposed new alignment. In this road section, 4 (2 semi-modern and 2 modern type) public structures, drinking water supply pipe at Ch: 4+500~13+700, temporary/earthen canal at Ch: 10+300, & 10+600 and cemented canal at 10+500 will be affected during the construction. Existing Sitapail-Dharke track at Ch: 8+500, 8+900, and 9+000; Local small track at Ch: 9+360 and 9+800 and Prithiva Highway at Ch: 11+150 will be affected in construction phase. *The impact of loss of such religious sites will be direct in nature, medium in magnitude, site specific in extent and short-term in duration.*

Potential issues of conflicts associated with road construction work forces

Influx of people is anticipated during the time of construction. Pressure upon existing natural resources such as water, existing food availability, existing educational facilities are likely to be affected with the increase in the number of outside workers and the utilization of such resources and increase in the number of student in the existing educational facilities. Such impacts are likely at the existing market and settlement i.e. Khatripauwa, Kanakot, Lapsikhola, Kafle, Gajurelgaun, Arjelgaun, and Purano-Dharke areas. *The impact will be direct in nature, medium in magnitude, site specific in extent and short term in duration.*

Road safety issues

Local road users' safety may be an issue, when large numbers of construction vehicles ply on local roads during construction works. Locals and other vehicles plying the road during

construction will likely to face difficulty due to dust, noise, and stability of the slopes. Road safety along the proposed new alignment Sisnekhla-Dharke will also be significant during the time of excavation. The proposed section traverse through hilly area and forest section; cutting of hill slopes may trigger landslides and slope instability rendering increase in safety of labour workers and road users. Further, Road safety will be the major issue within the ROW of the proposed new alignments. The project has planned to construct 1 overpass at Ch: 5+740, and 2 underpasses at Ch: 6+760 and 8+460 for pedestrian and local safety. Information board about site condition, proper traffic signals, and other safety measures will be applied to reduce the accident during the construction. *The impact will be direct in nature, high in magnitude, local in extent and short-term in duration.*

Issues related to cultural assets

The issue of local culture and tradition is related to the activities of the outside workforce in the local area. The outside construction workforce coming from different parts, cultural and traditional values is envisaged to influence the local cultural and traditional values. The extent of such influence is difficult to predict. Project area is a co-existing ground of different ethnic groups with diverse sets of traditions and values since ages.

It is envisaged that the outside workforce and the local community will come together without any cultural and traditional conflicts. Moreover, the number of the workers involved is small; *the envisaged impacts on local culture and tradition is short period, site specific and of low magnitude.*

Issues on landscape aesthetics

The stockpiling of materials, construction excavation for structures and clearance of vegetation are some of the issues related to the general aesthetics. Due to construction of road, the natural landscape from Ch: 5+200 to Ch: 5+590 will fragment into two part. Except for the vegetation clearance, rest of the works is site specific, short term and low magnitude. *The vegetation clearance is an impact of long-term, site specific, moderate magnitude along ROW.*

Increase in sell and use of alcoholic products along the new proposed sections

Various socio-economic changes are likely in the project areas and adjacent Municipality/Rural municipality due to implementation of KNM project. Together with the change in land use pattern economic activities of the locals will be altered. Consumption and import of alcoholic products are expected to be increased especially at existing settlement areas where people gathering with increase in other facilities such as hotels, restaurants and lodges. *The impact will be direct in nature with medium magnitude, regional extent and long term in duration.*

HIV/AIDS and other diseases

The issue if community health is related to the outside workforce. The outside workforce may introduce transmissible disease of unknown nature to the communities. The outside workforce can get sexually involved with the local community individuals increasing the risk of STD and HIV/AIDS in the community. Poor sanitation practice of the outside workforce in the mark shift camps and construction sites is also potential to generate pollution issues affecting community health. *The envisaged risk is site specific, short duration and of low magnitude.*

Impact at the operation stage

Possible ribbon development along the road alignment

Encroachment of ROW for the establishment of shops and residences are likely with the gradual development of Ribbon settlement along the Sisnekhola-Dharke road alignment. This sort of impact is envisaged along the entire road alignment area. Similarly, Khatripauwa, Arjelgaun, Purano-Dharke and Ch: 4+300 to 6+760, Ch: 8+100 to 10+800 area will be possible ribbon development area. *The impact of encroachment will be direct in nature with high in magnitude, regional extent and long term in duration.*

Increase in accidents

It is anticipated that the road traffic accidents are likely due to the high-speed vehicles. With an improved road there is likely increase of vehicular traffic and over speeding in busy sections of the road such as Dilli Sabitri Secondary school, Lord Buddha Academy, Bhubaneswori Secondary school, Bus lay-bay area (i.e. Ch: 3+060, 3+140, 6+060, 6+820, 8+750, 8+960) and trading centers thereby increasing risks of road traffic accidents to communities along the Sisnekhola-Dharke road. Although this effect is long term it can be mitigated hence, the project has planned to construct 2 underpasses at Ch: 6+760 and 8+460; 1 overpass at Ch: 5+74. Awareness campaigns at the local level will be conducted to avoid such accident during operation. *The magnitude of the impact will be medium, local, and long term in nature.*

Development of settlements and market places along the proposed new Sisnekhola-Dharke sections

After construction, the condition of the road will improve and transportation of commodities to and from the Sisnekhola-Dharke will be easier. In addition, transportation will be eased for prospective visitors and tourists who would wish to raft in Trishuli which is a major tourist attraction in the area. It is also envisaged that more vehicle owners will be willing to have them operate on new road surface, which will result in attracting more vehicles on the road thus leading to low transport costs savings on general fuel consumption and reduction in travel time. Given the current state of this road, it is expected that the project impact will be high positive as the improved road will facilitate inter and intra community communication and transport. Similarly, Ch: 4+300 to 6+760 will be possible location of development settlement and market area. *The magnitude of the impact will be medium, local, and long term in nature.*

Increase in sell and use of alcoholic products along the new proposed sections

Various socio-economic changes are likely in the project areas and adjacent Municipality/Rural municipality due to implementation of road project. Together with the change in land use pattern economic activities of the locals will be altered. Consumption and import of alcoholic products are expected to be increased especially at existing settlement areas where people gathering with increase in other facilities such as hotels, restaurants and



Figure 8-4: Advertisement of alcoholic products is common along highways

lodges. *The impact will be direct in nature with medium magnitude, regional extent and long term in duration.*

Girl trafficking

Girl trafficking could be one of the potential problem during operation and maintenance period. Girl trafficking, prostitution is expected to be increased especially at existing settlement areas, where people gatherings are likely to be increased with increase in other facilities such as hotels, restaurants and lodges. *The impact will be direct in nature with medium magnitude, regional extent and long term in duration.*

Migration and immigration

Immigration of people from other areas and influx of workers are inevitable during the time of construction of any project. Immigration has been envisaged into the project especially during the time of operation stage with the availability of good jobs, services, and facilities. *The impact will be indirect in nature, low in magnitude, site specific in extent and short term in duration.*

Increasing in prostitution

This impact is likely during the operation phase and is thus long term since the small trading centres, i.e Khatripauwa, Arjelgaun, Purano-Dharke are likely to develop into bigger towns. *The impact will be direct in nature with medium magnitude, regional extent and long term in duration.*

HIV/AIDS and other diseases

The presence of an immigrant labour force and additional disposable income may result in undesirable interactions between the local communities (particularly youth) and the workforce, contributing to the spread of HIV/AIDS to both workers and the communities. This impact is likely to continue into the operation phase and is thus long term since the small trading centres are likely to develop into bigger towns. Accumulation of water in borrow pits and quarries and improperly designed drainage structures may encourage the breeding of malaria-transmitting mosquitoes and other water-borne diseases. *The impact will be direct in nature with medium magnitude, regional extent and long term in duration.*

8.4.3 Impacts on Bishaltar - Phisling Alignment

Physical Environment

Impact at the preconstruction stage

Impacts during detailed design and pre-construction phase

The construction of the proposed Bishaltar-Phisling will be a new two-lane carriageway road built to Asian Highway standards. The new alignment proposed along the right bank of Trishuli River is critical in determining the environmental impacts and route selection and the related impacts of various alignments are discussed in Chapter 8. The detail design will avoid construction impacts by good design and to minimize operational environmental pollution impacts as far as practicable. Opportunities to provide environmental enhancements have been identified along the Bishaltar-Phisling and included in the detailed designs. Routine matters such as avoiding unnecessary removing of trees and compensatory and enhancement plantation

has been incorporated in the detailed design and preconstruction stages. Other matters such as design and construction of the pedestrian and road underpasses, over passes, lead off drains and maintenance of the works (protection works) during construction has also be addressed in the detailed design stage. Opportunities for enhancements during detailed design, construction and operation, which are envisaged at this stage, have also been included in the Environmental Management Action Plan (EMAP). *The impact can be considered as low in magnitude, site specific in extent and short term in duration.*

Review of impact assessment, mitigation and EMAP

The EMAP will be reviewed during the construction phase by the construction contractor in line with best practice at the detailed design stage. Construction contractor of Bishaltar-Phisling package will be responsible to review all the environment assessment reports in order to update EMAP prior to start of construction work. If there are changes in project scope or alignment these will be disclosed to MoFE and World Bank and the ESIA, RAP, VDCP and EMAP will be revised. The revised ESIA, RAP and EMAP will be resubmitted to WB, incorporating any recommendations and requirements from MoFE. *The impact can be considered as low in magnitude, site specific in extent and short term in duration.*

Review of alignment to improve project acceptability

The proposed Bishaltar-Phisling alignment has avoided most of the sensitive receivers by at least 50m and there will be sufficient buffer distance between the works and the community in the settlements such that major significant impacts can be avoided in order to maintain the new highway construction to meet Asian Highway Standards.

Nonetheless, some significant construction impacts predicted similar to Sisnekhola-Dharke section can be expected from the works, particularly in terms of noise, vibration, dust and waste disposal and mitigation measures and public consultation are proposed to be undertaken at the implementation stage to ensure unavoidable nuisances are controlled and not allowed to escalate. Approximately, 7 km of proposed alignment traverses through fertile agricultural land and are inevitable from chainage 0+500 to 7+300. The cultivated land of Bishaltar, Benibesi, Ghyalchoktar, Sukumbasitol, Pudaliphat, Jyamirghat will be severely affected. *The impact can be considered as low in magnitude, site specific in extent and short term in duration.*

Access roads

The access to the existing settlements and schools during the time of construction has not been proposed in the detail design. Alternative diversions to local roads that access Benibesi, Dhobadighat, Sukumbasitol, Jyamirghat and Itar settlements has not been designed and hence should discussed in advance with the local authorities such as with ward office and municipality. All the above settlements along the proposed Bishaltar-Phisling alignment can be accessed through the motorable bridge established on the Trishuli River at Benighat which was constructed especiall to get access to Buhdigandaki Hydropower Project. The bridge has established direct connection between Benighat market area situated along the existing highway and Siurenitar settlement of Gorkha District situated at the right bank of Trishuli River. Further, signposted and other necessary information will be disseminated and will be provisioned before the start of construction. No access roads have been designed during the

preparation, but the ESIA consultants gave an indication of the likely approach based on observation and independent judgement. *The impact can be considered as low in magnitude, site specific in extent and short term in duration.*

Planning for erosion control

The hill slopes along the chainages 4+400 to 5+400, 7+600 to 8+200 Salleri Community forest area, 8+900 to 9+300 area close to Trishuli River bank, 10+100 to 15+000 Government and Nivare Community forest area are prone to significant erosion and landslides and the construction works will aggravate this situation. *The impact can be considered as low in magnitude, site specific in extent and short term in duration.*

Planning materials management and spoil disposal

Construction of new alignment along the proposed Bishaltar-Phisling will generate huge amount of spoil to be disposed. Significant public consultation will again be required for the plying of dump trucks and construction vehicles along the existing earthen tracks along the communities. Contractor will plan in advance in managing stockpiling areas for construction materials and disposal of excavated materials. *The impact can be considered as low in magnitude, site specific in extent and short term in duration.*

Traffic Management

Blockage and destruction of existing earthen tracks connecting rural villages of Ghyalchowk and Bhumlichok area from Benibesi, Dhobadighat, Sukumbasitol, Jyamirghat and Itar settlements is more likely. *The impact can be considered as low in magnitude, site specific in extent and short term in duration.*

Preparing the Contractor(s) to Address Mitigation Measures

The contractor will be well-informed by including the EMAP of Bishaltar-Phisling and environmental assessments in the bidding and contract document. The contractor(s) will be informed that they will be required to produce method statements and plans in advance as required in the EMAP for, temporary pedestrian and Traffic Management Plan, Drainage Plan, Erosion Control Plan, Materials Management Plan, Waste Management Plan, Spoil Disposal Plan, and Noise and Dust Control Plan for the proposed Bishaltar-Phisling alignment. *The impact can be considered as low in magnitude, site specific in extent and short term in duration.*

Impact at the construction stage

Disruption and relocation of existing services and public utilities

Table 8-17: List of existing tracks along the Bishaltar-Phisling alignment that are likely to be affected

Sn.	Chainage along the KNM	Approx. length affected Width (m)	Road Type	Linkage between
1.	1+560	16	Earthen track	Benibesi
2.	1+820 to 1+840	25	Earthen track	Benibesi
3.	3+700 to 3+850	150	Earthen track	Dhobadighat
4.	4+000 to 4+140	140	Earthen track	Sukumbasitol
5.	4+290	15	Earthen track	Sukumbasitol

Sn.	Chainage along the KNM	Approx. length affected Width (m)	Road Type	Linkage between
6.	4+900	25	Earthen track	Sukumbasitol
7.	5+600 to 5+900	300	Earthen track	Pudaliphat
8.	6+650 Jyamirghat	15	Earthen track	(alignment situated near to 2 stories new white house)
9.	7+650 to 8+700	1150	Earthen track	Existing earthen track near Salleri CF Itar)
10.	11+000 to 11+200	200	Earthen track	Existing earthen track connecting Thumka, Balaki, Korak settlement of Bhumlichowk with highway via suspension bridge
11.	12+200-12+400	200	Earthen track	Luklan, Devithandanda, Balaki, Korak settlements of Bhumlichowk connecting with existing highway via suspension bridge

Source: Field Survey, 2017

Table 8-18: List of likely affected bridges

Sn.	Chainage along the KNM	Location Name	Bridge over	Bridge type	Connecting location
1.	11+150	Prem khola	Trishuli River	Suspension	Thumka, Balaki, Korak settlement of Bhumlichowk with existing highway
2.	12+420	Beldanda	Trishuli River	Suspension	Luklan, Devithandanda, Balaki, Korak settlements of Bhumlichowk with existing highway
3.	15+280	Phisling	Trishuli River	Suspension	Gadhaibesi, Aidanda, Tamundanda, Khanigau, Apchaur, Pokharigau, Archanbas, Devithandanda, settlements of Bhumlichowk with existing highway

Source: Field Survey, 2017

Table 8-19: List of affected electric poles situated along the proposed Bishaltar-Phisling alignment

Sn.	Road Section	Chainage	Type of Poles			Total
			Metal	Wooden	Cement	
	Improvement of Existing Nagdhunga – Mugling Road					
New Alignment from Sisne Khola - Dharke and Benighat - Phisling						
1.	Bishaltar - Phisling	0+00~15+300	65	20	-	85

Source: Field Survey, 2017



Table 8-20: Drinking Water Supply along the Bishaltar-Phisling Section

Sn.	Road Section	Chainage	1" Dia. Pipe		0.5" Dia. Pipe		1.5" Dia. Pipe		2" Dia. Pipe	
			GI	PVC	GI	PVC	GI	PVC	GI	PVC
1.	Bishaltar - Phisling	0+00~15+300	-	-	-	2.56	-	0.8	-	-

Source: Field Survey, 2017

Table 8-21: List of Irrigation Canals to be affected within the proposed Bishaltar-Phisling alignment

Sn.	Chainage	Canal Type	Approx. Length Affected (m.)
1.	0+600~0+800	Cemented	200
2.	1+800~12+500	Earthen	400
3.	3+200~3+600	Earthen	400
4.	4+200~4+600	Earthen	400
	Total		1400

Source: Field Survey, 2017

The impact due to disruption and relocation of existing services and public utilities will high in magnitude, local in extent and short term in duration.

Change in Land use and loss of productive topsoil

The total area of land use cover within the proposed new alignments Bishaltar-Phisling Road length (RoW) is 77.82 ha. In which; approximately 2.33 ha of barren land, 5.55 ha of grassland, 8.23 ha. settlement, 10.04 ha. water bodies, 10.89 ha of forest and about 16.58 ha of cultivated land situated within the ROW will be acquired permanently during the construction of road alignment. However, all the land area acquired within the 50m ROW will not be changed or destroyed permanently for the construction of alignment. Only the land use cover within the 10 meters will be changed permanently into the carriage width. The proposed alignment traverse through Salleri Community Forest at the chainage 7+400 to 8+500 will be severely affected where substantial number of Sal trees required to be removed which will render hill collapse and significant landslides are likely with the destruction of the Community Forest and the top soil along the length. Existing earthen tracks at chainage 1+560 at Benibesi, 1+820 to 1+840 at Benibesi, 3+800 to 3+850 at Dhobadighat, 4+000 to 4+140 at Sukumbasitol, 4+290 Sukumbasitol, 5+720 to 5+900, 6+650 at Jyamirghat will be affected directly with the implementation project. Earthen motorable track with 3 m average width is existed all along the right bank of Trishuli river connecting various settlements will be affected at above mentioned chainage.

Approximately, 73.96 ha of cultivated land will be destroyed along the Bishaltar-Phisling road alignment. The area within the 12 meters of carriage width covering 16.58 ha of cultivated land will be completely changed into road. Approximately, 50,550 cums of top soil of the fertile cultivated land will be affected during the time of construction. Fertile cultivated land situated along the flat terraces in Bishaltar, Benibesi, Ghyalchoktar, Sukumbasitor, Pudaliphat, Jyamirghat, and Kautikhet will be severely affected with the construction of proposed new alignment. The adjacent cultivated lands between the aforementioned areas will be affected severely during construction activities and change in land use pattern. The natural drainage flow from one terrace to another cultivated terrace in this area will be discontinued. Cultivated

lands are likely to be affected due to discontinuity of natural drainages. The existing agricultural production will also be affected with the implementation of the proposed project. Moreover, the forest and vegetated area between Kauti khet and Phisling are to be affected severely along the proposed alignment. This is the last 5.5 km section which comprises rocky area, steep slope, vegetation cover area with no easy accessible and is likely to be affected beyond the 25 meters of ROW during road width excavation. Massive amount of cutting and filling will affect existing terrains changing its land use type. Moreover, the construction of highway will further acquire lands adjacent to proposed highway alignment for temporary purposes. Lands such as barren land, flood plain, plateau etc., are likely to be acquired for the establishment of labour camp, crusher sites, worker campsite, for the disposal of spoil etc. Land use pattern of identified labour campsite, crusher sites, and spoil disposal sites will be utilized during the time of construction and will be changed temporarily. *The overall impact of land use change will be direct in nature, high in magnitude with site specific in extent and long term in duration.*

Landslides, Slope Destabilization and Soil Erosion

Landslides are likely at the several locations along the proposed Bishaltar-Phisling such as 4+400 to 5+400 Chuwatar area where steep slope and ongoing toe erosion by Trishuli River, 7+600 to 8+200 Jyamirghat, 8+900 to 9+300 Thumka, and last 10+100 to 15+000 chainage. All these areas will be very vulnerable to landslide during the time of road width excavation. Landslide in these chainages along the alignment may trigger further landslide on the hillside beyond the ROW. Last 5.5 km section of the proposed alignment is very steep, easily inaccessible, rocky with vegetation cover where the construction and excavation of new road will have severe impact upon natural hill slopes and landslides are likely. Further, the excavated materials are likely go directly into the Trishuli River during excavation affecting river water quality and ecosystem. The last 5.5 km right bank section of the proposed alignment is located just opposite to the Jogimara along the existing highway where both banks of the Trishuli River comprises similar nature of rock formation and hence could be expected that the excavations on the right bank along the proposed road corridor might have similar failure or effects along the Jogimara that had occurred during the time of road excavation, improvement and widening at the left bank highway. As the area is not easily accessible, excavated materials at this stretch is likely to be dropped directly into the Trishuli River situated downhill during the time of road opening and construction. Landslide and soil erosion are likely at new open cut sections during construction phase where heavy mass of spoil will be generated. The excavation work at the steep slope along the last 5.5 km section intensify erosion and can be envisaged new landslides. *The overall impact of land slide will be direct in nature, high in magnitude with site specific in extent and long term in duration.*

Spoil disposal

Approximately, 314,856 cums of excess rock and soil materials will be required to dispose safely with the construction and excavation of Bishaltar-Phisling new proposed alignment. It is estimated that 1,084,615 cums of excavated materials will be generated from the alignment with the excavation of hill slopes. About 769,760 cums of excavated material will be reused in back filling and other purposes during construction. Thus, the side tipping of excavated

material is very likely during the time of construction. Direct disposal of excavated material during the time of construction will affect adjacent private and cultivated lands. Such disposal of spoil especially at the valley side of the alignment will trigger land slide, causing soil erosion, destroy vegetations. It is further likely that the spoil will go directly into the Trishuli River with the excavation of hill slopes at various chainages especially at the last 5.5 km. Disrupt of natural drainages and river water pollution due to direct disposal is likely along the last 5.5 km of the proposed alignment. Natural drainages such as Dhabadhi khola, Prem khola existed along the alignment are likely to be affected due to haphazard disposal of the spoil. *Impact of disposal landslides and erosion of fresh cut hill slopes will be direct in nature with high in magnitude, local in extent and long-term in duration.*

Disruption and blockage upon natural drainage

The proposed Bishaltar-Phisling alignment crosses 23 big and small natural drainages; construction and excavation of proposed new alignment will have severe impact upon such natural drainages. The major natural drainages along the alignment are Lamou khola, Dhobadi khola, Judi khola, Sano khola, Kaudi khola, Prem khola and Khani khola at Phisling. Blockage to these natural drainages especially during rainy season will trigger landslide and mass wasting at the downstream. Direct disposal of spoil material will generate water depletion, water logging, a concentration of water flow as well as increase the speed of flow, which will be erosive in nature.

Diversion as well as overloading existing drains results in water flowing where it normally would not, e.g. on vulnerable soils where frequent effects are scouring, gullyng, bank cutting and soil erosion along the Nivare community forest. The impact of these incremental impacts usually cumulates in massive landslides, which in turn can cause slope instability and landslides. In absence of proper water management, a concentrated flow can lead to scouring, gullyng and soil erosion at cultivated land existed at Benibesi, Ghyalchoktar, Dhobadighat, Sukumbasitol, Pudaliphat, Jyamirghat, and at Kautikhet which in turn can cause disruption of cultivated land adjacent to natural drainage, instability and trigger landslides. *Impact of disposal upon natural drainage will be direct in nature with high in magnitude, local in extent and mid-term in duration.*

Water Pollution

Degradation of water quality of existing Rivers such as Lamou khola, Dhobadi khola, Judi khola, Sano khola, Kaudi khola, Prem khola and Khani khola River is likely especially during the time of construction. As the proposed new alignment traverse across those natural drainages; the disposal of soil and chemical wastes from construction works as well as from camps is likely along the above stated Rivers. Further, impact upon other small streams along the Bishaltar-Phisling are also likely due to direct disposal of wastes. *The nature of impact will be direct with medium in magnitude, site specific in extent and short-term in duration.*

Soil Contamination

Contamination of soil is likely with the implementation of proposed Bishaltar-Phisling road project and will significantly deficit in agricultural production along the proposed new alignment 16.58 ha of cultivated land will be affected directly with the construction of proposed

new proposed alignment; hence top soil of cultivated land and agricultural products from the land within the proposed road carriage width will be lost permanently with the implementation of the project. Further, the soil adjacent to the proposed alignment will be affected with temporary utilization such as establishment of labour camps, workshop area, construction vehicle parking and piling of construction materials. Cultivated land along the project area will be affected directly with disposal of chemical wastes and other construction wastes into natural drainages as locals have been utilizing water from such natural drainage for irrigation purposes along the fertile land of the project area. Particularly, the locals have been utilizing natural water from all these local streams for the irrigation. *The cumulative impact of loss of top soil and agricultural products along the proposed alignment will be direct in nature, medium in magnitude with site specific in extent and long term in duration.*

Water logging

Water logging especially along the cultivated land will be likely during the time of construction along the proposed new Bishaltar-Phisling alignments. Severe impact of water logging is likely along the fertile cultivated area at Benibesi, Ghyalchoktar, Dhobadighat, Sukumbasitol, Pudaliphat, Jyamirghat, and at Kautikhet are likely to be affected with the construction and excavation activities. *The impact of water logging of land will be direct in nature with medium in magnitude, site specific in extent and short-term in duration.*

Quarrying of Construction Materials

Quarry for the construction materials is more likely especially from the Trishuli River and hill sides along the proposed new alignment. Quarry of hill slopes along the alignment and near existed community forests such as Salleri CF is more likely during the time of construction. The alignment has been proposed through the existing two big quarries at chainage 5+390 to 5+600 and traverse very close at location 3+700 to 3+800. Illegal excavation by construction contractor is very likely from hill slopes and Trishuli River banks elsewhere within the 2 kilometres from the project alignment in order to acquire stones required for slope stabilization activities for hill slope along the Salleri and Nivare community forest and other forests along the Trishuli River banks. *The nature of impact due to operation of quarry will be direct with high in magnitude, site specific in extent and long-term in duration.*

Table 8-22: Quarry sites identified along the KNM.

S. No.	Location/ Chainage	Description
1	0+500	Gravelly Sandy Silt
2	1+500	Gravelly Sandy Silt
3	2+000	Gravelly Sandy Silt
4	2+500	Gravelly Sandy Silt
5	3+000	Silty Sand
6	3+500	Silty Sandy Gravel
7	4+000	Gravelly Sandy Silt
8	4+500	Sandy Silt
9	5+000	Sandy Silt
10	5+500	Sandy Sand
11	6+000	Sandy Gravel
12	6+500	Sandy Silt
13	7+000	Sandy Gravel

S. No.	Location/ Chainage	Description
14	7+500	Sandy Gravel
15	8+000	Silty Sandy Gravel
16	8+500	Silty Sandy Gravel
17	9+000	Silty Sandy Gravel
18	9+500	Silty Sand
19	10+000	Sandy Silty Gravel
20	10+500	Silty Sandy Gravel
21	11+000	Sandy Gravel
22	11+500	Sandy Silty Gravel
23	12+000	Gravelly Silty Sand
24	12+500	Sandy Gravel
25	14+500	Sandy Gravel
26	15+000	Silty Sandy Gravel
27	15+235	Sandy Silty Gravel

Source: Detail design for the improvement of Kathmandu (Nagdhunga)-Naubise-Mugling Road and Bridges. Draft Design Report (Volume I-Main Report).

Stone Crushing Plants

Operation of Stone crushing plant by contractor will have dust, air, noise pollution at the vicinity of the proposed location. Excessive noise and dust from the plant will create disturbance to nearby settlements, school at Bishaltar, and huge cultivated lands etc. during the construction. The project area comprises significant scattered settlements, cultivated lands situated close proximity along the proposed alignment are likely to be affected if construction contractor establishes unmanaged stone crushing plant. *The nature of impact due to operation of crusher plant will be direct with medium in magnitude, site specific in extent and medium-term in duration.*

Stockpiling and transportation of materials

Stock piling of construction materials and aggregates as well as excavated material if deposited haphazardly along the alignment as well as at the valley side will be washout affecting downhill settlements and cultivated lands. Damage to fresh cutting outer slopes throughout the alignment is also likely due to high velocity of wind resulting erosion and landslides due to piling at the outward slopes is likely. Especially; at section 10+000 to 15+000 of Bishaltar-Phisling section where the existing hill slopes are steep and likely to be vulnerable to landslide. *Impact of likely future washout during heavy rains will be direct in nature with high in magnitude, local in extent and mid-term in duration.*

Air Pollution

Excavations for road width opening will be carried out operating drill machines, excavators, load and unload heavy vehicles etc. Air pollution due to operation of such machines and generation of dust is likely throughout the vicinity of the project alignment; as the overall alignment of the proposed new Bishaltar-Phisling traverse through terrace cultivated lands, community forests, scattered settlements. Operation of construction vehicles will have significant impact upon local inhabitants, upon cultivated lands along the Bishaltar, Benibesi, Ghyalchoktar, Dhobadighat, Sukumbasitol, Pudaliphat, Jyamirghat, and at Kautikhet settlements are likely to be affected. Further, the impact of air pollution upon forest and natural

habitat is likely such as Sallere community forest and Nivare community forest and along the remaining government and vegetated areas. Impact of dust and noise pollution upon settlement areas due to operation of crusher plants, batching and bitumen mixing plant is likely to causes inconvenience to nearby settlements in terms of air, dust and noise pollution. Excessive noise and dust from the operated machines and vehicles will also create disturbance to nearby settlements, school, and upon cultivated lands during the construction. Severe impact upon agricultural is also likely due to construction activity. Dust cover on cultivated farm lands during the construction will have severe impact upon production of agricultural products. Physical impact upon air, and noise due to operation of quarry was anticipated during construction phase of the project. *The impact will be direct in nature with high in magnitude, regional in extent and medium-term in duration.*

Impact of chemicals on environment

The proposed section passes through cultivated land, community and government forests, settlements, natural drainages, schools, local cultural sites etc. where impact of chemicals is likely with its haphazard use. Chemicals such as epoxy, gypsum, additives, admixtures, cements, bitumen etc. is inevitable during the time of construction. Containers of such chemicals such as bitumen drums often get damaged during transit, leading to a leakage in storage places, spillage of diesel and lubricants which often are not or not adequately cleaned up afterwards. It is likely that the bitumen could remain at the boiling area and decanter sites for many years after the completion of road construction if it is not properly rehabilitated along the river corridors of Lamou khola, Dhobadi khola, Judi khola, Sano khola, Kaudi khola, Prem khola and Khani khola River. The impact of chemicals upon cultivated lands, community forest, drinking water resources, and natural drainage as well as to local inhabitants is very likely during the time of construction. *The impact will be direct in nature with high in magnitude, local in extent and medium-term in duration.*

Noise pollution

Noise pollution is likely along the alignment especially at the school areas and settlements along the proposed alignment. Severe impact of noise is likely at Chandrodaya Higher Secondary School at Bishaltar, settlements along the alignment such as Bishaltar, Benibesi, Ghyalchoktar, Dhobadighat, Sukumbasitol, Pudaliphat, Jyamirghat, and Itar. Similarly, mobilization of construction vehicles, establishment of labour camps and mobilization etc. will generate significant noise and will have impact upon community and settlements. Locals along with students of the Higher Secondary School will be affected severely. *The impact will be direct in nature with high in magnitude, site specific in extent and short-term in duration.*

Water flow disruption and erosion of riverbanks

Banks of 23 natural drainages that are traverse across by the proposed alignment are likely to be affected during the construction. These natural drainages lie along the proposed alignment and will have disruption in water flow and erosion of topsoil due to felling of vegetations growing along the bank during the time of construction and excavation for the new road and other construction activities. Lamou khola riverbanks from 1+640 to 1+660 is likely to be affected with the construction activities. Similarly, other riverbanks such as Dhobadi khola,



Judi khola, Sano khola, Kaudi khola, Prem khola and Khani khola streams are also likely to be affected by erosion and disrupting natural flow during construction. A bridge along the Trishuli River at chainage 1+300 will likely to disrupt natural flow of the river during excavation for the foundation under the river. Construction of bridges generally carried out with the temporary flow diversion of river through narrow channel; as the bridge has been proposed at the location where the flow of river is curve; the flow diversion likely to modify the natural flow of river water by concentrating flows at certain periods increasing the velocity. *The impact will be direct in nature, high in magnitude with site specific in extent and short-term in duration.*

Road Safety and traffic during construction

Road safety along the proposed new alignment Bishaltar-Phisling section traverse through hilly area and forest section; cutting of hill slopes may trigger landslides and slope instability rendering increase in safety of labour workers and road users. Open and construction of new alignment will have significant road safety issue especially along the existing urban areas where existing earthen track connecting those areas. Track connecting Benibesi, Dhobadighat, Sukumbasitol, Jyamirghat and Itar will be affected where road safety will be the serious issue during construction. Further, Road safety will be the major issue within the ROW of the proposed and existing new alignments. *The impact will be high in magnitude, site specific in extent, and medium term in duration.*

Occupational Health and Safety of Labour and accidents

Occupational health and Safety of the labour worker will be the major issue during the time of construction. More than 700 labour workers will be involved during the time of construction and excavation of the Bishaltar-Phisling road alignment. Accidents and health hazards are likely during excavation of new roads, operation of construction vehicles such as excavators and dump trucks, operation of crusher plants, operation of quarry sites likely to have impact upon health and safety. *The impact will be direct in nature, high in magnitude with site specific in extent and medium-term in duration.*

Labour Camps

Approximately, 6 ha of land will be acquired for the establishment of labour camps and Contractor's camp at the vicinity of the project area. The major impact from the establishment of camps will be generation of solid waste, waste from latrines and toilets, scraps of PPEs such as old helmet, visibility vests, safety boots etc. Further, the impact with the operation of camps will be disturbance to local community, conflict with local people and community, pressure upon local shops, local agricultural products and other resources. Further, issues of health of labour, community health, communicable diseases such as HIV/AIDS, and vector borne diseases etc. Bishaltar, Benibesi, Ghyalchoktar, Chuwatar, Dhobadighat, Sukumbasitol, Pudaliphat, Jyamirghat, and Itar settlements along the alignment are likely to be vulnerable with the operation of camps. About one labour campsite will be established according to the construction package during construction. There will separate labour camps of bridges packages. Labour camps envisaged for all the construction packages is presented in Chapter 10. *The impact of temporary loss of land will be direct in nature with low in magnitude, site specific in extent and short-term in duration.*



Impact due to possible use of child labour

Mobilization and utilization of child labour is likely during the time of construction in each construction package. It is likely that children from outside the valley will be engaged in road construction. However, construction contractor will be responsible to avoid child labour. Contractor will be penalized as per Labour Act 2074, and Children Act 2018 reviewed in Chapter 12.

Impact at the operation stage

Landslide and slope stability along proposed new sections

New landslides are likely to be developed along the proposed new Bishaltar-Phisling alignment during the time of operation. Landslides are more likely along the chainage 4+400 to 5+400 Chuwatar where the alignment has been proposed through steep slope and ongoing toe erosion by Trishuli River, chainage 7+600 to 8+200 at Jyamirghat, chainage 8+900 to 9+300 at Thumka, and landslides are more likely at the last 5.5 kilometers of the proposed alignment during operation. Further, all previous landslide areas along the existing alignment are likely to be vulnerable with the excavation for widening and improvement if proper toe walls have not been established during the time of construction. *The impact of landslide and slope stability along the proposed new section will be direct in nature and high in magnitude, local in extent and long-term in duration.*

Air pollution

Air pollution is likely with the plying of substantial number of vehicle along the new alignment. Existing settlements, schools, and local inhabitants along the alignment will be the major receivers of Bishaltar-Phisling alignment. *The impact upon air due to plying of significant number of vehicles will be high in magnitude, site-specific in extent and long term in duration due to operation.*

Noise

Movement of vehicles, establishment of market areas at the link roads connecting to the new highways, mobility of locals, including establishment of industries and its operation within the project vicinity will be the major sources of noise during the time of operation. Local residences of Bishaltar, Benibesi, Ghyalchoktar, Chuwatar, Dhobadighat, Sukumbasitol, Pudaliphat, Jyamirghat, and Itar will be the major noise receivers with the operation of the project. Chandrodaya Higher Secondary School at Bishaltar will be severely affected due to noise. *The impact of noise due to operation will be high in magnitude, site-specific in extent and long term in duration due to operation.*

Cross drainage outfall and gullies

About 23 big and small natural drainages are existed along the proposed Bishaltar-Phisling alignment. Private and cultivated lands will be affected if outfall of roadside drain dispose haphazardly into such lands. Gully erosion is likely along the Salleri Community forest area due to haphazard disposal of roadside drain. Similarly, undulation land along Chuwatar, cultivated lands at Bishaltar, Benibesi, Ghyalchoktar, Chuwatar, Dhobadighat, Sukumbasitol, Pudaliphat, Jyamirghat, and Itar along the alignment are likely to be affected with the

unmanaged and haphazard disposal of roadside drain during the operation. *However, the magnitude of impact due to cross drainage outfall and gullies will be medium, low in extent and site specific in duration with the operation of proposed project.*

Safety and accident

Existing settlement areas such as Bishaltar, Benibesi, Ghyalchoktar, Chuwatar, Dhobadighat, Sukumbasitol, Pudaliphat, Jyamirghat, and Itar along the alignment will be more vulnerable to traffic safety and are likely to be the accident-prone area. Those settlements will be surrounded by the highway and locals will be more vulnerable to every day traffic and accident. Safety will be the major issue during the time of operation of existing and proposed new alignment during the time of operation. It is further anticipated that more link roads are likely to be developed connection new highway with rural villages; safety along such junctions will be more vulnerable during operation. *The operation of proposed alignment will have impact direct in nature with high in magnitude, site specific in extent and short-term in duration.*

Waste Management

Pollution and waste hazards is likely during the time of operation due to haphazard disposal of wastes by road users all along the existing and proposed new Bishaltar-Phisling alignment. Moreover, impact on water sources such as river crossing area and along the bridge location due to vehicle washing, fuel leakage, poor sanitation practices, increased human activities/settlement/market center expansions/hotel operations to the nearby such water sources. *The operation of proposed alignment will have impact due to solid waste will be direct in nature with high in magnitude, site specific in extent and short-term in duration.*

Biological Environment

Impacts at the pre-construction stage

Preparation for felling of trees

Approved consent from community forest user's group and Department of Forest will be required prior to harvesting of the trees affected. A step of this mandatory process is to hammering of all the trees to be cut. This process will be accomplished by DFO, Gorkha district. DFO Gorkha district has to be approached with appropriate papers, to identify the trees within the ROW and then hammer all affected trees in the CF and GF of the district. The proponent in collaboration with the DFO will keep record of all the trees hammered and develop facilities needed to store the logs cut. In collaboration with the DFO, the harvesters/contractor will be trained to proper felling, sectioning, hauling, pilling and handover of cut trees. *The magnitude of the impact is high with site specific extent and long term in duration.*

Protecting wildlife and habitat

The vegetated area of Keraghari, Nibhare, and Salleri CFs comprises of birds and small animals that are likely to be affected with the construction of proposed alignment, Bishatar-Phisling alignment. A government managed forest is available between Salleri and Nibhare community forests. This forest is a good habitat of wildlife and birds. Vultures and kites were observed in

the forest. *The magnitude of the impact is high with site specific extent and long term in duration.*

Impacts at the construction stage

Clearing of Forest and loss of vegetation and grazing area

The estimated length of the forest along the proposed alignment is 6.075 km which comprises an area of 28.15 ha. In this section, estimated number total trees to be felled were 6916, of which 78% of pole size trees were estimated to be affected during the implementation of Bishaltar-Phisling Section. The number and volume of trees affected along the proposed alignment is presented in detail in table 5-26. The details of the forest are presented in the Table 8-23 and

Table 8-24 as well. *The magnitude of the impact is high with site specific and extent is long term in duration.*

Table 8-23: Forest length and area affected

SN	Alignment	Affected length (m)	Affected area (ha)	Remarks
1	Salleri - CF	1379	4.67	
2	Nibhare - CF	491	2.46	
	Keraghari – CF	260	1.3	
	Total	2130	8.43	
	After Salleri CF	3680	18.4	
	Total	3680	18.4	
	Surung Pakha - LHF	265	1.32	
	Total	265	1.32	
	Grand Total	6075	28.15	

Table 8-24: Loss of trees

Sn.	Alignment	No of trees	Wood volume (m3)	Remarks
1	Salleri CF	4828	550.99	
2	Nibhare CF	835	31.57	
	Keraghari CF	72	20.93	
	Total	5735	603.49	
	After Salleri GF	1181	366.5	
	Total	1181	366.5	
	Grand Total	6916	969.99	

Loss of biomass and carbon from the felled trees

Biomass and carbon was calculated for trees to be felled from the forests along the alignment. A total of 969.99 m3 of wood volume will be lost whose biomass value is 1455.73 tonnes and carbon value is 625.94 tonnes. This data is besides the private forests that the highway will be traversed during the construction. Details in table below 6-25. *The magnitude of the impact is high with site specific extent and long term in duration.*

Table 8-25: Loss of wood volume, total biomass and carbon

Sn.	Alignment	Wood volume (m3)	Biomass (tons)	Carbon (tons)	Remarks
1.	Salleri CF	550.99	826.88	355.56	
2.	Nibhare CF	31.57	47.38	20.37	
3.	Keraghari CF	20.93	31.41	13.51	
	Total	603.49	905.67	389.44	
1.	After Salleri GF	366.5	550.06	236.5	
	Total	366.5	550.06	236.5	
	Grand Total	969.99	1455.73	625.94	

Disturbance to natural habitats and critical natural habitats

The project area does not comprise any critical habitat of wildlife and birds. Lots of movement of wildlife is observed with the highest number of secondary evidences of wildlife species on the river banks. These animals will be affected in reaching the Trishuli river for water and pray. Reduction of forest area permanently also affect wildlife habitat. *The magnitude of the impact is medium with site specific extent and long term in duration.*

Habitat fragmentation and barrier effect for wildlife movement

Bishaltar-Phisling proposed road alignment does not pass through any specific and critical habitat of wildlife. However, the alignment is proposed close to the Trishuli River and is passes through dense vegetated area only at Nivare community forest and adjacent steep and rocky government forest area the fragmentation of habitat and barrier effect for wildlife movement will be very less due to construction of the project. This sort of impact is especially likely at the last 5.5 km of the proposed road alignment where vegetation cover is more significant. *The magnitude of the habitat fragmentation is medium with site specific extent and long term in duration.*

Disturbance to biodiversity and wildlife

Clearing of vegetation of Salleri, Nivare, Keraghari community forests and government forest situated between Salleri and Nibhare community forests along the Bishaltar-Phisling alignment affects wildlife species such as common leopard, langur, ghoral, grey wolf, martens, and leopard cat and others. These are protected in national and listed in CITES. Mammals such as rhesus monkey, golden jackal, porcupine, squirrel etc. In addition, construction of the proposed alignment along the farmlands such as at Bishaltar, Benibesi, Ghyalchoktar, Chuwatar, Dhobadighat, Sukumbasitol, Pudaliphat, Jyamirghat, and at Kautikhet directly may affects birds, occurring in this river valley and farmlands. Resident birds which breed in this area are affected. *The magnitude to the disturbance to biodiversity and wildlife is medium with site-specific extent and long term in duration.*

Impacts on Herpeto-fauna and Fish species

Some herpetofauna such as Comon garden lizard (*Calotes versicolor*) and Brahminy skink (*Mabuya carinata*) observed during the field survey. In addition, Cobra, Karait and Green pit viper snakes are identified in the area by locals. Excavation for new road, cutting and filling

activities and continuous widening of road width with vehicular movement along the proposed road alignment will have significant impact upon small species such as frogs, lizards and snakes. The water pollution due to such project activities, excavation of quarries, haphazard disposal of solid waste and accidental spill of oil and lubricants will have affect aquatic life present in the Trishuli River especially along the last 5.5 km from Kautikhet to Phisling section.

Further, operation of labor camps during construction phase is likely increase in fishing activities along the Trishuli River. Direct disposal of wastes into Trishuli River from the camps will have threat to fish population. In order to minimize the expected impacts alternate arrangement such as provision of meat, waste bins and septic tanks, soak pits constructed as per site requirement before release to water bodies. *Impact due to construction of the proposed alignment is low in magnitude, local in extent and medium term in duration.*

Use of forest products and fuel wood by the construction workers during construction activities

Existing forest situated at the vicinity of the proposed alignment are likely to be affected during construction due to pressure laid by construction labour for fuel wood in labour camps. Labours will have easy accessibility upon existing forests situated at the project vicinity. Forest resources adjacent to the proposed alignment such as Salleri CF, Nivare CF and adjacent vegetated area during the time of construction will be vulnerable from the haphazard utilization by construction workers including outside migrants are likely. Using of wood for the boiling of bitumen is also very likely. Hence, adjacent forests are likely to be degraded during the time of construction. *The impact will be direct in nature, high in magnitude, local in extent and mid-term in duration.*

Hunting and poaching of wild animals by labourers

Hunting and poaching of wild animals by labourers is unlikely along this section. Though no critical habitat and wild animals are identified along the existing community forest along the alignment small animals and birds are likely to be affected. This sort of activities is likely especially from Kautikhet to Phisling where good cover of vegetation prevails. *The impact upon wild animals along this section will be medium in magnitude, site specific in extent and short term in duration.*

Forest fire

Forest fire are likely during construction due to haphazard smoking and throwing of light cigarette remains and match sticks by labour forces. Near Nivare and Salleri community forest forest fire is likely as they are better sites for labour camps. Itar, a site adjacent Salleri community forest is another site for labour camp. *The impact will be indirect in nature, medium in magnitude, site specific in extent and short term in duration.*

Illegal felling of trees

During the construction phase of the highway, forests are accessible to all. Gradual encroachment into forest area along the periphery and project area is likely especially in the government forests. Encroachment could slowly increase in acquiring land by squatters and then illegal trading of trees and other forest products. Tree felling, wood cutting, illegal export

of fuel wood and Non-Timber Forest Products (NTFPs), are likely. *The impact will be indirect in nature with low magnitude, site specific in extent and short term in duration.*

Impact at the operation stage

Illegal felling of trees

Gradual encroachment into remaining parts of Salleri CF, Nibhare CF, and Keraghari CF area and vegetation periphery to the project area is likely with the operation and gradual increment in the population within the area. Tree felling, woodcutting, illegal export of fuel wood and other forest products including Non-Timber Forest Products (NTFPs) are likely during the operation of proposed highway. Significant impact upon community forest area and along the last 5.5 km of the section is envisaged. Further, the Salleri CF comprising protected Sal trees are likely to be depleted during operation due to encroachment and illegal felling and selling of woods. Impact upon forest will also affect directly to the user groups of 367 households as well as to the adjacent communities. *The impact will be indirect in nature with low magnitude, site specific in extent and short term in duration.*

Damage of aquatic habitats

Direct impact upon aquatic habitats during the time of operation is minimal. Road and bridge side accident and vehicle drop into Trishuli River, direct disposal of waste into the river will have impact upon aquatic habitat along the alignment. Further, the proposed Bishaltar-Phisling section comprises about 23 natural drainages whereas the major streams along the alignment are Dhobadi khola, Judi khola, Sano khola, Kaudi khola, Prem khola and Khani khola streams are the tributaries of Trishuli River where construction of motorable bridge will be required. Any sort of vehicle accident or drop of vehicle and spillage of diesel along these streams will have direct impact upon aquatic life of Trishuli River. *The impact will be direct in nature with medium magnitude, local in extent and short term in duration.*

Road safety concerns in wildlife crossing area

The proposed alignment comprises significant length of community forests and other vegetated areas especially at the last 8 km of the section. Salleri community forest, Nivare community forest and its adjacent vegetated area are the major forests existed along the alignment are the major area where wildlife encounter is likely during operation. Road crossing by wildlife in search of water along the riverbank is very likely. As the Bishaltar-Phisling road alignment is proposed close to the Trishuli River bank; vehicle wildlife collision is very likely especially during night time along the Salleri community forest area and along the last 5.5km section. *The impact will be direct in nature with medium magnitude, site specific in extent and short term in duration.*

Spillage of oil, diesel in the river due to accident

Aquatic environment along the Dhobadi khola, Judi khola, Sano khola, Kaudi khola, Prem khola and Khani khola streams river corridor is likely to be affected due to roadside accident during the time of operation. Such impact has been envisaged especially at the bridge locations along the proposed last 5.5km of new alignments. All the streams are tributaries of Trishuli River, spillage of oil and diesel along the tributaries will have effect upon the aquatic life of

Trishuli River. *The impact will be direct, medium significance, local and short-term in duration.*

Socio-economic and Cultural Environment

Impacts at the pre-construction stage

Loss of private property and assets

Benibesi, Beldanda, Ghyalchowktar, Dhobadighat, Sukumbasibasti, Chuwatar, Pudaliphat, Jyamirghat, Itar, and Phisling are the major settlement area of the Bishaltar-Phisling section. Few number of market sheds providing services of tea and lunch for people of nearby villages in Bishaltar-Phisling section area. Total 47 private structures and 356 private land parcels of 238 households will be affected by the road project. Out of 47 structures, 27 residential structure, 20 other structures including kitchen, toilet, water tap, water tank, bio-gas plant, animal shed etc. Most of the affected structures are semi-modern and hut types. Due to be a new section, significant amount of land will be affected by road project. Approximately 17.72 ha. (Belongs to 238 HHs) private land need to be acquired for the ROW of 50-meter road width along the proposed Bishaltar-Phisling road alignment. *The impact of loss of private properties is low in magnitude, site specific in extent and short term in duration.*

Grievances raised by the locals and labours if any

Impact upon private property and acquisition of cultivated land for project implementation will be the major concern of local people. Locals will have deep interest and concern about the compensation of affected structures and affected private lands. Besides, households depend on agriculture for their livelihood and can lose their private property due to implementation of Bishaltar-Phisling Road Section is categorized as severely affected families and has been considered as Severely Project Affected Families (SPAFs) who require compensation. Grievances raised by the locals and labours during pre-construction stage might delay start site clearance and construction works.

Approximately 238 HHs will be needed to address the grievance issues. Adequate provisions and compensation arrangement is described in the Resettlement and Rehabilitation Action Plan. *The impact is low in magnitude, site specific in extent and short term in duration.*

Impacts at the construction stage

Loss of productive land

Construction of new road obviously impact agricultural, barren and forest land. In the results of road upgrades and construction, local farmers of Benibesi, Beldanda, Ghyalchowktar, Dhobadighat, Sukumbasibasti, Chuwatar, Pudaliphat, Jyamirghat, Itar, and Phisling will lose about 17.72 ha of cultivated land permanently. Approximately, 103.6 tons of agricultural products will be lost yearly with the loss of cultivated area along the Bishaltar-Phisling road section. Although, it will be insignificant in terms of overall project benefit as well as to the development of agricultural sector of the district. *The impact will be direct in nature, medium in magnitude, local in extent and long term in duration.*



Land and property acquisition, compensation, resettlement and rehabilitation

Only 47 private structures will be affected by the construction of road project. Approximately about 17.72 ha land will be required for acquisition for the construction of road alignment. Temporary use of land will be required during road construction for contractor's campsites, labor force campsites, quarry sites, crusher plant, and stock piling yard etc. Among the affected households, Brahmin (52.6%), Chhetri (11.6%), Dalits (6.8%), Newar (7.4%), Gurung (2.6%), Chepang (11.1%), and Gharti (3.2%). *The impact of land acquisition will be direct in nature, high in magnitude, local in extent and long term in duration.*

Disruption of community structure

The increase in competition for existing resources are likely that can put the indigenous people at a disadvantage, especially when the settlers introduce ecologically inappropriate and unsustainable production systems. Public structure will not be affected by the construction of road. *The impact will be indirect in nature, low in magnitude, site specific in extent and short term in duration.*

Livelihood

Substantial population along the Bishaltar-Phisling alignment are considered as low-income population. Their major livelihood depends upon agricultural, livestock and small shop business. Low income level population will be severely affected with the permanent acquisition of their land and property. It is further anticipated the Benibesi, Beldanda, Ghyalchowktar, Dhobadighat, Sukumbasibasti, Chuwatar, Pudaliphat, Jyamirghat, Itar, and Phisling area likely obstruction in project construction and implementation works by such severely affected groups with the loss of their cultivated lands, business during the time of excavation and construction of alignment. The local farmers of these area will be directly affected with the acquisition of those Khet and Bari land and will further loss in agricultural products and their livelihoods. *The impact will be direct in nature, low in magnitude, site specific in extent and short-term in duration.*

Conflict in or with nearby host community

Conflict between workers and local people is likely during the time of construction. Such impacts are likely through the Bishaltar-Phisling road length during the time of construction, especially at market places i.e. Benibesi, Beldanda, Ghyalchowktar, Dhobadighat, Sukumbasibasti, Chuwatar, Pudaliphat, Jyamirghat, Itar, and Phisling and at community forest area where workers and local will be interacted directly. *The impact will be indirect in nature, medium in magnitude, site specific in extent and short term in duration.*

Issues related to vulnerable indigenous people

There are vulnerable groups in every social setting and these include, women, children, the elderly and people with disabilities. The assets loss inventory of the project affected household identified 25 households of ethnic minorities (Chepang), 15 Dalits households, 1 women headed households, and 2 aged member households were identified in the Bishaltar-Phisling road section. *The magnitude of the impact is evaluated as Medium Negative as it can be prevented.*



Impact due to damages of community infrastructures

In this road section, public structures will not be affected by the road. Such infrastructures i.e. Drinking water supply pipe at Ch: 15+300, temporary/earthen canal at Ch: 3+200, 4+200 & 12+500 and cemented canal at 0+600 will be affected during the construction. Existing Pallotar track at Ch: 14+000; and Tangchowk track at Ch: 16+200 will be affected in construction of road. *The impact of loss of such religious sites will be direct in nature, medium in magnitude, site specific in extent and short-term in duration.*

Impact due to conflicts associated with road construction work forces

Influx of people is anticipated during the time of construction. Impacts are likely at the existing market and settlement i.e. Benibesi, Beldanda, Ghyalchowktar, Dhobadighat, Sukumbasibasti, Chuwatar, Pudaliphat, Jyamirghat, Itar, and Phisling areas. *The impact will be direct in nature, medium in magnitude, site specific in extent and short term in duration.*

Road safety

Local road users' safety may be an issue, when large numbers of construction vehicles ply on local roads during construction works. Road safety along the proposed new alignment Bishaltar-Phislingwill will be significant during the time of excavation. The proposed section traverses through hilly area and forest section; cutting of hill slopes may trigger landslides and slope instability rendering increase in safety of labour workers and road users. Further, Road safety will be the major issue within the ROW of the proposed new alignments. The project has planned to construct 1 overpass at Ch: 3+760, and 1 underpass at Ch: 5+740 for pedestrian and local safety. *The impact will be direct in nature, high in magnitude, local in extent and short-term in duration.*

Issues related to cultural assets

The issue of local culture and tradition is related to the activities of the outside workforce in the local area. The extent of such influence is difficult to predict. Project area is a co-existing ground of different ethnic groups with diverse sets of traditions and values since ages. However, the number of the workers involved is small; *the envisaged impacts on local culture and tradition is short period, site specific and of low magnitude.*

Issues on landscape aesthetics

The stockpiling of materials, construction excavation for structures and clearance of vegetation are some of the issues related to the general aesthetics. Due to construction of road, the natural landscape from Ch: 0+100 to Ch:1+000; Ch:1+420 to Ch:2+550; Ch:4+000 to Ch:4+750; Ch:5+500 to Ch:7+100 will fragment into two parts. Except for the vegetation clearance, rest of the works is site specific, short term and low magnitude. *The vegetation clearance is an impact of long-term, site specific, moderate magnitude along ROW.*

HIV/AIDS and other diseases

The issue of community health is related to the outside workforce. The outside workforce may introduce transmissible disease of unknown nature to the communities. The outside workforce can get sexually involved with the local community individuals increasing the risk of STD and

HIV/AIDS in the community. Poor sanitation practice of the outside workforce in the mark shift camps and construction sites is also potential to generate pollution issues affecting community health. *The envisaged risk is site specific, short duration and low in magnitude.*

Impact at the operation stage

Possible ribbon development along the road alignment

Encroachment of ROW for the establishment of shops and residences are likely with the gradual development of Ribbon settlement along the Bishaltar-Phisling road alignment. This sort of impact is envisaged along the entire road alignment area. Similarly, Beldanda (1+800 Km), Dhobadighat (3+400 Km), Sukumbasi Tol (4+100 Km), Pudaliphant (5+900 Km), Jyamirghat (6+600 Km) and Itar (8+200Km) and Phisling (15+300 Km) area will be possible ribbon development area. *The impact of encroachment will be direct in nature with high in magnitude, regional extent and long term in duration.*

Fragmentation of cultivated land

Fertile land existed along the proposed alignment will be fragmented during the time of operation and will be difficult to access due to heavy traffic. Cultivated land that will be fragmented during the time of operation are presented in the following table.

Table 8-26: Fragmentation of cultivated land

Sn.	Chainage		Affected length in m	Location name	Remarks
	From	To			
1.	0+060	1+020	60	Bishaltar	
2.	1+420	2+600	1020	Benibesi and Ghyalchoktar	
3.	3+860	4+800	940	Sukumbasitol	
4.	5+390	5+460	70		
5.	5+660	6+400	860	Pudaliphat	
6.	6+400	7+220	820	Jyamirghat	
7.	8+400	8+900	500	Itar	This section does not fragment the cultivated land
8.	9+380	10+090	710	Kautikhet	
9.	14+940	15+140	200	Khani khola, Phisling	

Increase in accidents

With an improved road there is likely increase of vehicular traffic and over speeding in busy sections of the road such as Chandrodya HH school area, Beldanda, Dhobadighat, Sukumbasi Tol, Pudaliphant, Jyamirghat, Itar, & Phisling area and proposed bus lay-bay area (i.e. at Ch: 1+800, 1+880, 4+280, 4+340, 6+580, 9+480, 9+580, 15+060, 15+120), and trading centers thereby increasing risks of road traffic accidents to communities along the Bishaltar-Phisling road.

Although this effect is long term it can be mitigated hence, the project has planned to construct 1 underpass at Ch: 5+740; 1 overpass at Ch: 3+760. *The magnitude of the impact will be medium, local, and long term in nature.*

Development of settlements and market places

After construction, the condition of the road will improve and transportation of commodities to and from the Bishaltar-Phisling will be easier. In addition, transportation will be eased for prospective visitors and tourists who would wish to raft in Trishuli River, which is a major tourist attraction in the area. It is also envisaged that more vehicle owners will be willing to have them operate on new road surface, which will result in attracting more vehicles on the road thus leading to low transport costs savings on general fuel consumption and reduction in travel time. Given the current state of this road, it is expected that the project impact will be high positive as the improved road will facilitate inter and intra community communication and transport. Similarly, the Ch:0+100-1+000; Ch:1+420-2+550; Ch:4+000-4+750; Ch:5+500-7+100 will be the possible locations for the development of settlement and market area affecting agriculture land. *The magnitude of the impact will be medium, local, and long term in nature.*

Increase in sell and use of alcoholic products along the new proposed sections

Various socio-economic changes are likely in the project areas and adjacent Municipality/Rural municipality due to implementation of road project. Together with the change in land use pattern economic activities of the locals will be altered. Consumption and import of alcoholic products are expected to be increased especially at existing settlement areas where people gathering with increase in other facilities such as hotels, restaurants and lodges. *The impact will be direct in nature with medium magnitude, regional extent and long term in duration.*

Girl trafficking and Increasing in prostitution

There is potential of the exploitation of the female members by the construction workforce, mostly the outside workforce, during construction and post-construction period. Girl trafficking could be one of the potential problem during operation and maintenance period. Due to the implementation of road project, various socio-economic and cultural changes are likely in the project areas and adjacent Municipality/Rural municipality. Girl trafficking, prostitution is expected to be increased especially in existing settlement areas, with appearing the new facilities such as hotels, restaurants and lodges.

The construction and operation of Bishaltar-Phisling road project likely to increase prostitution activities along the alignment. This impact is likely to continue into the operation phase and is thus long term since the small trading centres are likely to develop into bigger towns. *The impact will be direct in nature with medium magnitude, regional extent and long term in duration.*

Migration and immigration

No any project could be implemented without workers and labours imported from outside the project area for the construction of Benighat-Phisling alignment. Immigration of people from other areas and influx of workers are inevitable during the time of construction and operation with the availability of good jobs, services, and facilities. *The impact will be indirect in nature, low in magnitude, site specific in extent and short term in duration.*



HIV/AIDS and other diseases

The presence of an immigrant labour force and additional disposable income may result in undesirable interactions between the local communities (particularly youth) and the workforce, contributing to the spread of HIV/AIDS to both workers and the communities. This impact is likely to continue into the operation phase and is thus long term since the small trading centres are likely to develop into bigger towns. Accumulation of water in borrow pits and quarries and improperly designed drainage structures may encourage the breeding of malaria-transmitting mosquitoes and other water-borne diseases. *The impact will be direct in nature with medium magnitude, regional extent and long term in duration.*



8.4.4 Impacts due to construction of Bridges

Four new bridges have been proposed to construct along existing Naubise-Mugling road section. The proposed new bridges details are presented below.

Table 8-27: New bridges parallel to the existing bridges along the KNM

Sn.	Name of Bridge or Khola / Existing Bridge ID no.	Existing Chainage (km)	Design Chainage at centre of bridge (km)	Proposed Span arrangement (c/c of Bearings) (m)	Angle of Skew of Bridge (degree)	Total Length of Bridge (f/f of dirt wall) (m)	Type of Superstructure	Type of Substructure	Type of Foundation	Existing Bridge Carriageway Width (m)	Existing Bridge Overall Width (m)	Proposed Bridge Carriageway Width (m)	Proposed Bridge Overall width (m)	Remarks
a.	Khuhare 24/H004/005	12+359	12+359	1 x 25	39	26.48	Precast RCC Beam and Slab	RCC Cantilever Abutment	Open	6.10	8.50	7.50	11.90	New bridge on downstream.
b.	Chiraundi 24/H004/011	26+560	26+563	1 x 17	0	18.48	Precast RCC Beam and Slab	RCC Counterfort Abutment	Open	6.00	8.00	7.50	11.90	New bridge on upstream
c.	Gomati 24/H004/017	49+853	50+165	1 x 17	0	18.48	Precast RCC Beam and Slab	RCC Cantilever Abutment	Open	6.00	8.00	7.50	11.90	New bridge on downstream
d.	Hugdi 24/H004/020	61+665	61+930	1 x 35 + 1 x 20	0	57.96	PSC and RCC beam and slab	RCC Counterfort abutment & RCC wall pier	Open	6.00	8.00	7.50	11.90	New bridge on downstream.
e.	Repair and rehabilitation of bridges along the KNM.	Table 5-3					PSC and RCC beam and slab	RCC Counterfort abutment & RCC wall pier	Open	6.00	8.00	7.50		
f.	6 bridges to be constructed along Sisnekhola-Dharke alignment						PSC and RCC beam and slab	RCC Counterfort abutment & RCC wall pier	Open	6.00	8.00	7.50		
g.	8 bridges to be constructed along Bishaltar-Phising alignment						PSC and RCC beam and slab	RCC Counterfort abutment & RCC wall pier	Open	6.00	8.00	7.50		

Source: Draft Design Report 2018



Adverse Impacts

Physical environment

Impacts at the Construction Stage

Landscape disturbance and bank instability

Excavation for the foundation of the bridge will cause landscape disturbance land instability, soil erosion and landslides may occur along the banks and approach road. As the project area is located at hilly terrain the excavation work is likely to disturb slope stability. Disturbance to landscape and instability of banks are likely in all proposed bridges along the existing KNM. *The magnitude of impact will be medium with local extent and short term in duration.*

Quarry and extraction of river bed materials

Boulders gravel and sand are likely to be extracted from the river near to the bridge construction site by the all package contractors during the time of excavation for bridge foundation and other construction works. *The magnitude of impact will be high with local extent and long term in duration.*

Soild erosion due to construction and excavation of approach road

Excavation and construction of approach road and side structures will disturb the landscape and soil erosion. Roadside slopes may trigger landslide during the excavation. *The magnitude of impact will be medium with local extent and short term in duration.*

Change in river regime

The river diversion works will be done for the construction of the pier foundation. The increase in the sedimentation and change morphology of the river is likely with the river diversion. *The magnitude of impact will be medium with local extent and short term in duration.*

Water pollution

The direct disposal of construction material into water bodies (Khahare, Chiraundi, Gomati, and Hugdi streams) may also lead to further adverse impacts by increasing the sedimentation of the water and its ecosystem. *The magnitude of impact will be medium with local extent and short term in duration.*

Noise pollution

There is minimum noise source available within the project area and even the implementation of project will not produce remarkable amount of noises in the project area. The movement of vehicle, construction activities will be the major sources of noise during construction. *The impact is low in terms of magnitude, Site specific extent with short terms in duration.*

Dust and air pollution

During project activities, there is possibility of minimum emission of dusts and smoke. Workers may be affected by dust and smoke from operation of crusher plant, transportation of materials, and operation of heavy equipment. There is a high chance of dust emission due to the construction work during dry season. Dust will also affect the roadside vegetation and local

people. The impact due to air pollution *will be direct, of medium significance, site-specific and short term in nature.*

Disposal and construction waste management

The impact due to the haphazard disposal of spoil or construction wastes materials is likely if there no proper management of construction waste. Approximately; 12,000 cubic meters cum of cutting material will be generated from the excavation for approach road and foundations. *The impact is low in terms of magnitude, local extent with short terms in duration.*

Transportation and stockpiling of construction materials

Transportation and stockpiling of construction materials are likely to be carried out on the public land near the riverbank close to the bridge. Minimum pollution and disturbance is likely due to frequent travelling of heavy vehicles during the transportation of construction materials at the project area. *The impact will be low in terms of magnitude with site specific in extent and short term in duration.*

Impacts associated with labour camp operation

Establishment of camps near the bank of the river is likely. Approximately 35 to 50 labours will be required for the construction. Waste from the camps will be generated at the vicinity of camp location. Kitchen wastes, liquid wastes from temporary laterines, solid wastes, and rubbish are likely to be generated with the operation. *The impact will be low in terms of magnitude, site specific in extend and short term in duration.*

Spillage of chemical

Spillage are likely but at a low level during the operation of machines and vehicles for materials transport, for excavation. Also, there are chances of diesel spillage due to accidents of vehicle and during transportation of construction materials. *The impact will be medium in terms of magnitude, site specific in extend and short term in duration.*

Loss of utilities

Some utilities such as electric poles are likely to be affected with the construction of new proposed bridges. Approximately 3 poles are likely to be affected at each bridge construction site. In total, 10 electric poles are likely to be affected with the construction of new proposed bridges. *The impact will be medium in terms of magnitude, site specific in extend and short term in duration.*

Impacts at the Operation Stage

Increase in Dust and smoke with vehicle movement

The operation of new bridges and roads will generate dust and smoke to the ambient environment due to plying of vehicles. However, the amount of generation of dust from the proposed road will be remarkably less than that of traditional gravel and earthen roads. However, *the impact is medium in magnitude, site specific in extent with long term in duration.*



Noise

Sources of noise are not available in the project area; the operation of KNM road and constructed new bridges will produce significant noise, in the project area. The frequent movement of vehicles will be the major sources of noise during operation. *The impact is low in terms of magnitude, local extent but long terms in duration.*

Climate Change Impact

Predicted increase in precipitation may cause the water level higher than usual in Trishuli River and its tributaries. Bridge span capacity should be designed taking into account 15-20% increase of the storm water. *The impact is high in magnitude, site specific in extent and long term in duration.*

Biological environment

Impacts at the Construction stage

Construction serve as barrier to movement of migratory aquatic species

The construction of bridge foundation will serve as a barrier to the movement of migratory aquatic species. And the temporary diversion will also serve as a barrier to the movement of fishes. *The impact is medium in magnitude, local in extent and short term in the duration.*

Likely damage of aquatic habitats and animal due to extraction of sand and gravel from river

Sand and gravel extraction, initiated during construction, is a main cause for loss of habitats including spawning grounds, and feeding grounds of aquatic life (fish/ aquatic insects/ phytoplankton/ zooplanktons).

The changes in river morphology, longitudinal profile and depth and velocity of water flow may also lead to adverse impacts on the aquatic life. *The impact is medium in magnitude, local in extent and short term in the duration.*

Use of fuel wood by the construction workers in construction activities

The constructions workers living in the camps likely to use fuel wood for the cooking and also to some extent the use of fuel wood is likely in winter season for heating purpose. *The impact is low in magnitude, local in extent and short term in the duration.*

Degradation in fish population due to construction workers involve in fishing

There will be degradation in the fish population if the construction workers involve in fishing. If such activity occurs, then impact will be till few hundred meters upstream and downstream of the bridge location. *The impact will be direct and medium significance, local and short term.*

Impact at the Operation Stage

Impact on growth of the natural forest and vegetation

Undesired cumulative and induced impacts on the growth of the natural forest and vegetation may include accelerated logging, illegal extraction of timber and other forest products existed

near to the proposed bridge construction site. *The impact will be indirect, of low significance, local, and long-term.*

Impact upon aquatic life due to vehicle drop and spillage of oil and diesel in the river due to accident

Around 16 globally threatened fish species may be found in the Trishuly River. Their spawning sites might be impacted during bridge construction. The accidental spillage and discharge of harmful chemicals in river is likely due to the vehicle drop in the river. The impact upon aquatic system is likely for few hundred meters downstream from the proposed bridge site. *The impact will be direct, high significance, local and short-term.*

Socio-economic and Cultural environment

Impacts at the Pre-construction Stage

Impact due to acquisition of land

About 0.21 ha. of additional land at Kahare, Chiraudi, Gomati and Hugdi area will be required for construction of four new bridges in the existing Naubise-Mugling road section. The local farmers of these area will be directly affected with the acquisition of those cultivated land and will further loss in agricultural products and their livelihoods. *These impacts will be direct, high significance, local, and long-term in nature.*

Impact due to acquisition of structures

The construction of new bridges private and public structures will be affected in existing Naubise-Mugling road section. 4, 28 and 4 number of private structures will be affected at Chiraudi khola, Hugdi and Gomati khola respectively. Total 36 private structures belongs to 34 HHs and 2 public structures will be affected during the construction of new bridges. *These impacts will be direct, high significance, local, and long-term in nature.*

Impacts at the Construction Stage

Health and sanitation chances of increase in transmission of disease from outside work force

During construction, non-local workers of contractor are likely to produce impact upon health and sanitation of the area. Impact due to unawareness, open defecation and direct disposal of wastes into the ambient environment by the non-local labours could produce significant impact upon the health of the locals. If sanitation issues will not address properly; there is likely spreading and emergence of disease among the labour in camp as well. *The impact from unawareness on camp sanitation by the labour will be low in magnitude, local and short term in nature.*

Conflict and disturbance due to non-local labour

Conflict between non-local labour and local people and with other construction crew members could be existed. The conflict might also be existed while hiring local people in the Project. This also could lengthen the construction period of the Project. *These impacts will be direct, low significance, local, and short-term in nature.*



Traffic safety and traffic movement

As the construction of new bridges are just close to the downstream of existing bridges. Impact upon existing traffic is likely with the construction activities and plying of construction vehicle, storage of construction materials close to the existing highway. *These impacts will be direct, high significance, local, and short-term in nature.*

Disturbance in movement of local inhabitants

Movement of locals will be affected during the time of construction inhabited close to the proposed bridge locations. *These impacts will be direct, high significance, local, and short-term in nature.*

Occupational health and safety for bridge construction work

During construction period, workers could be exposed to various health risks and hazards. The labours could encounter injuries and accidents due to lack of adequate safety measures. Proper instructions and handling training should be given to the workers before handling risky heavy equipment and at the mean time proper safety practices be made in order to escape any kind of possible mishaps during the construction phase. Typical health hazards could be encountered during rock cutting, slope cutting, working in bridge over river, equipment handling, river training, etc. Other possible health impacts are respiratory and eye diseases due to exposure to dust, and smoke. Similarly, unhygienic sanitary condition e.g. lacking of latrines and washing facilities and unsafe water location increases the chances of additional and often endemic diseases like diarrhea, dysentery and cholera. In the absence of stringent health and safety regulations and regular sensitization, the identified impacts will be *indirect, high significance, local and short-term in nature.*

Impacts at the Operation Stage

Safety of pedestrians with the plying of vehicles

Pedestrians along the bridge and approach roads will be vulnerable to accidents during operation. *These impacts will be direct, high significance, local, and long-term in nature.*

Encroachment of land near the bridge area

The implementation of project might encroach upon the nearby agricultural land that might be changed into the built-up area with the private house for the future growing urbanization near the bridge. *The impact is medium in magnitude, local in extent and long term in the duration.*



CHAPTER 9: Impact Analysis and Evaluation

9.1 Impact Analysis and Evaluation

All together 82 general issues were identified for existing highway from Kathmandu to Naubise and Naubise to Mugling and 2 new alignments: Sisne-khola – Dharke and Bishaltar – Phishling, including 14 beneficial and 68 adverse for pre-construction, construction and operation phases. Many issues are similar for separate sections, but there are also some differences between them, most prominent between existing highway and new alignments.

Table 9-1: Number of adverse issues in the project area of KNM road bridges

Issues/Sections		Existing KNM road	Sisnekhola-Dharke	Bishaltar-Phishling	Proposed bridges
Physical	Pre-construction	5	7	7	-
	Construction	16	20	18	11
	Operations	6	6	6	2
Biological	Pre-construction	3	2	2	-
	Construction	5	10	10	3
	Operations	4	5	4	3
Socio-economic and cultural	Pre-construction	2	2	2	2
	Construction	12	12	12	5
	Operations	8	8	8	2
Total		61	72	69	28

Source: *Project team, 2017*

Each issue was then briefly summarized and the positive and negative impacts associated with each alternative were derived during brainstorming session in the office. Following the process described in Nepal Government Gazette “National Environmental Assessment Guidelines, 1993” and Environmental Impact Assessment Guidelines, 2014 (Government of Nepal), these issues were weighted and ranked on the following basis:

Table 9-2: Scoring table for the evaluation of impacts

Type	Impact	Symbol	Rating
Magnitude	High	H	60
	Medium	M	20
	Low	L	10
Extent	Regional	R	60
	Local	L	20
	Site Specific	S	10
Duration	Long Term	Lt	20
	Medium Term	Mt	10
	Short Term	St	5

Source: *National EIA Guidelines, 1993.*



A sum of the impact values for magnitude, extent, duration provides a maximum of 140 and a minimum of 25 points. The impact values or scores for each of the alternatives are summed up and multiplied by the probability of occurrence of the particular impact. The final impact scores for all alternatives are compared and the highest value corresponds to the greatest potential for environmental and social impact.

Probability of Impact: Because analysis of the issues, the probability is the measure of the likelihood that an event will occur. Probability is quantified as a number between 0 and 1, where “0” indicates that impact cannot occur and “1” indicates that impact is certain 100%. The higher probability of an event, the more likely it will occur. According to EPR, the real impact might be calculated multiplying the sum of score of the effects on the probability of occurrence (EPR, 1997). Thus, total score of the impact was calculated by multiplying the sum of all effects on probability.

Then, the assessment of the impacts was quantified in four packages: for the existing highway from Kathmandu to Mugling, for two new alignments: Sisnekhola-Dharke and Bishaltar-Phishling, and for bridges - by experts, engaged in data collection and analysis. Tables with analysis of impacts in four packages and calculation of scores are provided below.

9.2 Significance of the Impacts

Significance of the impacts have been assessed for each from 3 selected packages for the different stages of the project implementation. Below analysis of the significance of the impacts has been provided also by mentioned packages and stages:

9.2.1 Upgrades of existing highway from Kathmandu to Naubise and from Naubise to Mugling:

Physical environment

At the preconstruction stage, there will not be any significant adverse impacts on physical environment. The most important issue is review of impact assessment, mitigation measures and EMPs.

Data analysis shows that at the construction stage along the existing KNM road the impacts of air pollution and impact related to road safety will be high. Then, the impact of disruption and relocation of public utilities, land use change and loss of topsoil will be significant. Landslides, slope destabilization and soil erosion are also likely along the alignment during the time of construction. Further, the impacts anticipated with high magnitudes are impact due to disposal of spoil, obstruction to natural drainage pattern, pollution to water resources, impact due to operation of borrow pits and quarries, occupational health and safety of labour and accidents during the time of construction.

At the operation stage, the traffic safety and accident probability, including waste management issue, will be high. Instability of hill slopes is likely to be triggered during the time of operation along the highway. Further, the impacts anticipated with high magnitude during the operation is impacts due to poor drainage.



Biological Environment

At the preconstruction stage, there will not be any significant impact on the environment.

During construction stage, there will be a medium impact on biological environment, associated with use of forest products by the construction workers, disturbance, hunting and poaching of wildlife by workers. Other significant impact is expected from cutting of trees, clearance of shrubs and herbs in the forest area for roadwork.

At the operation stage, it is expected that impact on forest resources will increase with possible extraction of firewood and timber due to better access to resources. More likely, traffic intensity and high speed of moving transportation will create more disturbances for wildlife, including higher rates of roadkill animals.

Socio-economic and cultural environment

There will not be any significant impact on socio-economic environment during preconstruction phase.

During construction, one of the most serious issues is an occupational health, because more likely distribution of HIV/AIDs and other diseases. Road safety issues are also important and need to be addressed. Another serious issue is a land and property acquisition, compensation, resettlement and rehabilitation that should be addressed and monitored in accordance with law and existing practices. However, issues related to land and property acquisition, compensation, resettlement and rehabilitation are also likely with high magnitude during the construction.

At the operation stage, the most serious issue is relevant to cumulative impact of road development and unplanned ribbon settlements along the road. All other issues have approximately the same scoring and can be addressed with appropriate mitigation measures.

9.2.2 Construction of new road at Sisnekhola-Dharke section:

Physical environment

There will be no any significant adverse impact on physical environment during preconstruction stage.

The analysis of impact upon physical environment during the construction stage along the new Sisnekhola – Dharke alignments shows that the impact of air pollution, occupational health and safety will be high. It is expected that the impact of land use change, loss of topsoil, disposal of spoil, disruption and relocation of public utilities also will be significant. Landslides, slope destabilization and soil erosion are likely along the Nisakot Community forest during the time of construction, when cutting of trees may provoke land instability. Moreover, the impact anticipated with high magnitude are disruption and blockage upon natural drainage, use of bitumen and other toxic chemicals, water flow disruption and erosion of river banks, impact related to road safety and traffic during construction.

The analysis of impacts on physical environment during operation stage shows that the traffic safety and accident including air, noise and waste management issues will be high. Further, instability of hill slopes along the Nisakot Community Forest is likely to be triggered during the time of operation.



Biological Environment

There will not be any significant adverse impact upon biological environment during the time of preconstruction phase.

The analysis of impact upon biological environment during the construction stage indicates that the impact of forest clearance and loss of biomass will be high in nature. Disturbance of natural habitats is a second issue on significance followed by use of forest product by construction workers. More likely that existing bird and wildlife habitats in Nisakot Community Forest along the road will be lost during construction of new alignment. This habitat might be compensated later with establishment of green plantations along the road.

During operation stage, the spillage of oil and diesel is assumed to have severe impact on aquatic life in Sisnekhola-Dharke section. However, more likely that biodiversity of the section might be affected by loss of habitats such as Nisakot Community Forest, increased pressure on forest resources due to new access zone along this alignment and increase in fire, associated with higher population pressure.

Socio-economic and cultural environment

It is expected that it can be moderate effect of loss of private property and assets on households, located closely to new alignment. However, this impact will be mitigated through existing mechanisms.

The occupational health is also serious issue in this section due to more likely distribution of HIV/AIDs and other diseases. Land and property acquisition, compensation, resettlement and rehabilitation is another serious issue in Sisnekhola – Dharke section during construction. This issue is supplemented by loss of productive land, because area along the alignment is used for agriculture. Further, road safety issues need to be addressed. Issue of landscape aesthetics is also serious for this section, especially in connection to the destruction of Nisakot Community Forest.

At the operation stage, the most serious issue is relevant to cumulative impact of road development and unplanned ribbon settlements along the road. Another issue is increase in the sales of alcoholic products along the highway, which also can cause the serious road safety issues. All other issues have approximately the same scoring and can be addressed with appropriate mitigation measures using mitigation hierarchy approach.

9.2.3 Construction of new road at Bishaltar-Phishling section

Physical environment

There will be no any significant adverse impact on physical environment during the time of preconstruction phase.

The analysis of impact on physical environment during the construction stage along Bishalar-Phishling section indicates that the impacts of air pollution, spoil disposal, change in land use will be high. Impacts of landslide and soil erosion, relocation of utilities, operation of burrow pits is also significant during the construction activities. Landslides, slope destabilization and soil erosion are also likely at the last 5.5 km along the alignment. Further, the impacts

anticipated along the proposed new alignment with high magnitude during construction are disruption and blockage upon natural drainage, water flow disruption and erosion of riverbanks.

At the operation stage, the most serious issue is instability of hill slopes, especially at the last 5.5 km of the section, which will be very vulnerable. Traffic safety and accident probability are also significant along this road. Air, noise and waste management issues are also recognized to be considerable in this section.

Biological Environment

There will be no any significant impact on biological environment during preconstruction stage.

The analysis of impacts on biological environment during the construction stage along the proposed Bishaltar-Phisling alignment shows that the impact of forest clearance and loss of biomass will be high in nature. Further, use of forest products and firewood by construction workers are very likely during construction. Disturbance of wildlife should be also significant, especially along 5.5 km of the section, which will be built through the relatively intact forest habitats.

During the operation stage, indirect and cumulative impacts of the road development on forest habitat, forest products and wildlife will be very high. First, because the road will open the access to the valuable forest products in the area with difficult access due to remoteness and lack of road infrastructure. Road will fragment habitats and create barriers on the way of wildlife and other forest biodiversity to the river, especially in the last 5.5 km of the section. These issues should be addressed accordingly in the Environmental Management Plan for this section.

Socio-economic and cultural environment

Loss of private property and assets will be a serious issue at the preconstruction phase in the Bishaltar-Phisling section. It should be addressed through existing mechanisms.

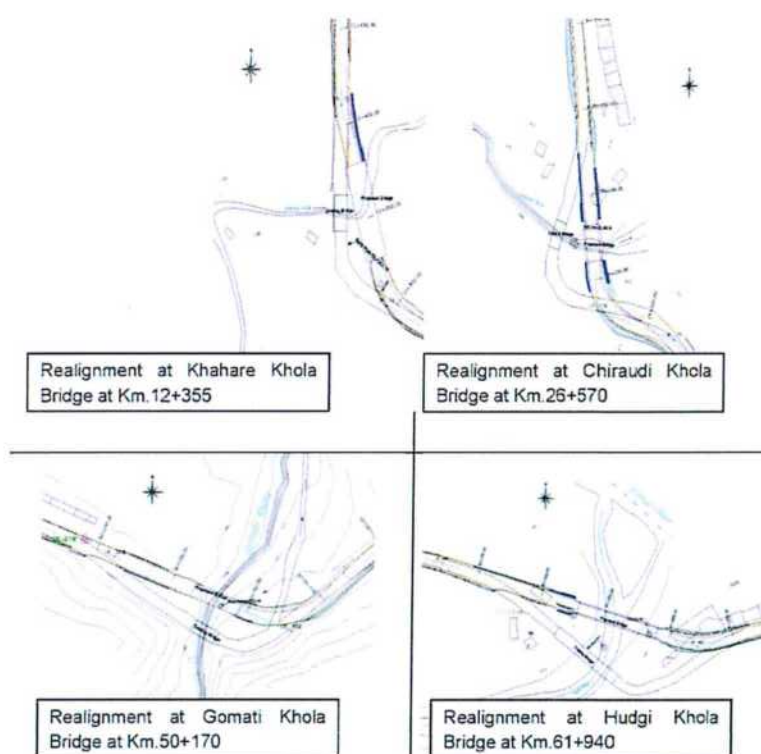
The occupational health is also serious issue in this section due to more likely distribution of HIV/AIDs and other diseases. Land and property acquisition, compensation, resettlement and rehabilitation are also very serious issue in Bishaltar-Phisling section during construction. This issue is associated with loss of productive land, because area along the alignment is used for agriculture. Further, road safety issues are serious during construction stage. Issue of landscape aesthetics is also serious for this section; the construction through hill forest should be done with minimal damage to valuable types of trees and beautiful forest landscape of the area.

At the operation stage, the most serious issue is relevant to cumulative impact of road development and unplanned ribbon settlements along the road. Another issue is increase in the sales of alcoholic products along the highway, which also can cause the serious road safety issues. All other issues have approximately the same scoring and can be addressed with appropriate mitigation measures.

All analysed and listed above issues will be addressed in the next chapter within the structure of proposed Environmental and Social Management Plans for existing highway and two new proposed alignments.

9.2.4 Construction of Bridges along the KNM

Some of the Major Realignments at four locations of existing bridges in KNM section of the project road where the relocation of bridge was proposed for safety measures. Location and name of the bridges are Khahare Khola Bridge : Ch. 12+355; Chiraudi Khola Bridge : Ch. 26+570; Gomati Khola Bridge : Ch. 50+170; and Hugdi River Bridge : Ch. 61+940. Further, remaining other 21 bridges along the existing KNM will also be improved.



Physical environment

There will be no any significant adverse impact on physical environment during the time of preconstruction phase. Minor disturbance of landscape, band instability, extraction of riverbed materials, dust and air pollution can be considered as the major physical impact with the construction of bridge.

Similarly, likely damage of aquatic habitats and animal due to excavation of sand and gravel for foundation from river during construction and the impact upon aquatic life due to vehicle drop and spillage of oil and diesel in the river due to accident has been assessed as the major impact upon biological aspect during the operation.

Moreover, Occupational health and safety for bridge construction workers will be the major issue during the time of construction. Safety of pedestrians with the plying of vehicles near to the bridge location will be major issue during operation and encroachment of land near the bridge area are likely during operation of the project.

Biological Environment

It is anticipated that construction of bridge activity serve as barrier to movement of migratory aquatic species. Other anticipated impacts are damage of aquatic habitats and impact on aquatic animals due to extraction of sand and gravel from river, degradation in fish population and loss of fish habitats due to construction workers involve in fishing during construction. However,

the impact anticipated with high magnitude during operation is impact on aquatic life due to vehicle drop and spillage of oil and diesel in the river due to accident.

Socio-economic and Cultural environment

Acquisition of land and acquisition of structures will be the serious issue during the time of pre-construction stage.

It is anticipated that impacts related to occupational health and safety for bridge construction workers will be high during the time of construction.

Issue related to safety of pedestrians with the plying of vehicles, and encroachment of land near the bridge area are anticipated to be high during operation.



Table 9-3: Site-specific adverse impact analysis for existing road (KNM section)

Sn.	Impacts	Magnitude	Extent	Duration	Total	Probability	Total Score
Pre-construction Stage							
1	Review of impact assessment, mitigation and EMP	10	10	5	25	0.8	20
2	Planning for erosion control	10	10	5	25	0.6	15
3	Planning materials management and spoil disposal	10	10	5	25	0.6	15
4	Traffic Management	10	10	5	25	0.7	17.5
5	Preparing the Contractor(s) to Address Mitigation Measures	10	10	5	25	0.3	7.5
Construction Stage							
1	Disruption and relocation of existing services and public utilities	60	20	10	90	0.9	81
2	Change in Land use and loss of productive topsoil	60	10	20	90	0.9	81
3	Landslides, Slope Destabilization and Soil Erosion	60	20	10	90	0.8	72
4	Impact due to disposal of spoil	60	10	20	90	0.6	54
5	Obstruction to natural drainage pattern	60	20	10	90	0.5	45
6	Pollution of Water Resources	60	10	5	75	0.6	45
7	Impact due to operation of borrow pits and quarries	60	10	5	75	0.7	52.5
8	Stone Crushing Plants	20	10	10	40	0.7	28
9	Stockpiling and transportation of construction materials	60	20	10	90	0.8	72
10	Air pollution	60	60	10	130	0.8	104
11	Potential hazards caused by bitumen and other toxic chemicals	20	10	5	35	0.4	14
12	Noise pollution	20	10	5	35	0.5	17.5
13	Impact related to Road Safety during construction	60	60	5	125	0.8	100
14	Occupational Health and Safety of Labour and accidents	60	10	5	75	0.9	67.5
15	Loss of physical and cultural structures and infrastructures	20	10	5	35	0.6	21
16	Impact due to establishment of construction camps	20	10	5	35	0.4	14
Operation Stage							
Sn.	Impacts	Magnitude	Extent	Duration	Total	Probability	Total Score

Sn.	Impacts	Magnitude	Extent	Duration	Total	Probability	Total Score
1	Instability of the hill slopes	60	20	20	100	0.7	70
2	Right of Way encroachment	20	20	10	50	0.6	30
3	Impacts due to Poor Drainage	60	20	5	85	0.5	42.5
4	Air and Noise Pollution	20	20	20	60	0.7	42
5	Traffic safety and accident	60	10	20	90	0.8	72
6	Waste Management	60	10	20	90	0.8	72
Biological Environment							
Pre-construction Stage							
1	Dissemination of information to CFUG and DFO	20	20	20	60	0.5	30
2	Approval for tree cut	20	20	20	60	0.5	30
3	Hammering of affected trees	20	20	20	60	0.5	30
Construction Stage							
1	Clearing of shrubs and herbs of the forest areas	10	20	20	50	0.7	35
2	Disturbance, Hunting and Poaching of wildlife	20	20	10	50	0.7	35
3	Use of forest product by the construction workers and construction activities	20	20	5	45	0.8	36
4	Disturbances on aquatic lives and fishing activities	10	20	10	40	0.7	28
5	Disturbances on the corridor of the wildlife movement	20	10	20	50	0.7	35
Operation Stage							
1	Possible extraction of firewood and timber	20	20	20	60	0.6	36
2	Increased wildlife disturbance, hunting and poaching	10	20	5	35	0.5	17.5
3	Impacts on forest resources	20	20	20	60	0.8	48
4	Disturbances on the corridor of the wildlife movement	20	20	20	60	0.5	30
Socio-economic and cultural issues							
Pre-construction Stage							
1	Loss of private property and assets	M20	SS10	ST5	35	0.5	17.5



Sn.	Impacts	Magnitude	Extent	Duration	Total	Probability	Total Score
2	Grievances raised by the locals and labours if any	L10	SS10	ST5	25	0.1	2.5
Construction Stage							
1	Loss of productive land	L10	L20	ST5	35	0.1	3.5
2	Land and property acquisition, compensation, resettlement and rehabilitation	H60	L20	LT20	100	0.5	50
3	Disruption of community structure	L10	SS10	ST5	25	0.5	12.5
4	Livelihood issues	L10	SS10	ST5	25	0.9	22.5
5	Conflict in or with nearby host community	M20	SS10	ST5	35	0.5	17.5
6	Issues related to vulnerable indigenous people	M20	SS10	LT5	35	0.5	17.5
7	Impact due to damages of community infrastructures	M20	SS10	ST5	35	0.5	17.5
8	Potential issues of conflicts associated with road construction work forces	M20	SS10	ST5	35	0.5	17.5
9	Road safety issues	H60	L20	ST5	85	0.9	76.5
10	Issues related to cultural assets	L10	SS10	ST5	25	0.1	2.5
11	Issues on landscape aesthetics	M20	SS10	LT20	50	0.5	25
12	HIV/AIDS and other diseases	H60	R60	LT20	140	0.9	126
Operation Stage							
1	Possible ribbon development along the road alignment	H60	R60	LT20	140	0.9	126
2	Increase in accidents	M20	L20	LT20	60	0.9	54
3	Development of settlements and market places along the Nagdhunga-Mungling sections	M20	L20	LT20	60	0.9	54
4	Increase in sell and use of alcoholic products	M20	R60	LT20	100	0.9	90
5	Girl trafficking	M20	R60	LT20	100	0.5	50
6	Migration and immigration	L10	SS10	LT20	40	0.5	20
7	Increasing in prostitution	M20	R60	LT20	100	0.5	50
8	HIV/AIDS and other diseases	M20	R60	LT20	100	0.5	50

Table 9-4: Site-specific adverse impact analysis for Sisnekhola- Dharke Alignment

Sn.	Impacts	Magnitude	Extent	Duration	Total	Probability	Total Score
Pre-construction Stage							
1	Review of impact assessment, mitigation and EMP	10	10	5	25	0.8	20
2	Review of alignment to improve project acceptability	10	10	5	25	0.7	17.5
3	Access roads	10	10	5	25	0.6	15
4	Planning for erosion control	10	10	5	25	0.6	15
5	Planning materials management and spoil disposal	10	10	5	25	0.7	17.5
6	Traffic Management	10	10	5	25	0.3	7.5
7	Preparing the Contractor(s) to Address Mitigation Measures	10	10	5	25	0.5	12.5
Construction Stage							
1	Disruption and relocation of existing services and public utilities	60	20	5	85	0.9	76.5
2	Change in Land use and loss of productive topsoil	60	10	20	90	0.9	81
3	Landslides, Slope Destabilization and Soil Erosion	60	10	20	90	0.8	72
4	Tunnel excavation	60	20	10	90	0.8	72
5	Spoil disposal	60	20	10	90	0.9	81
6	Disruption and blockage upon natural drainage	60	20	10	90	0.6	54
7	Pollution of Water Resources	20	10	5	35	0.9	31.5
8	Soil contamination	20	10	29	59	0.7	41.3
9	Water logging	20	10	5	35	0.7	24.5
10	Impact due to operation of borrow pits and quarries	60	10	20	90	0.8	72
11	Stone Crushing Plants	20	10	10	40		
12	Stockpiling and transportation of construction materials	60	20	10	90	0.9	36
13	Air pollution	60	60	10	130	0.8	104
14	Potential hazards caused by bitumen and other toxic chemicals	60	20	10	90	0.7	63
15	Noise pollution	60	10	5	75	0.9	67.5
16	Water flow disruption and erosion of river banks	60	10	5	75	0.7	52.5

Sn.	Impacts	Magnitude	Extent	Duration	Total	Probability	Total Score
17	Impact related to Road Safety and traffic during construction	60	10	5	75	0.8	60
18	Occupational Health and Safety of Labour and accidents	60	10	10	80	0.9	72
19	Loss of physical and cultural structures and infrastructures	20	10	5	35	0.5	17.5
20	Impact due to establishment of construction camps	20	10	5	35	0.9	31.5
Operation Stage							
1	Instability of the hill slopes	60	20	20	100	0.5	50
2	Air pollution	60	20	20	100	0.7	70
3	Noise	60	10	20	90	0.7	63
4	Cross drainage outfall and gullies	20	10	5	35	0.6	21
5	Traffic safety and accident	60	10	20	90	0.9	81
6	Waste Management	60	10	10	80	0.7	56
Biological Environment							
Preconstruction Phase							
1	Preparation for felling of trees	60	10	20	90	0.5	45
2	Disturbance to wildlife and habitat	60	10	20	90	0.5	45
Construction Stage							
1	Clearing of Forest and loss of vegetation and grazing area	60	10	20	90	0.9	81
2	Loss of biomass and carbon from the felled trees	60	10	20	90	0.9	81
3	Disturbance to natural habitats and critical natural habitats	20	10	20	50	0.9	45
4	Habitat fragmentation and barrier effect for wildlife movement	60	10	20	90	0.7	63
5	Disturbance to biodiversity and wildlife	10	10	20	40	0.5	20
6	Impacts on Herpeto-fauna and Fish species	10	20	10	40	0.5	20
7	Use of forest products and fuel wood by the construction workers during construction activities	20	20	5	45	0.7	31.5
8	Hunting and poaching of wild animals by labourers	10	10	5	25	0.5	12.5
9	Forest fire	20	10	5	35	0.6	21
10	Illegal felling of trees	10	10	5	25	0.8	20



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Sn.	Impacts	Magnitude	Extent	Duration	Total	Probability	Total Score
Operation Stage							
1	Illegal felling of trees	10	10	5	25	0.7	17.5
2	Damage of aquatic habitats	20	20	5	45	0.6	27
3	Habitat fragmentation and barrier effect for livestock/wildlife movement	60	10	20	90	0.9	81
4	Road safety concerns in wildlife crossing area	10	10	5	25	0.5	12.5
4	Spillage of oil, diesel in the river due to accident	20	20	5	45	0.7	31.5
5	Forest fire	10	10	5	25	0.8	20
Socio-economic and cultural environment							
Preconstruction Stage							
1	Loss of private property and assets	H60	SS10	LT20	90	0.5	45
2	Grievances raised by the locals and labours if any	H60	SS10	ST5	75	0.5	37.5
Construction Stage							
1	Loss of productive land	H60	L20	ST5	85	0.9	76.5
2	Land and property acquisition, compensation, resettlement and rehabilitation	H60	L20	LT20	100	0.9	90
3	Disruption of community structure	L10	SS10	ST5	25	0.1	2.5
4	Livelihood issues	L10	SS10	ST5	25	0.9	22.5
5	Conflict in or with nearby host community	M20	SS10	ST5	35	0.5	17.5
6	Issues related to vulnerable indigenous people	M20	SS10	LT5	35	0.1	3.5
7	Impact due to damages of community infrastructures	M20	SS10	ST5	35	0.5	17.5
8	Potential issues of conflicts associated with road construction work forces	M20	SS10	ST5	35	0.5	17.5
9	Road safety issues	H60	L20	ST5	85	0.9	76.5
10	Issues related to cultural assets	L10	SS10	ST5	25	0.1	2.5
11	Issues on landscape aesthetics	M20	SS10	LT20	50	0.9	45
12	HIV/AIDS and other diseases	H60	R60	LT20	140	0.9	126
Operation Stage							

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Sn.	Impacts	Magnitude	Extent	Duration	Total	Probability	Total Score
1	Possible ribbon development along the road alignment	H60	R60	LT20	140	0.9	126
2	Increase in accidents	M20	L20	LT20	60	0.9	54
3	Development of settlements and market places along the Sisnekhola-Dharke sections	M20	L20	LT20	60	0.9	54
4	Increase in sell and use of alcoholic products along the new proposed sections	M20	R60	LT20	100	0.9	90
5	Girl trafficking	M20	R60	LT20	100	0.1	10
6	Migration and immigration	L10	SS10	LT20	40	0.9	36
7	Increasing in prostitution	M20	R60	LT20	100	0.5	50
8	HIV/AIDS and other diseases	M20	R60	LT20	100	0.5	50

Table 9-5: Site-specific adverse impact analysis for Bishaltar- Phishling Alignment

Sn.	Impacts	Magnitude	Extent	Duration	Total	Probability	Total Score
Pre-construction Stage							
1	Review of impact assessment, mitigation and EMP	10	10	5	25	0.8	20
2	Review of alignment to improve project acceptability	10	10	5	25	0.7	17.5
3	Access roads	10	10	5	25	0.6	15
4	Planning for erosion control	10	10	5	25	0.6	15
5	Planning materials management and spoil disposal	10	10	5	25	0.7	17.5
6	Traffic Management	10	10	5	25	0.3	7.5
7	Preparing the Contractor(s) to Address Mitigation Measures	10	10	5	25	0.5	12.5
Construction Stage							
1	Disruption and relocation of existing services and public utilities	60	20	5	85	0.9	76.5
2	Change in Land use and loss of productive topsoil	60	10	20	90	0.9	81
3	Landslides, Slope Destabilization and Soil Erosion	60	10	20	90	0.8	72
4	Spoil disposal	60	20	10	90	0.9	81

Sn.	Impacts	Magnitude	Extent	Duration	Total	Probability	Total Score
5	Disruption and blockage upon natural drainage	60	20	10	90	0.6	54
6	Pollution of Water Resources	20	10	5	35	0.9	31.5
7	Soil contamination	20	10	29	59	0.7	41.3
8	Water logging	20	10	5	35	0.7	24.5
9	Impact due to operation of borrow pits and quarries	60	10	20	90	0.8	72
10	Stone Crushing Plants	20	10	10	40	0.9	36
11	Stockpiling and transportation of construction materials	60	20	10	90	0.8	72
12	Air pollution	60	60	10	130	0.8	104
13	Potential hazards caused by bitumen and other toxic chemicals	60	20	10	90	0.7	63
14	Noise pollution	60	10	5	75	0.9	67.5
15	Water flow disruption and erosion of river banks	60	10	5	75	0.7	52.5
16	Impact related to Road Safety and traffic during construction	60	10	5	75	0.8	60
17	Occupational Health and Safety of Labour and accidents	60	10	10	80	0.9	72
18	Labour camps	20	10	5	35	0.9	31.5
Operation Stage							
1	Landslide and slope stability	60	20	20	100	0.8	80
2	Air pollution	60	20	20	100	0.7	70
3	Noise	60	10	20	90	0.7	63
4	Cross drainage outfall and gullies	20	10	5	35	0.6	21
5	Traffic safety and accident	60	10	20	90	0.9	81
6	Waste Management	60	10	10	80	0.7	56
Biological Environment							
Preconstruction Stage							
1	Preparation for felling of trees	10	10	5	25	0.5	12.5
2	Disturbance to wildlife and habitat	60	10	20	90	0.5	45
Construction Stage							
1	Clearing of Forest and loss of vegetation and grazing area	60	10	20	90	0.9	81



Sn.	Impacts	Magnitude	Extent	Duration	Total	Probability	Total Score
2	Loss of biomass and carbon from the felled trees	60	10	20	90	0.9	81
3	Disturbance to natural habitats and critical natural habitats	60	10	20	90	0.9	81
4	Habitat fragmentation and barrier effect for wildlife movement	60	10	20	90	0.9	81
5	Disturbance to biodiversity and wildlife	60	10	20	90	0.9	81
6	Impacts on Herpeto-fauna and Fish species	60	20	10	90	0.7	63
7	Use of forest products and fuel wood by the construction workers during construction activities	60	20	10	90	0.7	63
8	Hunting and poaching of wild animals by labourers	20	10	5	35	0.7	24.5
9	Forest fire	20	10	5	35	0.8	28
10	Illegal felling of trees	10	10	5	25	0.8	20
Operation Stage							
1	Illegal felling of trees	10	10	5	25	0.7	17.5
2	Disturbance to biodiversity and wildlife	60	10	20	90	0.9	81
3	Habitat fragmentation and barrier effect for wildlife movement	60	10	20	90	0.9	81
4	Damage of aquatic habitats	20	20	5	45	0.6	27
5	Road safety concerns in wildlife crossing area	20	10	5	35	0.5	17.5
6	Spillage of oil, diesel in the river due to accident	20	20	5	45	0.7	31.5
Socio-economic and cultural environment							
Pre-construction Stage							
1	Loss of private property and assets	H60	SS10	LT20	90	0.9	81
2	Grievances raised by the locals and labours if any	H60	SS10	ST5	75	0.5	37.5
Construction Stage							
1	Loss of productive land	H60	L20	ST5	85	0.9	76.5
2	Land and property acquisition, compensation, resettlement and rehabilitation	H60	L20	LT20	100	0.9	90
3	Disruption of community structure	L10	SS10	ST5	25	0.1	2.5
4	Livelihood issues	L10	SS10	ST5	25	0.9	22.5
5	Conflict in or with nearby host community	M20	SS10	ST5	35	0.5	17.5

Sn.	Impacts	Magnitude	Extent	Duration	Total	Probability	Total Score
6	Issues related to vulnerable indigenous people	M20	SS10	LT5	35	0.5	17.5
7	Impact due to damages of community infrastructures	M20	SS10	ST5	35	0.1	3.5
8	Potential issues of conflicts associated with road construction work forces	M20	SS10	ST5	35	0.5	17.5
9	Road safety issues	H60	L20	ST5	85	0.9	76.5
10	Issues related to cultural assets	L10	SS10	ST5	25	0.1	2.5
11	Issues on landscape aesthetics	M20	SS10	LT20	50	0.9	45
12	HIV/AIDS and other diseases	H60	R60	LT20	140	0.9	126
Operation Stage							
1	Possible ribbon development along the road alignment	10	10	5	25	0.5	12.5
2	Increase in accidents	H60	R60	LT20	140	0.9	126
3	Development of settlements and market places along the Bishaltar-Phisling sections	M20	L20	LT20	60	0.9	54
		M20	L20	LT20	60	0.9	54
4	Increase in sell and use of alcoholic products along the new proposed sections	M20	R60	LT20	100	0.9	90
5	Girl trafficking	M20	R60	LT20	100	0.9	90
6	Migration and immigration	L10	SS10	LT20	40	0.9	36
7	Increasing in prostitution	M20	R60	LT20	100	0.5	50
8	HIV/AIDS and other diseases	M20	R60	LT20	100	0.9	90

Table 9-6: Adverse impact due to construction of Bridges along the KNM

Sn.	Impacts	Magnitude	Extent	Duration	Total	Probability	Total Score
Physical environment							
Construction Stage							
1.	Landscape disturbance and bank instability	20	20	5	45	0.8	36
2.	Quarry and excavation of river bed materials	60	20	5	85	0.8	68


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Sn.	Impacts	Magnitude	Extent	Duration	Total	Probability	Total Score
3.	Soil erosion due to construction and excavation of approach road	20	20	5	45	0.6	27
4.	Change in river regime	20	20	5	45	0.5	22.5
5.	Water pollution	20	20	5	45	0.7	31.5
6.	Noise pollution	10	10	5	25	0.5	12.5
7.	Dust and air pollution	20	10	5	35	0.8	28
8.	Disposal and construction waste management	10	20	5	35	0.5	17.5
9.	Transportation and stockpiling of construction materials	10	10	5	25	0.5	12.5
10.	Impacts associated with labour camp operation	10	10	5	25	0.7	17.5
11.	Spillage of chemical	20	10	5	35	0.7	24.5
Operation stage							
1.	Increase in Dust and smoke with vehicle movement	20	10	20	50	0.8	40
2.	Noise	5	20	20	45	0.8	36
Biological environment							
Impacts at the Construction stage							
1.	Construction serve as barrier to movement of migratory aquatic species	20	20	5	45	0.5	22.5
2.	Damage of aquatic habitats and impact on aquatic animals due to extraction of sand and gravel from river	20	20	5	45	0.7	31.5
3.	Degradation in fish population and loss of fish habitats due to construction workers involve in fishing	20	20	5	45	0.5	22.5
Impact at the Operation Stage							
1.	Impact on growth of the natural forest and vegetation	10	20	20	50	0.5	25
2.	Impact on aquatic life due to vehicle drop and spillage of oil and diesel in the river due to accident	60	20	5	85	0.7	59.5
3.	Disturbance of wildlife, habitat fragmentation	10	20	5	35	0.8	28

Sn.	Impacts	Magnitude	Extent	Duration	Total	Probability	Total Score
Socio-economic and Cultural environment							
Impacts at the Pre-construction Stage							
1.	Impact due to acquisition of land	10	20	5	35	0.7	24.5
2.	Impact due to acquisition of structures	10	20	5	35	0.7	24.5
Impacts at the Construction Stage							
1.	Health and sanitation chances of increase in transmission of disease form outside work force	10	20	5	35	0.8	28
2.	Conflict and disturbance due to non-local labour	10	20	5	35	0.8	28
3.	Traffic safety and traffic movement	10	20	5	35	0.9	31.5
4.	Disturbance in movement of local inhabitants	10	20	5	35	0.6	21
5.	Occupational health and safety for bridge construction workers	60	20	5	85	0.9	76.5
Impacts at the Operation Stage							
1.	Safety of pedestrians with the plying of vehicles	60	20	20	100	0.8	80
2.	Encroachment of land near the bridge area	60	20	20	100	0.8	80

The impacts in the aforementioned tables with high total score are considered as significant impacts due to implementation of the proposed project.



CHAPTER 10: Measures to Reduce or Control the Impacts

10.1 Human Resources Requirements and Capacity Assessment EMP Implementing Agency

10.1.1 Pre-construction stage environmental measures

Referencing to the potential negative impacts of the project as described in Section 7, the identified compensation, mitigation and enhancement measures during the pre-construction stage are explained in the following.

Land acquisition and compensation

Land will be required especially for the proposed new alignments Sisnekhola-Dharke and Bishaltar-Phisling along the right bank of Trishuli River. Adequate compensation for the acquisition of affected land and structures will be provided as per Land Acquisition Act 2034.

The executing agency for the project has determined the registered land ownership and value of the affected land as part of the pre-construction stage. Evaluation of values will be based on land capability for agriculture, location, recent land transactions, Land Acquisition Act, 2034 and other parameters, normally used for calculating land values. The executing agency will follow all legal procedures for acquisition of land and compensation amount will be finalized by the Compensation Determination Committee (CDC) of the district, chaired by Chief District Officer. There is a need in land acquisition for the implementation of Sisnekhola-Dharke and for the Bishaltar-Phisling alignment. Land also will be acquired in 4 locations, where new bridges proposed in order to straighten the existing alignments. Then, land will be acquired temporarily for the establishment of engineer camp and office along the KNM and new proposed area only during construction phase; 5 ha of land will be required temporarily for the camp establishment at government land area. Hence, no compensation will be required for the owner accommodation, offices, laboratories; the land will be leased for the construction period.

Replanting of trees

The seasonal filling and release of water will prevent any re-growth of trees in the reservoir areas. Provision for compensation in the form of planting 25 trees for each cleared during construction is provided as part of the Project. Besides provision for re-planting, the compensation includes provisions to the CUFGs authorities for overseeing and protecting the re-planted areas within the community forest area and provision to Department of Forest for any replanting outside the community forest along the alignment, where possible, and protection cost for a 5-year operation period has been proposed. The re-planting and protection of the trees planted are foreseen to be carried out by the CUFGs authorities as well as by Department of Forest outside the community forest area under the EMP, with payment for the compensation services by contractors.



10.1.2 Specific mitigations requirements during construction

Local employment

The contractor will employ local labor for the works to the maximum possible extent. No children under the age of 14 should be employed and children between 14 and 18 should not be engaged in hazardous works, in compliance with the labor rules of Nepal.

Construction stage environmental measures

The contractor's environmental responsibilities would be prescribed in the Tender Documents and later in documents on the award of the Contract. They would include the need to adhere the social and environmental clauses in the Contract and the measures outlined in the EMP. The contractor shall take due considerations to the requirements outlined in the following sub-sections.

General contractor requirements

The Contractor will take all reasonable steps to protect the environment and to prevent environmental damage and public nuisance, resulting from construction activities. Contractor will comply with all statutory requirements, environmental regulations and environmental quality standards, as stated in the Environmental Protection Act, 1997 of GoN; for any works in the CF adhere to the Forest Act, 1993 (amendment 2007) and rules prescribed by the CF authorities, GoN, and Nepal environmental guidelines relevant to the project and the updated EMP.

Permission for any pre-construction activities must be obtained in writing from MoFE or from Community forests.

Necessary permission for contractor personnel to enter community forest must be obtained either from MoFE or from Community Forest User Groups and Ilaka office. Contractor shall bear all costs associated with environmental pollution avoidance and environmental mitigation, including any clean-up operations, if necessary within the community forest area.

Pollution from wastes

All construction sites will be maintained in clean and safe conditions provide and maintain appropriate facilities for temporary storage of all wastes before transportation and disposal.

All wastes generated during construction will be disposed in an environmentally acceptable manner. This shall include consideration of the nature and location of disposal sites, so, as to cause least environmental impact. All precautionary measures shall be taken, when handling and storing fuels and lubricants, to avoid causing environmental pollution. This is will include establishment of contingency plans for clean up in the event of spillage.

Protection of human health

Adequate sanitation facilities shall be provided on all construction sites, contractor's office(s) etc., when established. Disposal from all sanitary systems shall be undertaken to avoid causing environmental pollution. Wastewater should be routed through suitable sanitary facilities and soak ways, without contaminating either ground or surface water or causing a health risk.



An adequate supply of water for drinking and washing purposes will be provided for all site personnel, including all workers, as appropriate. Drinking water quality should comply with GoN standards and WHO guideline values.

Noise

Any unnecessary noise for disturbance will be avoided during construction. All vehicles and mechanics will be maintained to a high standard, in accordance with manufacturer's maintenance procedures. Noise generating activities will be carefully sited to avoid unnecessary noise disturbance to local residents, in accordance with GoN noise guidelines.

Air quality and dust

Dust nuisance will be minimized by regular watering of material stockpiles, access roads, bare soil, sand and other areas, as appropriate and as determined by weather conditions.

Disruption to road traffic and other access routes

Disruption to road traffic and other access routes will be minimized in consultation with local authorities and representatives. Contractor will be responsible to prepare and update traffic management plans prior to the construction activities. Contractor will follow local laws and regulations as per DOR.

Operation of camps

Contractor will comply with IFC Accommodation Guideline 2009 (Workers' accommodation: processes and standards; A guidance note by IFC and the EBRD/IFC) for the establishment of constructed related camps for labour and engineers. The details are presented in 10.3.3.

10.1.3 Measures during operation

- Length man will be recruited in every kilometre along the new and existing alignment to maintain road clean and maintain roadside drainage in working condition.
- The proponent will carry out regular maintenance work of road and bridges when and where necessary. Periodic maintenance will also be carried out to maintain road clean and safe especially prior to and post monsoon period. Proponent to maintain road safety avoiding accident during operation will carry out addition and changing of traffic signs and road safety markings.
- The proponent together with other stakeholder such as community forest user groups, forest area office and Division Forest Office will carry out monitoring of plants planted as compensation.
- Proponent will maintain and renovate all roadside furniture regularly to provide roadside services and facilities.
- Proponent will carry out regular monitoring of traffic flow and regular maintenance of traffic signals as well as install CCTV for regular monitoring and will maintain safety along the road alignment.



10.1.4 Grievance redress mechanism

The process for resolving complaints that may arise in the project will be handled by a grievance redress mechanism (GRM). The Safeguard and Monitoring & Evaluation Unit under the Project Management and Supervision Consultant (PMSC) will establish the GRM within 1 month from start of the project and before construction work begin.

The types of grievances expected to be handle concerning either land acquisition or more generally, construction-related grievances, and any other social and environmental issues brought up during construction by households and affected people who lives relatively close to construction sites.

Any household/local stakeholder, feeling that adverse and material harm caused by the project may contact municipality leaders or local leaders of affected municipalities or rural municipalities that would then forward the complaint to the PMSC or the stakeholder may contact directly GESU-DOR or DCID-DOR. The Municipality and PMSC staffs will also be ready to receive a complaint and resolve and will take to the higher level of authority if necessary.

Local households and stakeholders will be informed about setting up of the Grievance mechanism by the PMSC before start of any construction as part of the community mobilization process. Besides, the information board will be in place at construction site with specific information related to the construction works and will provide in local language the description of project and grievance mechanism, where and to whom stakeholders can deliver their complaints, and in what form: verbal or written.

When obtaining the information from the complainant, in verbal or written form, either directly or from the Municipality/District Coordination Committee (DCC) and Community offices, PMSC office will complete a Grievance Action Form (GAF) to record all grievances and actions taken in a Grievance log. Minimal information recorded in this form will include (i) basic data about the affected person (name, address, contact number); (ii) category of grievance filed (legal, social, environmental, technical/ engineering, financial, etc.); (iii) detailed description of grievance; and (iv) type of action taken. The GAF will be filled out by the person receiving a grievance and signed by the affected party and the receiver of the complaint. The affected party will receive a copy signed by both.

The Safeguard and M&E Unit will handle received grievances related to works on the road construction in collaboration with the GESU-DOR and the construction contractor. In each case, the Safeguard and M&E Unit will be supported by the PMSC in cooperation with the proponent DCID, DOR. The construction contractor will clarify, if the construction works cause the complaint. The PMSC will inform and update the complainant about the progress of grievance mitigation within 24 hours for urgent issues and 7 days for non-urgent issues.

Once verified problem/complaint is well founded and due to the construction works, decision will be implemented together with the Safeguard Unit, PMSC and Contractor. Contractor will take the necessary corrective actions and try to resolve the grievance informally directly with the complainant. If any sort of filed level grievance is not possible to redress or at the choice

of the complainant, a formal redress can be forwarded to the Grievance Redress Committee (GRC).

The GRC will be formed to review complaints that cannot be resolved immediately. The committee will be formed by the Project Director of the proponent as chair, the Unit Leader from the Safeguard and M&E Unit (PMSC) and members of local stakeholders involved: Municipality representative, community members, NGOs, etc. A complainant has the right to appear in person, to be accompanied by a family member, and/or to request to be represented by senior community member. In the event that the contractor, proponent, PMSC; does not address a grievance the affected person can seek legal redress of the grievance in the appropriate courts under the formal legal court system.

In the case if established GRM is not in a position to resolve the issue, affected people can also use the World Bank Accountability Mechanism through direct contact (in writing) to the World Bank or Government of Nepal (GoN). The complaint can be submitted in any of the official languages of WB or in local Nepali language.

Depending on the complaints and the mitigation measures decided and implemented, if necessary, the EMP will be updated in order to avoid similar problems afterwards.

The PMSC Safeguard unit will provide monthly reports of any complaint registered, and how it has been dealt with to the local authorities. The PMSC Safeguard unit will regularly provide information to dissemination to the local stakeholders and communities of any grievances received and how they have been resolved, through the community mobilization process or through the Communication Strategy Plan implementation.

For this sub-project, a grievance redress mechanism will be established to allow project affected persons (PAPs) to appeal any disagreeable decisions, practices, and activities arising compensation for land and assets, and technical and general project-related disputes. As specified in ESMF the PAPs will be made fully aware of their rights and the procedures for doing so verbally and in writing during compensation, survey, and time of compensation. There is potentiality of several types of grievances: grievances related to land acquisition and resettlement requirements, grievances related to compensation or entitlement and any other social and environmental issues. The PAPs will have access to both locally established grievances redress committee (GRC) as Local Consultative Forum (LCF) and formal courts of appeal system. The Local Consultative Forum will be formed prior to the project implementation consisting of the representative of PMSC, representative from proponent site office, representative from project affected municipalities and wards, representative from construction contractor, local NGO, Community Based Organizations and local political representatives. The LCF will be responsible to assist the project during compensation determination, distribution of compensation and compliance monitoring. However, LCF will act as GRC in order to settle all the social and environmental complains and grievances registered during the time of project construction. Every PAP can appeal to the court if they feel that they were not compensated appropriately. They may appeal to appellate court within 35 days of the public notice given to them.



Grievance recording register will be established at Proponent office, Contractor's Office and Consultant's RE office as well. Project affected people as well as local people can lodge their complaints at these Offices related to assets acquisition and other social and environmental concerns due to construction related activities.

Special project grievance mechanisms such as on site provision of complain hearings allows project affected persons to get fair treatment on time. The GRC will be established in each road sections covering affected Rural Municipality/Municipality to handle initial grievances of the project-affected people. The PAPs will have unhindered access to the grievance redress office to forward and file their complains. The provision of Social Mobilizer in the project implementation is good practices in this regard. Social Mobilizer can be mobilized in order to help PAPs to file the complaints to the concerned agency. PAPs will be exempted from all administrative fees incurred, pursuant to the grievance redressal procedures except for cases filed in court Proposed mechanism for grievance resolution is given below:

Stage 1: Complaints of PAPs on any aspect of compensation, relocation, or unaddressed losses will be settled in first instance verbally or in written form in field based project office. The concerned personnel to settle the issues at local level can discuss the complaint in an informal meeting with the PAP. The community consultation, involvement of social and resettlement specialist and environmental specialist will be helpful in this regard. It will be the responsibility of the GRC and Project In-charge to resolve the issue within 15 days from the date of the complaint received.

Stage 2: If no understanding or amicable solution reaches or no response from the project office, the PAP can appeal to the CDC and project proponent/DOR. While lodging the complaint, the PAP must produce documents to support his/her claim. The CDC will provide the decision within 15 days of registering the appeal. In the case if established GRM is not in a position to resolve the issue, affected people can also use the World Bank Accountability Mechanism through direct contact (in writing) to the World Bank or Government of Nepal (GoN).

Stage 3: If the PAP is not satisfied with the decision of CDC and project proponent or in absence of any response of its representatives, within 35 days of the complaint, the PAP, in his/her last resort, may submit its case to the court.



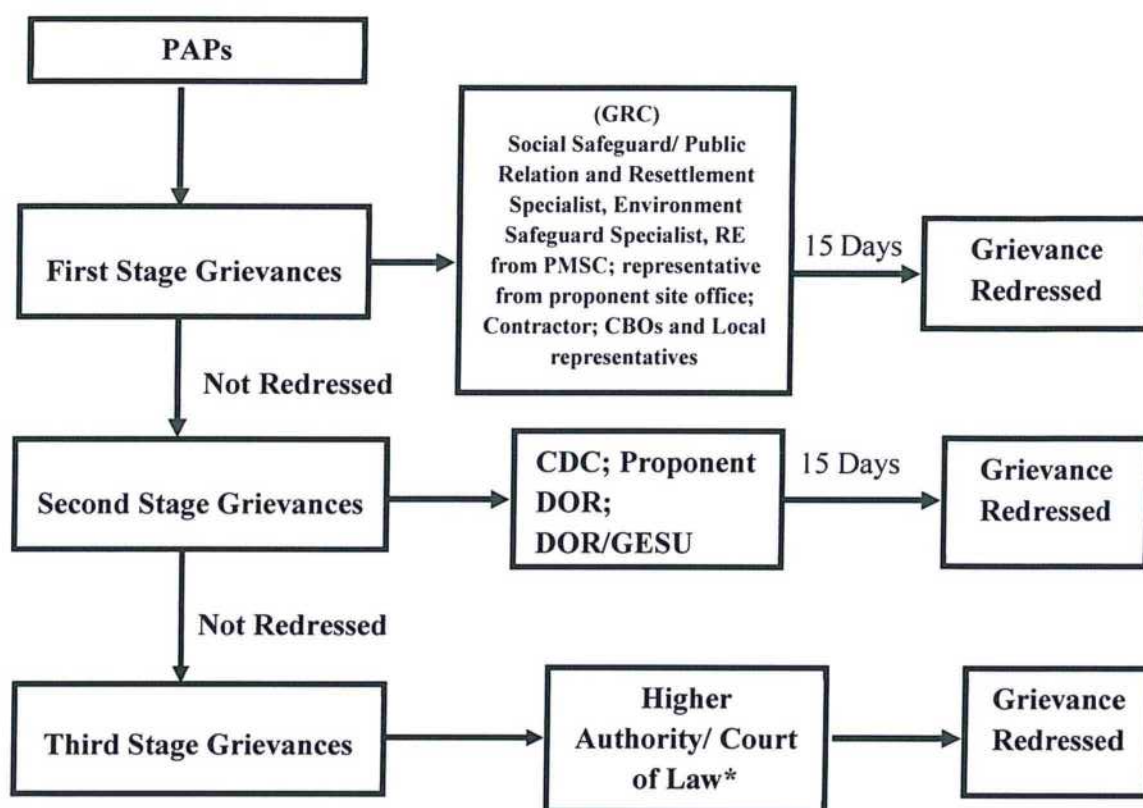


Figure 10-1: Grievance Redress Mechanism (GRM)

CDC= Compensation Determination Committee, PAPs= Project Affected Persons, GRC= Grievance Redress Committee, PMSC= Project Management and Supervision Consultant, DOR= Department of Roads, GESU= Geo-Environment and Social Unit. *Aggrieved person may also access the country's legal system at any stage (of the three stages) of the grievance redress mechanism.

10.2 Implementation plan of the environmental protection measures

10.2.1 Plan for Beneficial Impact Augmentation Measures

The proposed KNM road project is designed to provide tangible benefits not only to the Kathmandu, but also to enhance the overall economic growth of the region providing long term development of freight transportation and connection between adjoining project affected RMs for economic and social benefits. Livelihood generation will be the major beneficial impact during construction as well as operation phases of the project through its implementation. Similarly, safe, easy, and timesaving transportation are the major beneficial impacts of the project.

Hence, enhancement measures have been proposed to augment beneficial impacts of the project that will be undertaken in appropriate time at appropriate location with appropriate cost. The following matrix presents Environmental Management Plan for augmentation measures for the beneficial impacts (Table 10-1).

10.2.2 Plan for Adverse Impact Mitigation Measures

Proposed mitigation measures for identified adverse impacts are presented in this Chapter of the EIA report. Most of the proposed mitigation measures were considered to be the civil Engineering, presented in the Project costs and also have been briefly underlined in the

following Matrix (Table 10-2). All mitigation measures were considered in accordance with mitigation hierarchy. They highlight activities to avoid negative impacts, when possible, provide recommendations to reduce and minimize impacts during pre-construction, construction and operation stages, underline opportunities for compensation, remediation and offset the adverse impacts of project implementation.

Table 10-1: Benefits augmentation and enhancement measures

Activities/Impact / Issue	Location/s	Augmentation and enhancement measures	Responsible agency	Verification Methods
Construction Phase				
Physical Environment				
Improved Road Infrastructure	Along the KNM and proposed new alignments	Construction of roadside services and facilities	Construction Contractor and Proponent-DCID, DOR	Site visit, Observation and interaction with locals
Biological Environment				
Establishment of animal crossing and compensatory replantation of affected trees	Along the KNM and proposed new alignments	Construction of animal passing along the road and plantation of trees, greenery development	Construction Contractor and Proponent-DCID, DOR	
Socio-economic and Cultural Environment				
Generation of Employment	Along the KNM and proposed new alignments	Employment of locals and women.	Construction Contractor and Proponent-DCID, DOR	Site visit, Observation and interaction with locals
Opportunities of New Income Generating Activities	Along the KNM and proposed new alignments	Employment of locals and women.	Construction Contractor and Proponent-DCID, DOR	Site visit, Observation and interaction with locals
Enhancement of Technical Skill and Know-How	Population along the KNM and proposed new alignments	Awareness and on job trainings to employees, construction labours, locals etc.	Construction Contractor and Proponent-DCID, DOR	Site visit, Observation and interaction with locals
Operation and maintenance Phase				
Physical Environment				
Development of new local infrastructure and easement of former environment problems	Along the KNM and proposed new alignments	Stabilization of unstable slopes and application of bioengineering.	Construction Contractor and Proponent-DCID, DOR	Site visit, Observation and interaction with locals
Improved Access to Services and Transportation and establishment of road side service centers	Along the KNM and proposed new alignments	Smooth operation of vehicles, avoiding accidents etc. Establishment and operation of public toilets along the highway at every 5 km interval along the highway.	Construction Contractor and Proponent-DCID, DOR	Site visit, Observation and interaction with locals

Activities/Impact / Issue	Location/s	Augmentation and enhancement measures	Responsible agency	Verification Methods
Biological Environment				
Establishment of nurseries and green zone	Along the KNM and proposed new alignments	Improve habitat of birds, and improve spawning area of fish along the river.	Construction Contractor and Proponent-DCID, DOR	Site visit, Observation and interaction with locals
Socio-economic and Cultural Environment				
Opportunities for tourism development and enhancement of local economy	Along the KNM and proposed new alignments	Roadside services for tourist and road users.	Construction Contractor and Proponent-DCID, DOR	Site visit, Observation and interaction with locals
Enhance in living standard and lifestyle of local communities alleviating poverty	Along the KNM and proposed new alignments	Self-employment opportunity to locals	Construction Contractor and Proponent-DCID, DOR	Site visit, Observation and interaction with locals
Facilitated Industrial Development along the proposed alignment.	Along the KNM and proposed new alignments	Self-employment opportunity to locals	Construction Contractor and Proponent-DCID, DOR	Site visit, Observation and interaction with locals
Increase in Land Value	Along the KNM and proposed new alignments	Change in land use pattern at the vicinity of the project and urbanization along the link roads	Construction Contractor and Proponent-DCID, DOR	Site visit, Observation and interaction with locals
Opportunities for women and gender specific benefits	Along the KNM and proposed new alignments	Self-employment opportunity to locals	Construction Contractor and Proponent-DCID, DOR	Site visit, Observation and interaction with locals
Access to social services for local people	Along the KNM and proposed new alignments	Operation of the project	Construction Contractor and Proponent-DCID, DOR	Site visit, Observation and interaction with locals
Opportunities for diversification of local economy and Exploitation of Untapped Potentials	Along the KNM and proposed new alignments	Self-employment opportunity to locals	Construction Contractor and Proponent-DCID, DOR	Site visit, Observation and interaction with locals
Improved linkage to other districts and enhanced market cooperation opportunities	Along the KNM and proposed new alignments	Construction of bridges and other link roads.	Construction Contractor and Proponent-DCID, DOR	Site visit, Observation and interaction with locals

Table 10-2: Matrix of site-specific impacts and mitigation measures along KNM road

SN	Activities/ Issue	Location/s	Impact	Mitigation Measures
10.1.1 Preconstruction Phase (Physical Environment)				
(i)	Land clearance	Along the ROW	Loss of vegetation and physical structures	-Compensation -Offset: Plant of nurseries
(ii)	Review of EMAP	-	-	- Contractor will prepare site specific environmental management action plan for each construction package and will seek approval from supervision consultant prior to construction.
(iii)	Review of access roads	Along the proposed alignments	Likely affected during construction	Plan for providing access to locals and immediate impact receptors.
(iv)	Planning for Erosion control	Identified vulnerable areas and new landslide areas during excavation of new roads	Direct disposal, loss of life and property, land slide during construction.	- Erosion control measures - Establishment of erosion control plan should be in place prior to construction. Contractor will seek approval for the plan from supervision consultant for each likely land slide area.
(v)	Establishment of camps	Proposed sites	- generation of waste; establishment of camp at unspecified locations etc.	- Contractor will seek approval from supervision consultant for the establishment of camp at any location .
(vi)	Traffic Management	Along the existing roads and highway	- Traffic jam during construction - Road side accident - Unaccessible to ply along the under construction highway stretch who require emergency to reach hospital and health institution in Kathmandu and other emergency people during construction such as Ambulance.	- Contractor will establish Traffic Management Plan for each construction stretch and will seek approval from supervision consultant prior to construction.
(vii)	Waste Management	ROW along the highway; camp sites	-Health issue -Pollution -Aesthetics Blockage of natural drainages	- Selection of sites for proper disposal of waste -Instruction to labours - Orientation and trainings to labourers for safe disposal of waste

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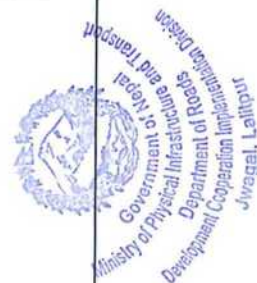
SN	Activities/ Issue	Location/s	Impact	Mitigation Measures
(viii)	Preparing construction contractor to address mitigation measures	- Camps, stock piling area, along the construction site, quarry and borrow site etc.	- Lack of preparation of contractor avoiding air/dust, noise, accident, safety issue during construction.	- Aware contractor about safeguarding environment and society prior to the construction by supervision consultant. - Meetings prior to construction with contractor for all safeguards issues. - Ensure contractor will take every action correctly safeguarding environment and social prior to construction.
10.1.2 Construction Phase (Physical Environment)				
(i)	Relocation of utilities	Along the alignment	Disruption in existing services at local level.	Proper relocation and restoration of all affected utilities by the contractor.
(ii)	Excavation and widening of existing KNM	Within the 50-meter ROW along the existing KNM	Minor change in landuse along the existing KNM	Land only within the ROW will be acquired for improvement and upgrading; land acquired temporary will be rehabilitated after completion of construction
(iii)	Excavation of hill slopes	Krishabhir, Jogimara, Simle, Belkhu, Adamghat, Phurke khola-Dhading bridge junction, Huilingtar, Phisling, Chumlingtar, Chumkhola, Kurintar to Mugling.	Landslides, Slope Destabilization and Soil Erosion	Avoided haphazard excavation of slopes. Benching of slopes and excavation in piece-meal applied along the steep slope area. Management of existing natural drainage. Bioengineering and slope protection work, established engineering structures.
(iv)	Disposal of spoil	Valley side of the road all along the alignment.	During site clearance, excavation in slopes estimated in 215,887cu. m. of spoil materials for disposal.	Excavated spoil and other construction materials disposed at identified spoil disposal site. Haphazard disposal of spoil will be avoided
(v)	Construction and excavation; disposal of spoil	Natural drainages along the existing KNM	Obstruction to natural drainage pattern	Avoided haphazard disposal of spoil. Labour camps will not be established close to natural drainage and avoided direct disposal of any wastes.
(vi)	Construction activities, likely disposal of soil, chemical wastes, etc. into water bodies.	Along the existing Trishuli and Mahesh khola and other water supply pipelines along the KNM.	Pollution of water resources	Use water only if ample source of water supply exists within construction area; or buying water required for the construction. Existing water sources and supply system will not be affected. Acquired consent with the locals in order to use available water sources.


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SN	Activities/ Issue	Location/s	Impact	Mitigation Measures
(vii)	Operation of borrow pits and quarries	River banks of Trishuli and Mahesh khola; hill side quarry	Disturbance to landscape, air and noise, accidents, ponding, increase of sedimentation level etc. with the operation.	Avoided haphazard quarry along the riverbank and hills. Permanent barricade at quarry location for safety, established safety signage boards, and installed noise barrier. Prepared borrow pit operation plan and obtained approval from supervision engineers prior to operation of quarry.
(viii)	Operation of stone crushing	Along the existing KNM.	Dust, air and noise. Likely accident.	Avoided establishment of operation near schools and settlements.
(ix)	Stockpiling and transportation of construction materials	Along the existing alignment; proposed stock piling area.	Dust emission, washout affect to downhill to the Trishuli, cultivated, and discomfort to locals.	Stockpile materials covered with tarpaulin, sprinkling of water carried out near and around the stockpile to avoid erosion; proper barricade and security guard for the area.
(x)	Road excavation, construction activities, operation of dump trucks, etc.	Along the existing alignment, especially at existing urban areas. Crusher plant, batching plant sites, School, urban and settlement areas	Air pollution	Avoiding operation of drill machines, excavators, loading and unloading of waste materials during wind. Dust masks available to labour workers, sprinkling of water along the dusty road during road excavation twice a day. Avoided direct disposal of effluent from batching plant.
(xi)	Use of chemicals	Campsite, workshops, natural drainage along the alignment.	Land and water pollution. Chemical hazards	Handling chemicals properly. Storage of chemicals 100 meters away from any water sources. Spillage kit in place at the construction site.
(xii)	Excavation with the widening of existing highway, operation of camps and other activities	Hotels, shops, resorts situated all along the highway, settlements, school, health posts	Noise pollution	Barricade of construction area, provided operational schedule to local inhabitants. Monitoring noise level maintained at national standard.
(xiii)	Operation of construction vehicles, excavation etc.	Naubise, Baireni, Pida, Gajuri, Malekhu, Benighat, Jogimara and Darechowk, etc.	Road safety	Installed safety signage boards, barricades, provide PPEs to all labour workers, managed local traffic avoiding disturbances, informed and aware locals, provided on job trainings to labours.
(xiv)	Construction safety of labourer	Along the KNM alignment	Occupational health and safety of labourer and accident	Installed safety signage boards, barricades along the construction sites, provided PPEs to all labour workers,

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SN	Activities/ Issue	Location/s	Impact	Mitigation Measures
				managed local traffic, aware and informed locals, provided on job trainings
(xv)	Physical cultural structures	Along the KNM	Loss of physical cultural structures	Relocation of physical cultural structures
(xvi)	Establishment of camps	Along the identified location or along the KNM	Waste and health hazards, degradation of land, streams and rivers	Prepared camp management plan prior to start of work, provided all required facilities at camp sites which will maintain health and hygiene of labour, installed temporary toilets, supply potable water, etc.
(xvii)	Change in land-use, loss of productive topsoil	Along the ROW and in DIA	-Impact on agro-production, loss of vegetation and forest, aesthetic, pollution	Preservation of topsoil and rehabilitation after construction; re-plantation, selected construction time to avoid severe impact on agriculture
Operation and maintenance Phase (KNM Physical Environment)				
(i)	Instability of the hill slopes	Krishabhair, Jogimara, Simle, Belkhu khola, Adamghat, Phurke khola-Dhading bridge junction, Huilingtar, Phisling, Chumlingtar, Chumkhola, Kurintar to Mugling.	Destabilization of slopes	Bio-engineering and slope protection works
(ii)	Encroachment of Right of Way	Along the highway.	Obstruction in traffic movement, local discomfort	Planning of service stations, coordinated development along existing road. Special cross-road structures and infrastructure
(iii)	Impacts due to Poor Drainage	Natural drainages	Flooding Soil erosion Change in hydrology sedimentation	Proper drainage structures, management of flow, management of garbage and debris
(iv)	Air and Noise Pollution	Along the alignment	Health problem of locals and road users	Installation of traffic signals with no horn, speed control and monitoring, establishment of vehicle emission test facility at Nagdhunga and Mugling. On-time repair and maintenance of damaged road, potholes.



SN	Activities/ Issue	Location/s	Impact	Mitigation Measures
(v)	Traffic safety and accident	Along the highway, especially at urban areas.	Accident frequency, human health, loss of property and assets	Establishment of traffic signals, GPS tracking for speed control for public buses playing the highway.
(vi)	Waste Management	Along the highway drain, in urban areas	Waste, health and hygiene to locals and road users.	Establishment of litter bins, Waste management, daily collection, and disposal in designated location will be carried out coordination with local municipality.
Preconstruction Phase (KNM Biological Environment)				
(i)	Tree felling	In Community Forests	Loss of different species of trees, vegetation, wildlife disturbance, habitat loss and change	Compensatory plantation of 25 saplings for each felled tree; selection of native trees, establishment of nurseries
(ii)	Disturbed wildlife and destroyed habitat	Along the ROW and in DIA	Loss of habitats; barrier effect; loss of biodiversity	Avoid cutting of trees during rainy season and construction work in the breeding season, instructed construction workers minimized adverse effects.
Construction Phase (KNM Biological Environment)				
(i)	Clearing of forest, loss of vegetation and grazing area	Along RoW area	Loss of trees and vegetation, disturbance	Replantation, compensation to the CFUG; providing incentives to use biogas and other alternative sources of energy
(ii)	Disturbance, hunting and poaching by workers	Around labour camps	Lost biodiversity, loss of forest resources	Instructions for workers, control by managers, awareness and distributed printed materials about rules and regulations
(iii)	Use of forest products by construction workers	In proximity of labour camps	Loss of forest products and NTFP	Instruction of workers before construction Control from management team Alternative energy sources and food
(iv)	Impacts on herptiles and fish species	Near new bridges and in proximity of natural habitats	Loss of species; impoverishment of aquatic habitats	Culverts; avoiding of construction in the fish breeding season; Avoiding pollution of water-courses
(v)	Habitat fragmentation, barriers for wildlife movement	Chainages: 21+400 – 21+500; 33+340- 33-600; 35+000 – 35+ 400.	Roadkill wildlife, fragmented populations, loss of species richness and abundances	Wildlife/livestock cross-road structures in appropriate locations; design culverts as reptile& amphibian tunnels; awareness to the drivers; signs; speed limits
Operation Phase (KNM Biological Environment)				

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SN	Activities/ Issue	Location/s	Impact	Mitigation Measures
(i)	Possible extraction of fire-wood and timber	Around settlements due to improved accessibility	Loss of community assets and profit, biodiversity loss	Engagement of CFUGs in forest management; awareness materials; regular control of the area; alternative sources of energy
(ii)	Increased wildlife disturbance, hunting and poaching, impact on forest resources	In the forest areas along the road	Loss of forest products and NTFP	Enforcement and control; Anti-poaching regulations; Awareness campaigns; Planning of rural development
(iii)	Habitat fragmentation, barriers for wildlife movement	In forest areas, adjacent to KNM section	Roadkill wildlife, fragmented populations, loss of species richness and abundances	Established monitoring of crossroad structures in the designated above chainages. Adaptive management.
Preconstruction Phase (KNM Socio-economic and Cultural Environment)				
(i)	Loss of private property and assets	Nagdhunga, Baadbiagyang, Chisapani, Piplmod, Khatripauwa, Kanakot, Khanikhola, Naubise etc.	Loss of assets, loss of income, businesses, effect of livelihood	Compensation Resettlements Alternative livelihood sources
(ii)	Grievance raised by locals and workers	Along the road	Delay of construction or hampering of work	Grievance redress mechanism; community consultation;
Construction Phase (KNM Socio-economic and Cultural Environment)				
(i)	Loss of productive land	Dharke, Juge-Khola, Belku, Benighat, Charodi	Loss of agricultural production, 0.32 ha of fertile land loss	Accurate delineation of land needed for construction, preservation of land and soil outside of ROW
(ii)	Land and property acquisition	4 new bridge location area	0.21 ha will be affected	Compensation, resettlement and rehabilitation
(iii)	Destruction and damage of community structures	Along the road	About 9 public structures, bus stations, temples, toilets, and others will be affected.	Replacement and restore of structures. Contractor will be responsible for the damage and restoration of any religious trees (Chautaro) along the alignment. Contractor will coordinate with local stakeholders and supervision consultant for the restoration and relocation of such structures and will carry out from lumpsum amount after seeking approval from supervision consultant and safeguards consultant. Cost presented in Table 10-31

SN	Activities/ Issue	Location/s	Impact	Mitigation Measures
(iv)	Livelihood issues	Along the road	Loss of business and livelihood activities	Replacement and providing specific area for businesses
(v)	Conflict with nearby host community	Along the road and along the camp locations	Disputes in community, social disorder	Security, instruction of construction workers, supervising and control by management team
(vi)	Vulnerable indigenous people, cultural assets, gender	Along the road	Chepang, Dalits, Women headed households, senior citizens	Awareness about the situation to contractor workers, special instructions
(vii)	Road safety	Along the road, mostly in urban areas	Accidents	Signage, bus stops, overbridge, footpaths, instruction boards, zebra and lights, etc.
(viii)	Landscape aesthetics	Along the road and camp locations	Human health and well-being	Planning of rehabilitation and offsets, control stockpiling & construction excavation materials, camp sites etc.
(ix)	AIDS and other diseases	Along the road	Human health, safety and community	A awareness program, instructions relevant to water and waste management, frequent health check of camp
Operation Phase (KNM Socioeconomic and Cultural Environment)				
(i)	Ribbon development, settlement and market places	Along the road	Pressure in community infrastructure, safety	Planning of new economic initiatives for local communities (service centres, etc.). Prohibit open urination practices by road users/passengers along the highway. Establishment of notice boards directing public using public toilets.
(ii)	Increase in accidents	Along the road	Safety and health, loss of assets	Regulations, awareness and road infrastructure (lights, signs, zebra, etc.) and adaptive management
(iii)	Increase in sell and use of alcohol products	Along the road	Human health and well-being, accidents, violence	Stricter regulations, control of alcohol sale, prohibition of alcohol advertisement on roads
(iv)	Trafficking and increase in prostitution	Along the road especially at urban areas along the road	Human health, well-being, violence, accidents	A awareness campaigns, creation of jobs for girls and women, vocational training for women, etc.
(v)	Migration and immigration	Along the road	Pressure in urban and market area, well-being	Integrated planning of development
(vi)	HIV/AIDS and other diseases	Along the road	Health, well-being, community life	A awareness campaigns, regular health camp operations


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Table 10-3: Adverse Impact Mitigation measures for the construction of Sisnekhola-Dharke Alignment

SN	Activities/ Issue	Location/s	Impact	Mitigation Measures
Preconstruction Phase (Sisnekhola-Dharke-Physical Environment)				
(i)	Review of impact assessment, mitigation and EMP	Proponent office /Monitoring and supervision consultant	N/A	Review of anticipated impacts and mitigation measures and incorporate all mitigation cost in BOQ
(ii)	Review of alignment to improve project acceptability	Review from chainage 8+500 to 9+400 where alignment is super-imposing with existing earthen track of Sitapaila-Dharke alignment.	Likely duplication during construction	Coordination with Sitapaila-Dharke project office and confirmation for the common alignment along the Sitapaila-Dharke and Sisnekhola-Dharke.
(iii)	Access Road	Waglethok, Rupakot settlement, local schools and access to Gajurelgaun and Purano Dharke settlements	Alternative diversions to local roads that access Waglethok, Rupakot, local schools and access to Gajurelgaun and Purano Dharke settlements has not been designed.	Contractor will plan the access to site during work; also provided access to local people without affecting the existing mobility and seek approval from engineers prior to the construction. Sign-posted and other necessary information will be disseminated before construction.
(iv)	Planning for erosion control	Nisakot community forest and tunnel portal including tunnel outlet area	Erosion likely during construction.	Engineering controls for erosion protection measures need to be planned. Preparation of Erosion Control and Temporary Drainage Plan in advance by C.
(v)	Planning for construction of camps	Proposed campsite location.	Health hazard and pollution due to operation of camps.	Sites selected for worker camps and back-up areas for stockpiling materials and equipment planned in advance in consultation with local community and located to avoid the most productive agriculture; use of waste/barren land and non-agricultural plots as far as possible.
(vi)	Plan for Traffic management	Along the new planned alignment	Likely disturbance to local transportation during construction	A provisional temporary pedestrian and traffic management plan prepared by the construction contractor; updated by CSC and agreed with the proponent one month prior to start of works. Alternative roads, footpaths and access discussed in advance with local authorities in the ward and municipality office and sign-posted
Construction Phase (Sisne khola-Dharke Physical Environment)				

SN	Activities/ Issue	Location/s	Impact	Mitigation Measures
(i)	Relocation of utilities	Along the alignment as presented in chapter above.	Disruption in existing services at local level.	Proper relocation and operation of all affected utilities by the contractor.
(ii)	Excavation for Sisnekhola-Dharke	Within the 50-meter ROW along the alignment.	Change in land use and loss of productive topsoil along the proposed new alignment	Land only within the ROW will be acquired for the improvement and upgrading; land acquired temporary will be rehabilitated after the completion of construction.
(iii)	Excavation of hill slopes	Nisakot Community forest area, Waglethok, Rupakot Settlement	Landslides, Slope Destabilization and Soil Erosion	Avoided haphazard excavation of slopes. Benching of slopes and excavation in piece-meal applied along the steep slope area. Management of existing natural drainage. Bioengineering & slope protection works, establishment of engineering structures.
(iv)	Disposal of spoil	Valley side of the road all along the alignment.	During site clearance & excavation estimated 302,949.00 cu. m. of spoil generated materials	Excavated spoil and other construction materials will be disposed at identified spoil disposal sites. Haphazard disposal of spoil will be avoided.
(v)	Disposal of spoil generated from 180m tunnel	Waglethok	During site clearance & excavation estimated 17,741.00 cu. m. of spoil from tunnel. Haphazard disposal, soil erosion, and land slide likely	Disposal of spoil at identified site at chainage 2+400 and 7+100-300 for tunnel spoil as presented in Annex 8. Contractor will develop tunnel excavation plan and will get approval from the client prior to the construction and excavation. Controlled blasting and excavation using machines and excavator will be required especially for the excavation of tunnel proposed near Waglethok settlement along the Sisnekhola-Dharke alignment, where hard rock will be difficult for human labour to excavate. Local community will be informed before blasting the tunnel portals. 100 m periphery from the tunnel portals will be sealed completely during the time of opening of tunnel portal and blasting avoiding people entering into the area. Siren will be blown prior to every blasting at the tunnel face in order to inform and maintain safety within the work place and construction area. Each blasting will be carried only by and in presence of assigned blaster.



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SN	Activities/ Issue	Location/s	Impact	Mitigation Measures
(vi)	Construction and excavation; disposal of spoil	Natural drainages along the proposed Sisnekhola-Dharke	Obstruction to natural drainage pattern along the Nisakot community forest alignment crosses 37 big and small natural drainages	Avoided haphazard disposal of spoil. Labour camps will not be established close to the natural drainage; avoided direct disposal of any kind of wastes. Channelize natural gullies within the Nisakot CF with cascade and other protection structures.
(vii)	Construction activities, likely disposal of soil, chemical wastes, Operation of crusher plants etc.	Sisne khola, Sikre khola, Dhuni khola, Mahesh khola, and Naubise khola River	Pollution of water resources	Use water only if ample source of supply exists within the construction area; otherwise contractor will buy water required for the construction activity. Preventing any affect to existing water sources and water supply system from construction activity. Consent with locals in order to use available water sources.
(viii)	Soil contamination	Cultivated land along Dhunibeshi RM-9, cultivated land along Gajurelgau and Purano Dharke settlement	32.07 ha of top soil of cultivated land and agricultural products within the proposed road carriage width will be lost permanently	Consent from locals for temporary acquisition of private and cultivated land. Maintained designated storage area for chemicals and other construction materials, camp sites and workshops etc. Regular monitoring of storage areas.
(ix)	Haphazard disposal of spoil, disturbance to natural drainage.	Nisakot community forest; cultivated land near Dillishabitri Secondary School; at Purano Dharke near school playground	Water logging	Disposal of spoil only at designated and identified sites. Avoid haphazard disposal at the valley side, along the natural drainage along the cultivated land and private lands.
(x)	Operation of borrow pits and quarries	River banks of Trishuli and Mahesh khola; hill side quarry	Disturbance to landscape, air and noise, accidents, ponding, increase of sedimentation level etc. with the operation.	Avoidance haphazard quarry along river banks and hills or providing permanent barricade at quarry location for safety with safety signage boards, noise barrier. Borrow pit operation plan with approval from supervision engineers prior to the operation of any quarry.
(xi)	Operation of stone crushing	Along the proposed Sisnekhola-Dharke alignment	Dust, air and noise pollution. Likely accident.	Contractor will avoid establishment near school and settlement.
(xii)	Stockpiling and transportation of	Along the existing alignment; in proposed stock piling area.	Dust emission, washout effect to downhill to Dhuni-khola; Mahesh	Stockpile materials will be covered with tarpaulin, sprinkling of water will be carried out near and around the stockpile to

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SN	Activities/ Issue	Location/s	Impact	Mitigation Measures
	construction materials		khola; cultivated land; discomfort to locals.	avoid erosion; proper barricade and security guard will also be provided. Pillings will not be carried out near the water bodies.
(xiii)	Road excavation, construction activities, operation of dump trucks, etc.	Along new alignment, especially at Nisakot Community forest, Waglehok and Rupakot Crusher plant, batching plant sites, school, urban and rural settlements	Air pollution	Avoidance of drill machines, excavators' operations, loading and unloading of waste materials during wind. Masks will be available to workers, sprinkling of water along the dusty road during excavation twice a day. Contractor will avoid direct disposal of effluent from batching plant.
(xiv)	Use of chemicals	Campsite, workshops, natural drainage along the alignment.	Land and water pollution. Chemical hazards	Worker will handle chemicals properly. Storage of chemicals 100 meters away from any water sources. Spillage kit will be in place during the construction site.
(xv)	Excavation activities with widening of highway; operation of camps and other works	Hotels, shops and resorts situated along highway, settlements, school, health posts	Noise pollution	Minimizing effect through barricade of construction area, providing operational schedule to local inhabitants. Monitoring noise level, maintained at national standard.
(xvi)	Operation of construction vehicles, excavation etc.	Khatripauwa, Waglehok, Rupakot, Gajurelgaun, Dillisabitri School area, Purako Dharke.	Road safety, community wellbeing	Installation safety signage boards and traffic signals, barricades, providing PPEs to all labour workers, management local traffic and avoiding disturbances, inform and aware locals, provide on job trainings to labours.
(xvii)	Construction safety of labourer	Along the Sisnekhola-Dharke alignment	Occupational health and safety of labourer and accident	Safety signage boards, barricades along the construction sites, provided PPEs to all labour workers, provided on job trainings to labours
(xviii)	Physical cultural structures	Along the Sisnekhola-Dharke alignment	Loss of physical cultural structures	Relocation of physical cultural structures
(xix)	Establishment of camps	Along the identified location or along the Sisne khola-Dharke	Waste and health hazards, degradation of land, streams and rivers,	Prepared camp management plan prior to work, placed at camp sites. It will maintain health and hygiene instructions.
	Operation and maintenance Phase (Sisne khola-Dharke Physical Environment)			
	Temporary toilets, supply potable water			

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SN	Activities/ Issue	Location/s	Impact	Mitigation Measures
(i)	Instability of the hill slopes	Nishikot Community forest, tunnel portal area.	Destabilization of slopes	Bioengineering and slope protection works
(ii)	Encroachment of Right of Way	Along the proposed Sisnekhola-Dharke.	Obstruction in traffic movement, local discomfort	Awareness to locals; road marking, traffic signals in place and barricading along the road where necessary during operation.
(iii)	Impacts due to Poor Drainage	Natural drainages in Nisakot Community forest area.	Degradation of existing gullies, increase in soil erosion	Maintenance of drainage along the new road during DLP by contractor.
(iv)	Air and Noise Pollution	Along the alignment, especially at Khatripauwa, Waglethok, Rupakot, Dillisabitri schools, Buddha vision HS, Gajurelgau, Purano, Dharke	Health problems for locals and road users	Installation of traffic signals with no horn, speed control, installation of speed monitoring, monitoring of noise and air quality
(v)	Traffic safety and accident	Along the highway near Schools and settlements such as Khatripauwa, Waglethok, Rupakot, Gajurelgau, Purano Dharke and junction.	Road safety and community wellbeing	Establishment of traffic signals, GPS tracking for speed control for public buses plying the highway.
(vi)	Waste Management	Along the highway, settlement areas such as Khatripauwa, Waglethok, Rupakot, Gajurelgau, Purano Dharke, etc.	Waste, health and hygiene to locals and road users.	Waste management, coordination with local municipality.
Preconstruction Phase (Sisne khola-Dharke, Biological Environment)				
(i)	Preparation for felling of affected trees	Nisakot CF	Felled 274 trees and 2367 poles, wildlife disturbance, habitat loss and change	Plan for compensatory plantation of 25 saplings for each felled tree in advance; selection of native trees, establishment of nurseries.


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SN	Activities/ Issue	Location/s	Impact	Mitigation Measures
(ii)	Disturbed wildlife and habitat	Along the ROW and in DIA	Loss of habitats; barrier effect; loss of biodiversity	Avoid cutting of trees and construction work during rainy season
Construction Phase (Sisne khola-Dharke, Biological Environment)				
(i)	Clearing of forest, loss of vegetation and grazing area	Nisakot CF – 3.43 ha, Government F – 0.18 ha, Sisne-Khola Dharke – 11.52 km	There will be loss of 3.43 ha in CF and 0.18 ha in GF and 2726 trees and poles	Replantation, compensation to the CFUG; incentives to use biogas and other alternative sources of energy. Hammering of trees that will be felled. Advising on proper felling, sectioning, hauling, piling and handover of cut trees.
(ii)	Loss of biomass and carbon from felled trees	Nisakot CF, Government Forest	Biomass and carbon volume (table)	Replantation, compensation to CFUG and to DFO; Biogas and other alternative energies
(iii)	Disturbance to habitats	Nisakot CF	Nisakot CF will lose its integrity and biodiversity Two <i>Pinus</i> species and <i>Alnus nipalensis</i> will be affected	Compensatory plantation or new place for the forest as offset, training of CFUGs, private forest initiative. Check trees with bird of prey nests; avoiding felling of trees during nesting seasons.
(iv)	Habitat fragmentation, barriers for wildlife movement	In forest areas, adjacent to KNM section	Roadkill wildlife, fragmented populations, loss of species richness and abundances	Wildlife/livestock cross-road structures in appropriate locations; design culverts as reptile & amphibian tunnels
(iii)	Disturbed wildlife and habitat	Along the ROW and in DIA	Loss of habitats; barrier effect; loss of biodiversity	Control for nesting birds, avoiding work in the breeding season, instructed construction workers
(v)	Impacts on herptiles and fish species	Near new bridges and in proximity of natural habitats	Loss of species; impoverishment of aquatic habitats	Culverts established in appropriate places; Avoiding pollution of water-courses and impact on spawning sites
(vi)	Use of forest products by construction workers & hunting and poaching of wildlife	In proximity of labour camps	Loss of forest products and NTFP	Instruction of workers before construction Control from management team Alternative energy sources and food providing


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SN	Activities/ Issue	Location/s	Impact	Mitigation Measures
(vii)	Forest fire	Near labour camps	Loss of forest area, wildlife and community assets, air pollution, human health, safety	Instruction of workers Fire-extinguishers in the labour camps Trained supervisors Control of the works. Alternative energy sources. Improved access to fire control measures
8.2.1.2 Operation Phase (Sisne khola-Dharke Biological Environment)				
(i)	Illegal felling of trees	Access zones	Community assets and profit loss, biodiversity loss	Engagement of CFUGs in forest management
(ii)	Damage of aquatic habitats	In proximity of bridges	Loss of fish and other aquatic fauna	Speed control on the bridge; appropriate signage, prevention of water pollution by cars, etc.
(iii)	Habitat fragmentation, barriers for wildlife movement	Nisakot community forest area.	Roadkill wildlife, loss of species richness and abundances	Established monitoring of cross-road structures, adaptive management
(iv)	Forest fire	Nisakot CF	Loss of forest area, wildlife and community assets, air pollution, human health, safety	Forest control in the dry season. Awareness programme. Alternative energy sources. Improved access to fire control measures. Control of brick-kiln area
(i)	Loss of private property and assets	13 locations (in table), 137 private structures, from 65 households	Loss of assets, loss of income, businesses, effect of livelihood	Compensation Resettlements Alternative livelihood sources
(ii)	Grievance raised by locals and workers	Along the road	Delay of construction or hampering of work	Grievance redress mechanism; community consultation;
Construction Phase (Sisne-khola-Dharke Socio-economic and Cultural Environment)				
(i)	Loss of productive land	Along the Sisne-Dharke section	Loss of agricultural production, 67.77 ha of fertile land loss	Accurate delineation of land needed for construction, preservation of land and soil outside of ROW
(ii)	Land and property acquisition	Along the section	67.77 ha will be affected	Compensation, resettlement and rehabilitation
(iii)	Destruction and damage of	Along the road	4 public structures with Shiva Temple, irrigation canal and road	Replacement and restoration of structures

SN	Activities/ Issue	Location/s	Impact	Mitigation Measures
	community structures			
(iv)	Livelihood issues	In 7 major settlements	Loss of business and livelihood activities	Replacement and providing specific area for businesses
(v)	Conflict with nearby host community	Along the road	Disputes in community, social disorder	Security, instruction of construction workers, supervising and control by management team
(vi)	Vulnerable indigenous people, cultural assets, gender	Along the road	Danurwar-rai, Dalits, Women headed households, senior citizens	Awareness about the situation to contractor workers, special instructions. Priority will be given to vulnerable and disadvantaged group in employment opportunities and incoming generating trainings.
(vii)	Road safety	Along the road, mostly in urban areas	Health impact and Accidents, especially in school area	Signage, bus stops, overbridge, footpaths, instruction boards, zebra and lights, etc.
(viii)	Landscape aesthetics	Along the road	Human health and well-being of the local people will be affected.	Planning of rehabilitation and offsets, control stockpiling & excavation materials, etc.
(ix)	HIV/AIDS and other diseases	Along the road	Human health, safety and community environment	Awareness program for communicable diseases and vector borne diseases, instructions relevant to water and waste management, frequent health check of camp
(i)	Ribbon development, settlement and market places	Khatripauwa, Arjalgau, Purano Dharke	Pressure in community infrastructure, safety	Planning and proposal of new economic initiatives for local communities (service centres, etc.). Prohibition on open urination practices by road users/passengers. Establishment of notice boards directing public using public toilets.
(ii)	Increase in accidents	Along the road	Safety and health, loss of assets, danger at school area	Regulations, awareness and road infrastructure (lights, signs, zebra, etc.) and adaptive management
(iii)	Increase in sell and use of alcohol products	Along the road	Health and well-being, accidents, violence	Stricter regulations, control of alcohol sale, prohibition of alcohol advertisement on roads


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SN	Activities/ Issue	Location/s	Impact	Mitigation Measures
(iv)	Trafficking and increase in prostitution	Along the road	Human health, well-being, violence, accidents	Awareness campaigns, creation of jobs for girls and women, vocational training for women, etc.
(v)	Migration and immigration	Along the road	Pressure in urban and market area, wellbeing	Integrated planning of development
(vi)	HIV/AIDS and other diseases	Along the road	Health, well-being, community life	Awareness campaigns, regular health camp operations

Table 10-4: Adverse Impact Mitigation Measures for Bishaltar – Phishling Alignment

Sn.	Activities/ Issue	Location/s	Impact	Mitigation measures
8.2.1.1 Preconstruction Phase (Bishaltar-Phishling, Physical Environment)				
(i)	Access roads	Benibesi, Dhobadighat, Sukumbasitol, Jyamirghat and Itar settlements	Alternative diversions to local roads not yet designed	Signage posts and other information disseminated and provided before construction. Discussion in advance with local authorities such as ward office and municipality.
(ii)	Planning for erosion control	4+400 to 5+400, 7+600 to 8+200 Salleri CF, 8+900 to 9+300 area close to Trishuli River, 10+100 to 15+000 GF and Nivare CF	Land slide and erosion during construction and excavation.	Review of EIA and other document and plan for the control of erosion in advance.
8.2.1.2 Construction Phase (Bishaltar-Phishling Physical Environment)				
(i)	Relocation of utilities	Along the alignment as presented in Table 5-52	Disruption in existing services at local level.	Proper relocation and operation of all affected utilities by the contractor.
(ii)	Excavation and opening of Bishaltar-Phishling highway	Within the 50-meter ROW along the proposed Bishaltar-Phishling	Change in land use and loss of productive topsoil	Acquired land within the ROW; land acquired temporary will be rehabilitated after construction. Public consultation for the plying of dump trucks and vehicles along the existing earthen tracks. 30 cm of topsoil will be kept in one place and reused for agriculture again.


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Sn.	Activities/ Issue	Location/s	Impact	Mitigation measures
(iii)	Excavation of hill slopes	4+400 to 5+400 Chuwatar, 7+600 to 8+200 Jyamirghat, 8+900 to 9+300 Thumka, and last 10+100 to 15+000	Landslides, Slope Destabilization and Soil Erosion	Avoidance of haphazard slope excavation. Benching and excavation in piece-meal applied along steep slopes, especially at the Nivare CF. Bio-engineering and slope protection, engineering structures. Plan for managing stockpiling areas, disposal of excavated materials and excavation of hill slopes at the last 5.5 km section.
(iv)	Disposal of spoil	Valley side of the road all along the alignment.	During site clearance, excavation in slopes estimated 382,929 cu. m. of spoil materials for disposal.	Excavated spoil and other materials disposed at identified sites. Avoided haphazard disposal of spoil. Excavated spoil from hill slopes will not be disposed directly into Trishuli River.
(v)	Construction and excavation; disposal of spoil	23 big and small natural drainages; Lamou khola, Dhobadi-, Judi-, Sano-, Kaudi-, Prem- and Khani kholas at Phisling	Obstruction to natural drainage pattern	Avoided haphazard spoil disposal. Labour camps will be far to natural drainage; avoided direct disposal of any wastes. Channelize natural gullies especially in the last 5.5 km.
(vi)	Construction activities, likely disposal of soil, chemical wastes, Operation of crusher plants etc.	Along the existing Trishuli and Lamou khola, Dhobadi khola, Judi khola, Sano khola, Kaudi khola, Prem khola and Khani khola River	Pollution of water resources	Use water from ample sources supply within construction area or will buy it outside project area. Existing water sources and supply system will not be affected. Consent with locals in order to use available water sources.
(vii)	Soil contamination	Cultivated land along the alignment	Top soil of cultivated land and agricultural products from the land within the proposed road carriage width will be lost permanently	Consent for temporary acquisition of private land. Maintained designated storage area for chemicals and other materials, camp sites and workshops. Topsoil kept separately from subsoil, stored at a safe place with protective measures that to reuse to reclaim land, form a cover layer on spoil disposal and landscaped areas.
(viii)	Construction activities, haphazard disposal of spoil, disturbance to natural drainage.	Fertile cultivated area at Benibesi, Ghyalchoktar, Dhobadighat, Sukumbasitol, Pudaliphat, Jyamirghat, at Kautikhet	Water logging	Spoil disposal only at the designated sites. Avoided haphazard disposal at the valley side, along the natural drainage, along cultivated and private lands.



Sn.	Activities/ Issue	Location/s	Impact	Mitigation measures
(ix)	Operation of borrow pits and quarries	Riverbanks of Trishuli hill side quarry.	Disturbance to landscape, air and noise, accidents, ponding, increase of sedimentation level etc. with the operation.	Avoided haphazard quarry along the riverbank and hills; provided permanent barricade at quarry location for safety, established safety signage boards, installed noise barriers. Prepared borrow pit operation plan with approval from supervision engineers prior to operation of quarry.
(x)	Operation of stone crushing	Along the Bishaltar-Phisling	Dust, air and noise. Likely accident.	Avoided operations near school and settlements. Acquired permission from engineers prior to the establishment.
(xi)	Stockpiling and transportation of construction materials	Along the alignment; proposed stock piling area and 10+000 to 15+000, where the hill slopes are steep and vulnerable to landslide	Dust emission, washout affect to downhill to the Trishuli and cultivated and discomfort to locals.	Stockpile materials covered with tarpaulin, water sprinkling carried out near and around the stockpile to avoid erosion; proper barricade and security guard provided for the area.
(xii)	Road excavation, construction activities, operation of dump trucks, etc.	Along the existing alignment, especially at existing urban areas. Crusher plant, batching plant sites, School, urban and settlement areas	Air pollution	Avoid operation of drill machines, excavators, loading and unloading of waste materials in windy days. Dust masks for labour workers, sprinkling of water along the dusty road. Avoid direct disposal of effluent from batching plant.
(xiii)	Use of chemicals	Camp site, workshops, natural drainage along the alignment.	Land and water pollution. Chemical hazards	Orientation to workers for handle of chemicals. Storage of chemicals in 100 meters away from any water sources. Spillage kit in place at construction site.
(xiv)	Excavation activities with the widening of existing highway and operation of camps and other activities	Hotels, shops, resorts and eatery shops along the highway, settlements, school, health posts	Noise pollution	Barricade for construction area, operational schedule to local inhabitants. Monitoring noise level maintained at national standard.



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Sn.	Activities/ Issue	Location/s	Impact	Mitigation measures
(xv)	Operation of construction vehicles, excavation etc.	Ghyalchowk and Bhumlichok area from Benibesi, Dhobadighat, Sukumbasitol, Jyamirghat and Itar	Road safety and traffic management.	Safety and traffic signage, barricades, provided PPEs to all workers, managed local traffic avoiding disturbance, informed and aware locals, on job trainings to workers
(xvi)	Construction safety of labourer	Along the alignment	Occupational health and safety of labourer and accident	Safety signage, barricades in the construction sites, provide PPEs to all workers, manage local traffic and disturbances, inform and aware locals, on job trainings to labours
(xvii)	Establishment of camps	In identified locations or along the section	Waste and health hazards, degradation of land, streams and rivers,	Camp management plan prior to work, provided required facilities at camp sites to maintain health and hygiene, installed temporary toilets, supplied potable water, etc.
Operation and maintenance Phase (Bishaltar-Phising, Physical Environment)				
(i)	Instability of the hill slopes	Chainage: 4+400 to 5+400 Chuwatar, 7+600 to 8+200 at Jyamirghat, chainage 8+900 to 9+300 at Thumka, and at last 5.5km	Destabilization of slopes	Bioengineering and slope protection works; regular monitoring of sites; adaptive management
(ii)	Plying of vehicle	Along new alignment	Air pollution, Health problem of locals and road users	Regular cleaning of road surface, allocation of staff for each km for drain cleaning, establishment of vehicle emission test facility at Bishaltar.
(iii)	Operation of highway and mobility of vehicles	Along the Bishaltar-Phising alignment	Noise to local and road users	Installation of noise restriction or no horn traffic sign at Schools and major settlements. Road marking along the road.
(iv)	Cross drainage outfall and gullies	Cultivated land along the proposed alignment.	Erosion, landslide, waterlogging etc.	Outfall of roadside drainage will be disposed off natural drainage.
(v)	Encroachment of Right of Way	Along the highway.	Obstruction in traffic movement, local discomfort	Awareness to locals regarding road safety, proper roadside markings and traffic signals, barricading where necessary.
(vi)	Traffic safety and accident	Along the highway, especially at urban areas.	Community health and wellbeing	Establishment of traffic signals, GPS tracking for speed control on highway. Traffic awareness to locals and schoolchildren.

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Sn.	Activities/ Issue	Location/s	Impact	Mitigation measures
(vii)	Waste Management	Along the highway drain, Urban areas	Waste, health and hygiene to locals and road users.	Waste management, coordination with local municipality.
8.2.1.1				
(i)	Tree felling of trees (preparation)	Ghorka District	Loss of trees and forest, wildlife disturbance, habitat loss and change	DFO of Ghorka District asked to harvest trees before construction; identified and marked trees
(ii)	Disturbed wildlife and habitat	2 government managed forests: Salleri and Nibhare	Habitat and biodiversity loss – vultures and kites	Avoiding work in the breeding season, instructed construction workers
8.2.1.2				
(i)	Clearing of forest, loss of vegetation and grazing area	5.81 km in the last section of alignment (more details in tables)	There will be loss of 29.49 ha, 620 trees and 6227 poles	Replantation, compensation to the CFUG; providing incentives to use biogas and other alternative sources of energy
(ii)	Loss of biomass and carbon from felled trees	3 forests in Ghorka district	Biomass and carbon volume 1140 t, carbon 834.59 t	Replantation, compensation to CFUG and to DFO; Biogas and other alternative energies
(iii)	Disturbance to habitats	3 forests near Trishuli River	Wildlife and biodiversity loss in the community forests	Select compensatory plantations or new place for the forest establishment as offset habitats, training of CFUGs, private forest initiative
(iv)	Habitat fragmentation, barriers for wildlife movement	In forest areas, adjacent to Trishuli river	Roadkill wildlife, fragmented populations, loss of species richness & abundances	Wildlife/livestock cross-road structures in appropriate locations; designed culverts as reptile & amphibian tunnels
(iii)	Disturbed wildlife and habitat	Along the ROW and in DIA	Loss of habitats & biodiversity; barrier effect	Avoiding work in the breeding season, instructed construction workers
(v)	Impacts on herptiles and fish species	In the section located closely to Trishuli River	Loss of species; impoverishment of aquatic habitats	Culverts, herptile tunnels, avoiding of construction in fish breeding season. Prevention of Trishuli River pollution during construction
(vi)	Use of forest products by construction workers & hunting	In proximity of labour camps	Loss of forest products and NTFP	Instruction of workers before construction Control from management team Alternative energy sources and food



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Sn.	Activities/ Issue	Location/s	Impact	Mitigation measures
	and poaching of wildlife			
(vii)	Forest fire	Near labour camps, especially in Nivare and Saleri community forests (Itar)	Loss of forest area, wildlife and community assets, air pollution, human health, safety	Instruction for workers. Fire- extinguishers in the camps. Trained supervisors. Control of the execution. Alternative energy sources. Improved access to fire control measures
8.2.1.2	Operation Phase (Biological Environment)			
(i)	Illegal felling of trees	Access zones	Community assets and profit loss, biodiversity loss	Engagement of CFUGs in forest management
(ii)	Damage of aquatic habitats	In proximity of bridges	Loss of fish and other aquatic fauna	Speed control on the bridge; appropriate signage, etc.
(iii)	Habitat fragmentation, barriers for wildlife movement	8 km section in Nivare and Saleri community forests	Roadkill wildlife, fragmented populations, loss of biodiversity	Established monitoring of cross-road structures; adaptive management
8.2.1.1	Preconstruction Phase (Socio-economic and Cultural Environment)			
(i)	Loss of private property and assets	82 private structures, belonging to 45 households	Loss of assets, income and businesses, effect on livelihood	Compensation Resettlements Alternative livelihood sources
(ii)	Grievance raised by locals and workers	Along the road	Delay of construction or hampering of work	Grievance redress mechanism; community consultation;
8.2.1.1	Construction Phase (Socio-economic and Cultural Environment)			
(iii)	Loss of productive land	Along the Benihat- Phishling section	Loss of agricultural production, 32.07 ha of fertile land loss	Accurate delineation of land needed for construction, preservation of land and soil outside of ROW
(iv)	Land and property acquisition	Along the section	32.07 ha will be affected	Compensation, resettlement and rehabilitation
(v)	Destruction and damage of community structures	Along the road	82 public structures: incl. drinking water pipeline & irrigation canal	Replacement and restoration of structures



Sn.	Activities/ Issue	Location/s	Impact	Mitigation measures
(vi)	Livelihood issues	In 10 major settlements	Loss of business and livelihood activities	Replacement and providing specific area for businesses
(vii)	Conflict with nearby host community	Along the road	Disputes in community, social disorder	Security, instruction of construction workers, supervising and control by management team
(viii)	Vulnerable indigenous people, cultural assets, gender	Along the road	Chepang, Dalits, Women headed households, senior citizens	Awareness about the situation to contractor workers, special instructions. Priority will be given to vulnerable and disadvantaged group in employment opportunities and incoming generating trainings.
(ix)	Road safety	Along the road	Health impact and Accidents, especially in school area	Signage, bus stops, overbridge, instruction boards, zebra and lights, footpaths, etc.
(x)	Landscape aesthetics	Along the road	Human health and well-being	Planning of rehabilitation and offsets, control stockpiling & construction excavation materials, etc.
(xi)	HIV/AIDs and other diseases	Along the road	Human health, safety and community environment	Awareness program, instructions relevant to water and waste management, frequent health check of camp
8.2.1.1 Operation Phase (Socio-economic and Cultural Environment)				
(i)	Ribbon development, settlement and market places	6 major settlement areas	Pressure in community infrastructure, safety	Planning and proposal of new economic initiatives for locals (service centres). Prohibition on open urination practices by road users/passengers. Establishment of notice boards directing public using public toilets.
(ii)	Increase in accidents	Along the road	Safety and health, loss of assets, danger at school area	Regulations, awareness and road infrastructure (lights, signs, zebra, etc.), adaptive management
(iii)	Increase in sell and use of alcohol products	Along the road	Human health and well-being, accidents, violence	Stricter regulations, control of alcohol sale, prohibition of advertisement on roads
(iv)	Trafficking and increase in prostitution	Along the road	Human health, well-being, violence, accidents	Awareness campaigns, creation of jobs for women, vocational training for women, etc.
(v)	Migration and immigration	Along the road	Pressure in urban and market area, wellbeing	Integrated planning of development

Sn.	Activities/ Issue	Location/s	Impact	Mitigation measures
(vi)	HIV/AIDS and other diseases	Along the road	Health, well-being, community life	Awareness campaigns, regular health camp operations

Table 10-5: Adverse Impact Mitigation Measures for Bridges along the KNM

Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures
8.2.1.1	Construction Phase (KNM Bridges-Physical Environment)			
(i)	Excavation for bridge foundation	Proposed bridge areas at 25 locations for new and improvement of existing	Landscape disturbance and bank instability	Protection of river banks, application of river training works, establishment of abutments.
(ii)	Excavation for bridge foundation	Proposed bridge areas	Quarry and excavation of river bed materials	Construction and excavation of bridge foundation carried out only during dry season.
(iii)	Excavation for access road	Proposed bridge areas and approach roads near the bridges	Soil erosion due to construction and excavation of access road	Construction and excavation of bridge foundation carried out only during dry season.
(iv)	Excavation for bridge foundation	Proposed bridge areas	Change in river regime	Diversion of river to another side; opposite to the excavation area. Excavation of foundation during dry season.
(v)	Excavation for bridge foundation	Proposed bridge areas	Water pollution	Avoided direct disposal of excavated material to the river, excavation carried out during dry season.
(vi)	Excavation for bridge foundation by heavy machines	Proposed bridge areas	Noise pollution	Prohibition to the unauthorized persons at construction sites. Safety gears will be provided to labour workers.
(vii)	Excavation for bridge foundation and approach road	Proposed bridge areas	Dust and air pollution	Sprinkling of water along the approach road, existing highway, and stockpiling wards.



Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures
(viii)	Excavation and disposal of spoil	Proposed bridge areas	Disposal and construction waste management	Disposal of excavated materials only on designated sites.
(ix)	Transportation of construction materials	Proposed bridge areas	Transportation and stockpiling of construction materials	Stockpile of construction materials at designated area, good house-keeping, cover with tarpauline sheets while transporting, water sprinkling as and when required.
(x)	Operation of labour camps	Proposed bridge areas	Impacts associated with labour camp operation	Labour camp management plan will be in place, proper disposal system for the waste generated from the camps.
(xi)	Use of diesel and other chemicals	Proposed bridge areas	Spillage of chemical	Spillage kit will be in place, avoid spillage as far as possible, proper handling of chemicals, storage of chemicals only in designated area
Operation Stage (KNM Bridges-Physical Environment)				
(i)	Plying of vehicles	Proposed bridge areas	Increase in Dust and smoke with vehicle movement	Maintenance of road, regular cleaning of road surface, allocation of length man.
(ii)	Plying of vehicles	Proposed bridge areas	Noise	Traffic signals in place, maintained speed limits, avoided horns at settlement and school area.
8.2.1.2 Construction Phase (KNM Bridges-Biological Environment)				
(i)	Excavation for bridge foundation	Proposed bridge areas	Construction serve as barrier to movement of migratory aquatic species	Construction activity during dry season, avoided catch fish, chenalized river water to other side from the excavation.
(ii)	Excavation for bridge foundation	Proposed bridge areas	Damaged aquatic habitats and animals due to extraction of sand and gravel	Construction and excavation of bridge foundation will be carried out only during dry season.
(iii)	Construction activities and operation labour camp	Proposed bridge areas	Use of fuel wood by the construction workers in construction activities	Contractor will supply legal sources of energy for the camps. Avoid use of fuelwood.



Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures
(iv)	Hunting and poaching of animals and fishing activity	Proposed bridge areas	Impact on fish population due to construction workers fishing	Instructions to labour workers; control from management team.
Operation Stage (KNM Bridges-Biological Environment)				
(i)	Operation of road and bridges	Proposed bridge areas	Impact on growth of the natural forest and vegetation	Roadside barricade to forest area along the road.
(ii)	Possible vehicle drop and spillage of oil and diesel in the river due to accident	Proposed bridge areas	Impact upon aquatic life; aquatic habitat destruction	Installation of traffic signs, speed control, awareness and information boards to road users.
Pre-construction stage (KNM Bridges-Socio-economic and cultural Environment)				
(i)	Land acquisition	Proposed bridge areas	Acquisition of land and relocation of affected people.	Acquisition and compensation of land as per Land acquisition act 2034 B.S.
(ii)	Demolition of structures	Proposed bridge areas	Impact due to acquisition of structures	Compensation to the affected structures
Construction stage (KNM Bridges-Socio-economic and cultural Environment)				
(i)	Operation of camps, influx of labours from outside area	Proposed bridge areas	Health and sanitation chances of increase in transmission of disease form outside work force	Sanitation and potable water supply at labour camps and construction sites. Regular health checkup of labour workers.
(ii)	Camp establishment and operation	Proposed bridge areas	Conflict and disturbance due to non-local labour	Establishment of camps will be at least 100 m away from any residence, contractor will be responsible to avoid conflicts.
(iii)	Construction activities, and likely obstruction	Proposed bridge areas	Traffic safety and traffic movement	Traffic management plan in place. Allocation of traffic boy for the smooth mobilization of existing traffic, safety signs.

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Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures
	to existing traffic due such activities			
(iv)	Bridge construction and excavation activities	Proposed bridge areas	Disturbance in movement of local inhabitants	Safety signals and traffic signs will be in place, awareness to locals and labour workers.
(v)	Bridge construction and excavation activities	Proposed bridge areas	Occupational health and safety for bridge construction workers	Awareness, on job trainings to labourers, PPEs to all workers, any time availability of First Aid facilities in camps and bridge construction site.
Operation Stage (KNM Bridges-Socio-economic and cultural Environment)				
(i)	Operation of the bridges	Proposed bridge areas	Safety of pedestrians with the plying of vehicles	Installation of RCC crash barrier along the bridge
(ii)	Operation of the bridges	Proposed bridge areas	Encroachment of land near the bridge area	Permanent barricade within the ROW of Bridge area. Prohibition on open urination practices and waste disposal practice by road users/passengers near or underneath to bridge. Establishment of notice boards directing public using public toilets.



10.3 Common measures for mitigation

Mitigation hierarchy approach will be applied during all stages of project and in accordance with best practices to ensure a mechanism to manage risks and potential impacts related to physical, biological and socio-economic environment and balance conservation needs and precautionary principles with development priorities. Selection of mitigation measures in each case is based on existing practices, regulations and standards in the road development sector of Nepal.

10.3.1 Establishment and operation of quarry and borrow pits

Physical impact on air, noise and water due to operation of quarry was predicted as negligible in major human locations and settlements. However, materials will be acquired from at least 15 m away from riverbank for surface extraction. Whereas for underground river bed extraction; a quarry site will be at least 500 m upstream and 500 m downstream from any proposed and existing bridge sites. Materials will be extracted in pits at regular intervals using machines and equipments. The establishment and operation of a quarry site will be at least 50 m far from road and 500 m away from settlement areas to avoid the impact of dust and noise pollution. Contractor will secure government permit and other relevant environmental requirements for operation of quarry site with recommendation from project engineer. Adequate drainage system will be provided to prevent the water pollution of natural streams and flooding of the excavated area. Proper drainage and erosion control measures will be installed at the sites as per its requirement. Hill slopes of quarry sites will be stabilized with proper slope maintenance activities. For a quarry operation a Contractor or operator will seek approval from the project office before its operation; no any quarry will be excavated without any approval from the project office. Quarry site will be rehabilitated and re-vegetated as far as possible to merge with surrounding landscape after completion of the quarry works for the alignment. However, it is more likely that construction contractor will buy construction materials from existing crushing plants established at the bank of Trishulir River along the highway from Nagdhunga to Mugling. The list of existing crushing plants are presented in the Annex.

10.3.2 Establishment of stone crushing plant

Contractor will establish crusher plant close to the proposed quarry sites. Stone Crushing Plant will be operated only during daytime. Establishment of crusher plant nearer than 500m from any settlement areas, school, health post, market and cultural sites will be strictly avoided. If necessary and if requested by locals, based on rational reasons, timing of operation will be planned in consultation with local communities that do not disturb schools, health posts, markets, settlement areas, etc. Contractor will compensate to the affected landowners, if land and crops are damaged due to operation of crushing plant. Effluent from any crusher plant will be treated before its disposal and will not be disposed directly into the river systems. Crushing plant will not be operated during off hours from 5:00 PM to 7:00 AM. Contractor will clean overall land area and will bring it into original condition after closure and dismantling of the crusher plants. Contractor will compulsory adopt preventive and safety measures to control dust and avoid noise pollution.



Further, the Contractor must exert all efforts to supervise this work site, especially to prevent children from approaching the plant. Contractor will establish series of settling ponds with (3mX2mX2m) for the collection of waste water generated from the plant operation before dispose effluent into the nearby river. Contractor will be responsible to clean the settling ponds regularly before operation. Possible crusher plant sites have been identified at eleven locations along the proposed KNM road alignment as well as close to the proposed quarry site area. These plants are proposed close to the proposed labour campsites. Proposed labour camps locations are presented in the maps below. However, contractor will seek permission from engineer prior to establishment. Crusher plant sites are one of the major sources of air and noise pollution. Buffer zone of five meter will be established around the compound for the plantation.

10.3.3 Operation of camps

Construction contractors will enforce strict rules for the behaviour of the workforce hosted in the camps. The following measures will be adopted and applied for construction and removal of the camps however, will not be limited to it. Proposed labour camps locations are not close to the proposed alignment and are presented in the maps below.

Construction contractor will comply with the following requirements and will comply with IFC Accommodation Guideline 2009 (Workers' accommodation: processes and standards; A guidance note by IFC and the EBRD/IFC).

- a. Permission for camp areas must be obtained in writing from the Project prior to its establishment. Permission for camp areas, if within the community forest, must be obtained in writing form of permission from concern authorities and CFUG office.
- b. Suitable latrines and other sanitary arrangements at the camps and sites, where work is in progress, will be made available to the personnel. Male and Female latrines will be established separately and 1 latrine for 15 workers will also be maintained.
- c. Contractor will ensure that a proper health and safety operational plan is approved and in place prior to starting construction works.
- d. Access tracks and the camp area as well as drilling sites will be sited to cause minimum disturbance. Only kerosene, gas or other suitable energy sources will be allowed for cooking. Use of firewood will be strictly forbidden.
- e. Safety rules will be applied and firefighting equipment will be provided especially at campsites and all working areas. Proper signage boards will be installed in order to maintain safety.
- f. Personal Protective Equipment (PPEs) will be provided to all the labour workers in order to maintain safety.
- g. Movement of local people will be restricted within worker camps, construction sites for safety.
- h. Poaching and hunting of wild animals will be strictly prohibited. Contract agreements will specify heavy penalties for illegal hunting, trapping and wildlife trading. No permanent structures will be built at the camp, and the camp site to be cleared and cleaned free of all debris and waste at end of the works.
- i. All rubbish (except for oils and other mechanical or chemical waste) will be buried or removed. Organic waste will be buried. Non-organic waste will be removed. Waste oils,

chemicals and mechanical waste will be stored and removed. Non-organic waste shall be removed from the site.

- j. Wastewater will be routed through suitable sanitary facilities and soak ways, without contaminating either ground or surface water or causing a health risk.
- k. Waste oils, chemicals and mechanical waste shall be stored temporarily near the camp and shall be disposed of safely 500m away from any water bodies. Further, solid waste generated from the labour camps will not be disposed directly into open place and water bodies. The generated wastes will be collected within the camps and disposed into the municipal waste. The contractor shall coordinate with the local waste collector or municipal waste collector for the proper management and disposal of solid wastes generated from the camps and offices during the time of construction, and this shall be continued during the time of operation.
- l. Camp sites will be facilitated with lighting systems, communication and security.
- m. Adequate potable water will be supplied to all labour workers for drinking, cooking, washing and bathing purpose.
- n. Generated liquid wastes from kitchen and latrines will be managed separately in separate pits. Direct disposal to the natural drainage will be strictly avoided.
- o. Provision of an adequate supply of water for drinking and washing purposes for all site personnel, including all workers will be maintained. Drinking water quality will comply with GoN standards.
- p. Health services, first aid kits and regular health checks will be provided.
- q. General insurance, health services, first aid kits and regular health check-ups will be provided to laborers.

10.3.4 Disposal of Spoil and disposal plan

During the commencement of construction, the construction contractor will be responsible to prepare construction environmental management action plan (EMAP) incorporating all environmental issues mentioned in the bidding and contract documentation. The contractor will be responsible to provide construction methods and plans in advance for the commencement of construction as well as required to follow instructions mentioned in the EIA safeguarding environment. Contractor will comply following plan for spoil disposal during the commencement of construction civil works but not limited to:

- Spoil will be disposed properly at identified spoil disposal site.
- Spoil disposal sites will be rehabilitated by providing proper water drainage systems and applying bioengineering techniques and plantation.
- Direct and haphazard disposal of spoil upon valley side River, water bodies, cultivated and private lands will be strictly avoided.
- Disposal of spoil upon natural forest shall also be strictly avoided.
- Excess muck and earth will not be disposed of on fragile hill slopes instead will be used for back filling of gabion walls and other toe and retaining walls.



- Locals feed backs and consent including guidelines⁶ lined by the government agency will be followed to safeguard environment.
- Wherever possible, surplus spoil will be used to fill eroded gullies and depressed areas.
- If feasible, spoil material will be disposed in abandoned quarries and borrow pits as means to help restore original contours;
- Contractors will be advised to use the excavated materials for reclaiming the degraded land in near vicinity in consultation with local communities on their preferences.
- Spoil on fragile slopes, flood ways, wetland, farmland; forest areas, natural drainage path; religious and culturally sensitive sites, wetlands, canals and other infrastructures will never be disposed;
- Acidic and saline spoil will not be spread onto agriculture land.
- Spoils shall never be disposed on areas that will create inconvenience to the local community or it will deprive the livelihood of people.
- Spoil material may be discharged to a landfill or tipping site that is constructed using a series of small spoil benches to prevent slope overloading;
- During disposal, the spoil will be placed in layers of about 15 cm and compact each layer at optimum moisture content,
- After the disposal, the site will be landscaped, provided with proper drainage, plant with vegetation, and will provide adequate protection against erosion and scouring.
- Spoil will not be disposed in rivers, lakes and water bodies;
- Exposed areas will be planted with suitable vegetation at the earliest opportunity following the GESU/DoR Manual on 'Vegetation Structures for Stabilizing Highway Slopes- A Manual for Nepal'.
- Contractor will be responsible to provide adequate compensation to land and property; if damaged by spoil storage and disposal;
- Spoil disposal sites will be developed into community facilities like playground or park by reclaiming;
- Topsoil must be a cover layer on spoil disposal and landscaped areas, reclaimed land, slope of embankments prior to turfing, replanting, or developing as farmland.
- Spoil will be used in local road net and embankment construction works. (*Environment and Social Management Framework, DOR, GON, April, 2007*)

Equally, other plans will be formulated and implemented by the Contractor referring guidelines⁷⁸⁹¹⁰ prepared by DOR and GON to manage environment as well as minimize environmental impacts resulting from road construction, operation, maintenance, and rehabilitation.

⁶ *Guide to Slope Protection Works, DOR, GON 2007*

⁷ *Environmental Management Guidelines, July, 1999*

⁸ *National Environmental Impact Assessment Guidelines, 1993*

⁹ *Environmental Impact Assessment Guidelines for the Road sector*

¹⁰ *Environment and Social Management Framework, DOR, GON, April, 2007*

Table 10-6: Summary of Generated Excavated Quantity

Sn.	Road Section	Length (Km)	Cut Vol. (Cu.m.)	Fill Vol. (Cu.m.)	Cumulative Vol. (Cu.m.)	Reusable Vol.	Disposable Vol.
						(Cu.m.)	(Cu.m.)
1.	Nagdhunga - Naubise (0+00~12+400)	12.4	31,994	9,330	22,664	5,651	17,013
2.	Naubise - Baireni (0+00~24+200)	24.2	91,901	31,635	60,266	15,067	45,199
3.	Baireni - Bishaltar (24.20~53+00)	28.8	139,174	17,872	121,302	30,326	90,976
4.	Bishaltar - Mugling (53+00~82+400)	29.4	102,899	19,300	83,599	20,900	62,699
Sub Total		94.8	365,968	78,137	287,831	71,944	215,887
5.	Sisne Khola - Dharke Section (0+00~11+200)	11.15	808,597	257,753	550,844	247,895	302,949
6.	Bishaltar - Phisling Section (0+00 ~ 15+300)	15.35	981,476	285,243	696,233	313,304	382,929
Sub Total		26.503	1,790,073	542,996	1,247,077	561,199	685,878
TOTAL		121.3	2,156,041	621,133	1,534,908	633,143	901,765

Table 10-7: Disposal Sites identified along Sisnekhola-Dharke Alignment

Sn.	Longitude	Latitude	Elevation	District	Municipality -Wards
1	85.18973		-	Dhading	Dhunibeshi - 8
2	85.174916		965.1	Dhading	Dhunibeshi - 8
3	85.167196		889.9	Dhading	Dhunibeshi - 8
4	85.18171		-	Dhading	Dhunibeshi - 5
5	85.142171		815.8	Dhading	Dhunibeshi - 5
6	85.142089		816.8	Dhading	Dhunibeshi - 5
7	85.157565		845.5	Dhading	Dhunibeshi - 5
8	85.139362		-	Dhading	Dhunibeshi - 5
9	85.148702		-	Dhading	Dhunibeshi - 5
10	85.180581		917.8	Dhading	Dhunibeshi - 5

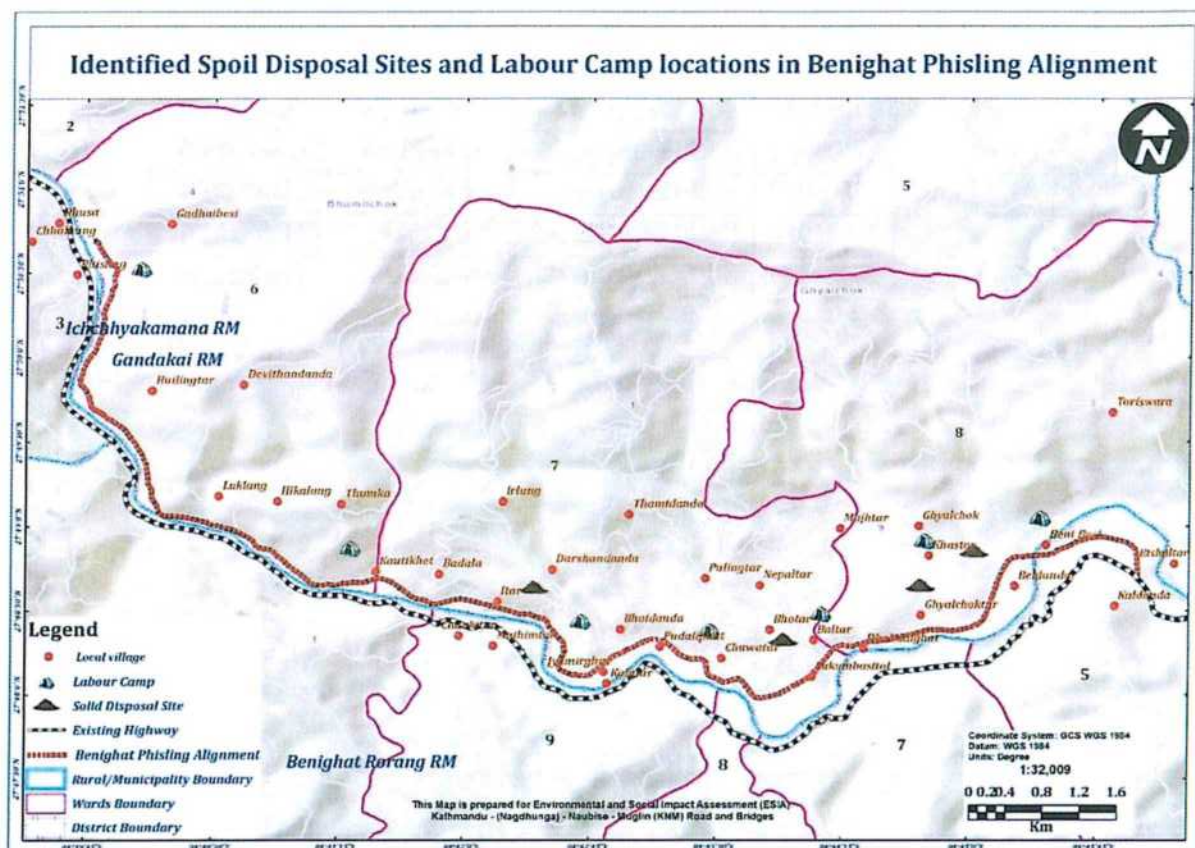
Source: Draft Detail Design of Improvement of Nagdhunga-Naubise-Mugling Road and Bridges, 2018

Table 10-8: Disposal Site Bishaltar Phisling

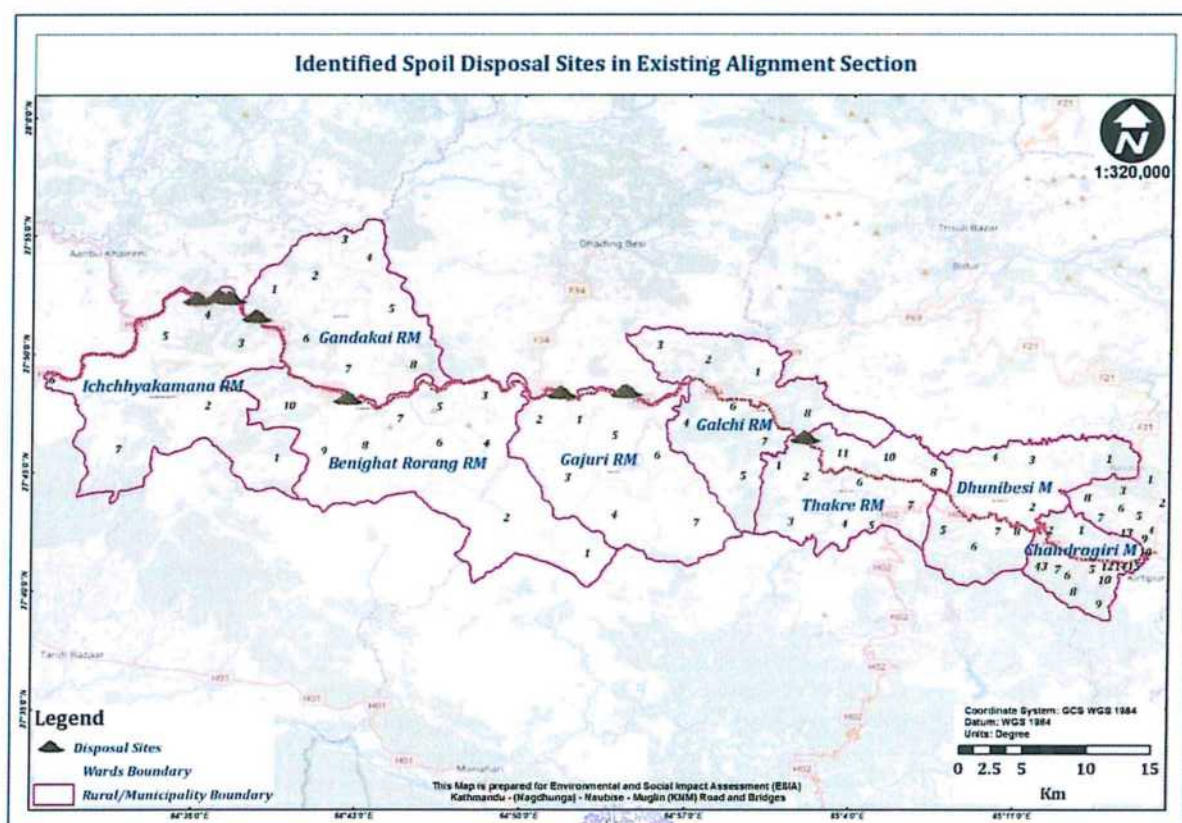
Sn.	Longitude	Latitude	Labels	District	GaNa_Palik
1	84.749108	27.80405	Soil Disposal Site 9	Dhading	Benighat Rorang - 7
2	84.625074	27.87198	Soil Disposal Site 7	Chitawan	DARECHOK-3
3	84.709984	27.80178	Soil Disposal	Gorkha	Gandaki RM 7

Sn.	Longitude	Latitude	Labels	District	GaNa_Palik
4	84.723428	27.80289	Soil Disposal	Gorkha	Gandaki RM 7
5	84.745605	27.8062	Soil Disposal	Gorkha	Gandaki 8
6	84.751368	27.8063	Soil Disposal	Gorkha	Gandaki 8
7	84.690133	27.81064	Soil Disposal	Gorkha	Gandaki 6
8	84.66191	27.82947	Soil Disposal	Gorkha	Gandaki 6



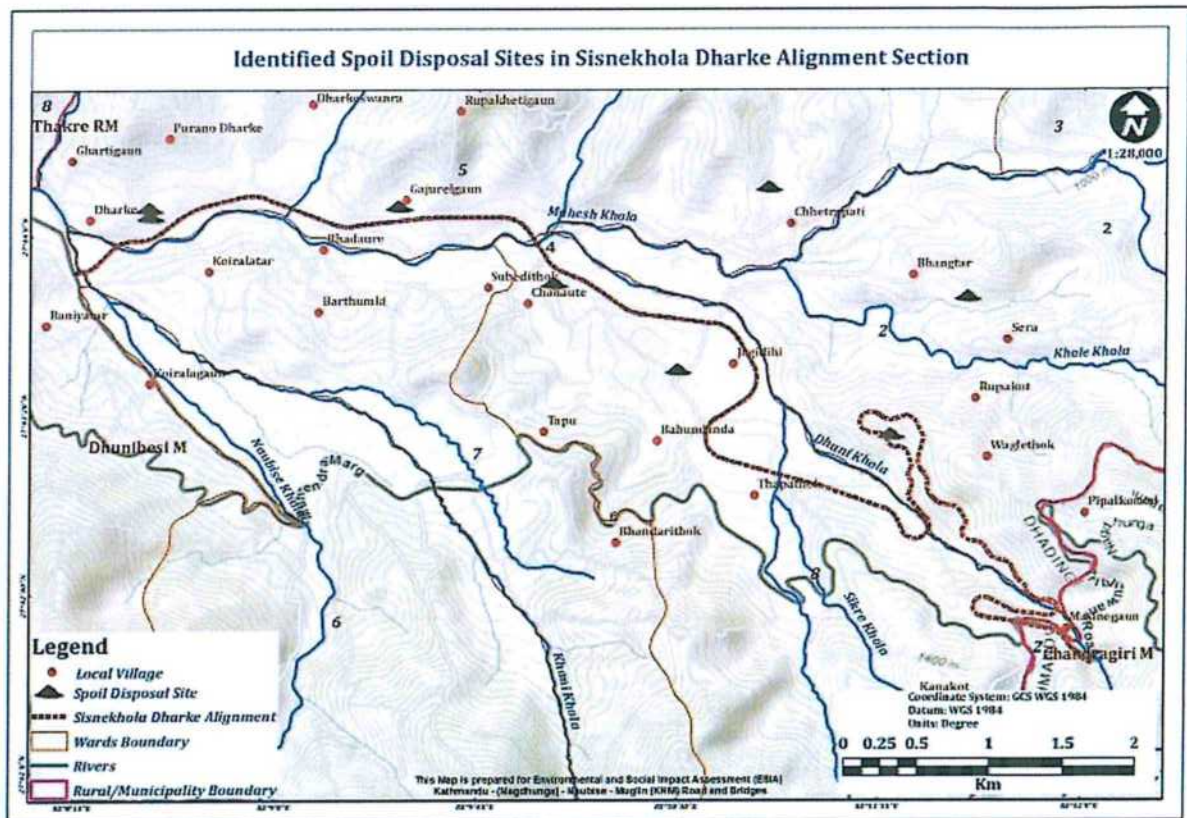


Map 10-1: Identified spoil disposal sites and labour camp locations along Bishaltar-Phisling alignment.

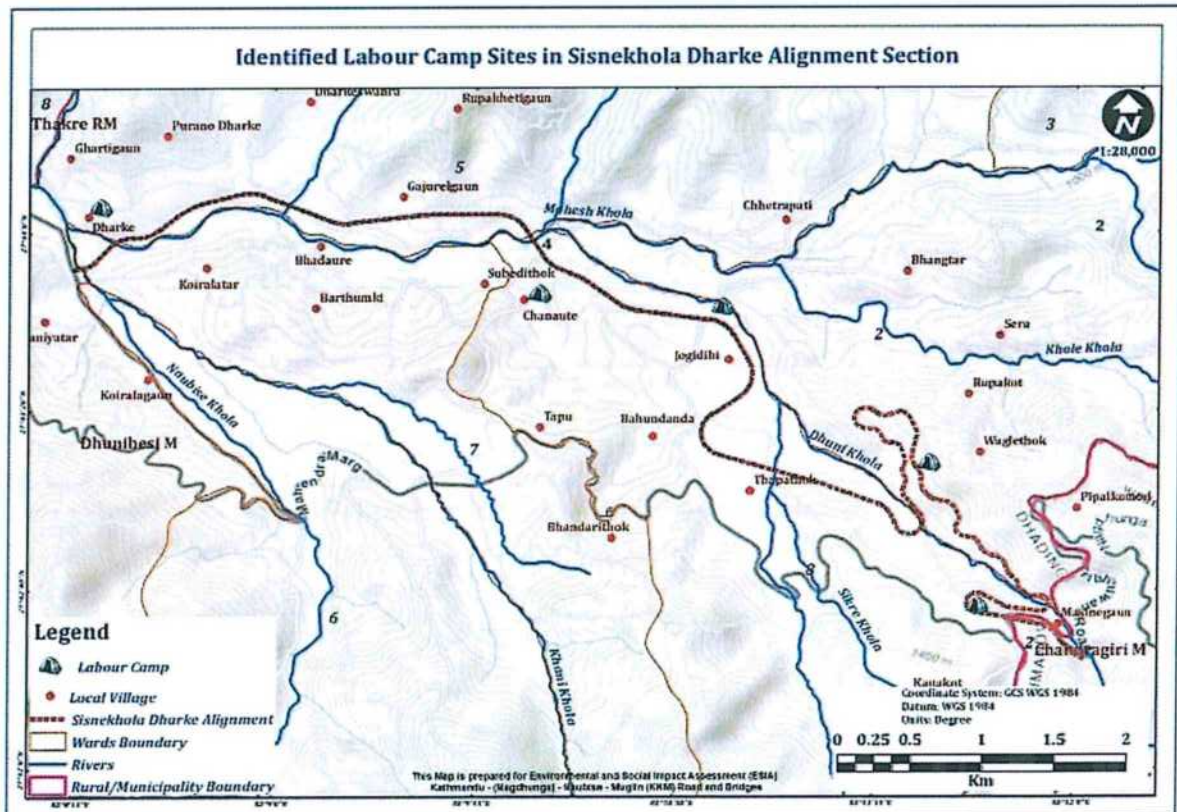


Map 10-2: Identified spoil disposal site in existing KNM

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Map 10-3: Spoil Disposal Sites for Sisnekhola-Dharke section



Map 10-4: Labor Camp for Sisnekhola-Dharke section

10.3.5 Road safety during operation

Implementation of project should not affect the accessibility of local people. Subways and flyover for accessibility has been proposed in the detail design to maintain smooth running of existing accessibility within the project area.

It is anticipated that about 28 passing zones will be required; however, 19 passing zones/foot over bridges (FOBs) have been proposed under priority basis analyzing need of the locals. All 19 passing zones will be constructed with overhead bridge for easy access to people while crossing the highway with safety point of view. Though pedestrian bridge is required at Naubise Bazar, there is no location suitable for fitting the same.

Table 10-9: Location of Proposed Pedestrian Overhead Bridges along the Easting Road

S/N	Location of the Bazars	Chainage	Pedestrian Bridge (Foot-over Bridge)	
			Nos of Pedestrian Bridges	Span (m)
1	Khanikhola	10+775	1	21
2	Dharke	2+775	1	30
3	Mahadevbesi	10+680	1	30
4	Simle	14+250	1	30
5	Galchhi- Baireni	23+650	1	21
6	Gajuri	37+600	2	30
		37+850		
7	Malekhu	43+400	3	30
		44+350		
		44+700		
8	Sital Bazar	47+100	1	21
9	Benighat	50+915	1	30
14	Bishaltar	53+325	1	21
15	Majhimtar	61+000	1	21
16	Phisling	68+300	1	21
17	Lewatar	76+200	1	21
18	Ramailo Danda	77+100	1	21
19	Kurintar	74+800	1	21
20	Mugling	82+300	1	30
Total			19	

Source: Draft Detail Design of Improvement of Nagdhnga-Naubise-Mugling Road and Bridges, 2018

Climbing lane has been provided at those locations where vertical gradient is very high and sufficient space is available for additional lane. This will facilitate the commercial heavy vehicles to ply smoothly and to reduce the traffic congestion in highway. List of climbing and extra lanes is given below in Table 10-10 and Table 10-11.

Table 10-10: Location for Extra Lane (Nagdhunga Naubise Section)

Sn.	Chainage		Length (m)	Remarks
	From	To		
1	1+240	1500	260	Valley Side
2	2+360	2660	300	Valley Side
3	4+760	5+100	340	Valley Side
4	6+250	6+550	300	Valley Side
5	7+160	7+720	560	Valley Side
6	7+160	7+720	560	Hill Side
7	8+060	8+370	310	Valley Side
8	10+060	10+670	610	Valley Side
9	11+110	12+150	1040	Valley Side
10	11+600	12+030	430	Hill Side
	Total Length		4710	

Table 10-11: Location of Proposed Climbing/Extra Lane (Naubise Mugling Section)

Sn.	Chainage		Length of Climbing/ Extra Lane)	Remarks
	From	To		
1	0+050	2+020	1970	Valley Side
2	3+020	3+700	680	Valley Side
3	4+380	5+080	700	Valley Side
4	5+275	6+580	1305	Valley Side
5	7+800	8+150	350	Valley Side
6	11+780	12+300	520	Valley Side
7	13+150	13+360	210	Valley Side
8	13+480	14+100	620	Valley Side
9	14+800	16+100	1300	Valley Side
10	15+500	15+940	440	Hill Side
11	17+040	17+680	640	Valley Side
12	18+380	18+720	340	Valley Side
13	19+680	20+220	540	Valley Side
14	20+320	20+900	580	Valley Side
15	21+150	22+410	1260	Valley Side
16	22+300	22+800	500	Hill Side
17	22+450	23+000	550	Valley Side
18	23+900	24+970	1070	Valley Side
19	25+150	26+550	1400	Valley Side
20	26+650	28+850	2200	Valley Side
21	29+000	30+400	1400	Valley Side
22	30+700	32+420	1720	Valley Side
23	34+000	34+920	920	Hill Side
24	33+840	35+240	1400	Valley Side
25	35+600	36+440	840	Valley Side
26	38+155	38+615	460	Valley Side

Sn.	Chainage		Length of Climbing/ Extra Lane)	Remarks
	From	To		
27	38+700	39+640	940	Valley Side
28	41+040	41+520	480	Valley Side
29	42+080	42+500	420	Valley Side
30	45+500	45+875	375	Valley Side
31	52+430	53+050	620	Valley Side
32	55+005	55+410	405	Valley Side
33	55+000	55+410	410	Valley Side
34	55+500	56+860	1360	Valley Side
35	56+360	56+860	500	Hill Side
36	61+100	61+800	700	Valley Side
37	66+170	66+660	490	Valley Side
38	71+160	71+900	740	Hill Side
39	71+160	72+060	900	Valley Side
	TOTAL LENGTH		32255	

Source: Draft Detail Design of Improvement of Nagdhnga-Naubise-Mugling Road and Bridges, 2018 (Updated data from DDT)

Moreover, four-lane improvement will be carried out along the existing KNM highway stretch are as follows:

Table 10-12: Location of Builtup Area (Four Lane Section)

Sn	Location of the Bazars	From	To	Length (m)	Remarks
1	Khanikhola	10+670	11+110	440	
2	Dharke	2+550	2+970	420	
3	Mahadevbesi	10+500	10+850	350	
4	Simle	14+100	14+370	270	
5	Galchhi- Baireni	23+530	23+900	370	
6	Gajuri	37+400	38+130	730	
7	Malekhu	43+310	43+520	210	
		43+650	45+220	1570	
8	Sital Bazar	46+900	47+360	460	
9	Benighat	50+770	51+170	400	
10	Bishaltar	53+000	53+510	510	
11	Majhimtar	60+670	61+150	480	
12	Phisling	68+120	68+540	420	
13	Kurintar	74+000	75+320	1320	
14	Lewatar To Ramailo Danda	75+840	77+380	1540	Additonal 1120 m
15	Mugling	82+050	82+403	350	
	Total Length			9820	Length on DPR 7340 m

Source: Draft Detail Design of Improvement of Nagdhnga-Naubise-Mugling Road and Bridges, 2018 (Updated data from DDT)

The length of Four-lane improvement in this stretch is 9.820 Kms.

Road safety measures will not be compromised during the operation of highway and tunnel. Environmental enhancement including safe driving inside the tunnel will be ensured installing all measures established for Asian Standard Highways. Road accident will be avoided as far as possible, maintaining road geometry, regular road surface, controlled speed of vehicle etc. Well ventilation and lighting system including sufficient backups for lighting will be maintained properly to avoid power outage during the time of operation, especially within the tunnel. Umpteen traffic signals including other enhancement measures will be provided considering driving safety within and outside the tunnel portals as well as along the highway. Well ventilation will be provided in order to avoid suffocation due to the accumulation of dust and smoke inside the tunnel. Standby rescue team will be established for twenty-four-hour outside the tunnel portals to avoid loss of life and property from any sort of accidents. For maintaining the traffic Safety, total of 38 Bus and 6 Truck Lay Bys has been proposed along the road alignment with extra lane to maintain the continuous flow of traffic on highway. 24 pairs of indented bus bays arranged staggered in a first right configuration; 48 mid-block zebra-crossing complemented with rumble strip sets in advance to the crossing; improved signage; 30 kph speed limit, etc., was recommended to safeguard pedestrians at bazar areas. Construction of 2 m wide footpaths on both sides throughout the market areas and gradual upgradation of divided carriageway with service roads in the mid and longterm, respectively, at all the market areas will be constructed. Table 10-13 and Table 10-16 illustrate the proposed Location and Numbers of Bus and Truck Lay Bys with provision of underpass and overpass area in the highway.

Table 10-13: Proposed Location of Bus Lay-Bys and Truck Lay-Bys

Bus Lay-bys			Truck Lay-bys		
Sn.	Chainage	Location	Sn.	Chainage	Location
Section: Nagdhunga - Naubise Section					
1	12+180	Naubise	1	7+375	
Section: Naubise - Baireni Section					
1	0+050	Naubise	1	15+875	Near Simle Bazar
Section: Baireni - Bishaltar Section					
1	27+650	Ekelephat	1	29+750	Ghumnejhari
2	27+750				
3	29+950	Ghumnejhari			
4	30+050				
5	34+920	Ghatbeshi			
6	35+020				
7	41+175	Belkhu			
8	41+275				
9	53+275	Bishaltar			
Section: Bishaltar - Migling Section					
1	53+375	Bishaltar	1	56+130	After Charaudi Khola Bazar
2	55+550	Charaudi Khola Bazar	2	74+300	Chumlingtar (after the finalization of Toll Plaze
3	55+650				



Bus Lay-bys			Truck Lay-bys		
Sn.	Chainage	Location	Sn.	Chainage	Location
4	60+850	Majhimtar			
5	60+950				
6	68+350	Phisling			
7	68+450				
8	74+400	Kuringhat			
9	74+500				
10	77+740	Manakamana Gate			
11	77+845				

Section: Sisne Khola - Dharke Section

1	3+060				
2	3+140		Nil		
3	6+060				
4	6+820				
5	8+750				
6	8+960				

Section: Bishaltar - Phisling Section

1	1+800		1	7+000~7+100	
2	1+880				
3	4+280				
4	4+340				
5	6+520				
6	6+580				
7	9+480				
8	9+580				
9	15+060				
10	15+120				

Source: Draft Detail Design of Improvement of Nagdhnga-Naubise-Mugling Road and Bridges, 2018

At many locations along the project road on Sisne-Dharke new road, existing roads are crossing the project road at different levels. In order to provide un-interrupted crossing of the vehicles of wither roads, a structure is provided so that there is no cross-over of the vehicular movements. Vehicular Underpass (VUP) is provided where existing road passes under the Project Road and Vehicular Overpass (VOP) is provided where existing road goes over the Project Road.

Table 10-14: VUP/VOP along Sisnekhola-Dharke

Sn.	Tentative Chainage (km)	Overpass / Underpass	Box Size (m)	Barrel length (m)	Remarks
1	1+370	VUP	7 x 5.5	12	Existing road under project road



Sn.	Tentative Chainage (km)	Overpass / Underpass	Box Size (m)	Barrel length (m)	Remarks
2	5+500	VOP	12 x 5.5	7	Existing road over project road.
3	6+760	VUP	7 x 5.5	12	Existing road under project road
4	8+460	VUP	7 x 5.5	12	Existing road under project road

Source: Draft Detail Design of Improvement of Nagdhunga-Naubise-Mugling Road and Bridges, 2018

Table 10-15:VOP/VUP along Bishaltar-Phisling

Sn.	Tentative Chainage (km)	Overpass / Underpass	Box Size (m)	Barrel length (m)	Remarks
1	3+760	VOP	12 x 5.5	7	Existing road under project road
2	5+740	VUP	7 x 5.5	12	Existing road over project road.

Source: Draft Detail Design of Improvement of Nagdhunga-Naubise-Mugling Road and Bridges, 2018

Table 10-16: Summary of Proposes Safety Measure for Public

Sn.	Road Section	Bus Lay-Bay	Truck Lay-Bay	Toll Plaza	Wayside Amenity	Underpass	Overpass
a.	Nagdhunga - Naubise Section	1	1	-	-	-	-
b.	Naubise - Baireni Section	1	1	2	1	-	-
c.	Baireni - Bishaltar Section	9	1	-	-	-	-
d.	Bishaltar - Migling Section	11	2	-	-	-	-
e.	Sisne Khola - Dharke Section	6	0	-	-	(2); 6+760 8+460	(1); 5+740
f.	Bishaltar - Phisling Section	10	1	-	-	(1); 5+740	(1); 3+760
Total		38	6	2	1	4	2

Source: Draft Detail Design of Improvement of Nagdhunga-Naubise-Mugling Road and Bridges, 2018

Further, the Existing Toll Gates be replaced with the regular Tolling Booths around the same location (due to terrain constraints) and only the area is developed in this contract, barricaded and earmarked for erection of Toll infrastructure in future under a Separate Contract. The existing toll fee location are situated at Dharke and at Majhimatar. Adequate supply of potable water and toilet facility will be provided for the proposed toll and office facility.



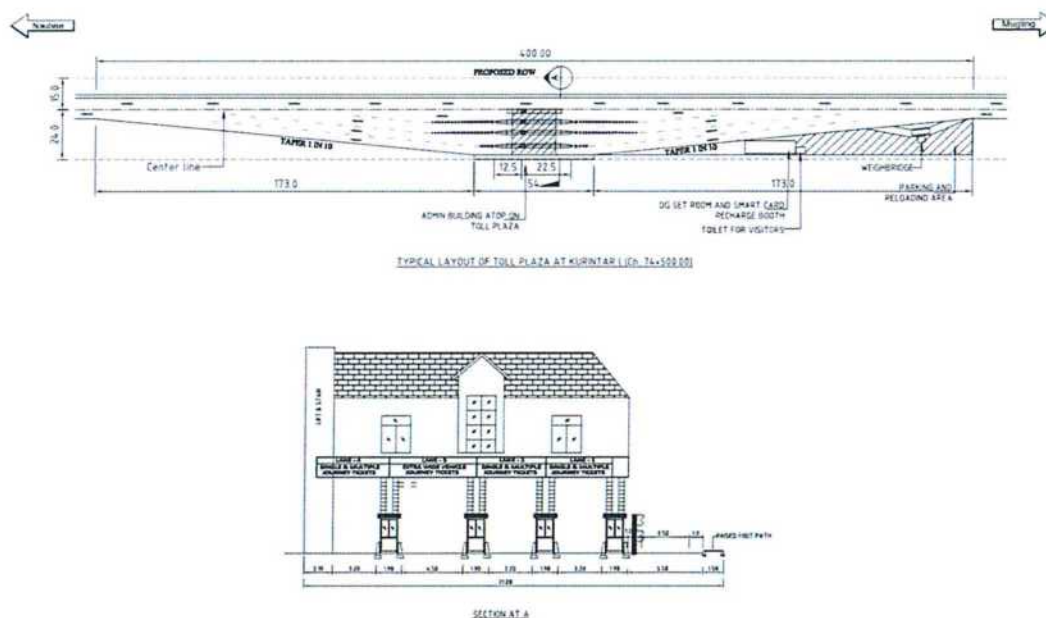


Figure 10-2: Toll station layout

Source: Draft Detail Design of Improvement of Nagdhunga-Naubise-Mugling Road and Bridges, 2018

10.3.6 Preparing the contractor(s) to address mitigation measures

The contractor(s) will be informed that they will be required to produce method statements and plans in advance as required in the EMAP for temporary pedestrian and Traffic Management Plan, Drainage Management Plan, Erosion Control Plan, Quarry and Materials Management Plan, Waste Management Plan, Camp Management Plan, Spoil Disposal Plan, and Crusher Operation Plan, Noise and Dust Control Plan, Compensatory Replantation Plan for all the packages.

10.3.7 Traffic accidents

It is predictable that the road traffic accidents are expected due to the high-speed vehicles. Although the highway will have separate lanes for movement; high speed vehicle accidents are likely. Traffic flows create many community safety issues, because the road will not have direct access to the local villages, except through some intersections. That to avoid accidents, road traffic signals, road marking and other safety measures will be applied to reduce driving risks and providing enhancements to driving conditions near the intersections and inside the Tunnels. In order to avoid illegal and accidental crossings of road by local people; barbed fencing will be carried out along the highway. Awareness campaigns for local communities will be organized to avoid such accidents during operation. At major market and settlement areas and major road crossing and intersection area, the junction improvement work has been proposed in 12 major junctions as illustrated in the Table 10-17.

Table 10-17: Junction Improvement Location

Section	Chainage	Name	Remarks
	0+000	Nagdhunga	

Section	Chainage	Name	Remarks
Nagdhunga - Naubise	3+360	Sisne Khola Tunnel with New Alignment	Being Done by JICA
Naubise - Baireni	0+000	Naubise Junction	
	2+300	Sisne Khola-Dharke Junction	
	22+425	Galchhi-Nuwakot Junction	
Baireni - Bishaltar	42+300	Malekhu Dhading Bridge Junction	Near Malekhu Bridge
	43+650	Malekhu Bazaar	
	51+050	Benighat Way to Gorkha	
Bishaltar - Mugling	53+100	Bishaltar-Phishling New Road Junction 1	At Bishaltar
	68+540	Bishaltar-Phishling New Road Junction 2	At Phishling
	77+925	Manakamana Temple Gate	
	82+410	Mugling Bazaar	Level Crossing
Sisnekhola-Dharke	1+370		Intersection
	5+820	Thapathok Area	Intersection
	8+950		Intersection
	8+580	Near Arjel Tole	Intersection
Bishaltar Phisling	1+840		Level Crossing
	4+140		Level Crossing
	5+440		Level Crossing
	6+660		Level Crossing
	8+100		T Junction
	8+780		T Junction
	15+260		T Junction

Source: Draft Detail Design of Improvement of Nagdhunga-Naubise-Mugling Road and Bridges, 2018

10.3.8 Excavation of Tunnel and operation

A series of heavy excavation works produce approximately 17,741.00 Cu.m. of spoil during excavation of 180m of tunnel and portals proposed at New Road Alignment at Sisne Khola to Dharke to Khani Khola Area. Heavy excavation activities are likely to produce seismic hazards including landslide and soil erosion at the tunnel portal areas during the time of tunnel excavation. Locals will be informed about the possibilities of such hazards and their access to tunnel portal and periphery areas during blasting and excavation will be strictly prohibited.

Tunnel and road excavation work will be carried out only during day time. The contractor will comply with Tunnel Construction Management Plan including other necessary guidelines¹¹ published by GoN for slope protection works. If done, blasting should strictly follow the license requirements from Ministry of Home Affairs. Where the vibration from blasting is exceeding

¹¹ Guide to Slope Protection Works, DOR, GON, 2007

the maximum permissible level, information from the blasting should be used to modify blasting patterns and calculate a reduced charge for future blasts with the aim of eradicating damage and to minimize damage as far as possible. In the event, if blasting is required it shall be carried out in line with the rules under the Act¹² in the prescribed manner and after prior notice to all local residents and the local town authorities. Some accidental cases are predicted within the tunnel due to the problem of visibility during the time of operation of tunnel. This sort of impact has been envisaged especially during sunny days and clear weather outside the tunnel portal. Accident is likely while entering a vehicle into tunnel as a driver might fail to manage the track properly due to sudden change in ambient environment from shiny to darker area, while travelling in high velocity. Difficulty in rescue and more suffocation due to the accumulation of dust and smoke is possible, if vehicle accident occurred within the tunnel. Lighting system inside the tunnel will be managed significantly providing enough backups for lighting to avoid power outage during the time of operation. Moreover, lighting systems will be adjusted so as to acclimatize with the outer environment and weather although vehicle will have high velocity.

10.3.9 Road side drain safety

Road side drainage all along the highway will be covered with thick slab so as to utilize the space above the drain. Covering of road side drain will widen the road width with ample space for plying vehicles especially during traffic jam especially at urban and market centers. Road side drain will be cleaned regularly opening the drain cover.

10.3.10 Protection of landslide areas

This road project has envisioned for extending the existing road along with the excavation of new road alignment. As the proposed new alternative road is a virgin alignment requiring fresh cuttings of hillside slopes and valley side slopes; likely impacts of slope instability and landslide will be anticipated at the areas having slopes greater than 45 degrees. Landslide and soil erosion will also be triggered due to excavation work in previously landslide and erosion prone areas like Krishna Bhir, Jogimara and Kurintar to Mugling area of existing road alignment. Similarly, landslide and soil erosion are likely at new open cut sections of Sisne Khola to Darke and Benighat to Kurintar area during construction phase where heavy mass of spoil will be generated. Slope protection works including bioengineering activities will be carried out to stabilize the roadside unstable slopes and landslide areas. The landslide and erosion prone areas after road excavation works in section wise are as illustrated in the Table 10-18.

Table 10-18: Highly Landslide Prone Area

Sn.	Chainage		Length (m)	Soil/Rock Type	Landslide Hazard
	From	To			
Nagdhunga Naubise Section					
1	0+000	0+200	200	Boulder Mixed soil	High

¹²Explosives Act, GON, 1961

Sn.	Chainage		Length (m)	Soil/Rock Type	Landslide Hazard
	From	To			
2	0+200	0+250	50	Hard Rock	High
3	0+250	0+850	600	Hard Rock	High
4	0+850	3+360	510	90 % Weathered Rock, 10 % Hard Rock	High
5	3+360	5+200	840	90 % Weathered Rock, 10 % Hard Rock	High
9	6+900	7+350	450	90 % Boulder Mixed soil, 10 % Weathered Rock	High
10	7+350	7+580	230	Weathered Rock	High

Naubise Baireni Section

13	11+080	11+200	0+120	60 % Soil, 40 % boulder mixed soil	High
14	11+200	11+800	0+600	70 % Weathered Rock, 30 % Hard rock	High
15	11+800	12+220	0+420	Boulder mixed soil	High

Baireni Bishaltar Section

39	30+080	30+200	0+120	Soil	High
40	30+200	30+780	0+580	80 % Weathered Rock, 20 % Hard Rock	High
45	33+320	33+860	0+540	Soil	High
52	42+000	42+790	0+790	60 % Hard Rock, 40 % Weathered Rock	High
56	46+100	46+900	0+800	Weathered Rock	High

Bishaltar Mugling Section

71	56+630	56+900	0+270	Soil	High
72	56+900	58+000	1+100	80 % Weathered Rock, 20 % Hard Rock	High
73	58+000	58+365	0+365	80 % Weathered Rock, 20 % boulder mixed soil	High
76	59+820	60+865	1+045	Weathered Rock	High
80	62+350	68+000	5+650	90 % Hard Rock, 10 % Weathered Rock	High
81	68+000	68+800	0+800	boulder mixed soil	High
82	68+800	71+200	2+400	Hard Rock	High
83	71+200	72+100	0+900	Soil	High
84	72+100	73+250	1+150	80 % Hard Rock, 20 % Weathered Rock	High

Sn.	Chainage		Length (m)	Soil/Rock Type	Landslide Hazard
	From	To			
92	78+675	80+260	1+585	Hard Rock	High
93	80+260	80+560	0+300	Boulder mixed soil	High
94	80+560	81+060	0+500	Hard Rock	High
Sisne Khola Dharke Road					
1	0+000	0+850	0+850	50 % weathered Rock, 50 % Hard Rock	High
2	0+850	1+000	0+150	boulder mixed soil	High
3	1+000	3+900	2+900	80 % weathered Rock, 20 % Hard Rock	High
4	3+900	4+400	0+500	80 % boulder mixed soil, 20 % weathered Rock	High
Bishaltar Phisling Road					
7	9+200	9+600	0+400	70 % Boulder Mixed Soil, 30 % soil	High
8	9+600	14+600	5+000	Hard Rock	High
9	14+600	15+000	0+400	50 % Boulder Mixed Soil, 50 % Weathered Rock	High

Source: Draft Detail Design of Improvement of Nagdhnga-Naubise-Mugling Road and Bridges, 2018

10.3.11 Measures for cutting of hill slopes

Angle of slope cutting will be maintained for fresh cutting slopes in order to avoid instability, landslide and erosion. However, sections with highly weathered rock exposure and slide areas partially along the Kirshina Bhir, Jogimara and ahead of Kurintar to Mugling section need to be considered, duly providing civil engineering structures. Moreover, the excavation of hill slopes at Nisakot-Community forest and opening of new road alignment along the last 5.5 km section of Bishaltar-Phisling alignment will be carried out considering the following.

- Construction contractor will choose the best work period to limit risks of erosion- avoid rainy season
- The contractor will avoid the creation of cut spots and embankments, which are of an angle greater than the natural angle of repose for the local soil type,
- Excavation along the hill slopes will be carried out protecting trees and vegetation along the proposed road alignment vicinity and re-vegetation of cut slopes as soon as possible.
- Contractor will replant disturbed areas immediately after disturbance stopped and not after construction has been completed, and their maintenance will be ensured,
- Drainage improvement activities will also be carried out immediately to control location, volume and speed of water flows in water courses in the vicinity of exposed soils and slopes.



Slope cutting will be done based on the natural type of material, and natural slope will be maintained. Following table presents the general angle of slope cutting in different types of geological characteristics.

Table 10-19: Guideline for Slope Cutting

Type of Material and Natural Condition	Angle of Cutting (vertical: horizontal)
Loose clay and vulnerable geology	2:1
Compacted soil with slope towards road	4:1
Soft rock	6:1
Hard rock	8:1

It is mainly the slope of toe that is vulnerable to slides and erosion. Thus, installation of retaining walls, gabion boxes, installation of rock-bolts will be adopted while cutting the slope along the 5.5 km after Kauti khet along the Bishaltar-Phisling new alignment. In cut areas, the exposed slope will be protected using conventional civil engineering structures in conjunction with bio-engineering techniques. Minimum damage to vegetation will be undertaken during excavation and construction. Exposed slopes will be planted with locally available vegetation as soon as possible using previously stockpiled top-soil. All areas susceptible to erosion, such as cut and fill areas, will be protected by either temporary or permanent drainage works. Measures will be taken to prevent ponding of surface water and scouring of slopes channelizing natural drainage. Newly eroded channels will be backfilled and restored to natural contours. Where crossing unstable terrain is unavoidable, the road width for the section affected will be minimize to reduce disruption to the slope. Special attention will be paid to drainage and leave a temporary road surface until a stable condition is achieved. It will be further ensured that the excavated materials or rocks will not go directly into the Trishuli River while excavation. Engineering measures for slope protection along the last 5.5 km of Bishaltar-Phisling will include followings:

- Intercepting ditches at the tops and bottoms of slopes.
- Gutters to be established and used to control the flow of water down a slope;
- Cutting of hill slopes into terraced or stepped slopes to reduce the steepness of a slope;
- Application of riprap or rock material embedded in a slope face, sometimes combined with plantation;
- Contractor will use of retaining structures such as gabion, cribs etc. with battered back against the slope;
- Installation of gravity stonewall or RCC wall.

Special attention will be given to drainage and will leave a temporary road surface until a stable condition is achieved. For the protection of open cut slope, bioengineering method as means of mitigation along with civil engineering structures has been proposed with detailing of site condition. Total required quantities with cost estimation has been done in this detail design stage. The following table includes the details of sites requiring bioengineering as slope stabilization measure.



Table 10-20: Summary of Bio-engineering

Pkg.	Section	Slope preparation works (m2)	Supply and planting rooted grass slips at spacing of 100mm in row & 250 mm spacing between two rows.	Supply & planting tree/shrubs (No.)	Supply & Brush layering (Rm)	Supply & broadcast grass seeds @ 25 gms/m2.	Supply & planting large bamboos (no.)	Supply & Jute netting works (m2)	Shrubs seeds sowing (Bhujetro) m2	Bamboo crib wall (Rm)	Fascines with live pegs (Rm)	Bolster (30cm cyld., gravel filled Mesh wire) (Rm)	Dry stone rip-raps (Rm)	Total
I	Nagdhunga - Naubise (0+00-12+400)	255,530	1,852,593	488,701	344,462	13,500	188,952	1,590,050	1,022,120	670,440	544,730	203,490	271,220	7,445,789
II	Naubise - Baireni (0+00-24+200)	191,552	1,388,752	366,343	222,851	323,244	108,954	661,980	766,208	395,160	356,495	102,942	122,240	5,006,721
III	Baireni - Bishaltar (24.20-53+00)	305,664	2,216,062	584,582	409,519	515,808	53,432	733,370	1,222,655	71,040	620,867	256,158	355,260	7,344,415
IV	Bishaltar - Mugling (53+00-82+400)	548,365	3,975,644	1,048,747	711,136	925,365	108,326	1,382,370	2,193,459	790,320	1,102,911	465,633	800,290	14,052,566
V	Sisne Khola - Dharke Section (0+00-11+200)	906,814	6,574,399	1,406,084	1,078,636	459,074	180,780	3,478,640	3,627,255	2,157,840	1,531,074	266,931	461,265	22,128,792
VI	Bishaltar - Phising Section (0+00-15+300)	2,105,113	15,262,072	1,757,421	984,521	1,016,806	229,492	8,962,690	8,420,453	924,852	1,556,917	448,875	790,740	42,459,953
Total		4,313,038	31,269,522	5,651,879	3,751,125	3,253,797	869,937	16,809,100	17,252,150	5,009,652	5,712,994	1,744,029	2,801,015	98,438,273

10.4 Compensatory plantation:

The scale and extent of impact on forest area was assessed during field surveys with estimation of damaged and cut trees and poles. Evaluation was done for other vegetation that will be removed. During the field activities all stakeholders of the forests, which will be affected, were informed about project activities and potential impacts on their forests and ecosystems. During reconnaissance biodiversity and forest survey, several meetings were held about loss of forest area and trees, when all concerned stakeholders were informed, including members and staff of CFUGs, Division and Sub-Division Forest Office, District Soil Conservation Office, Local Development Office and local communities. They were aware about compensation of tree loss. The compensation, according to existing regulations is 1:10 or planting of 10 new trees (saplings) against one loss tree or pole. If the planted saplings died in first years, they should be replaced with new saplings again during 3 consecutive years. The plantation will be protected, nurtured and handed to the interested stakeholder on 5-year after establishment. It is expected that local groups will be engaged in the management and protection of plantations, which will be fenced and watched by safeguards from community. Staff from local community/leashold forest will be hired to conduct silvicultural works for better re-plantation. The location and size of potential areas for re-plantation and nurseries were also discussed. Stakeholders were informed about conditions for good nursery and participated in the discussion relevant to location, land quality, water availability, access roads and other technical details for establishment of nurseries. Location places for nurseries were chosen in consultation with local CFUGs and DFOs. It was figured out that the availability of land for tree plantation is scarce in the project area; the detailed design team studied this issue in depth and mapped potential sites. Even though, it is still difficult to attain required 112.2 ha of open area for plantation, and further discussion with concerned DFO, CFUG and other interested stakeholders is needed. Although, local stakeholders confirmed that they will participate in the establishment and rearing of nurseries and new plantations. Special plantation programme of the Government can respond partly to the need of the project.

Local stakeholders will be involved in the forest management during preconstruction and construction phases, ensuring safety of the forest and evaluating amount and types of forest products removed from forests. Protected tree species, occurring within the carriage width and required to be cut, will be marked properly and volume of those affected trees will be calculated. All the forest products, generated during clearance of the forest area will be distributed among the CUFGs, because according to community forest rules and regulations, the forest product generated in the course of forest management will be used under the jurisdiction of the users themselves. CUFGs will be equally participate during the marking of affected trees. The stakeholder will ensure that only the affected trees are marked and cut accordingly. Further, DFO will provide tree cutting permission of affected trees. Members of CUFGs along the proposed alignment will facilitate the project to seek approval for the affected trees for cutting during the early stage of the project construction.



Loss of trees and forest area:

The study revealed that 11961 trees (trees and poles) will be cut to construct and improve the highway affecting 37.44 ha of forest area. In Kathmandu Naubise section, there will be 41 trees, in Naubise Mugling Section 2302, in new sections, Sisnekhola-Dharke and Bishaltar-Phisling, there will be 2,702 and 6,916 trees cut, respectively. While felling proper recording and storing of the trees should be done in accordance and in collaboration with the concerned DFO.

Following existing regulations, the project will carry out a compensatory plantation scheme, replacing trees cut. It is estimated that a total of 1,79,514 (119,610 saplings in the ration of 1:10 and additional 59,904 saplings for the use of 37.44 ha. of forest area) will be required replenishment programme. It is cheaper to grow saplings within the project area. Seven nurseries have been proposed to establish in the project area: five of them in collaboration with the community forest user groups and two - with Division or Sub-Division Forest Offices. These saplings will be planted in an area of 112.2 (74.76+37.44 ha) (1,600 saplings in 1 Ha.) and maintained for 5 years before it is handed over to the respective affected forests under different management regimes.

Table 10-21: Affected area, number of trees cut and area required for compensatory plantation

SN	Section	Forest area in Ha.	Trees cut number			Area and saplings required		
			Trees	Pole	Total	Saplings	Area (Ha)	Nurseries
1	Kathmandu (Nagdhunga) -Naubise	3.91	3	38	41	410	0.26	1
2	Naubise-Mugling		49	2253	2302	23020	14.39	1
3	Sisnekhola-Dharke	3.61	278	2424	2702	27020	16.89	1
4	Bishaltar-Phisling	28.15	649	6267	6916	69160	43.23	2
	Total	37.44	979	10982	11961	119610	74.76	5
	Total saplings required for the use of 37.44 ha. of forest area					59904	37.44	
	Grand Total					179514	112.2	

Source: Field survey 2017

Locations of nurseries were chosen in consultation with local CFUGs and DFOs. Nurseries were proposed in accordance with the number of saplings required in each case. The Bishaltar Fisling section requires the highest number of saplings for plantation and more area for replacement plantations (Table 10-22). More no of sites are proposed for selecting effective site during implementation.

Table 10-22: Nursery sites

Sn	Section	Nurseries		Remarks
		Location	GPS coordinates and mileage	
1	Kathmandu (Nagdhunga) -Naubise	Naubise AFO (Large Nursery)	27-43'05.40"N 85-09'16.89" E	
2	Naubise-Mugling	Bairenni (near Galchi)	27-47'56.07" N 85-00'02.98" E	



Sn	Section	Nurseries		Remarks
		Location	GPS coordinates and mileage	
3		Simle	27-45'02.28"N 85-03'00.23" E	
4		Siurenitar Ilaka Forest Office, Gorkha	27-48'48.12" N 84-46'20.76" E	right side of highway and east of suspension bridge
5		Kurin ghat	27-52'08.51" N 84-37'51.08"E	
6	Sisnekhola-Dharke	Kalika CFUG	3.9 km from Sisnekhola	
7	Bishaltar-Phisling	Salleri CFUG	7.5 km from Bishaltar	

Source: Field survey 2018

The nursery locations have been selected in such manner that they will be located on equal distance from the replantation sites. The capacity of each nursery is varying and maximum 100,000 saplings. Nurseries will be managed by the CFUGs, which do not have technical knowledge and need some instructions and training for growing saplings. Two nurseries were deliberately chosen in the area forest offices to provide larger quantities of saplings, under supervision of forestry professionals. With negotiation, the Area Forest Offices in Naubise, Dhading and Siurenitar, Gorkha can produce also larger numbers of planted trees. Other nurseries are placed in Baireni, Kurin-ghat and Simle in Dhading; Salleri CFUG of Gorkha and Kalika CFUG of Dhading.

The forestry programme performed at district level is called "A decade of Forestry Programme (Ban Dasak)". In accordance with this programme, the division forest offices plan to realize a huge plantation in suitable sites. The CFUGs are highly concerned about the location of plantations and people, involved in the plantation work. They all are willing to provide space for forest plantations in their forest area. The CFUGs suppose that plantation should be formed with fast growing, local and high value timber species. They have ensured their participation for the success of replantation efforts. The CFUGs are keen to support not only production of seedlings, but to rear and establish the plantations. Also, it should be discussed the opportunity for plantation of trees in degraded forest.

Along the Naubise-Mugling segment, Mahesh Khola area can be used for plantation. In Sisne-Khola – Dharke section, the new plantation can be proposed along the riverside, located closely to the school, in which proximity the disposal site will be located. Along Kathmandu (Nagdhunga) – Naubise and Sisnekhola Dharke segment, the banks of some rivers and creeks could be planted, including Mahesh Khola (7 km), Naubise Khola (6 km), 4 tributaries of the Mahesh Khola river (between 4+100 to 8+800) around 6 km (or 9.5 km stripe). Another potential is Trishuli River, where some islands could be selected for planted of trees. Kurintar area is a potential site for plantation with about six-hectare island in the middle of Trishuli River. North of Benighat, a small village called Darbung.

Towards the Eastern side of Durbang fant (agricultural land) and west of Furke danda and Ranswara and north-east of Tangli Chok, a sizable block of degraded forest is found. Size of this



forest is estimated to be about 200 ha of land. Durbang is about 9.5 km from Kurintar. The Ilaka forest office staff at Suirentar and Gorkha were also consulted about potential sites. As the project is distributed in 4 districts, DFO Gorkha alone may not be in a position to decide, because coordinated decisions should be taken among all districts, including Dhading, Kathmandu and Chitwan. Potential sites are presented in the Table 10-23.

Table 10-23: Plantation sites

SN	Segment	Side		
			Right	Left
1	Naghdhunga Naubise	-	4+050; 6+100	0+300; 2+950~3+250; 8+800; 9+500
2	Naubise Mugling	-	0+200~0+300; 19+700 30+200~050; 40+450; 49+050; 67+950~68+200; 70+800~71+050; 77+000~77+150;	0+500; 2+350~500; 8+200~350; 10+100~200; 11+250~550; 12+300; 14+600; 28+650; 30+850~31+050; 31+600; 33+300~400; 34+600~700; 60+200; 63+750; 65+050; 65+550; 67+200; 72+550; 73+750; 79+500; 80+990~81+050
3	Sisne Khola-Dharke	-	9+700	1+500~700; 3+300~600; 7+500~900
4	Bishaltar – Phisling	-	3+00~400; 4+000~400; 7+400; 7+850~ 8+200; 8+800~ 9+100; 9+600~ 10+00; 10+400~800	0+600;4+200; 7+700; 13+200

Adapted from ICT (India), Sosang (N Korea) and FBC (Nepal), 2018. Environmental Assessment Report (Draft Design Report), Nepal India Trade and Transport Project.

Species for Replacement Plantation

It was found that preferred species in community forests is Sal in the Naubise- Mugling and Bishaltar-Phisling Sections. Distribution of forest type is another factor; two types of forests - Hill Sal and Terai mixed hardwood – contain the Sal tree as a dominant species. Of the total species, sal occupied 44%, followed by Khair (21%) (Table 10-24). Some other species were also proposed after consultation with the stakeholders. The communities also mentioned the NTFP species, used for income generating and grass/bamboo species, generating income in short span of time. Some of these, especially grass species and horticultural species will be grown to distribute among local stakeholders to generate income from enterprising at the local level (cooperatives, etc.). Some of the horticulture species were also proposed such as Mango, Banana, Lemon, Pineapple, Cassia, and Guava.



Table 10-24: Species raised in nurseries for replacement plantation (species preferred to be grown in replacement plantation)

Sn.	Species	
	Local name	Latin name
<i>Tree species</i>		
1.	Sal	<i>Shorea robusta</i>
2.	Khair	<i>Acacia catechu</i>
3.	Kholesalla	<i>Pinus roxburghii</i>
4.	Chilaune	<i>Schima wallichiana</i>
5.	Sissoo	<i>Dalbergia sissoo</i>
6.	Patesalla	<i>Pinus patula</i>
7.	Utis	<i>Alnus nepalensis</i>
8.	Bakaino	<i>Melia azdachata</i>
9.	Camuna	<i>Sisegium cuminee</i>
10.	Badkaule	<i>Casearia graveolens</i>
11.	Lapsi	<i>Choerospondias axillaris</i>
12.	Khanayo	<i>Ficus semicordata</i>
<i>Non Timber Forest Species and grass species</i>		
13.	Harro	<i>Terminalia chebula</i>
14.	Barro	<i>Terminalia chebula</i>
15.	Bael	<i>Aegele marmelos</i>
16.	Jamun	<i>Syzygium cumuni</i>
17.	Taru bans	<i>Bambusa nutans</i> sub-species (nutans)
18.	Choya/Tama Bans	<i>Bambusa nepalensis</i>
19.	Mal bans	<i>Bambusa nutans</i> subsp. (cupulata),
20.	Khar	<i>Imperata cylindrical</i>
21.	Amriso	<i>Thysanolaena maxima</i>

Source: Field survey, 2017

Extension, training, orientations, and employment for the local people:

Training of the local people, district forestry organizations, and workers, involved in the construction is important for the success of the forest rehabilitation. During implementation the plantation program, the local stakeholders will be trained to work with growing of saplings in nurseries and trees in the plantations. Some of the trained people also will get chance to be hired as well. About 134 fence watchers will be employed for 5 years with a salary of NPR 10,000 a month for protection of plantations. It will provide very good resources for the rural household economy. Besides, local forest users will be employed in establishing and running nurseries, producing seedlings, fencing of nurseries, plantations, clearing of plantation site, pitting and plantation of area, and in silvicultural activities including harvesting and clear felling of affected forest area and hauling the trees and timber to the road-head or a depot.

All the schools within 2 km corridor will be selected to provide orientation classes for biodiversity management. Such orientation will be provided to secondary school students. Providing orientation to school students will be an effective tools to disseminate the information related to project implementation and importance of biodiversity. PMSC will provide orientation to schoolchildren aiming to enhance biodiversity and forest management. The orientation will also focus upon road safety and accident, importance of roadside greenery, and biodiversity conservation. At least 3-orientation class will be conducted in every month during the project period. Further, drawing competition, essay competitions etc. will also be conducted to enhance or widen the knowledge of the students on road safety and accident and biodiversity conservation.

Costs of replacement plantations:

A total cost including the extension/training cost of the replacement plantation of trees affected will be NRs 73,917,043.20 (In words Seventythree million, nine hundred seventeen thousand fortythree and twenty paisa only). The total estimate also include cost for rearing maintaining plantations, management including cost for extension activities.

Table 10-25: Cost of cutting of affected trees and compensatory plantation and its establishment

Item	Quantity	Unit	Unit cost	Cost
These activities shall be carried out in coordination with CF or separately contracted body			NRs	NRs
Cutting of affected trees including transportation and storage of wood logs (5 trees a manday)	11,961	No.	140	1,674,540.00
Fencing plantation area	187	ha	150,000	28,050,000.00
Plantation of trees for compensation*1	187	ha	55,881	10,449,747.00
Establishment of Nursery	5	No.	400,000	2,000,000.00
Seedling production	179514	No.	15	2,692,710.00
19 Watchmen for the protection of planted trees for 5 years	95	No.	84,000	7,980,000.00
Silvicultural activities in the plantation for 187 days/year for 3 years	561	No.	3,500	1,963,500.00
Training on Plantation rearing and management (200 persons per training)	8	No.	200,000	1,600,000.00
Forest fire control and fighting	10	No.	100,000	1,000,000.00
Knowledge on wild animal behavior, habitat, range and co-existence.	24	No.	100,000	2,400,000.00
Training users and forest staff on plantation silviculture (forest fire control)	8	No.	100,000	800,000.00



Item	Quantity	Unit	Unit cost	Cost
Extension activities: Sign boards and signs for Forest fire sensitivity, Animal passing, Educative sign boards on animal behaviors, habitat and others	20	Location	50,000	1,000,000.00
Orientation to school children, local clubs regarding the project, environmental management and management and enhancement of biodiversity management	20	Months	100,000	2,000,000.00
Sub-total				63,610,497.00
Contingencies (@ 10% of sub-total)				6,361,049.70
TOTAL				69,971,546.70
Note: 1\$=112 as of 15 August, 2018			In USD	624,745.95
Labor rate of Kathmandu District for 2074/75 is NRs 900. Annually, the rate is revised and expected to reach 1000 or more by the time the project is implemented				

To save the cost and make plantation projects more sustainable and practical at the local level, the leasehold forestry can be developed. The degraded forests will be identified, not more than 10 ha. and developed as leasehold forestry programmes. This will save the costs of rearing, maintaining, and protection (fencing and watcher). According to the CFUGs this approach could be an effective way of conducting successful replacement plantations.

Roadside plantations and its costs:

Training of the local people, district forestry organizations, and workers involved in the construction is important for the success of the replenishment plantation programme. The training will also incorporate technique and other details of urban plantation, including roadside plantation and species selection. Roadside plantation species are ornamental and long-life plants. More details of plantation training will be as in 10.4 (cost of replacement plantations). In areas like Nagdhunga, Naubise, Dharke, Mugling and others, plantation will be a single plant roadside plantation. However, in places like roadside between Khanikhola and Naubise where there is no houses built, line/s plantations can be done. In areas with steep slopes, depending upon the soil characteristic, steepness, aspect and overall carrying capacity species and spacing between individual or lines will be decided. However, its to be known that, roadside plantation, with previous experience, was not that thought of in this case.

Watchmen will in place for all the roadside centers where plantation is to be carried. A special fence that will keep away animals specially. In addition, the saplings to be planted are to be at least 4 feet tall saplings, costs of which will be much higher than those planted in block plantations. In

the absence of exact location/area/ length of roadside plantation being not known, some basic details of the roadside plantation are as tabulated below.

Table 10-26: Roadside plantation and indication for costs

Sn.	Roadside plantation Items	Item specification	Remarks
3.	Site selection	Wherever the situation allowed	
4.	Soil quality	Generally poor to very poor	
5.	Site preparation	Bigger pits, compost filling is must	
6.	Fencing	Generally metal fence and a ring per plant Cost not known	
7.	Fence watcher	Employed for 3 years (min), who will also conduct plantation maintenance and silvicultural activities	Sallary not less than NRs 12,000
8.	Cost of tall saplings	Not known	
9.	No of tall saplings	Not known	
10.	Species of plantation	After consultation with the locals	
11.	Cost of sign board/s	Not known	
12.	Meetings with the locals	As needed in cooperation with the local group	

Note: Labor rate of Kathmandu District for 2074/75 is NRs 900. Annually, the rate is revised and expected to reach 1000 or more by the time the project is implemented.

To save the cost and make plantation projects more sustainable and practical collaboration with the local stakeholders, both individuals and groups, pays for the success of the plantations. Clubs, NGOs at local level, schools, CFUG, LHFG, Army units (if available), police units (if available), etc could be such some potential groups.

Saplings for roadside plantation need to be of a height which is beyond the reach of free roaming cattle. These are grownup tall and healthy saplings which will grow well in these harsh sites largely. Unlike the above plantation the pitch dug are larger, deeper and need ample forest soil added with good quantity of compost. Fencing similarly is different compared to the block plantations, as fencing is done individually largely.

10.5 Recommendations for wildlife cross-road structures in the project area

Although the project team did not find the critical wildlife habitats in the project area, the number of species would be adversely impacted, especially in the new planned alignments, including 5 globally threatened and 16 nationally threatened mammal species found in forests and other natural habitats along alignments. Besides, in many places rural people told that high-speed highway will interrupt the normal movement of people and livestock along the road, therefore over-passes and underpasses should be constructed in highly populated rural areas, where cattle breeding has the significant scale. So, not only wildlife crossing structures, but also livestock crossing structures are needed to ensure safety and permeability of the high-speed highway for people, livestock, and wildlife. It is also important to know for what kind of animal crossing structures are planned, because various animals may use different types of crossing structures and different strategies for

crossing landscape. Therefore, there are two main aims to provide measures to reduce habitat fragmentation and wildlife collisions:

- Ensuring links and connectivity between wildlife habitats and also between rural settlements and livestock grazing places;
- Reducing wildlife or livestock vehicle collisions and improving motorist safety.

Safety features: Rope way for Monkeys

Due to the conservation efforts and forest cover increment in the remaining fragmented forests of the middle mountain region of Nepal, number of monkeys has increased. With the increase in number Human-Monkey conflict and roadkill by vehicles are also rising in recent years. Thus to mitigate road kills, ropeway pass should be installed at the community forests adjoining the highway. Such ropeway pass will ease the movement of monkeys across the highway and road kills can be minimized significantly. Please refer to the points below which specifies where such potentials exists. Number of such crossover depends upon the population of monkey. Monkeys normally cross over or move for food and drinking water. Keeping in mind the availability of such spots these will required to be constructed. Some of such sites where monkey population was significant are Patleban CF, Bhasmelampokhari CF, Indradevi CF, Panchakanya CF, Amaltari CF, Falepakho CF, Balkumari CF, Chiraudi CF, Indreni CF, Thulodanda CF, Nivare CF, and Cheppang CF. Please refer to table below for more details.

Table 10-27: Forests with sizable population of monkeys in the project area

Sn.	Latitude	Longitude	Remarks
1	27° 42' 29.77"	85° 12' 15.30"	Patleban CF
2	27° 45' 59.80"	85° 02' 30.53"	Bhasmelampokhari CF
3	27° 48' 13.50"	84° 56' 17.38"	Indradevi CF
4	27° 47' 49.48"	84° 55' 28.94"	Panchakanya CF
5	27° 47' 54.08"	84° 55' 08.56"	Amaltari CF
6	27° 48' 35.11"	84° 49' 31.83"	Falepakho CF
7	27° 48' 46.65"	84° 47' 49.35"	Gov. Forest
8	27° 47' 49.60"	85° 00' 20.53"	Balkumari CF
9	27° 43' 35.88"	84° 58' 14.76"	Chiraudi CF
10	27° 48' 49.98"	84° 57' 9.9"	Indreni CF
12	27° 48' 3.13"	84° 52' 2.20"	Thulodanda CF
13	27° 50' 29.1"	84° 39' 59.1"	Nivare CF
14	27° 49' 46.14"	84° 39' 54.48"	Cheppang CF
15	27° 45' 36.61"	85° 2' 32.71"	
16	27° 48' 50.29"	84° 47' 49.96"	Numbers of monkeys were observed crossing the highway
17	27° 48' 3.43"	84° 42' 37.62"	
18	27° 48' 27.60"	84° 42' 15.64"	

10.5.1 Ensuring wildlife connectivity:

Among large species only Common Leopard (*Panthera pardus*) need special measures to connect habitats in the project area. This is a nocturnal animal, which use natural landscape features for movement across landscape. Providing the path under bridges for terrestrial animals will be sufficient and significant measure to ensure connectivity of leopard's population in the project area.



Figure 10-3: Fishing cat killed on road accident on 16th Nov, 2016

Among low-mobility medium-sized and small mammals, several species can be detected in the project area such as Leopard Cat and other wild cats, civets, mongooses, Chinese Pangolin. They are already affected by road development in midhill area with high level of road mortality confirmed by observations of DFO staff. Mostly these animals also can use terrestrial path under bridges along river valleys, however, they also will benefit from special infrastructure established such as underpasses, culverts, box or arch tunnels.

Semi-aquatic and aquatic animals, associated with rivers and riparian habitats, such as Fishing Cat, Jungle Cat, Golden Monitor Lizard, some snakes, lizards and amphibian species will benefit from adapted culverts and management of space under-bridges, ensuring wildlife connectivity.

Semi-arboreal mammals such as Terai Grey Langur, other monkeys, squirrels, civets, and martens need special arboreal bridges in the areas with high population densities.

10.5.2 Reducing wildlife or livestock – vehicle collisions:

Many relatively simple measures can be proposed to ensure safety of people (pedestrians and motorists), connect people and livestock, bisected by road, and ensure highway permeability for wildlife populations. These measures are listed below:

Special infrastructure includes wildlife or livestock overpasses for multiple use, canopy crossing for monkeys and other mammal-climbers, underpasses for large or medium animals, box or arch tunnels (or modified culverts) for amphibian and reptile movement and bridges with water-flow, also adapted for movement of wildlife and livestock. Identifying the right type of wildlife crossing structure depend on design of the wildlife crossing type for specific animals (large, medium or small), needs in crossing structures in specific places and topography of the site, defining engineering solutions.

Habitat adaptation can be done through management of roadsides and wildlife habitats along the road (cutting of grass, keeping open roadsides to prevent animal movement to the road, etc.).

Special measures in the areas with high animal density, where animals may cross road often such as animal signs with speed limitation and other signage, speed reduction, lighting and reflectors, animal detection systems and fencing.

Some of these measures might be proposed along the existing Kathmandu – Mugling highway and along new alignments in Sisnekhola- Dharke and Bishaltar-Phishling.

10.5.3 Wildlife Mitigation measures along the KNM Road and new Alignments: Mitigation measures along existing Kathmandu – Naulise – Mugling Highway

Although during time of highway operations, the permeability of wildlife populations was significantly disrupted by existing road and intensive traffic flow, the need in cross-road structures still exists, especially in rural areas where many people hold domestic cattle and livestock, and in



Figure 10-4: Group of red monkey sighted at Naulise

the places, where the road crossing the river and stream valleys, serving as natural dispersal corridors for the wildlife moving across mountains. It is reasonable to adapt culverts and bridges in such places also for wildlife movement. During construction the bridges, the design of terrestrial paths should be considered that to ensure movement of wildlife and livestock in such places. The bridges will serve in this case as

underpasses for wild and domestic animals and

also for people in rural communities in some cases.

Speed signs and other signage, lighting and reflectors and fencing to prevent domestic and wild animals moving through the roads should be established in appropriate places.

Mitigation measures along Sisne-Khola-Dharke Section: The main wildlife habitats along Sisnekhola – Dharke section are located in Nisakot Community Forest, which will be severely affected with many cut trees and cleared vegetation. Certainly, that this will affect local wildlife, which will lose habitats and connectivity with major habitats. According to expert opinion, there is no need in the construction of cross-road structures along this section because forest habitat will be lost and new forested habitats will be established only with re-plantation of trees and saplings from nurseries in new locations along the road.

The natural rehabilitation process will compensate loss and movement of the wildlife species from this area. However, the bridges with special terrestrial paths under construction will ensure dispersal of wildlife from surrounding relatively intact areas and recolonization of new plantations by wildlife species in this area. Culverts also can serve for dispersal and movement across landscape small reptile and amphibian species.



Mitigation measures along Benighat-Phishling Section: In this section, the road will be built through agricultural and forest area. Forest area is located along the last 5.5 km of the planned alignment. More likely, that habitats, located closely to the road, will be lost and many populations of local species affected by barrier effect and habitat fragmentation. To prevent this negative impact on local wildlife, the underpasses for small and medium-sized animals as well as tunnels for reptiles and amphibians can be recommended along this section of the road in places with natural topography (precipices, streams, small valleys, etc.) supporting dispersal of wildlife species on distance in 1.5 – 2 km each from other: at least, 2-3 underpasses and 4 herptile tunnels can be recommended to be built in this area. The monkey overpass also can be proposed in the potential areas, where road bisect monkey (Terai Grey Langur or others) habitats. Other mitigation measures in this section will include animal signs (monkeys and leopard), speed signs, culverts and bridges adapted for wildlife movements.

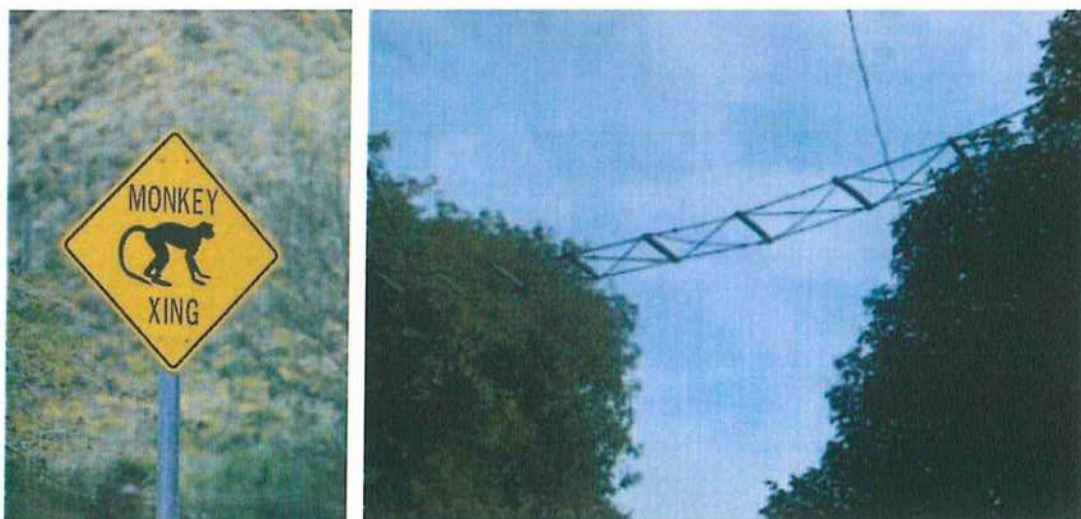


Figure 10-5: Monkey sign and rope overpass for tree-climbing animals in Southern Brazil.



Figure 10-6: Reptile and amphibian fence and tunnel in Canada, providing guiding to small animals to the tunnel along the fencing.

Table 10-28: Section wise required land area, project affected households, public/private/community infrastructure relocation

SN	Sections	Required land area for compensation of affected private land (Ha.)	Number of project affected HHs requiring compensation	Number of Project Affected Private Structures	Required land area for compensation (in Ha.)	Number of trees for compensatory plantation	Number of infrastructures requiring relocation				Disposable Spoil volume in cum	Pedestrian Bridge (Foot-over Bridge)	Location of Bus Lay-Byes and Truck Lay-Byes	To Plaza	Wayside Amenity	Underpass	Overpass
							Electric poles (no)	Irrigation canals (m)	Existing Trunks (km)	Water supply pipes (m)							
1.	Nagdhunga-Naubeise	0.21	78	76	0.26	410.00	1,161.00	-	-	43.76	17,013.00	-	2	-	-	-	-
2	Naubeise Mugling				14.39	23,020.00	-	-	-	-	198,874.00	19	25	2	1	-	-
3	Sisne	25.4	384	58	16.89	27,020.00	105.00	400.00	1.68	3.70	302,949.00	-	6	-	-	2	1
4	Khola-Dharke				43.23	69,160.00	85.00	1,400.00	0.40	3.36	382,929.00	-	11	-	-	1	1
	Bishaltar-Phisling	17.72	248	47	74.76	119,610.00	1,351.00	1,800.00	2.08	50.82	901,765.00	19	44	2	1	3	2
	Total	43.33	710	181													



10.6 Cost estimation for relocation of utilities and measures for mitigation

10.6.1.1 Cost Estimation for the relocation of affected Electric Poles

Below is the Cost estimation of relocation of Electric Poles

Table 10-29: Cost Estimation of Relocation of Project Affected Electric Poles

Nos. of Affected Pole	Relocation Cost (NRs.)
1351	67,550,000.00

Source: Field Survey, 2017

10.6.1.2 Cost Estimation for the relocation of affected Water Pipes

Table 10-30: Cost Estimation of Relocation of Project Affected Water Supply Pipes

1" Dia. Pipe		0.5" Dia. Pipe		1.5" Dia. Pipe		2" Dia. Pipe		Total (NRs.)
GI	PVC	GI	PVC	GI	PVC	GI	PVC	
282,000	1,958,000	-	141,200	-	217,000	-	505,800	3,104,000.00

Source: Field Survey, 2017

10.6.1.3 Cost Estimation for the affected public structures

Table 10-31: Cost estimated for project affected public structures (chautaro, temple, sheds etc.)

Road Section	No. of Affected Structure	Estimated Cost (NRs.)
Nagdhunga -Mugling	9	2,738,457.00
Sisnekhola-Dharke	1	475,477.00
Total	10	3,213,934.00

Source: KNM Final Design Report July 2018

10.6.1.4 Cost Estimation for resettlement and rehabilitation and implementation of EMP, RAP and VCDP

Table 10-32: Cost estimated for resettlement, Rehabilitation, implementation of RAP and VCDP

Cost Item	Amount (NRs.)
Cost Estimation of Project Affected Private Land	2,886,085,586.00
Cost Estimation of Project Affected Private Structures	252,580,767.00
Cost Estimation of Resettlement Assistance	5,840,000.00
Cost Estimation of Rehabilitation Assistance	1,980,000.00
Cost Estimation of Material Shifting and Dismantling	16,920,000.00
Cost Estimation for Livelihood Support Training	11,700,000.00
Estimated Cost for RAP Implementation Activities	8,580,000.00
Estimated Cost for VCDP Implementation Activities	10,015,000.00
Estimated Cost for External Monitoring	2,500,000.00
Contingency 10 % of Total Cost	319,620,135.00
Total	3,515,821,488.00

Source: KNM Final Design Report July 2018



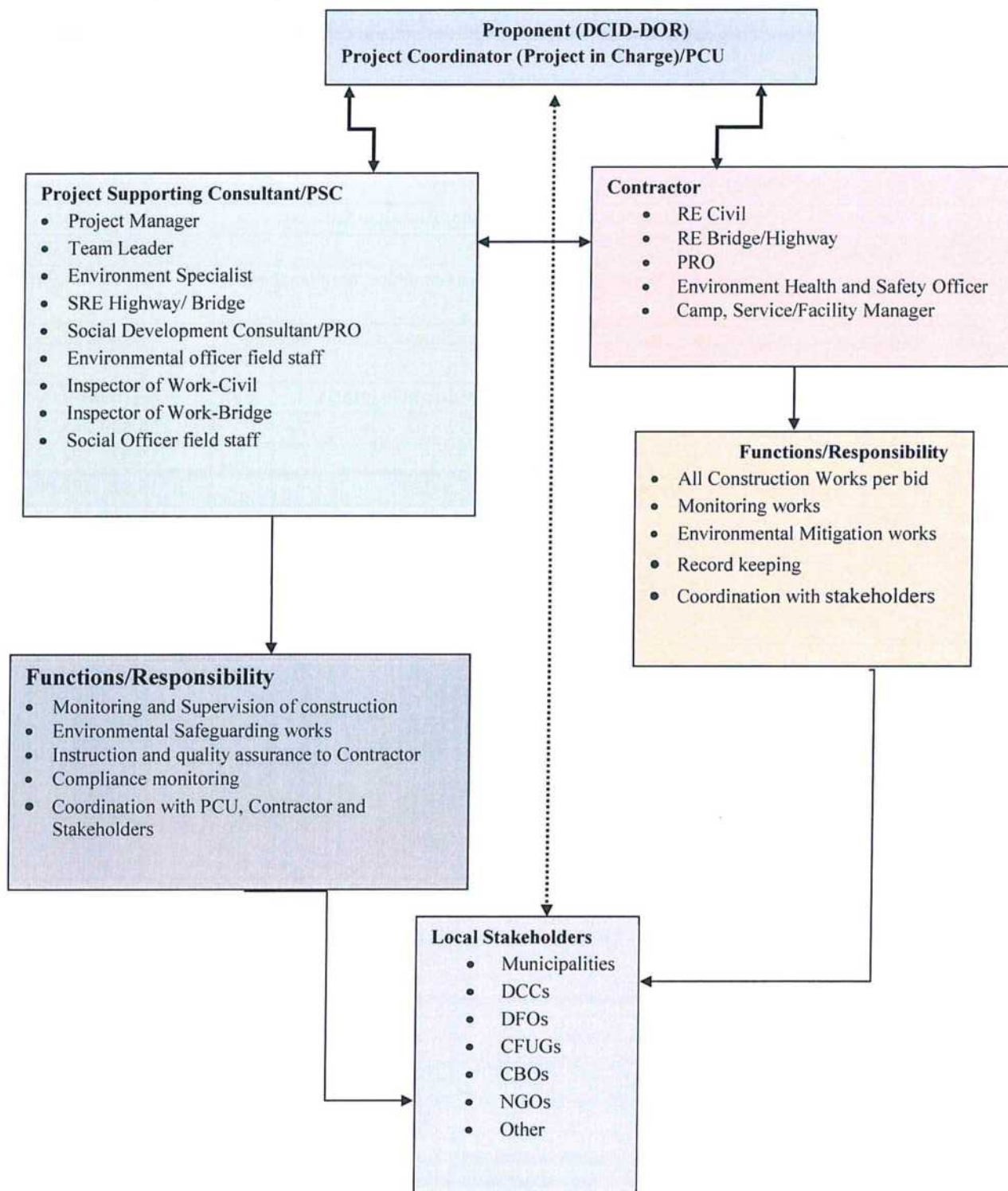
Table 10-33: Estimated cost for Environment Mitigation Measures and enhancement

Sn.	Particulars	Total Cost
1.	Cost of compensatory plantation and nursery establishment and trainings (Table 10-25)	69,971,546.70
2.	Relocation of electric poles (Table 8-4, Table 8-13, and Table 8-19)	67,550,000.00
3.	Relocation of water supply pipes (Table 8-5, Table 8-12, Table 8-20)	3,104,000.00
4.	Relocation of irrigation canal (Table 8-11, Table 8-21)	7,087,965.00
5.	Tunnel and fencing for wild animal crossings (Along Bishaltar Section)	1,000,000.00
6.	Bioengineering (Table 10-20)	98,438,273.00
7.	Cost estimated for project affected public structures (chautaro, temple, sheds etc.) (Table 10-31)	3,213,934.00
8.	Orientation on transportation and traffic safety for schoolchildren of schools along the project site and for women's group.	1,400,000.00
9.	Income generation trainings focusing indigenous/vulnerable groups	1,200,000.00
10.	Safety Cost (Included in Detail Design)	158,839,023.20
	Total Environmental Mitigation Cost	412,536,304.40
11.	Land Acquisition and Resettlement Cost (Table 10-32)	3,515,821,488.00
12.	Total	4,340,162,534.30

Note: Cost for Rehabilitation of existing road network (Table 10-17) is included in detail design.



10.7 Project flow cycle



CHAPTER 11. Environmental Monitoring and Audit

11.1 Environment Monitoring Plan

Environmental monitoring will be carried out to ensure effective implementation of the proposed measures for the mitigation of anticipated and predicted environmental impacts. Timely and regular monitoring of the project activities will be required to ensure the effectiveness of the proposed environmental mitigation measures. The objective of monitoring is to provide information that the predicted impacts of a project are within the acceptable limits and to provide early warning about unacceptable environmental conditions; checking the implementation of enhancement and mitigation measures in the manner described in the impact chapter of EIA report. Environmental Monitoring will be carried out with the identification of a set of indicators. At the same time EMP assists to ensure compliance with environmental laws and in ameliorating and eliminating adverse impacts caused by the project. A detailed monitoring program in the form of an Environmental Management Plan (EMP) has been prepared for its effectiveness during monitoring.

In road construction projects, the consideration of landscape issues is very essential, because many indirect and cumulative impacts may affect physical, biological and social environment at the large scale. For example, deforestation may cause adverse impact on soil erosion and slope-stability in the new alignments, where forests and other vegetation prevent land-slides. Populations of threatened and common species in the project area (especially in Benighat – Phishling section) can be impacted by fragmentation effect, because the new highway will create barriers for their movement to Trishuli River. In combination with better access to the area for people, created by road, the populations of many local species can be declined due to hunting and poaching. Community life might be also affected, because road facilitate specific activities connected to access for better labour and product markets, opportunities for business development, land use change, access to urban centers and other social benefits, creating not only positive, but also adverse impacts, such as loss of physical assets and deterioration of natural resources and associated economic activities

Therefore, the EMP identifies monitoring objectives and specifies the type of monitoring, with linkages to the impacts assessed in the EIA report and the mitigation measures described in the EMP.

According to EPR, 1997, the concerned body i.e. the Ministry of Physical Infrastructure and Transportation (MoPIT), in case of highway construction proposals, shall monitor and evaluate the impact of project implementation on the environment. The proponent will be responsible for in-built monitoring Activities. However, Ministry of Forests and Environment (MoFE) and other relevant agencies should also be involved and consulted during the monitoring.



11.2 Objective of EMP

The primary objective for the preparation of EMP is to implement proposed mitigation measures effectively and enhance monitoring program as well as further plan for environmental auditing for smooth and sustainable implementation of KNM Road project. The specific objectives of EMP are:

- to define environment management principles and guidelines for all phases (pre-construction, construction and operation) of the project;
- to establish the roles and responsibilities of all agencies involved in project environmental management;
- to formulate protection measure implementation plan for the mitigation of significant adverse environmental impacts including augment beneficial impacts;
- to provide necessary staff skills and a detailed accounting of the estimated costs to implement the plan;
- to formulate a monitoring programme for baseline, impact and compliance monitoring;
- assign the budget, time schedule and responsible parties for implementation
- to ensure effective and timely implementation
- to formulate an environmental auditing and evaluation of mitigation programme to be implemented after the construction of project.
- ensure compliance with relevant laws, regulations, permit conditions and standards

The EMP consists of the following parts: (i) implementation arrangements, (ii) roles and responsibilities for environmental management, (iii) acquisition of prior clearances and no-objection certificates, (iv) general guidelines, (v) a listing of environmental impacts and mitigation measures; (vi) the environmental monitoring and reporting program for construction and operation stages; (vii) recording, auditing and corrective actions; and (viii) the environmental management budget and resources.

11.3 Institutional Arrangement for EMP Implementation

The environmental management framework during construction is based on and integral with the overall project management framework for the project.

The project will be implemented by the Department of Roads (DOR) as the Executing Agency. The World Bank will be as a financial institution of the investment. The Development Cooperation Implementation Divisions (DCID) of Department of Road (DOR) is the Implementing Agency (IA) for Kathmandu (Nagdhunga)-Naubise-Mugling (KNM) Road and Bridge Project. Upon completion of construction of the KNM, Development Cooperation Implementation Divisions (DCID) - DOR, will carry out the operation, management, and maintenance.



The KNM road and bridges will be built under several construction contract/s packages. The implementation of the EMP will be the responsibility of the construction contractor/s supervision and overseen by a Project Management and Supervision Consultancy (PMSC) and environment unit established as Geo-Environment and Social (GESU) of DOR. The construction contractor/s will be responsible for implementing mitigation requirements in the construction specifications.

Overall construction and environmental management of the KNM will be under the DCID-DOR and will be supported by GESU-DOR. Environmental and Social staffs of the GESU will oversee the environmental and social aspects of the project during the time of construction and operation of the project.

A Project Management and Supervision Consultancy (PMSC) will support DCID and GESU, and provide consultancy for monitoring and supervision during the time of construction. A PMSC will be responsible for implementing the project activities, training employees and contractors on commitment, analyzing the results, implementing adaptive management.

Staffing for the PMSC is shown in Table 11-1. Tentative staffing of PMSC team will include Highway engineer as a Team Leader with other supportive staffs such as an Environmental Safeguard Specialist and a Social Safeguard Specialist in order to safeguard construction works of the KNM and proposed new alignments. The PMSC will be responsible to monitor and supervise dam construction works and its associated safeguard works related to the construction of access roads, spoil disposal, bridge construction, camp establishment, stock piling, quarry sites established, felling of trees and compensatory replantation etc. The PMSC will also be responsible to monitor and supervise safety works carried out by the construction contractor during construction, and monitor actual impacts predicted in the ESIA report for the construction stage of the project.

The PMSC environment specialist will support the GESU environmentalist in implementing the ESMP. The PMSC environmental specialist will provide training in environmental monitoring, evaluation and assessment to the contractor staffs and also to make them aware and familiar with the measures of mitigations mentioned in the Bidding document and EIA. This will consist as mitigation measures presented in the EIA including safety due to construction works. Besides, the PMSC environmentalist will support in monitoring, evaluation, and reporting to senior level staffs.

Table 11-1: Project Management and Supervision Consultant staffing

Team Leader				
Deputy Team Leader				
RE- Civil and Bridge IOW-Civil Junior Engineer	Environment Specialist	Health and Safety Specialis-2	Social Safeguard / Public Relation and Resettlement Specialist	Account and Junior Finance Officer
Admin Officer				



There will be a supporting environmental staff under PMSC for monitoring, evaluation, and construction supervision, to fulfil all the EIA and EMP requirements, and ensure proper implementation of mitigation measures during the time of construction. The Social Safeguard Specialist has also been proposed and will be responsible to settle all the social issues and any unforeseeable issues encountered during the time of construction. The roles and responsibilities for different agencies are summarized in Table 11-2.

Table 11-2: Environmental and social management responsibilities

Organizations	Responsibilities	Schedule
Executing Agency (Ministry of Physical Infrastructure and Transport)	-Review of the project design, construction and operation activities against approved EIA and EMP measures and national environmental standards.	At least once a year during construction
	-Auditing of project general performance during operation phases	Every two years in the operation stage.
Ministry of Forests and Environment	-Approving EIA and EMP measures, following national environmental standards and license conditions.	Prior to construction
Community Forest User Groups	-Approval of permits for pre-construction activities and permit for staff to enter the community forest. -Approval of permits for construction activities and works in the community forest. -Provide recommendation letter to EIA document	Prior to construction
Implementing Agencies: Department of Roads; Development Cooperation Implementation Divisions (DCID), construction, operation and maintenance of the KNM.	-Ensure that the EIA and EMP measures are incorporated in the final project design and bidding document.	Prior to contract award.
	-Assist contractors in acquire necessary permits and approval for project construction and operation.	Before construction.
	-Ensure that the project construction activities are in accordance with the EMP and other GON legislative requirements.	During construction.
	-Implementation of repair and maintenance of project components including environmental safeguards	During operation.
	-Monitoring and record keeping regarding environmental measures and impacts	During operation
	-Ensure public consultation, participation and involvement in all phase of project implementation	Project period



Organizations	Responsibilities	Schedule
Ministry of Forestry and Environment	-Provide permits for admission and the construction works, including operation of quarry/borrow sites and watershed activities in community forest.	Prior to, and during construction
Project Management and Supervision Consultant (PMSC)	-Oversee environmental mitigation measures as per EIA and EMP are incorporated into the final design. Update the EMP as required during detailed design.	During final design
	-Supervision and impact and compliance monitoring of the construction contractor's activities and environmental mitigation measures as per EMP and provisions of inspection reports.	As per EMP
	Conduct environmental monitoring and prepare periodic monitoring reports for submission to WB and DOR.	As per EMP
	-Assist IA in the implementation and supervision of environmental compensation and enhancement programs and their monitoring and auditing.	As per EMP
	-Ensure all the plans prepared as required and as mentioned in EIA in order to safeguard environment of the community forests and other forests	Prior to construction
	-Ensure public participation and involvement in project construction	Construction period
	-Ensure construction contractors follow worker's safety rules and regulations	Construction period
Geo-Environment and Social Unit (GESU), DOR	Monitor support and supervise PMSC to achieve its responsibilities. Responsible to handle all the environmental, social and resettlement issues supporting PMSC.	Prior to construction and during Construction and operation period
Construction Contractor	-Acquire necessary permits and approval for project construction, entrance to community forest area. - Appoint one Environment Health and Safety Focal Person and one Personal Relation Officer	Before construction.
	-Prepare a detailed Construction EMP (CEMP/EMAP) before construction and get it approved from DOR. -Implement mitigation measures as specified in the CEMP/EMAP updated by the DOR as necessary during detailed design.	As per EMP during construction

Organizations	Responsibilities	Schedule
	-Monitoring and record keeping of environmental mitigation measures	As per EMP during construction
	-Implementation of the corrective actions as recommended by the supervising consultants	As per EMP during construction
	-Ensure public participation and involvement in project construction	Construction stage
Independent Environment Monitoring Consultant	- Review safeguards documents including EIA and EMP and request changes if and when required	Project Period
	- Oversee and periodically monitor Contractor's implementation of the EMP and review control procedures carried out by DOR DCID and GESU.	Project Period
	-Review environmental impacts of project interventions and monitor progress with regards to environmental targets and indicators	Project Period
	Review reports and report to EA through the PEMU/Project Director on EMP efficiency, contractors' performance and announce corrections needed	Project Period
CBOs, Municipality and DCC	-Monitor that the environmental mitigation measures and enhancement measures are implemented in all stages of the project as per EMP.	Project Period

11.4 Acquisition of permits and clearances

Table 11-3 summarizes the status of clearances and no-objection certificates that are already obtained or are likely necessary for implementation of the construction works.

Table 11-3: Status of permits and clearances

Agency or group	Purpose and status	Responsible party	Timeframe
Government of Nepal	Construction and upgrades of the strategic road from Kathmandu to Mugling has to be accepted as National Priority Project.	GoN/WB	Signing of loan agreement



Agency or group	Purpose and status	Responsible party	Timeframe
Ministry of Forests and Environment (MoFE)	Approval of application for initiating an EIA. Status: Application Letter sent by MoPIT to MoFE. approval of EIA. Status: To be issued 1. Approval of Scoping Report including ToR for EIA. Status: obtained. 2. Approval of EIA. Status: obtained. 3. Approval for cutting of affected trees along the alignment. Status: To be obtained.	IA MoFE/IA	Prior to forward Scoping Report to MOFE. 1. Prior to GoN EIA process 2. Prior to construction 3. Prior to construction and excavation
Nepal Electricity Authority	Permission to relocate affected electric poles along the alignment Status: To be obtained.	IA	Prior to construction
Department of Archaeology	Clearance for works close to and at cultural and religious sites. Status: To be obtained.	IA	Prior to construction
Private property and Land owners	Acquisition of land for Sisnekhola-Dharke proposed 12km new alignment and Benighat-Phisling 15.3km. Status: To be obtained	IA	Prior to construction

Note: IA: Implementing Agency.

11.5 Types of Monitoring

Monitoring Activities will be carried during construction and operation phase of the proposed KNM road project. Further, guideline¹³ and other relevant documents published from government agencies will also be followed for the monitoring Activities. The main types of monitoring include: baseline, impact and compliance monitoring. Baseline monitoring is aimed to collect the basic environmental parameters in the project area before construction begins. Impact monitoring measures physical, biological and socio-economic parameters during construction and operation stages. Compliance monitoring ensures that project is aligned with recommended environmental protection standards. The following types of monitoring activities will be carried out during the project construction and operation:

Baseline Monitoring

The main objective of baseline monitoring is to update the baseline information on the overall environmental conditions of the project implementation site. This project will proceed for construction immediately after the approval of this EIA report and hence, baseline monitoring is

¹³National EIA Guidelines, 1993

not required for the proposed project. Besides, during preparation of EIA the present information about overall environmental conditions was gathered, including (when possible) data on monitoring of the major physical, biological and socio-economic and cultural components, such as air and water quality, climatic conditions, land stability, soils and hydrology in the project area, forests, wildlife and use of forest resources, population structure and trends, local economies, etc.

Compliance Monitoring

Compliance Monitoring will be carried out in order to ensure the implementation and complied within practice of environment protection measures including all compensatory measures and conditions set-forth and commitments made in the EIA report. Further, the monitoring will be carried to ensure practical accomplishment of regulatory requirements and standards integrated into project documents. This study recommends the need for compliance with following recommendations:

- Incorporation of environmental protection measures in the detail design contract document and tender documents;
- Allocation of costs for environmental protection measures in tender document;
- Allocation of adequate budget for compensation of land, property and agri-products, tree cutting, transportation and stockpiling of forest products, and temporary acquisition of private land;
- Restriction upon haphazard disposal of spoil along hill slopes, vegetated areas, water bodies and other environmentally sensitive areas;
- Enforce use of recommended disposal sites that are approved by project manager;
- Regular supervision of spoil loading, transportation and dumping at designated site(s);
- Regular supervision on materials handling at earthworks, and stockpiling of construction materials;
- Regular supervision of quarry sites operation;
- Procedures for safe storage and use of explosives and toxic materials;
- Regular water spraying to arrest construction-related dust and vehicle maintenance to minimize gaseous emission;
- Inquiry on the usage of pressure horn in settlements, health and educational institutions;
- Relocation and rehabilitation of affected infrastructures (such as water supply taps and pipelines, electric poles and pylons, irrigation canals, etc.) located within the project area;
- Occasional supervision on the possible impacts of labourers on adjoining forests and wildlife;
- Extent of local labourers employed and skill training launched;
- Provisions for health and sanitation facilities at work camp, labour camp, including water supply and sanitation measures, etc.;
- Ensure Life Insurance of the labourers;



- Wage paid to labourers not minimizing the wage fixed by the concerned district to both male and female workers;
- Rehabilitation and restoration of quarry sites, work camps and labour camp(s);
- Occurrence of communicable diseases;
- Provision for occupational health and safety measures, regular check of health and safety issues;
- Compensatory plantation in the ratio of 1:10;
- Land acquisition and compensation;
- Resettlement of SPAFs;
- Launching of skill training, and public awareness activities;
- Avoid damage and disturbance historical, cultural sites and natural habitats;
- Regular monitoring of the local forest conditions, use and trafficking of forest products;
- Regular survey of the social and economic conditions for displaced families;
- Monitoring of fire hazards in the project area, including presence of fire-extinguishers and first-aid kits in the labour camps; and
- Other conditions set-forth during the approval of the EIA report, if any.

The Project Authority will establish separate Environmental Monitoring Units to monitor the compliance within the KNM project area. This monitoring team will comprise of the representatives from following ministries but not limited to MOPIT, MoFE and the EMU of the project. This team will make necessary site visits to monitor the compliances. Required budget for this monitoring team has been included in the monitoring budget.

Impact Monitoring

Impact monitoring will be carried out during project operation phase to assess the sufficiency and effectiveness of the environment protection measures identifying indicators of all physical, biological and socio-economic and cultural parameters. The monitoring will be carried out focusing upon each impact predicted and effectiveness of proposed mitigation measures; ensuring the Actual impacts in the field is really within the manageable limit. Further, the monitoring Activity will detect unexpected damages that are likely during near future and will provide early warning to the responsible agencies for undertaking corrective and additional measures to avert, if possible. Location, frequency and responsible agencies for monitoring are presented in the table below.

Impact monitoring will demonstrate understanding and consideration of the issues that can arise in the result of project implementation including:

- Air and noise, water-quality issues, landslide areas and soil erosion as a result of the project;
- Ecosystem and habitats, flora and fauna (especially globally and nationally threatened species);
- Social factors, including gender issues and indigenous people and cultural issues in the result of the project implementation;



- Measuring the effectiveness of mitigation and/or rehabilitation measures;
- Documentation of difference between predicted and real impacts,
- Methods for identification of non-predicted impacts and appropriate reporting remediation measures;
- Application and effectiveness of emergency and contingency plans
- Review of consultations and management arrangements with all stakeholders.

Monitoring Parameters

During the construction and operational stages of the project following parameters/indicators will be used for monitoring purposes:

Table 11-4: Major Parameters for Physical Environment

Air quality	Ambient air quality: TSPM, PM ₁₀ , PM _{2.5} and Lead sampling (PM ₁₀), Co ₂ (Carbon Dioxide), No _x , (Nitrogen Oxides), Sox, frequency of water sprinkling, road cleaning and sweeping etc.
River Water quality	Turbidity, Conductivity, pH, Colour, Conductivity and Total Coliforms were conducted at site with the help of portable kits.
Noise	Noise level at regular interval: assessment and interpretation for L _{max} , L _{min} , L _{eq} , L ₅ , L ₁₀ , L ₅₀ , L ₉₀ and L ₉₅ parameters.
Spoil disposal	Spoil bank reclamation and rehabilitation activities and bio-engineering
Slope stability	Disturbance to natural slopes, slope protection measure, adequate drainage facility (catch drains, side drains), Bioengineering, etc.
Quarry sites	Quantity of extracted material, any damage in the vicinity
Safety of workers	Life Insurance of labour, provision of personal protective equipment
Road safety	Traffic Signals, no horn signs, road signals and markings, speed control and GPS-tracking

Major Parameters for Biological Environment

Conditions of forests, tree falling, wildlife hunting and poaching, supply of energy, compensatory plantation, illegal use of fuel wood etc.

Table 11-5: Major Parameters for Biological Environment

Number of felled trees	Statistics of removed and planted trees, nurseries and plantations
Hunting and poaching	Cases, observed during construction and operation of highway



Habitat fragmentation	Cross-road structures installed, culverts and other engineering constructions adapted for wildlife and fish movement, established wildlife monitoring standards and practices
Aquatic wildlife observation	Sampling in the upper-stream and down-stream area near the bridges to compare impact on hydrobionts, aquatic wildlife and fish
Wildlife-vehicle collisions, safety issues	Established monitoring, collecting all wildlife roadkill data at the construction and operation stages
Fire-hazard	Project management checklists, site monitoring, fire-extinguishers in labour camps
Clean-up habitat rehabilitation	Site observation after construction, compiled protocols for site clean-up and rehabilitation

If wildlife crossroad structures will be installed, the impact monitoring is needed to ensure that they were installed in the recommended places and responded to established standards, providing conditions for safe wildlife movement across the road. Monitoring during operation stage will measure effectiveness of installed cross-road structures and their conservation value to reduce the risk of wildlife road mortality and increase motorist safety, to improve the permeability of the road and reduce risk of fragmentation for populations and to ensure connectivity of ecological processes during long period of time.

Specific indicators such as road mortality rates before and after installation of mitigation structures, animal movement and dispersal, population abundance, etc. can serve for evaluation of mitigation success or failure.

Monitoring plan should be defined in accordance with identified goals and objectives and chosen management questions, which are relevant to main monitoring goals and objectives that assess the efficiency of installed crossing structures or other mitigation measures.

Selection of sites for monitoring should indicate the difference between “controls” and “treatment” area showing difference in the results. There are many technics for data collection in ecological and zoological research, including using of digital cameras, mark-recapture technic, radio-telemetry and many others. The technic can be selected after defining the management questions and identification of monitoring indicators, for example, the Common Leopard and other cat species along the existing road and new Bishaltar – Phishling alignment. Their presence in the area was confirmed during biological survey and these species, more likely, will use cross-road structure (underpasses) for safe movement. The results of monitoring will inform decision making with regard to further planning and design the wildlife mitigation measures in similar road improvement or construction projects.

Monitoring and evaluation plan should include partnership coordination, scope of monitoring, planned time frame, methodology for data collection, team size, and needed financial resources. It will correspond with established goals and objectives (short-term and long-term), baseline

conditions, specific management questions, selected indicators, control and treatment areas, designed implementation of monitoring plan and with other established goals and tasks.

Major Parameters for Socio-economic and Cultural Environment

Compensation, employment, social services, agriculture production, health care facilities, education facilities, occupational health, and safety etc.

Table 11-6: Major Parameters for Socio-economic and Cultural Environment

Health and safety	Statistics of accidents and transmitted diseases during and after construction.
Business and local economy	Economic status of the project affected people/family whose business or economic activities are severely affected due to project implementation.
Property/land acquisition	Status of living standard who has received compensation among the project affected families/households whose land are acquired by the project.
Land use impact/change	Checklists to collect, keep and rehabilitate topsoil in the specific areas.
Community life	Signs related to safety and road traffic, noise level, dust and air quality near school, hospital, market, and settlement areas. Living standard of the local people, purchasing capacity, economic activities involved, agricultural dependency households, educational level, new employment opportunity generated due to project, local's involvement in social services etc.

11.6 Environment Management Plan

Environmental Management Plan is a framework for monitoring social and environmental aspect of the proposal. The project will execute monitoring activities with establishment of Environmental Monitoring Unit during the time of construction and operation of the project. Compliance and Impact Monitoring will be carried out for specific parameters for physical, biological and socio-economic and cultural environment maintaining appropriate indicators and appropriate methods of monitoring.

Monitoring Activity will be executed by responsible institutions and agencies and will be carried out frequently and periodically as appropriate for each parameter identified. Monitoring Activities has been proposed to avoid and reduce impacts of the project into acceptable level in appropriate time at appropriate location with appropriate cost.

The following matrix presents Environmental Monitoring Plan for each parameter including indicators for monitoring, together with location, time and frequency of monitoring by responsible agency.

Both adverse as well as beneficial impacts will be generated from development activities. Kathmandu (Nagdhunga)-Naubise-Mugling (KNM) Road and Bridge project is proposed through hilly areas of Kathmandu, Dhading, Gorkha and Chitwan Districts. This EMP comprises "project



owner's" version containing the comprehensive set of mitigation, management and monitoring measures, requirements, and institutional responsibilities for both construction and operation stages in order to fully address all identified impacts in accordance with mitigation hierarchy approach. Series of Site-Specific Environmental Management Action Plans (EMAPs) tailored specifically for construction contractors for each of the bid packages, developed so as to be directly annexable to bidding documents and contracts.

The proposed project passes through the river corridor of Mahesh Khola and Trishuli River, whereas the proposed new sections such as Sisnehol-Dharke and Benighat-Phisling section of KNM with 7.5-9.5 m carriage width as final output easing transportation from Kathmandu to Mugling.

Permanent change in land use, loss of forest cover, generation of spoil due to earthwork excavation and requiring safe disposal are considered as the major impacts with its implementation.

Construction and operation of KNM road project will generates substantial economic opportunities easing transportation reducing time and cost. Most of the impacts during construction activities can be reduced or restricted through construction works. With the enforcement of Environment Protection Act (EPA), 1997 and Environment Protection Rules (EPR), 1997 it has been mandatory to address the anticipated influences both positive and negative that occur in the construction of development project through effective environment management plan and programmes.

This EMP is designed to help clients meeting both statutory regulations and social obligations as per GON in reducing or eliminating adverse impacts as well as World Bank safeguard policy requirements.

Furthermore, the impacts mitigation measures and monitoring requirements are normally set out in this EMP. Construction supervision consultants as well construction contractor will be responsible for supervising in implementation of Contractor's EMPs (Table 11-7, Table 11-8, Table 11-9 and Table 11-10) for the construction of road and bridges. Whereas; client will be responsible to follow Employer's EMP presented in the Table 11-12. Supervision consultant will also follow Table 11-11 for monitoring of the project during construction.



Table 11-7: Environment Management Plan for existing KNM (Contractor's EMP)

Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
10.1.1 Preconstruction Phase (Physical Environment)										
(i)	Land clearance	Along the ROW	Loss of vegetation and physical structures	- Compensation -Offset: Plant of nurseries	Table 10-32	Construction contractor	DoR, Development Cooperation Implementation Divisions (DCID) Project Management and Supervision Consultant (PMSC), GESU-DoR	Site visit	Resettlement Action Plan; forest clearance certificate.	Once in every 6 month
(ii)	Review of EMAP	-	-	-	-	DCID-DOR, PMSC	DoR, DCID, PMSC, GESU-DoR	Review of EMAP prepared by Construction contractor	EMAP prepared by contractors for every package prior to construction	Every month after award of contract
(iii)	Review of access roads	Along the proposed alignments	Likely affected during construction	Plan for providing access to locals and immediate impact receptors.	-	DCID-DOR, PMSC	DoR, DCID, PMSC, GESU-DoR	Construction Survey and review of EIA and RAP.	Plan of access to existing link roads and adjacent settlements	Every month after award of contract

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Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
(iv)	Erosion control	Identified vulnerable areas and new landslide areas during excavation of new roads	Direct disposal, loss of life and property.	Erosion control measures	Included in BOQ	DCID-DOR, PMSC	DoR, DCID, PMSC, GESU-DoR	Contractor's construction methodology for the excavation for opening new proposed alignments	Plan for erosion control mentioned in bidding document.	Every month
(v)	Establishment of camps	Proposed sites	-	-	Contractor's Responsible	DCID-DOR, PMSC	DoR, DCID, PMSC, GESU-DoR	Visit proposed camp sites, observation and photographs	Review EMP and camp management plan of contractor	Every month
(vi)	Traffic Management	Along the existing roads and highway	-	-	Contractor's Responsible	DCID-DOR	DoR, DCID, PMSC, GESU-DoR	Review of Traffic management plan of construction contractor	Traffic management plan prepared by construction contractor in place	Every month
(vii)	Waste Management	Along the ROW	-Health issue -Pollution	- Selection of sites	Contractor's	DCID-DOR	DoR, DCID, PMSC, GESU-DoR	Field visit	Grievances from the	Monthly


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 Ministry of Physical Infrastructure
 Development Cooperation Implementation
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Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
			- Aesthetics	-Instruction of labours -Managers training	Responsible				local people.	
(viii)	Environment responsible procurement	-	-	-	-	DCID-DOR	DoR, DCID, PMSC, GESU-DoR	Review of tender document / BOQ	Ensure all the environment and social requirements are included in tender documents.	Monthly
(ix)	Preparing construction contractor to address mitigation measures	-	-	-	-	DCID-DOR	DoR, DCID, PMSC, GESU-DoR	Review of BOQ, kick off meeting, review meetings, construction survey and EMAP from contractor's side	Mitigation measures in BOQ items, and orientation provided to contractors	Weekly
10.1.2 Construction Phase (Physical Environment)										
(x)	Relocation of utilities	Along the alignment	Disruption in existing services at local level.	Proper relocation and restoration of all affected	Included in BOQ	Construction contractor	DoR/DCID, PMSC, GESU-DoR	Site visits and observation	Planning for the relocation, respective authority	Monthly

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Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
(xi)	Excavation and widening of existing KNM	Within the 50-meter ROW along the existing KNM	Minor change in land use along the existing KNM.	Land only within the ROW will be acquired for improvement and upgrading; land acquired temporary will be rehabilitated after completion of construction. Contractor will obey IFC EHS General Guidelines 2007 and IFC EHS Guideline for Toll Roads 2007.	Included in BOQ	Construction contractor	DoR, DCID Construction and Supervision Consultant, GESU	Site visit and observation	Excavation Methodology in place	Monthly
(xii)	Excavation of hill slopes	Krishabhir, Jogimara, Simle, Belkhu,	Landslides, Slope Destabilization and	Avoided hazardous excavation of slopes.	Mentioned in BOQ	Construction contractor	DoR, DCID, Construction and Supervision	Site visit and observation	Excavation methodology, Slope stability	Monthly

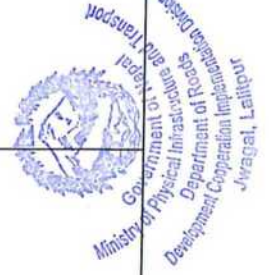
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Government of Nepal
Department of Roads
Development Cooperation Implementation Division
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Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
		Adamghat, Phurke khola- Dhading bridge junction, Huilungtar, Phising, Chumlingtar, Chumkhola, Kurintar to Mugling.	Soil Erosion	Benching of slopes and excavation in piece-meal applied along the steep slope area. Management of existing natural drainage. Bioengineering and slope protection work, established engineering structures. Contractor will obey IFC EHS General Guidelines 2007 and IFC EHS Guideline for Toll Roads 2007.		Implementation	Monitoring		and and handling of excavated materials.	
										
(xiii)	Disposal of spoil	Valley side of the road all along	During site clearance, excavation	Excavated spoil and other construction materials	Included in BOQ	Construction contractor	DoR, DCID, Construction and Supervision	Site visit, observation, and	Identified disposal area; disposal	Weekly

Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
		the alignment.	in slopes estimated in 354,957.00 cu. m. of spoil materials	disposed at identified spoil disposal site. Haphazard disposal of spoil will be avoided			Consultant, GESU	interview with locals	area boundary maintained; landscaping and rehabilitation	
(xiv)	Construction and excavation; disposal of spoil	Natural drainages along the existing KNM	Obstruction to natural drainage pattern	Avoided haphazard disposal of spoil. Labour camps will not be established close to natural drainage and avoided direct disposal of any wastes.		Construction contractor	DoR, DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Haphazard disposal of spoil; disposal practices and plan	Weekly
(xv)	Construction activities, likely disposal of soil, chemical wastes, etc. into water bodies.	Along the existing Trishuli and Mahesh khola and other water supply pipelines	Pollution of water resources	Use water only if ample source of water supply exists within construction area; or buying water required for the construction.	Included in BOQ	Construction contractor	DoR, DCID, Construction and Supervision Consultant, GESU	Site visit, observation and test of river water quality	Test results of water quality parameters.	Weekly site visit and observation/water quality test in every six months.


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Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
		along the KNM.		Existing water sources and supply system will not be affected. Acquired consent with the locals in order to use available water sources.						
(xvi)	Operation of borrow pits and quarries	River banks of Trishuli and Mahesh khola; hill side quarry	Disturbance to landscape, air and noise, accidents, ponding, increase of sedimentation level etc. with the operation.	Avoided quarry along the riverbank and hills. Permanent barricade at quarry location for safety, established safety signage boards, and installed noise barrier. Prepared borrow pit operation plan and obtained approval from	Mentioned in BOQ	Construction contractor	DoR, DCID, Construction and Supervision Consultant, GESU	Site visit, observation and interview with locals	Borrow pits and quarry site operational plan in place; approval from engineers.	Weekly



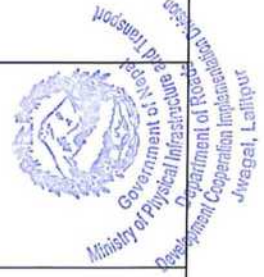
Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
(xvii)	Operation of stone crushing	Along the existing KNM.	Dust, air and noise. Likely accident.	Avoided establishment of operation near schools and settlements.	-	Construction contractor	DoR, DCID, CSC, GESU	Site visit and observation	Operation al Plans in place prior to operation and operated accordingl y.	Weekly
(xviii)	Stockpiling and transportation of construction materials	Along the existing alignment; proposed stock piling area.	Dust emission, washout affect to downhill to the Trishuli, cultivated, and discomfort to locals.	Stockpile materials covered with tarpaulin, sprinkling of water carried out near and around the stockpile to avoid erosion; proper barricade and security guard for the area.	Mentioned in BOQ	Construction contractor	DoR, DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Grievances and complain from locals; ambient air quality adjacent to storage and constructio n sites.	Weekly


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Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
(xix)	Road excavation, construction activities, operation of dump trucks, etc.	Along the existing alignment, especially at existing urban areas. Crusher plant, batching plant sites, School, urban and settlement areas	Air pollution	Avoiding operation of drill machines, excavators, loading and unloading of waste materials during wind. Dust masks available to labour workers, sprinkling of water along the dusty road during road excavation twice a day. Avoided direct disposal of effluent from batching plant.	Mentioned in BOQ	Implementation	Monitoring	Site visit and observation	Air quality parameters discussed above.	Quarterly during road width excavation.
(xx)	Use of chemicals	Campsite, workshops, natural drainage along the alignment.	Land and water pollution. Chemical hazards	Handling chemicals properly. Storage of chemicals 100 meters away from any water sources.		Construction contractor	DoR, DCID, Construction and Supervision Consultant, GESU	Site visit and observation, water quality of Trishuli river and tributaries lab test	List of chemicals, storage, and handling practice. Accident records; spillage of	Monthly



Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
				Spillage kit in place at the construction site.					chemicals and surface and ground water contamination	
(xxi)	Excavation with the widening of existing highway, operation of camps and other activities	Hotels, shops, resorts situated all along the highway, settlements, school, health posts	Noise pollution	Barricade of construction area, provided operational schedule to local inhabitants. Monitoring noise level maintained at national standard.	Included in BOQ	Construction contractor	DoR, DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Regular monitoring of noise level records.	Monthly
(xxii)	Operation of construction vehicles, excavation etc.	Naubise, Baireni, Pida, Gajuri, Malekhu, Benighat, Jogimara and Darechowk, etc.	Road safety	Installed safety signage boards, barricades, provide PPEs to all labour workers, managed local traffic avoiding disturbances, informed and aware locals,	Included in BOQ	Construction contractor	DoR, DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Accident records, safety application and facilities maintained.	Weekly



Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
(xxiii)	Construction safety of labourer	Along the KNM alignment	Occupational health and safety of labourer and accident	provided on job trainings to labourers. Installed safety signage boards, barricades along the construction sites, provided PPEs to all labour workers, managed local traffic, aware and informed locals, provided on job trainings	Included in BOQ	Construction contractor	DoR, DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Group insurance of worker, all time available of PPEs to workers and engineers.	Weekly
(xxiv)	Physical cultural structures	Along the KNM	Loss of physical cultural structures	Relocation of physical cultural structures	Included in BOQ	Construction contractor	DoR, DCID, CSC, GESU	Site visit and observation	Rehabilitation of affected physical cultural structures, grievances from locals.	Monthly
(xxv)	Establishment of camps	Along the identified location or	Waste and health hazards,	Prepared camp management plan prior to		Construction contractor	DoR, DCID, Construction and	Site visit and observation	Operational Plans in place prior	Monthly



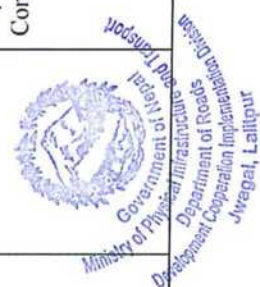
Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
(xxvi)	Change in land-use, loss of productive topsoil	Along the ROW and in DIA	-Impact on agro-production, loss of vegetation and forest, aesthetic, pollution	Preservation of topsoil and rehabilitation after construction; re-plantation, selected construction time to avoid severe impact on agriculture	Included in BOQ	Construction contractor	DoR, DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Top soil preservation practice and overlaying of top soil during backfilling.	After construction
(xxvii)	Operation and maintenance Phase (KNM Physical Environment)									
(xxvii)	Instability of the hill slopes	Krishabhir, Jogimara, Simle,	Destabilization of slopes	Bio-engineering and slope	-	Construction contractor	DoR, DCID, Construction and	Site visit and observation	Soil erosion, condition of	Monthly

Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
		Belkhu khola, Adamghat, Phurke khola- Dhading bridge junction, Huilungtar, Phisling, Chumlingtar, Chumkhola, Kurintar to Mugling.		protection works		Implementation	Monitoring		structures applied for slope stability.	
(xxix)	Encroachment of Right of Way	Along the highway.	Obstruction in traffic movement, local discomfort	Planning of service stations, coordinated development along existing road. Special cross- road structures and infrastructure	-	DOR-DCID, DOR project office and DOR- GESU	DoR, DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Construction of structures close or adjacent to the ROW	Monthly
(xxx)	Impacts due to Poor Drainage	Natural drainages	Flooding	Proper drainage structures,		Construction contractor during DLP, DOR-	DoR DCID, Construction and	Site visit and observation	Roadside drainage discharge	Monthly

Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
			Soil erosion Change in hydrology sedimentation	management of flow, management of garbage and debris		DCID, DOR project office and DOR-GESU	Supervision Consultant, GESU		locations, water-pounding area during rain.	
(xxxii)	Air and Noise Pollution	Along the alignment	Health problem of locals and road users	Installation of traffic signals with no horn, speed control and monitoring, establishment of vehicle emission test facility at Nagdhunga and Mugling.	Employers Responsibility	DOR-GESU	DoR, DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Grievances by locals, number of patient in local healthposts, record of death due to air and noise along the alignment.	Monthly
(xxxiii)	Traffic safety and accident	Along the highway, especially at urban areas.	Accident frequency, human health, loss of property and assets	Establishment of traffic signals, GPS tracking for speed control for public buses playing the highway.	Cost included in BOQ	DOR-DCID, DOR project office and DOR-GESU	DoR, DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Accident records; and grievances registered along the alignment.	Monthly


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Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
(xxxii)	Waste Management	Along the highway drain, in urban areas	Waste, health and hygiene to locals and road users.	Waste management, coordination with local municipality.		Municipality, Ward office, NGOs, DOR project office	Monitoring DoR, DCID, CSC, GESU	Site visit and observation	Record of blockage of drain due to solid waste; waste disposal practices at local level.	Monthly
Preconstruction Phase (KNM Biological Environment)										
(xxxiii)	Tree felling	In Community Forests	Loss of different species of trees, vegetation, wildlife disturbance, habitat loss and change	Compensatory plantation of 25 saplings for each felled tree; selection of native trees, establishment of nurseries	Included in BOQ/EIA	DFOs, CFUGs,	DoR, DCID, Project Construction and Supervision Consultant (PMSC)	Site visit, tree markings of affected trees in coordination with concern authority	Compensatory plantation plan is in place prior to felling of affected trees and forest clearance certificate acquired.	Prior to construction
(xxxiv)	Disturbed wildlife and destroyed habitat	Along the ROW and in DIA	Loss of habitats; barrier effect; loss of biodiversity	Avoid cutting of trees during rainy season and construction work in the breeding season, instructed	Included in BOQ/EIA	Construction contractor	DoR, DCID, Construction and Supervision Consultant	Site visits and observation	Coordination with CFUGs, forest clearance certificate acquired.	At the preconstruction stage



Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
				construction workers minimized adverse effects.						
	Construction Phase (KNM Biological Environment)									
(xxxv)	Clearing of forest, loss of vegetation and grazing area	Along RoW area	Loss of trees and vegetation, disturbance	Replantation, compensation to the CFUG; providing incentives to use biogas and other alternative sources of energy	Included in BOQ	Construction contractor in coordination with CFUG and DFOs	DoR, DCID, Construction & Supervision Consultant (CSC), GESU-DoR	Site visits and observation	Forest clearance certificate acquired; felling of marked trees only.	During and after construction (quarterly)
(xxxv)	Disturbance, hunting and poaching by workers	Around labour camps	Lost biodiversity, loss of forest resources	Instructions for workers, control by managers, awareness and distributed printed materials about rules and regulations	-	Construction contractor, GESU-DoR	PMSC; DFO	Field visits, Review of grievances recorded, observation at campsites.	Grievances received from locals	One time a week
(xxxv)	Use of forest products by	In proximity	Loss of forest	Instruction of workers	-	Construction contractor	DoR, DCID, Construction and	Observation and	Grievances received from locals;	Weekly


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Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
	construction workers	of labour camps	products and NTFP	before construction Control from management team Alternative energy sources and food			Supervision Consultant	interaction with locals	use of fuelwood in campsites and in other construction activities.	
(xxxii)	Impacts on herptiles and fish species	Near new bridges and in proximity of natural habitats	Loss of species; impoverishment of aquatic habitats	Culverts; avoiding of construction in the fish breeding season; Avoiding pollution of water-courses	-	Construction contractor	DoR, DCID, Construction and Supervision Consultant	Observation and interaction with locals	Grievances received from locals.	Before and after construction
(xi)	Habitat fragmentation, barriers for wildlife movement	Chainages: 21+400 – 21+500; 33+340- 33-600; 35+000 – 35+ 400.	Roadkill wildlife, fragmented population loss, loss of species richness and abundance	Wildlife/livestock cross-road structures in appropriate locations; design culverts as reptile & amphibian tunnels; awareness to the drivers;	-	Construction contractor	DoR, DCID, Construction and Supervision Consultant (CSC), GESU-DoR	Site specific visits, CT camera monitoring	Grievances received from locals.	Monthly



Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
Operation Phase (KNM Biological Environment)										
(xli)	Possible extraction of fire-wood and timber	Around settlements due to improved accessibility	Loss of community assets and profit, biodiversity loss	Engagement of CFUGs in forest management; awareness materials; regular control of the area; alternative sources of energy	-	DFO, CFUGs	Environmental agencies; GESU-DoR	Observation and interaction with locals and affected people.	Use of fuelwoods by locals nearby; Produced and distributed awareness materials	After construction
(xlii)	Increased wildlife disturbance, hunting and poaching, impact on forest resources	In the forest areas along the road	Loss of forest products and NTFP	Enforcement and control; Anti-poaching regulations; Awareness campaigns; Planning of rural development	-	DFO, CFUGs	Environmental agencies Branch (DCID), GESU-DoR	Observation and interaction with locals and affected people.	Statistic of poaching cases; distributed awareness materials	After construction
(xliii)	Habitat fragmentation, barriers for wildlife movement	In forest areas, adjacent to KNM section	Roadkill wildlife, fragmented population, loss of species	Established monitoring of crossroad structures in the designated above chainages.	-	DoR and regional transportation authorities with CFUGs and DFOs	GESU-DoR	Observation and interaction with locals.	Compensatory plantation in the ratio of 1:10 and its	Monthly

Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
Preconstruction Phase (KNM Socio-economic and Cultural Environment)										
(xiv)	Loss of private property and assets	Nagdhunga, Baadbjagyang, Chisapani, Pipmod, Khatripauwa, Kanakot, Khanikhol, Naubise etc.	Loss of assets, loss of income, businesses, effect of livelihood	Compensation Resettlements Alternative livelihood sources	Employer's Cost	GON	DoR, (DCID), Construction and Supervision Consultant	RAP	Procedure s regarding land acquisition and compensat ion have been properly set out and followed; preparatio n of RAP and VCDP, Infrastruct ures inventory.	Before construction and implementation of project
(xiv)	Grievance raised by	Along the road	Delay of construction or	Grievance redress mechanism;	-	GON	DoR, (DCID)	Minutes of meetings; number of	GRC in place	Responding to

Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
	locals and workers		hampering of work	community consultation;				grievance applications		applications weekly
	Construction Phase (KNM Socio-economic and Cultural Environment)									
(xlvii)	Loss of productive land	Dharke, Juge- Kholu, Belku, Benighat, Charodi	Loss of agricultural production , 0.32 ha of fertile land loss	Accurate delineation of land needed for construction, preservation of land and soil outside of ROW		Construction Contractor, DoR	DoR, (DCID), GESU	Observations and visits, collected applications from land users	Landuse pattern along the ROW	During construction
(xlviii)	Land and property acquisition	4 new bridge location area	0.32 ha will be affected	Compensation , resettlement and rehabilitation		GON	DoR, DCID, GESU	RAP, responded application for compensation	Landuse pattern along ROW	During construction
(xlviii)	Destruction and damage of community structures	Along the road	About 58 public structures, 8 bus stations, 26 temples, 4 toilets, 8 public taps, 2 others	Replacement and restore of structures		Construction contractor, DoR	DoR, (DCID), GESU	Field visits and assessment	Relocation status and condition	During construction



Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
(xlix)	Livelihood issues	Along the road	Loss of business and livelihood activities	Replacement and providing specific area for businesses		GoN	DoR, DCID, GESU	Field visits, interview and verification	Livelihood of affected people and living standard	During construction
(l)	Conflict with nearby host community	Along the road and along the camp locations	Disputes in communit y, social disorder	Security, instruction of construction workers, supervising and control by management team		Construction contractor	DoR, (DCID), GESU	Protocols of each event	Grievance records, records of conflict and brawls	During construction
(li)	Vulnerable indigenous people, cultural assets, gender	Along the road	Chepang, Dalits, Women headed household s, senior citizens	Awareness about the situation to contractor workers, special instructions		DoR, Construction and Supervision Consultant	DoR, (DCID), GESU	RAP, minutes of community meeting	Living status of Indigenous community due to implementa tion of project	During construction
(lii)	Road safety	Along the road, mostly in urban areas	Accidents Health	Signage, bus stops, overbridge, footpaths, instruction boards, zebra and lights, etc.		DoR, Construction and Supervision Consultant	DoR, (DCID), GESU	Field visits, number of installed structures	Status of safety measures applied along the road	During and after construction



Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
(lii)	Landscape aesthetics	Along the road and camp locations	Human health and well-being	Planning of rehabilitation and offsets, control stockpiling & construction excavation materials, camp sites etc.		Construction contractor	DoR, (DCID), GESU	Field visits	Operational plans properly placed and operated accordingly	Yearly
(liv)	AIDS and other diseases	Along the road	Human health, safety and community	Awareness program, instructions relevant to water and waste management, frequent health check of camp		DoR and construction contractor, local NGOs	DoR, (DCID), GESU	Number of awareness programs and events	Regular health checkup records of workers and engineers.	Once in every Six month.
Operation Phase (KNM Socio-economic and Cultural Environment)										
(lv)	Ribbon development, settlement and market places	Along the road	Pressure in community infrastructure, safety	Planning of new economic initiatives for local communities (service centres, etc.)		Local government, DoR	DoR, (DCID), GESU	Proper planning	Development of shops and market places.	After construction


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Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
(lvi)	Increase in accidents	Along the road	Safety and health, loss of assets	Regulations, awareness and road infrastructure (lights, signs, zebra, etc.) and adaptive management		DoR and regional transportation authorities	DoR, traffic police	Accident monitoring database	Accident records with police authority, Grievances etc.	After construction
(lvii)	Increase in sell and use of alcohol products	Along the road	Human health and well-being, accidents, violence	Stricter regulations, control of alcohol sale, prohibition of alcohol advertisement on roads		Local and national government	Local clubs and women groups, other NGOs	Observation and interview, communication	Comparison of availability of alcoholic products in shops and market area before and after implementation of project.	After construction
(lviii)	Trafficking and increase in prostitution	Along the road especially at urban areas along the road	Human health, well-being, violence, accidents	Awareness campaigns, creation of jobs for girls and women, vocational training for women, etc.		Local government	NGOs, clubs, women groups	Number of campaigns and awareness programs, etc.		After construction


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Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
(lix)	Migration and immigration	Along the road	Pressure in urban and market area, wellbeing	Integrated planning of development		Local and regional government	Local government	Statistic data	Inflow of population within and close to highway	Before and after construction
(lx)	HIV/AIDS and other diseases	Along the road	Health, well-being, community life	Awareness campaigns, regular health camp operations		Local government, community organizations	Health organizations	Statistic data, number of campaigns	Records at Health Institutions.	Before and after construction

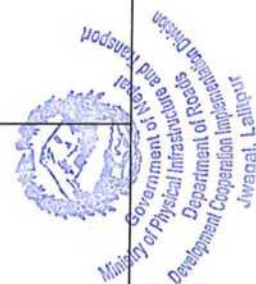
Table 11-8: Environment Management Plan for Sisnekhola-Dharke Road

SN	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicator	Frequency
						Implementation	Monitoring			
Preconstruction Phase (Sisnekhola-Dharke-Physical Environment)										
(i)	Review of impact assessment, mitigation and EMP	Proponent office /Monitoring and supervision consultant	N/A	Review of anticipated impacts and mitigation measures and incorporate all mitigation cost in BOQ	N/A	DoR, Foreign Cooperation Branch (DCID), GESU	DoR, Foreign Cooperation Branch (DCID), GESU	Review of ESIA/EIA and other project document	EMP incorporated in BOQ.	Before construction
(ii)	Review of alignment to improve project acceptability	Review from chainage 8+500 to 9+400	Likely duplication during construction	Coordination with Sitapaila-Dharke project office and confirmation for	N/A	DoR, Foreign Cooperation Branch (DCID), GESU	DoR, Foreign Cooperation Branch (DCID), GESU	Area survey	Final desing in place and ready for Bidding document.	Before construction

SN	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicator	Frequency
						Implementation	Monitoring			
		where alignment is super-imposing with existing earthen track of Sitapaila-Dharke alignment.		the common alignment along the Sitapaila-Dharke and Sisnekhola-Dharke.						
(iii)	Access Road	Waglethok, Rupakot settlement, local schools and access to Gajurelgau n and Purano Dharke settlements	Alternative diversions to local roads that access Waglethok, Rupakot, local schools and access to Gajurelgau n and Purano Dharke settlements has not been designed.	Contractor will plan the access to site during work; also provided access to local people without affecting the existing mobility and seek approval from engineers prior to the construction. Sign-posted and other necessary information will be disseminated before construction.	N/A	DoR, Foreign Cooperation Branch (DCID), GESU/Project Construction Monitoring and Supervision consultant.	DoR, DCID, GESU/Project Construction Monitoring and Supervision consultant.	Field visits and documentation	Access to tunnel area, forest area, cultivated lands etc. all along the proposed new alignment included in design map.	



SN	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicator	Frequency
						Implementation	Monitoring			
(iv)	Planning for erosion control	Nisakot community forest and tunnel portal including tunnel outlet area	Erosion likely during construction.	Engineering controls for erosion protection measures need to be planned. Preparation of Erosion Control and Temporary Drainage Plan in advance by C.	N/A	DoR, Foreign Cooperation Branch (DCID), GESU/Project Construction Monitoring and Supervision consultant.	DoR- DCID, GESU/Project Construction Monitoring and Supervision consultant.	Field visits and documentation	Cost for erosion control included in BOQ.	Before construction
(v)	Planning for construction of camps	Proposed campsite location.	Health hazard and pollution due to operation of camps.	Sites selected for worker camps and back-up areas for stockpiling materials and equipment planned in advance in consultation with local community and located to avoid the most productive agriculture; use of waste/barren land and non-agricultural plots as far as possible.		DoR, Foreign Cooperation Branch (DCID), GESU/Project Construction Monitoring and Supervision consultant.	DoR DCID), GESU/Project Construction Monitoring and Supervision consultant.	Field visits and documentation	Review EMP and camp management cost included in BOQ.	



SN	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicator	Frequency
						Implementation	Monitoring			
(vi)	Plan for Traffic management	Along the new planned alignment	Likely disturbance to local transportation during construction	A provisional temporary pedestrian and traffic management plan prepared by the construction contractor; updated by CSC and agreed with the proponent one month prior to start of works. Alternative roads, footpaths and access discussed in advance with local authorities in the ward and municipality office and sign-posted	N/A	DoR, Foreign Cooperation Branch (DCID), GESU	DoR DCID), GESU/Project Construction Monitoring and Supervision consultant.	Field visits and documentation	Traffic management plan prepared by construction contractor in place	Before construction
Construction Phase (Sisne khola-Dharke Physical Environment)										
(vii)	Relocation of utilities	Along the alignment as presented in Table 5-52.	Disruption in existing services at local level.	Proper relocation and operation of all affected utilities by the contractor.		Construction contractor	DoR DCID, CSC, GESU-DoR	Site visit and observation	Planning for the relocation, respective authority consulted, acquired	Monthly

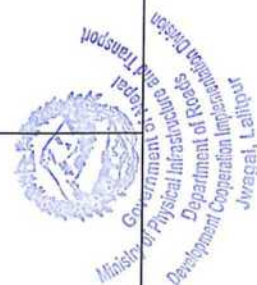
SN	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicator	Frequency
						Implementation	Monitoring			
(xxi)	Excavation for Sisnekhola- Dharke	Within the 50-meter ROW along the alignment.	Change in land use and loss of productive topsoil along the proposed new alignment	Land only within the ROW will be acquired for the improvement and upgrading; land acquired temporary will be rehabilitated after the completion of construction. Contractor will obey IFC EHS General Guidelines 2007 and IFC EHS Guideline for Toll Roads 2007.		Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	approval for shifting Excavation Methodology in place	Monthly
(xxii)	Excavation of hill slopes	Nisakot Community forest area, Waglethok, Rupakot Settlement	Landslides , Slope Destabiliza tion and Soil Erosion	Avoided haphazard excavation of slopes. Benching of slopes and excavation in piece-meal applied along the steep slope area. Management of existing natural drainage.	Includ ed in BOQ	Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Excavation methodology, Slope stability and handling of excavated materials.	Monthly



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SN	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicator	Frequency
						Implementation	Monitoring			
				Bioengineering & slope protection works, establishment of engineering structures. Contractor will obey IFC EHS General Guidelines 2007 and IFC EHS Guideline for Toll Roads 2007.						
(XXIII)	Disposal of spoil	Valley side of the road all along the alignment.	During site clearance & excavation estimated 310,913 cu. m. of spoil generated materials	Excavated spoil and other construction materials will be disposed at identified spoil disposal site. Haphazard disposal of spoil will be avoided.		Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit, observation, and interview with locals	Identified disposal area; disposal area boundary maintained; landscaping and rehabilitation	Weekly
(XXIV)	Construction and excavation; disposal of spoil	Natural drainages along the proposed Sisnekhola -Dharke	Obstruction to natural drainage pattern along the Nisakot community	Avoided haphazard disposal of spoil. Labour camps will not be established close to the natural drainage; avoided		Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Haphazard disposal of spoil; disposal practices	Weekly

SN	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicator	Frequency
						Implementation	Monitoring			
			y forest alignment crosses 37 big and small natural drainages	direct disposal of any kind of wastes. Channelize natural gullies within the Nisakot CF with cascade and other protection structures.						
(xxx)	Construction activities, likely disposal of soil, chemical wastes, Operation of crusher plants etc.	Sisne khola, Sikre khola, Dhuni khola, Mahesh khola, and Naubise khola River	Pollution of water resources	Use water only if ample source of supply exists within the construction area; otherwise contractor will buy water required for the construction activity. Preventing any affect to existing water sources and water supply system from construction activity. Consent with locals in order to use available water sources.		Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Test results of water quality parameters.	Weekly



SN	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicator	Frequency
						Implementation	Monitoring			
(XVii)	Soil contamination	Cultivated land along Dhunibeshi RM-9, cultivated land along Gajurelgau and Purano Dharke settlement	32.07 ha of top soil of cultivated land and agricultural products within the proposed road carriage width will be lost permanently	Consent from locals for temporary acquisition of private and cultivated land. Maintained designated storage area for chemicals and other construction materials, camp sites and workshops etc. Regular monitoring of storage areas.		Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Grievances, state of agricultural production.	Weekly
(XViii)	Haphazard disposal of spoil, disturbance to natural drainage.	Nisakot community forest; cultivated land near Dillishabitri Secondary School; at Purano Dharke near school playground	Water logging	Disposal of spoil only at designated and identified sites. Avoid haphazard disposal at the valley side, along the natural drainage along the cultivated land and private lands.		Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Stability along the drainages, erosion and landslide due to disposal	Weekly



SN	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicator	Frequency
						Implementation	Monitoring			
(XXVIII)	Operation of borrow pits and quarries	River banks of Trishuli and Mahesh khola; hill side quarry	Disturbance to landscape, air and noise, accidents, ponding, increase of sedimentation level etc. with the operation.	Avoidance of hazardous quarry along river banks and hills or providing permanent barricade at quarry location for safety with safety signage boards, noise barrier. Borrow pit operation plan with approval from supervision engineers prior to the operation of any quarry.	Mentioned in BOQ	Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit, observation and interview with locals		Weekly
(XXIX)	Operation of stone crushing	Along the proposed Sisnekhola -Dharke alignment	Dust, air and noise pollution. Likely accident.	Contractor will avoid establishment near school and settlement.		Construction contractor	DoR DCID, CSC, GESU	Site visit and observation	Grievances, air pollution parameters and noise test results; Operational Plans in place prior to operation and operated accordingly.	Weekly observation; however air and noise monitoring in every six months.



SN	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicator	Frequency
						Implementation	Monitoring			
(XXX)	Stockpiling and transportation of construction materials	Along the existing alignment; in proposed stock piling area.	Dust emission, washout effect to downhill to Dhuni-khola; Mahesh khola; cultivated land; discomfort to locals.	Stockpile materials will be covered with tarpaulin, sprinkling of water will be carried out near and around the stockpile to avoid erosion; proper barricade and security guard will also be provided. Pilings will not be carried out near the water bodies.	Mentioned in BOQ	Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Grievance, Storage practice of construction contractor. Ambient air quality adjacent to storage and construction sites.	Weekly
(XXXI)	Road excavation, construction activities, operation of dump trucks, etc.	Along new alignment, especially at Nisakot Community forest, Waglethok and Rupakot Crusher plant, batching plant sites, school,	Air pollution	Avoidance of drill machines, excavators' operations, loading and unloading of waste materials during wind. Masks will be available to workers, sprinkling of water along the dusty road during	Mentioned in BOQ	Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Test of air quality parameters discussed above.	Weekly



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SN	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicator	Frequency
						Implementation	Monitoring			
		urban and rural settlements		excavation twice a day. Contractor will avoid direct disposal of effluent from batching plant.						
(XXXii)	Use of chemicals	Camp site, workshops, natural drainage along the alignment.	Land and water pollution. Chemical hazards	Worker will handle chemicals properly. Storage of chemicals 100 meters away from any water sources. Spillage kit will be in place during the construction site.		Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation, water quality of Trishuli river and tributaries lab test	List of chemicals, storage, and handling practice. Accident records; spillage of chemicals and surface and ground water contamination	Monthly
(XXXiii)	Excavation activities with widening of highway; operation of camps and other works	Hotels, shops and resorts situated along highway, settlements, school, health posts	Noise pollution	Minimizing effect through barricade of construction area, providing operational schedule to local inhabitants. Monitoring noise level, maintained at national standard.		Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Regular monitoring of noise level records.	Monthly



SN	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicator	Frequency
						Implementation	Monitoring			
(XXXIV)	Operation of construction vehicles, excavation etc.	Khatripauwa, Waglethok, Rupakot, Gajurelgau, Dillisabitri School area, Purako Dharke.	Road safety, community wellbeing	Installation safety signage boards and traffic signals, barricades, providing PPEs to all labour workers, management local traffic and avoiding disturbances, inform and aware locals provide on job trainings to labours.		Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Accident records, safety application and facilities maintained.	Weekly
(XXXV)	Construction safety of labourer	Along the Sisnekhola -Dharke alignment	Occupational health and safety of labourer and accident	Safety signage boards, barricades along the construction sites, provided PPEs to all labour workers, provided on job trainings to labours		Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Group insurance of worker, all time available of PPEs to workers and engineers.	Weekly
(XXXVI)	Physical cultural structures	Along the Sisnekhola-Dharke alignment	Loss of physical cultural structures	Relocation of physical cultural structures		Construction contractor	DoR DCID, CSC, GESU	Site visit and observation	Rehabilitation of affected physical cultural structures,	Monthly

SN	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicator	Frequency
						Implementation	Monitoring			
(xxviii)	Establishment of camps	Along the identified location or along the Sisne khola-Dharke	Waste and health hazards, degradation of land, streams and rivers,	Prepared camp management plan prior to work, placed at campsites. It will maintain health and hygiene instructions. Temporary toilets, supply potable water. IFC standard for accommodation 2007 will be followed.		Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	grievances from locals. Operational Plans in place prior to operation and operated accordingly.	Monthly
Operation and maintenance Phase (Sisne khola-Dharke Physical Environment)										
(vii)	Instability of the hill slopes	Nishikot Community forest, tunnel portal area.	Destabilization of slopes	Bioengineering and slope protection works		Construction contractor	DoR DCID, CSC, GESU	Site visit and observation	Soil erosion, condition of structures applied for slope stability.	Monthly
(viii)	Encroachment of Right of Way	Along the proposed Sisnekhola-Dharke.	Obstruction in traffic movement, local discomfort	Awareness to locals; road marking, traffic signals in place and barricading along the road		DOR-DCID, DOR project office and DOR-GESU	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Construction of structures close or adjacent to the ROW	Monthly


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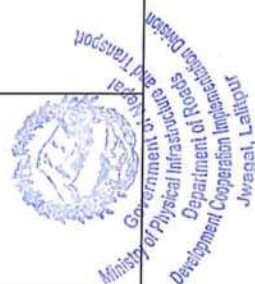
SN	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicator	Frequency
						Implementation	Monitoring			
(ix)	Impacts due to Poor Drainage	Natural drainages in Nisakot Community forest area.	Degradation of existing gullies, increase in soil erosion	Maintenance of drainage along the new road during DLP by contractor.		Construction contractor during DLP, DOR-DCID, DOR project office and DOR-GESU	DoR DCID, CSC, GESU	Site visit and observation	Roadside drainage discharge locations, water-pounding area during rain.	Monthly
(x)	Air and Noise Pollution	Along the alignment, especially at Khatripauwa, Waglehok, Rupakot, Dillisabitri schools, Buddha vision HS, Gajurelgau, Purano, Dharke	Health problems for locals and road users	Installation of traffic signals with no horn, speed control, installation of speed monitoring, monitoring of noise and air quality		DOR-GESU	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Grievances by locals, number of patient in local healthposts, record of death due to air and noise along the alignment.	Monthly
(xi)	Traffic safety and accident	Along the highway near Schools and settlements	Road safety and community wellbeing	Establishment of traffic signals, GPS tracking for speed control for public buses	Cost included in BOQ	DOR-DCID, DOR project office and DOR-GESU	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Roadside drainage discharge locations, water-pounding area during rain.	Monthly

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SN	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicator	Frequency
						Implementation	Monitoring			
		such as Khatripau wa, Waglethok, Rupakot, Gajurelgau , Purano Dharke and junction.		plying the highway.					pounding area during rain.	
(iii)	Waste Management	Along the highway, settlement areas such as Khatripau wa, Waglethok, Rupakot, Gajurelgau , Purano Dharke, etc.	Waste, health and hygiene to locals and road users.	Waste management, coordination with local municipality.		Municipality, Ward office, NGOs, DOR project office	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Grievances by locals, number of patient in local healthposts, record of death due to air and noise along the alignment.	Monthly
Preconstruction Phase (Sisne khola-Dharke, Biological Environment)										
(iv)	Preparation for felling of affected trees	Nisakot CF	Felled 274 trees and 2367 poles, wildlife disturbanc e, habitat	Plan for compensatory plantation of 25 saplings for each felled tree in advance; selection of		DFOs, CFUGs,	DoR DCID, Construction and Supervision Consultant	Site visit	Compensatory plantation plan is in place prior to felling of affected trees and forest	Prior to constructio n



SN	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicator	Frequency
						Implementation	Monitoring			
(v)	Disturbed wildlife and habitat	Along the ROW and in DIA	Loss of habitats; barrier effect; loss of biodiversity	Avoid cutting of trees and construction work during rainy season		Construction contractor	DoR DCID, Construction and Supervision Consultant	Site visits and observation	Coordination with CFUGs, forest clearance certificate acquired.	At the preconstru ction stage
Construction Phase (Sisne khola-Dharke, Biological Environment)										
(viii)	Clearing of forest, loss of vegetation and grazing area	Nisakot CF, Sisne- Khola Dharke – 11.2 km	There will be loss of 3.61 ha in CF and trees and poles	Replantation, compensation to the CFUG; incentives to use biogas and other alternative sources of energy. Hammering of trees that will be felled. Advising on proper felling, sectioning, hauling, piling and handover of cut trees.		Construction contractor in coordination with CFUG and DFOs	DoR DCID, Construction and Supervision Consultant (CSC), GESU- DoR	Site visits and observation	Forest clearance certificate acquired; felling of marked trees only.	During and after constructio n (quarterly)



SN	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicator	Frequency
						Implementation	Monitoring			
(ix)	Loss of biomass and carbon from felled trees	Nisakot CF, Government Forest	Biomass and carbon volume (table)	Replantation, compensation to CFUG and to DFOs; Biogas and other alternative energies		DoR with Construction contractor in coordination with CFUG and DFOs	DoR DCID, CSC, GESU-DoR	Site visits, documentation	Compensatory plantation location	Compensation before construction, replantation after
(x)	Disturbance to habitats	Nisakot CF	Nisakot CF will lose its integrity and biodiversity Two <i>Pinus</i> species and <i>Alnus nipalensis</i> will be affected	Compensatory plantation or new place for the forest as offset, training of CFUGs, private forest initiative. Check trees with bird of prey nests; avoiding felling of trees during nesting seasons.		Community groups under coordination of DoR and JESU	DoR DCID, Construction and Supervision Consultant	Visit of potential sites for offsets	Grievances received from locals	During construction
(xi)	Habitat fragmentation, barriers for wildlife movement	In forest areas, adjacent to KNM section	Roadkill wildlife, fragmented population, loss of species richness and	Wildlife/livestock cross-road structures in appropriate locations; design culverts as reptile & amphibian tunnels		Construction contractor	DoR DCID, Construction and Supervision Consultant (CSC), GESU-DoR	Site specific visits, interview with locals	Grievances received from locals	Monthly

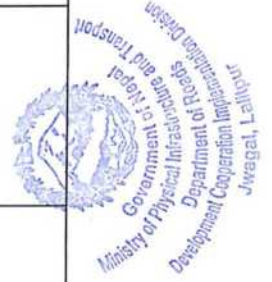


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SN	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicator	Frequency
						Implementation	Monitoring			
			abundances							
(vi)	Disturbed wildlife and habitat	Along the ROW and in DIA	Loss of habitats; barrier effect; loss of biodiversity	Control for nesting birds, avoiding work in the breeding season, instructed construction workers		Construction contractor	DoR DCID; Construction and Supervision Consultant	Site visits, interview and observation	Grievances received from locals	At the preconstruction stage
(vii)	Impacts on herptiles and fish species	Near new bridges and in proximity of natural habitats	Loss of species; impoverishment of aquatic habitats	Culverts established in appropriate places; Avoiding pollution of water-courses and impact on spawning sites		Construction contractor	DoR DCID, Construction and Supervision Consultant	Observation and interview	Grievances received from locals	Before and after construction
(viii)	Use of forest products by construction workers & hunting and poaching of wildlife	In proximity of labour camps	Loss of forest products and NTFP	Instruction of workers before construction Control from management team Alternative energy sources and food providing		Construction contractor	DoR DCID, Construction and Supervision Consultant	Site observation and interview with locals	Grievances received from locals	Weekly



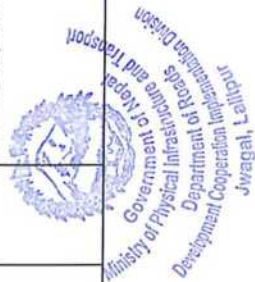
SN	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicator	Frequency
(xiv)	Forest fire	Near labour camps	Loss of forest area, wildlife and communit y assets, air pollution, human health, safety	Instruction of workers Fire-extinguishers in the labour camps Trained supervisors Control of the works. Alternative energy sources. Improved access to fire control measures		Implementation	Monitoring	Visual observations and interview with locals	Fire incidences and records.	Monthly
8.2.1.2	Operation Phase (Sisne khola-Dharke Biological Environment)									
(v)	Illegal felling of trees	Access zones	Communit y assets and profit loss, biodiversit y loss	Engagement of CFUGs in forest management		DFO, CFUGs	Environmental agencies	Observation and interview with locals	Status of replantation area.	Bi annual
(vi)	Damage of aquatic habitats	In proximity of bridges	Loss of fish and other aquatic fauna	Speed control on the bridge; appropriate signage, prevention of		DoR in cooperation with DFOs	DFOs, environment agencies, CFUGs	Observation and interview with locals	Availability of aquatic species in water bodies	When needed



SN	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicator	Frequency
						Implementation	Monitoring			
(vii)	Habitat fragmentation, barriers for wildlife movement	Nisakot community forest area.	Roadkill wildlife, loss of species richness and abundance	Established monitoring of cross-road structures, adaptive management		DoR and regional transportation authorities with CFUGs and DFOs	GESU-DoR	Observation and interview	Availability of species	Monthly
(viii)	Forest fire	Nisakot CF	Loss of forest area, wildlife and community assets, air pollution, human health, safety	Forest control in the dry season. Awareness programme. Alternative energy sources. Improved access to fire control measures. Control of brick-kiln area		Community and local administration (municipalities)	DFOs	Visual observations and interview	Incidence records.	Monthly
Preconstruction Phase (Sisne khola-Dharke Socio-economic and Cultural Environment)										
(iii)	Loss of private property and assets	13 locations (in table), 58 private structures, 384 households	Loss of assets, loss of income, businesses, effect of livelihood	Compensation Resettlements Alternative livelihood sources		GON	DoR DCID, Construction and Supervision Consultant	RAP	Procedures regarding land acquisition and compensation have been properly set out and	Before construction and implementation of project



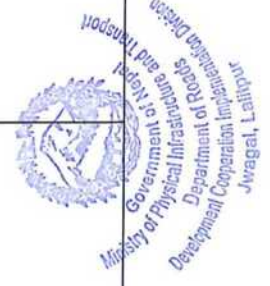
SN	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicator	Frequency
						Implementation	Monitoring			
(iv)	Grievance raised by locals and workers	Along the road	Delay of construction or hampering of work	Grievance readress mechanism; community consultation;		GON	DoR DCID	Minutes of meetings; number of applications	GRC in place	Responding to grievance applications
Construction Phase (Sisn-khola-Dharke Socio-economic and Cultural Environment)										
(xi)	Loss of productive land	Along the Sisn-Dharke section	Loss of agricultural production, 25.4 ha of fertile land loss	Accurate delineation of land needed for construction, preservation of land and soil outside of ROW		Construction Contractor, DoR	DoR, Foreign Cooperation Branch (DCID), GESU	Observations and visits, collected applications from land users	Landuse pattern along the ROW	During construction
(xii)	Land and property acquisition	Along the section	25.4 ha will be affected	Compensation, resettlement and rehabilitation		GON	DoR DCID), GESU	RAP, responded compens. applications	Landuse pattern along ROW	During construction
(xiii)	Destruction and damage of community structures	Along the road	4 public structures with Shiva Temple, irrigation	Replacement and restoration of structures		Construction contractor, DoR	DoR DCID), GESU	Field visits and assessment	Relocation status and condition	During construction



SN	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicator	Frequency
						Implementation	Monitoring			
			canal and road							
(XIII)	Livelihood issues	In 7 major settlements	Loss of business and livelihood activities	Replacement and providing specific area for businesses		GoN	DoR DCID), GESU	Field visits, verification	Livelihood of affected people and living standard	During construction
(XIV)	Conflict with nearby host community	Along the road	Disputes in community, social disorder	Security, instruction of construction workers, supervising and control by management team		Construction contractor	DoR DCID), GESU	Protocols of each event	Grievance records, records of conflict and brawls	During construction
(XV)	Vulnerable indigenous people, cultural assets, gender	Along the road	Danurwarai, Dalits, Women headed households, senior citizens	Awareness about the situation to contractor workers, special instructions		DoR, Construction and Supervision Consultant	DoR DCID, GESU	RAP, minutes of community meeting	Living status of Indigenous community due to implementation of project	During construction
(XVI)	Road safety	Along the road, mostly in urban areas	Health impact and Accidents, especially in school area	Signage, bus stops, overbridge, footpaths, instruction boards, zebra and lights, etc.		DoR, Construction and Supervision Consultant	DoR DCID), GESU	Field visits, number of installed structures	Status of safety measures applied along the road	During and after construction



SN	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicator	Frequency
						Implementation	Monitoring			
(xvii)	Landscape aesthetics	Along the road	Human health and well-being of the local people will be affected.	Planning of rehabilitation and offsets, control stockpiling & excavation materials, etc.		Construction contractor	DoR, DCID), GESU	Field visits	Operational plans properly placed and operated accordingly.	During and after construction
(xviii)	HIV/AIDs and other diseases	Along the road	Human health, safety and community environment	Awareness program for communicable diseases and vector borne diseases, instructions relevant to water and waste management, frequent health check of camp		DoR and construction contractor, local NGOs	DoR DCID), GESU	Number of awareness programs and events	Regular health checkup records of workers and engineers.	Once in every Six month.
10.2.1.1 Operation Phase (Sisne khola-Dharke Socio-economic and Cultural Environment)										
(vii)	Ribbon development, settlement and market places	Khatripauwa, Arjalgau, Purano Dharke	Pressure in community infrastructure, safety	Planning and proposal of new economic initiatives for local communities (service centres, etc.)		Local government, DoR	DoR DCID), GESU	Proper planning	Development of shops and market places.	After construction



SN	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicator	Frequency
						Implementation	Monitoring			
(viii)	Increase in accidents	Along the road	Safety and health, loss of assets, danger at school area	Regulations, awareness and road infrastructure (lights, signs, zebra, etc.) and adaptive management		DoR and regional transportation authorities	DoR, traffic police	Accident monitoring database	Accident records with police authority, Greivances etc.	After construction
(ix)	Increase in sell and use of alcohol products	Along the road	Health and well-being, accidents, violence	Stricter regulations, control of alcohol sale, prohibition of alcohol advertisement on roads		Local government,	Local clubs and women groups, other NGOs	Public awareness & communication	Comparison of availability of alcoholic products in shops and market area before and after implementation of project.	After construction
(x)	Trafficking and increase in prostitution	Along the road	Human health, well-being, violence, accidents	Awareness campaigns, creation of jobs for girls and women, vocational training for women, etc.		Local government	NGOs, clubs, women groups	Number of campaigns & awareness programs, etc.		After construction
(xi)	Migration and immigration	Along the road	Pressure in urban and market	Integrated planning of development		Local and regional government	Local government	Statistic data	Inflow of population within and	Before and after construction



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SN	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicator	Frequency
						Implementation	Monitoring			
(vii)	HIV/AIDS and other diseases	Along the road	Health, well-being, community life	Awareness campaigns, regular health camp operations		Local government, community organizations	Health organizations	Statistic data, number of campaigns	Records at Health Institutions, close to highway	Before and after construction

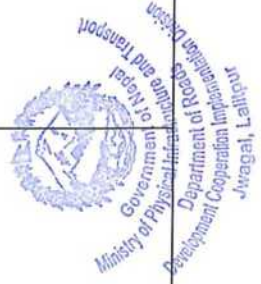
Table 11-9: Environment Management Plan for Bishaltar-Phisling Section

Sn.	Activities/ Issue	Location/s	Impact	Mitigation measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
8.2.1.1 Preconstruction Phase (Bishaltar-Phisling, Physical Environment)										
(i)	Access roads	Benibesi, Dhobadighat, Sukumbasitol, Jyamirghat and Itar settlements	Alternative diversions to local roads not yet designed	Signage posts and other information disseminated and provided before construction. Discussion in advance with local authorities such as ward office and municipality.		Construction and Supervision Consultant (CSC), GESU-DoR	DoR, DCID)	Site visit and observation	Plan of access to existing link roads and adjacent settlements mentioned in bidding document.	Monthly
(ii)	Planning for erosion control	4+400 to 5+400, 7+600 to 8+200	Land slide and erosion during construction	Review of EIA and other document and plan for the		Construction and Supervision Consultant	DoR, DCID)	Site visit and observation	Plan for erosion control is	Monthly

Sn.	Activities/ Issue	Location/s	Impact	Mitigation measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
		Salleri CF, 8+900 to 9+300 area close to Trishuli River, 10+100 to 15+000 GF and Nivare CF	n and excavation.	control of erosion in advance.		(CSC), GESU-DoR			mentioned in Bidding.	
8.2.1.2	Construction Phase (Bishaltar-Phising Physical Environment)									
(xviii)	Relocation of utilities	Along the alignment as presented in Table 5-52	Disruption in existing services at local level.	Proper relocation and operation of all affected utilities by the contractor.		Construction contractor	DoR DCID, CSC, GESU-DoR	Site visit and observation	Planning for the relocation, respective authority consulted, acquired approval for shifting	Monthly
(xix)	Excavation and opening of Bishaltar-Phising highway	Within the 50-meter ROW along the proposed Bishaltar-Phising	Change in land use and loss of productive topsoil	Acquired land within the ROW; land acquired temporary will be rehabilitated after construction. Public consultation for		Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Excavation Methodology in place	Monthly



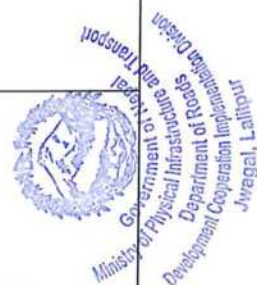
Sn.	Activities/ Issue	Location/s	Impact	Mitigation measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
				the plying of dump trucks and vehicles along the existing earthen tracks. 30 cm of topsoil will be kept in one place and reused for agriculture again. Contractor will obey IFC EHS General Guidelines 2007 and IFC EHS Guideline for Toll Roads 2007.						
(XX)	Excavation of hill slopes	4+400 to 5+400 Chuvatar, 7+600 to 8+200 Jyamirghat, 8+900 to 9+300 Thumka, and last 10+100 to 15+000	Landslides, Slope Destabiliza tion and Soil Erosion	Avoidance of haphazard slope excavation. Benching and excavation in piece-meal applied along steep slopes, especially at the Nivare CF. Bio- engineering and slope protection, engineering structures. Plan	Mentioned in BOQ	Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Excavation methodology, Slope stability and handling of excavated materials.	Monthly



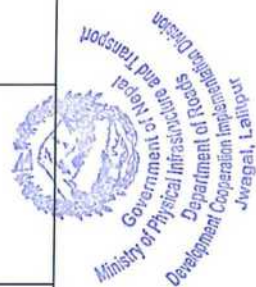
Sn.	Activities/ Issue	Location/s	Impact	Mitigation measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
				for managing stockpiling areas, disposal of excavated materials and excavation of hill slopes at the last 5.5 km section.						
(XVI)	Disposal of spoil	Valley side of the road all along the alignment.	During site clearance, excavation in slopes estimated 382,929 cu. m. of spoil materials will be generated.	Excavated spoil and other materials disposed at identified sites. Avoided haphazard disposal of spoil. Excavated spoil from hill slopes will not be disposed directly into Trishuli River.	Haulage cost included in BOQ.	Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit, observation and interview with locals	Identified disposal area; disposal area boundary maintained; landscaping and rehabilitation	Weekly
(XVII)	Construction and excavation; disposal of spoil	23 big and small natural drainages; Lamou khola, Dhobadi-, Judi-, Sano-,	Obstruction to natural drainage pattern	Avoided haphazard spoil disposal. Labour camps will be far to natural drainage; avoided direct disposal of any wastes.		Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Haphazard disposal of spoil; disposal practices and plan	Weekly

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Sn.	Activities/ Issue	Location/s	Impact	Mitigation measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
		Kaudi-, Prem- and Khani kholas at Phisling		Channelize natural gullies especially in the last 5.5 km.						
(xxiii)	Construction activities, likely disposal of soil, chemical wastes, Operation of crusher plants etc.	Along the existing Trishuli and Lamou khola, Dhobadi khola, Judi khola, Sano khola, Kaudi khola, Prem khola and Khani khola River	Pollution of water resources	Use water from ample sources supply within construction area or will buy it outside project area. Existing water sources and supply system will not be affected. Consent with locals in order to use available water sources.		Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit, observation and test of river water quality	Test results of water quality parameters.	Weekly site visit and observation/ water quality test in every six months.
(xxiv)	Soil contamination	Cultivated land along the alignment	Top soil of cultivated land and agricultural products from the land within the proposed road carriage	Consent for temporary acquisition of private land. Maintained designated storage area for chemicals and other materials, camp sites and workshops.		Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Disposal practice, Plan for collection of top soil and reuse for agricultural land.	Regular monitoring of storage areas. Weekly



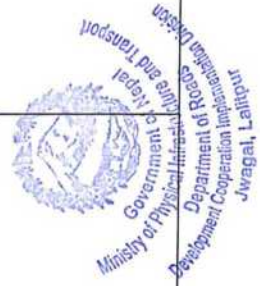
Sn.	Activities/ Issue	Location/s	Impact	Mitigation measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
			width will be lost permanently	Topsoil kept separately from subsoil, stored at a safe place with protective measures that to reuse to reclaim land, form a cover layer on spoil disposal and landscaped areas.						
(XXX)	Construction activities, haphazard disposal of spoil, disturbance to natural drainage.	Fertile cultivated area at Benibesi, Ghyalchoktar, Dhobadighat, Sukumbasitol, Pudaliphat, Jyaminghat, at Kautikhet	Water logging	Spoil disposal only at the designated sites. Avoided haphazard disposal at the valley side, along the natural drainage, along cultivated and private lands.		Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Disposal plan in place and disposal practice of contractor	Weekly



Sn.	Activities/ Issue	Location/s	Impact	Mitigation measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
(xxvi)	Operation of borrow pits and quarries	Riverbanks of Trishuli hill side quarry.	Disturbance to landscape, air and noise, accidents, ponding, increase of sedimentation on level etc. with the operation.	Avoided hazardous quarry along the riverbank and hills; provided permanent barricade at quarry location for safety, established safety signage boards, installed noise barriers. Prepared borrow pit operation plan with approval from supervision engineers prior to operation of quarry.	Mentioned in BOQ	Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit, observation and interview with locals	Borrow pits and quarry site operational plan in place; approval from engineers.	Weekly
(xxvii)	Operation of stone crushing	Along the Bishaltar-Phising	Dust, air and noise. Likely accident.	Avoided operations near school and settlements. Acquired permission from engineers prior to the establishment.		Construction contractor	DoR DCID, Construction & Supervision Consultant, GESU	Site visit and observation	Operational Plans in place prior to operation and operated accordingly	Weekly


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Sn.	Activities/ Issue	Location/s	Impact	Mitigation measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
(xxviii)	Stockpiling and transportation of construction materials	Along the alignment; proposed stock piling area and 10+000 to 15+000, where the hill slopes are steep and vulnerable to landslide	Dust emission, washout affect to downhill to the Trishuli and cultivated and discomfort to locals.	Stockpile materials covered with tarpaulin, water sprinkling carried out near and around the stockpile to avoid erosion; proper barricade and security guard provided for the area.	Mentioned in BOQ	Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Grievances and complain from locals; ambient air quality adjacent to storage and construction sites.	Weekly
(xxix)	Road excavation, construction activities, operation of dump trucks, etc.	Along the existing alignment, especially at existing urban areas. Crusher plant, batching plant sites, School, urban and settlement areas	Air pollution	Avoid operation of drill machines, excavators, loading and unloading of waste materials in windy days. Dust masks for labour workers, sprinkling of water along the dusty road. Avoid direct disposal of effluent from batching plant.	Mentioned in BOQ	Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Air quality parameters discussed above.	Quarterly during road width excavation.



Sn.	Activities/ Issue	Location/s	Impact	Mitigation measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
(xxx)	Use of chemicals	Camp site, workshops, natural drainage along the alignment.	Land and water pollution. Chemical hazards	Orientation to workers for handle of chemicals. Storage of chemicals in 100 meters away from any water sources. Spillage kit in place at construction site.		Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation, water quality of tributary of Trishuli river lab test	List of chemicals, storage, and handling practice. Accident records; spillage of chemicals and surface and ground water contamination.	Observation in every month; water quality test in every six month.
(xxvi)	Excavation activities with the widening of existing highway and operation of camps and other activities	Hotels, shops, resorts and eatery shops along the highway, settlements, school, health posts	Noise pollution	Barricade for construction area, operational schedule to local inhabitants. Monitoring noise level maintained at national standard.		Construction contractor	DoR DCID, Construction & Supervision Consultant, GESU	Site visit and observation	Regular monitoring of noise level records.	Monthly
(xxvii)	Operation of construction vehicles, excavation etc.	Ghyalchowk and Bhumlichowk area from Benibesi, Dhobadighat,	Road safety and traffic management.	Safety and traffic signage, barricades, provided PPEs to all workers, managed local traffic avoiding		Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Accident records, safety application and facilities maintained.	Weekly


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						Implementation	Monitoring			
		Sukumbasit ol, Jyamirghat and Itar		disturbance, informed and aware locals, on job trainings to workers						
(XXIII)	Construction safety of labourer	Along the alignment	Occupation al health and safety of labourer and accident	Safety signage, barricades in the construction sites, provide PPEs to all workers, manage local traffic and disturbances, inform and aware locals, on job trainings to labours		Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Group insurance of worker, all time available of PPEs to workers and engineers.	Weekly
(XXIV)	Establishment of camps	In identified locations or along the section	Waste and health hazards, degradation of land, streams and rivers,	Camp management plan prior to work, provided required facilities at camp sites to maintain health and hygiene, installed temporary toilets, supplied potable water, etc. IFC		Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Operational Plans in place prior to operation and operated accordingly .	Monthly



Sn.	Activities/ Issue	Location/s	Impact	Mitigation measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
				Standard for Accommodation 2007 will be followed.						
Operation and maintenance Phase (Bishaktar-Phising, Physical Environment)										
(viii)	Instability of the hill slopes	Chainage: 4+400 to 5+400 Chuvatar, 7+600 to 8+200 at Jyamirghat, chainage 8+900 to 9+300 at Thumka, and at last 5.5km	Destabilization of slopes	Bioengineering and slope protection works; regular monitoring of sites; adaptive management		Construction contractor	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Soil erosion, condition of structures applied for slope stability.	Weekly
(ix)	Plying of vehicle	Along new alignment	Air pollution, Health problem of locals and road users	Regular cleaning of road surface, allocation of staff for each km for drain cleaning, establishment of vehicle emission test facility at Bishaktar.		DOR-GESU	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Number of vehicle stuck along the highway requiring maintenance	Monthly


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Sn.	Activities/ Issue	Location/s	Impact	Mitigation measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
(x)	Operation of highway and mobility of vehicles	Along the Bishaltar-Phisling alignment	Noise to local and road users	Installation of noise restriction or no horn traffic sign at Schools and major settlements. Road marking along the road.		DOR-GESU	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Noise monitoring	Monthly
(xi)	Cross drainage outfall and gullies	Cultivated land along the proposed alignment.	Erosion, landslide, waterlogging etc.	Outfall of roadside drainage will be disposed off natural drainage.		DOR-DCID, DOR project office and DOR-GESU	DoR DCID, CSC, GESU	Site visit and observation	Status of outfalls	Monthly
(xii)	Encroachment of Right of Way	Along the highway.	Obstruction in traffic movement, local discomfort	Awareness to locals regarding road safety, proper roadside markings and traffic signals, barricading where necessary.		DOR-DCID, DOR project office and DOR-GESU	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Structures build close to highway	Monthly
(xiii)	Traffic safety and accident	Along the highway, especially at urban areas.	Community health and wellbeing	Establishment of traffic signals, GPS tracking for speed control on highway. Traffic awareness to locals and schoolchildren.	Cost included in BOQ	DOR-DCID, DOR project office and DOR-GESU	DoR DCID, Construction and Supervision Consultant, GESU	Site visit and observation	Accident records; and grievances registered along the the alignment.	Monthly



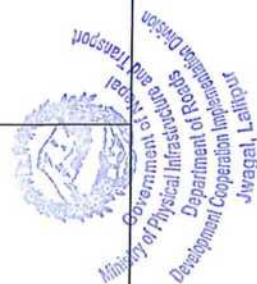
Sn.	Activities/ Issue	Location/s	Impact	Mitigation measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
(xiv)	Waste Management	Along the highway drain, Urban areas	Waste, health and hygiene to locals and road users.	Waste management, coordination with local municipality.		Municipality, Ward office, NGOs, DOR project office	DoR DCID, Construction & Supervision Consultant, GESU	Site visit and observation	Record of blockage of drain due to solid waste; waste disposal practices at local level.	Monthly
8.2.1.1 Preconstruction Phase (Bishaltar-Phising, Biological Environment)										
(iv)	Tree felling of trees (preparation)	Ghorka District	Loss of trees and forest, wildlife disturbance, habitat loss and change	DFO of Ghorka District asked to harvest trees before construction; identified and marked trees		DFOs, CFUGs,	DoR DCID, Construction & Supervision Consultant	Site visit, tree markings of affected trees in coordination with concern authority	Compensatory plantation plan is in place prior to felling of affected trees and forest clearance certificate acquired.	Prior to construction
(v)	Disturbed wildlife and habitat	2 government managed forests: Salleri and Nibhare	Habitat and biodiversity loss – vultures and kites	Avoiding work in the breeding season, instructed construction workers		Construction contractor	DoR DCID; Construction and Supervision Consultant	Site visits and observation	Coordination with CFUGs, forest clearance certificate acquired.	At the preconstruction stage
8.2.1.2 Construction Phase (Bishaltar-Phising, Biological Environment)										


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Sn.	Activities/ Issue	Location/s	Impact	Mitigation measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
(viii)	Clearing of forest, loss of vegetation and grazing area	5.81 km in the last section of alignment (more details in tables)	There will be loss of 29.49 ha, 620 trees and 6227 poles	Replantation, compensation to the CFUG; providing incentives to use biogas and other alternative sources of energy		Construction contractor in coordination with CFUG and DFOs	DoR DCID, Construction and Supervision Consultant (CSC), GESU-DoR	Site visits and observation	Forest clearance certificate acquired; felling of marked trees only.	During and after construction (quarterly)
(ix)	Loss of biomass and carbon from felled trees	3 forests in Ghorka district	Biomass and carbon volume 1140 t, carbon 834.59 t	Replantation, compensation to CFUG and to DFO; Biogas and other alternative energies		DoR with Construction contractor in coordination with CFUG and DFOs	DoR DCID, CSC, GESU-DoR	Site visits, documentation	Compensation by plantation location	Compensation before, replantation after
(x)	Disturbance to habitats	3 forests near Trishuli River	Wildlife and biodiversity loss in the community forests	Select compensatory plantations or new place for the forest establishment as offset habitats, training of CFUGs, private forest initiative		Community groups under coordination of DFOs, DoR and JESU	DoR DCID), Construction and Supervision Consultant, DFO	Visit of potential sites for offsets	Grievances received from locals	During construction
(xi)	Habitat fragmentation, barriers for	In forest areas, adjacent to	Roadkill wildlife, fragmented populations	Wildlife/livestock cross-road structures in appropriate		Construction contractor	DoR DCID, Construction and Supervision Consultant	Site specific visits, interview	Grievances received from locals	Monthly



Sn.	Activities/ Issue	Location/s	Impact	Mitigation measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
	wildlife movement	Trishuli river	, loss of species richness & abundances	locations; designed culverts as reptile & amphibian tunnels			(CSC), GESU-DoR			
(vi)	Disturbed wildlife and habitat	Along the ROW and in DIA	Loss of habitats & biodiversity; barrier effect	Avoiding work in the breeding season, instructed construction workers		Construction contractor	DoR DCID, Construction and Supervision Consultant	Site visits and observation	Grievances received from locals	At the preconstruction stage
(vii)	Impacts on herptiles and fish species	In the section located closely to Trishuli River	Loss of species; impoverishment of aquatic habitats	Culverts, herptile tunnels, avoiding of construction in fish breeding season, Prevention of Trishuli River pollution during construction		Construction contractor	DoR DCID, Construction and Supervision Consultant	Observation and interview	Grievances received from locals	Before and after construction
(viii)	Use of forest products by construction workers & hunting and poaching of wildlife	In proximity of labour camps	Loss of forest products and NTFP	Instruction of workers before construction Control from management team Alternative energy sources and food		Construction contractor	DoR DCID, Construction and Supervision Consultant	Site observation and interview with locals	Grievances received from locals	Weekly



Sn.	Activities/ Issue	Location/s	Impact	Mitigation measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
(iv)	Forest fire	Near labour camps, especially in Nivare and Saleri community forests (Itar)	Loss of forest area, wildlife and community assets, air pollution, human health, safety	Instruction for workers. Fire-extinguishers in the camps. Trained supervisors. Control of the execution. Alternative energy sources. Improved access to fire control measures		Construction contractor	DoR DCID), Construction and Supervision Consultant	Visual observations and interview with locals	Fire incidences and records.	Monthly
8.2.1.2 Operation Phase (Biological Environment)										
(iv)	Illegal felling of trees	Access zones	Community assets and profit loss, biodiversity loss	Engagement of CFUGs in forest management		DFO, CFUGs	Environmental agencies	Observation and interview with locals	Status of replantation area.	Bi annual
(v)	Damage of aquatic habitats	In proximity of bridges	Loss of fish and other aquatic fauna	Speed control on the bridge; appropriate signage, etc.		DoR in cooperation with DFOs	DFOs, environment agencies, CFUGs	Observation and interview with locals	Availability of aquatic species in water bodies	When needed
(vi)	Habitat fragmentation, barriers for wildlife movement	8 km section in Nivare and Saleri	Roadkill wildlife, fragmented populations, loss of	Established monitoring of cross-road structures;		DoR and regional transportation authorities with	GESU-DoR	Observation and interview	Availability of species	Monthly

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						Implementation	Monitoring			
		community forests	biodiversity	adaptive management		CFUGs and DFOs				
8.2.1.1	Preconstruction Phase (Socio-economic and Cultural Environment)									
(xii)	Loss of private property and assets	82 private structures, belonging to 45 households	Loss of assets, income and businesses, effect on livelihood	Compensation Resettlements Alternative livelihood sources		GON	DoR DCID, Construction and Supervision Consultant	RAP	Procedures regarding land acquisition and compensati on have been properly set out and followed; preparation of RAP and VCDP, Infrastructu res inventory.	Before construction and implementat ion of project
(xiii)	Grievance raised by locals and workers	Along the road	Delay of constructio n or hampering of work	Grievance redress mechanism; community consultation;		GON	DoR DCID)	Minutes of the meetings; number of applications	GRC in place	Responding to grievance applications
8.2.1.1	Construction Phase (Socio-economic and Cultural Environment)									


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Sn.	Activities/ Issue	Location/s	Impact	Mitigation measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
(xiv)	Loss of productive land	Along the Benighat- Phishling section	Loss of agricultural production, 17.72 ha of fertile land loss	Accurate delineation of land needed for construction, preservation of land and soil outside of ROW		Construction Contractor, DoR	DoR DCID), GESU	Observations and visits, collected applications from land users	Landuse pattern along the ROW	During construction
(xv)	Land and property acquisition	Along the section	17.72 ha will be affected	Compensation, resettlement and rehabilitation		GON	DoR DCID, GESU	RAP, responded compensation application	Landuse pattern along ROW	During construction
(xvi)	Destruction and damage of community structures	Along the road	82 public structures: incl. drinking water pipeline & irrigation canal	Replacement and restoration of structures		Construction contractor, DoR	DoR DCID), GESU	Field visits and assessment	Relocation status and condition	During construction
(xvii)	Livelihood issues	In 10 major settlements	Loss of business and livelihood activities	Replacement and providing specific area for businesses		GoN	DoR DCID), GESU	Field visits, verification	Livelihood of affected people and living standard	During construction
(xviii)	Conflict with nearby host community	Along the road	Disputes in community , social disorder	Security, instruction of construction workers, supervising and control by		Construction contractor	DoR DCID, GESU	Protocols of each event	Grievance records, records of conflict and brawls	During construction



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Sn.	Activities/ Issue	Location/s	Impact	Mitigation measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
(xix)	Vulnerable indigenous people, cultural assets, gender	Along the road	Chepang, Dalits, Women headed households, senior citizens	Awareness about the situation to contractor workers, special instructions		DoR, Construction and Supervision Consultant	DoR DCID), GESU	RAP, minutes of community meeting	Living status of Indigenous community due to implementation of project	During construction
(xx)	Road safety	Along the road	Health impact and Accidents, especially in school area	Signage, bus stops, overbridge, instruction boards, zebra and lights, footpaths, etc.		DoR, Construction and Supervision Consultant	DoR DCID, GESU	Field visits, number of installed structures	Status of safety measures applied along the road	During and after construction
(xxi)	Landscape aesthetics	Along the road	Human health and well-being	Planning of rehabilitation and offsets, control stockpiling & construction excavation materials, etc.		Construction contractor	DoR DCID), GESU	Field visits	Operational plans properly placed and operated accordingly.	During and after construction
(xxii)	HIV/AIDs and other diseases	Along the road	Human health, safety and community	Awareness program, instructions relevant to water and waste		DoR and construction contractor, local NGOs	DoR DCID), GESU	Number of awareness programs and events	Regular health checkup records of	Once in every Six month.

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Sn.	Activities/ Issue	Location/s	Impact	Mitigation measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
8.2.1.1 Operation Phase (Socio-economic and Cultural Environment)										
(vii)	Ribbon development, settlement and market places	6 major settlement areas	Pressure in community infrastructure, safety	Planning and proposal of new economic initiatives for locals (service centres)		Local government, DoR	DoR DCID, GESU	Proper planning	Development of shops and market places.	After construction
(viii)	Increase in accidents	Along the road	Safety and health, loss of assets, danger at school area	Regulations, awareness and road infrastructure (lights, signs, zebra, etc.), adaptive management		DoR and regional transportation authorities	DoR, traffic police	Accident monitoring database	Accident records with police authority, Grievances etc.	After construction
(ix)	Increase in sell and use of alcohol products	Along the road	Human health and well-being, accidents, violence	Stricter regulations, control of alcohol sale, prohibition of advertisement on roads		Local government,	Local clubs and women groups, other NGOs	Public awareness and communication	Comparison of availability of alcoholic products in shops and market area before and after implementation	After construction



Sn.	Activities/ Issue	Location/s	Impact	Mitigation measures	Cost	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
						Implementation	Monitoring			
(i)	Trafficking and increase in prostitution	Along the road	Human health, well-being, violence, accidents	Awareness campaigns, creation of jobs for women, vocational training for women, etc.		Local government	NGOs, clubs, women groups	Number of campaigns; awareness programs, etc.	ion of project.	After construction
(ii)	Migration and immigration	Along the road	Pressure in urban and market area, well-being	Integrated planning of development		Local and regional government	Local government	Statistic data	Inflow of population within and close to highway	Before and after construction
(iii)	HIV/AIDS and other diseases	Along the road	Health, well-being, community life	Awareness campaigns, regular health camp operations		Local government, community organizations	Health organizations	Statistic data, number of campaigns	Records at Health Institutions.	Before and after construction

Table 11-10: Environment Management Plan for Bridges

Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Frequency
8.2.1.1	Construction Phase (KNM Bridges-Physical Environment)					Implementation	Monitoring		
(i)	Excavation for bridge foundation	Proposed bridge areas	Landscape disturbance and bank instability	Protection of riverbanks, application of river training	Included in BOQ	Construction and Supervision Consultant (CSC), GESU-DoR	DoR DCID)	Site visit and observation	Monthly

Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Frequency
						Implementation	Monitoring		
(ii)	Excavation for bridge foundation	Proposed bridge areas	Quarry and excavation of river bed materials.	Construction and excavation of bridge foundation carried out only during dry season. Contractor will obey IFC EHS General Guidelines 2007 and IFC EHS Guideline for Toll Roads 2007.	Included in BOQ	Construction and Supervision Consultant (CSC), GESU-DoR	DoR DCID	Site visit and observation	Monthly
(iii)	Excavation for access road	Proposed bridge areas and approach roads near the bridges	Soil erosion due to construction and excavation of access road	Construction and excavation of bridge foundation carried out only during dry season.	Included in BOQ	Construction contractor	DoR, DCID, CSC, GESU-DoR	Site visit and observation	Monthly
(iv)	Excavation for bridge foundation	Proposed bridge areas	Change in river regime	Diversion of river to another side; opposite to the excavation area. Excavation of foundation during dry season.	Included in BOQ	Construction contractor	DoR, DCID, Construction and Supervision Consultant (CSC), GESU-DoR	Site visit and observation	Monthly


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Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Frequency
						Implementation	Monitoring		
(v)	Excavation for bridge foundation	Proposed bridge areas	Water pollution	Avoided direct disposal of excavated material to the river, excavation carried out during dry season.	Included in BOQ	Construction contractor	DoR, DCID, Construction and Supervision Consultant, GESU-DoR	Site visit and observation	Monthly
(vi)	Excavation for bridge foundation by heavy machines	Proposed bridge areas	Noise pollution	Prohibition to the unauthorized persons at construction sites. Safety gears will be provided to labour workers.	Included in BOQ	Construction contractor	DoR, DCID, Construction and Supervision Consultant (CSC), GESU-DoR	Site visit and observation	Monthly
(vii)	Excavation for bridge foundation and approach road	Proposed bridge areas	Dust and air pollution	Sprinkling of water along the approach road, existing highway, and stockpiling wards.	Included in BOQ	Construction contractor	DoR, DCID, Construction and Supervision Consultant, GESU-DoR	Site visit and observation	Monthly
(viii)	Excavation and disposal of spoil	Proposed bridge areas	Disposal and construction waste management	Disposal of excavated materials only on designated sites.	Included in BOQ	Construction contractor	DoR, DCID, CSC, GESU-DoR	Site visit and observation	Monthly
(ix)	Transportation of	Proposed bridge areas	Transportation and stockpiling	Stockpile of construction materials at	Included	Construction contractor	DoR, DCID, Construction and	Site visit and observation	Monthly

Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Frequency
						Implementation	Monitoring		
	construction materials		of construction materials	designated area, good house-keeping, cover with tarpauline sheets while transporting, water sprinkling as and when required.	in BOQ		Supervision Consultant (CSC), GESU-DoR		
(x)	Operation of labour camps	Proposed bridge areas	Impacts associated with labour camp operation.	Labour camp management plan will be in place, proper disposal system for the waste generated from the camps. IFC Standard for Accommodation 2007 will be followed.	Included in BOQ	Construction contractor	DoR, DCID, Construction and Supervision Consultant (CSC), GESU-DoR	Site visit and observation	Monthly
(xi)	Use of diesel and other chemicals	Proposed bridge areas	Spillage of chemical	Spillage kit will be in place, avoid spillage as far as possible, proper handling of chemicals, storage	Included in BOQ	Construction contractor	DoR, DCID, Construction and Supervision Consultant	Site visit and observation	Monthly


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Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Frequency
						Implementation	Monitoring		
			animals due to extraction of sand and gravel	will be carried out only during dry season.	in BOQ		Supervision Consultant (CSC), GESU-DoR		
(vii)	Construction activities and operation labour camp	Proposed bridge areas	Use of fuel wood by the construction workers in construction activities	Contractor will supply legal sources of energy for the camps. Avoid use of fuelwood.	Included in BOQ	Construction contractor	DoR, DCID, Construction and Supervision Consultant, GESU-DoR	Site visit and observation	Monthly
(viii)	Hunting and poaching of animals and fishing activity	Proposed bridge areas	Impact on fish population due to construction workers fishing	Instructions to labour workers; control from management team.	Included in BOQ	Construction contractor	DoR, DCID, CSC, GESU-DoR	Site visit and observation	Monthly
Operation Stage (KNM Bridges-Biological Environment)									
(iii)	Operation of road and bridges	Proposed bridge areas	Impact on growth of the natural forest and vegetation	Roadside barricade to forest area along the road.	Included in BOQ	Construction contractor	DoR, DCID, CSC, GESU-DoR	Site visit and observation	Monthly
(iv)	Possible vehicle drop and spillage of oil and diesel in the	Proposed bridge areas	Impact upon aquatic life; aquatic habitat destruction	Installation of traffic signs, speed control, awareness and information	Included in BOQ	Construction contractor	DoR, DCID, Construction and Supervision Consultant	Site visit and observation	Monthly


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Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Frequency
						Implementation	Monitoring		
	river due to accident			boards to road users.			(CSC), GESU-DoR		
	Pre-construction stage (KNM Bridges-Socio-economic and cultural Environment)								
(iii)	Land acquisition	Proposed bridge areas	Acquisition of land and relocation of affected people.	Acquisition and compensation of land as per Land acquisition act 2034 B.S.	Inclu ded in BOQ	Project Proponent, DCID	DoR, DCID, CSC, GESU- DoR	Site visit and observation	Monthly
(iv)	Demolition of structures	Proposed bridge areas	Impact due to acquisition of structures	Compensation to the affected structures	Inclu ded in BOQ	Construction contractor, Project Proponent, DCID	DoR, DCID, CSC, GESU- DoR	Site visit and observation	Monthly
	Construction stage (KNM Bridges-Socio-economic and cultural Environment)								
(vi)	Operation of camps, influx of labours from outside area	Proposed bridge areas	Health and sanitation chances of increase in transmission of disease form outside work force	Sanitation and potable water supply at labour camps and construction sites. Regular health checkup of labour workers.	Inclu ded in BOQ	Construction contractor	DoR, DCID, Construction and Supervision Consultant (CSC), GESU-DoR	Site visit and observation	Monthly
(vii)	Camp establishmen t and operation	Proposed bridge areas	Conflict and disturbance due to non- local labour	Establishment of camps will be at least 100 m away from any	Inclu ded in BOQ	Construction contractor	DoR, DCID, Construction and Supervision	Site visit and observation	Monthly

Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Frequency
						Implementation	Monitoring		
				residence, contractor will be responsible to avoid conflicts.			Consultant (CSC), GESU-DoR		
(viii)	Construction activities, and likely obstruction to existing traffic due such activities	Proposed bridge areas	Traffic safety and traffic movement	Traffic management plan in place. Allocation of traffic boy for the smooth mobilization of existing traffic, safety signs.	Included in BOQ	Construction contractor	DoR, DCID, Construction and Supervision Consultant (CSC), GESU-DoR	Site visit and observation	Monthly
(ix)	Bridge construction and excavation activities	Proposed bridge areas	Disturbance in movement of local inhabitants	Safety signals and traffic signs will be in place, awareness to locals and labour workers.	Included in BOQ	Construction contractor	DoR, DCID, Construction and Supervision Consultant, GESU-DoR	Site visit and observation	Monthly
(x)	Bridge construction and excavation activities	Proposed bridge areas	Occupational health and safety for bridge construction workers	Awareness, on job trainings to labourers, PPEs to all workers, any time availability of First Aid facilities in camps	Included in BOQ	Construction contractor	DoR, DCID, Construction and Supervision Consultant (CSC), GESU-DoR	Site visit and observation	Monthly


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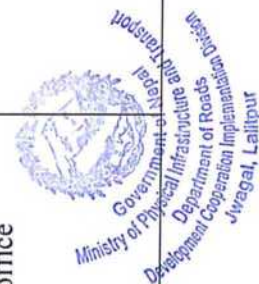
Sn.	Activities/ Issue	Location/s	Impact	Mitigation Measures	Cost	Responsible agency for		Verification Methods	Frequency
						Implementation	Monitoring		
				and bridge construction site.					
	Operation Stage (KNM Bridges-Socio-economic and cultural Environment)								
(iii)	Operation of the bridges	Proposed bridge areas	Safety of pedestrians with the plying of vehicles	Installation of RCC crash barrier along the bridge	Inclu ded in BOQ	Construction contractor	DoR, DCID, CSC, GESU- DoR	Site visit and observation	Monthly
(iv)	Operation of the bridges	Proposed bridge areas	Encroachment of land near the bridge area	Permanent barrication within the ROW of Bridge area	Inclu ded in BOQ	Construction contractor	DoR, DCID, CSC, GESU- DoR	Site visit and observation	Monthly

Table 11-11: Environmental Monitoring Plan

Sn.	Parameters/ Impact	Verifiable Indicators	Verification methods	Locations	Implementing Agency	Responsible Agency	Monitoring
	Compliance monitoring/pre-construction phase						
	Physical Environment						
1.	Land Clearance	Resettlement Action Plan	RAP verification with field visit	Along the proposed new alignments S-D and B-P	DCID-DOR	DoR, DCID, Project Management Supervision Consultant (PMSC)), GESU-DoR	
2.	Review of EMAP	EMAP prepared by contractor	Review of EMAP prepared by	Project office	DCID-DOR, PMSC	DoR, DCID, PMSC, GESU- DoR	



Sn.	Parameters/ Impact	Verifiable Indicators	Verification methods	Locations	Implementing Agency	Responsible Agency	Monitoring
3.	Review of access roads	Access to tunnel area, forest area, cultivated lands etc. all along the proposed new alignment.	Construction contractor Survey and review of EIA and RAP.	Along the proposed new alignments S-D and B-P	DCID-DOR, PMSC	DoR, DCID, PMSC, GESU-DoR	
4.	Erosion control	Plan for erosion control	Contractor's construction methodology for the excavation for opening new proposed alignments	Along the proposed new alignments S-D and B-P	DCID-DOR, PMSC	DoR, DCID, PMSC, GESU-DoR	
5.	Establishment of camps	Review EMP and camp management plan of contractor	Visit proposed camp sites, observation and photographs	Proposed camp sites	DCID-DOR, PMSC	DoR, DCID, PMSC, GESU-DoR	
6.	Traffic Management	Traffic management plan prepared by construction contractor in place	Review of Traffic management plan of construction contractor	Contractor office and project office	DCID-DOR	DoR, DCID, PMSC, GESU-DoR	

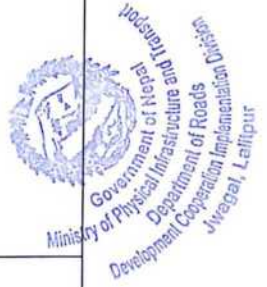


Sn.	Parameters/ Impact	Verifiable Indicators	Verification methods	Locations	Implementing Agency	Responsible Agency	Monitoring
7.	Waste Management	Grievances from the local people.	Field visit	Along the ROW of proposed new alignments and proposed disposal sites	DCID-DOR	DoR, DCID, PMSC, GESU- DoR	
8.	Environment responsible procurement	Ensure all the environment and social requirements are included in tender documents.	Review of tender document / BOQ	Project office	DCID-DOR	DoR, DCID, PMSC, GESU- DoR	
9.	Preparing construction contractor to address mitigation measures	Mitigation measures in BOQ items, and orientation provided to contractors	Review of BOQ, kick off meeting, review meetings, construction survey and EMAP from contractor's side	Project office	DCID-DOR	DoR, DCID, PMSC, GESU- DoR	
	Compliance construction phase	monitoring/pre-					
	Biological Environment						
10.	Marking of affected trees before felling and approval of tree	Tree cutting approval letter	Review of EIA and affected number of trees along the	Existing forests along the proposed	DCID-DOR, PMSC, DFO	DoR, DCID, PMSC, GESU- DoR	

Sn.	Parameters/ Impact	Verifiable Indicators	Verification methods	Locations	Implementing Agency	Responsible Agency	Monitoring
	cutting from Department of Forest	from Department of Forest	proposed alignment new	new alignment S-D and B-P			
11.	Compliance monitoring/pre- construction phase						
12.	Socio-economic and cultural environment						
13.	Compensation to affected structures and land	Compensation provided, transfer of land and demolition and relocation of affected structures	Interview with affected people	Project site	DCID-DOR, PMSC	DoR, DCID, PMSC, GESU- DoR	
14.	Plan for the relocation of affected utilities	Planning for the relocation, respective authority consulted, acquired approval for shifting	Meeting minutes with respective authority, Plan prepared.	Project office	Contractor	DoR, DCID, PMSC, GESU- DoR	
15.	Plan for the relocation of affected physical structures with	Plan prepared and in place.	Review of plan and reverification of physical structures	Especially along the existing KNM. Two such structures along the S-D.	Contractor	DoR, DCID, PMSC, GESU- DoR	


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Sn.	Parameters/ Impact	Verifiable Indicators	Verification methods	Locations	Implementing Agency	Responsible Agency	Monitoring
	cultural significance		with cultural significance				
16.	Compliance monitoring/ construction phase						
17.	Physical Environment						
18.	Plan prepared and placed for Muck / Spoil disposal and management	Muck / Spoil Site Management Plan prepared by Contractor	Review of EIA Document, Enquiry with project and Contractor	Contractor office and Project office	Construction contractor	Project Management and Supervision Consultant (PMSC), Proponent Foreign Cooperation Branch (DCID)-DOR/	
19.	Plan prepared and placed for Construction Camp Management, Traffic Management Plan, Drainage Management Plan, Erosion Control Plan, Quarry and Material Management Plan, Spoil Disposal Plan, Waste Management Plan, Crosser Operational Plan, Noise and Dust Control Plan,	All management plans prepared and are in place	Review of management plans	Contractor office and Project office	Construction contractor	Proponent Foreign Cooperation Branch (DCID)-DOR/ Contractor / and PMSC	



Sn.	Parameters/ Impact	Verifiable Indicators	Verification methods	Locations	Implementing Agency	Responsible Agency	Monitoring
	Compensation Replantation Plan						
20.	Occupational Health and Safety Management Plan prepared	Plan prepared and is in place	Review of EIA Document, Enquiry with project and Contractor	Project office, contractor office	Construction Contractor and PMSC	Proponent Contractor / and PMSC	DCID-DOR/ Contractor / and PMSC
21.	Landslides and vulnerable areas	Identified in EIA document and Detail Design Report	Review of documents and field observation, Photographs, GPS coordinates;	Project sites	Construction Contractor	Proponent Contractor / and PMSC	DCID-DOR/ Contractor / and PMSC
22.	Existing infrastructures	Number and type of affected infrastructures identified	Review of EIA and field verification	Project office, project sites	Construction Contractor	Proponent Contractor / and PMSC	DCID-DOR/ Contractor / and PMSC
23.	Identified spoil disposal sites	Sites identified during EIA	Review of EIA documents and field verification	Project sites (Maps 16- 19)	Construction Contractor	Proponent Contractor / and PMSC	DCID-DOR/ Contractor / and PMSC
24.	Identified crusher plant and labour campsites.	Sites identified during feasibility	Review of EIA document and field verification	Project sites	Construction contractor	Proponent Contractor / and PMSC	DCID-DOR/ Contractor / and PMSC
25.	Land use	Land use types	Land use affected (Maps, Tables)	RoW, DIA and IIA along KNM, Sisnekhola- Dharke and Bishaltar- Phishling	Construction contractor	Proponent Contractor / and PMSC	DCID-DOR/ Contractor / and PMSC

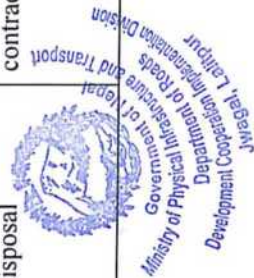

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Sn.	Parameters/ Impact	Verifiable Indicators	Verification methods	Locations	Implementing Agency	Responsible Agency	Monitoring
26.	Watershed	Erosion slope stability in the catchment	Observation, GPS coordinates	Along the road alignment	Construction contractor	Proponent Contractor / and PMSC	DCID-DOR/ Contractor / and PMSC
27.	Air and water quality parameters	Aforementioned parameters in Table	Measurement	Along the road alignment	Construction contractor/ PMSC	Proponent Contractor / and PMSC	DCID-DOR/ Contractor / and PMSC
28.	Incorporation of environmental protection measures in the detail design, contract document and tender documents	Detail design reports, contract document and tender documents	Review of final design document and project specification	Proponent office	Detail Design Team, Proponent	Proponent Contractor / and PMSC	DCID-DOR/ Contractor / and PMSC
29.	Allocation of cost for environmental protection measures in tender document	Detail design reports, contract document and tender documents	Review of final design document and project specification/Bid document	Proponent office	Detail Design Team, Proponent	Proponent Contractor / and PMSC	DCID-DOR/ Contractor / and PMSC
30.	Allocation of adequate budget for compensation of land, property and agri-products, tree cutting, transportation and stockpiling of forest products, and temporary	Official documents prepared in these regards, Agreement between proponent and locals and between proponent and DFO/CFUGs for trees cutting and compensation.	Review of project documents, process carried out for land acquisition and tree cutting and temp. acquisition of land, interview with locals, checklist	Proponent office/ Project Site Office	Proponent	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC

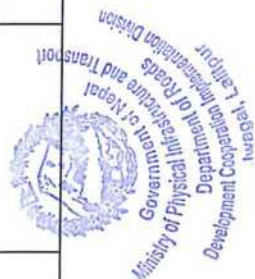


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Sn.	Parameters/ Impact	Verifiable Indicators	Verification methods	Locations	Implementing Agency	Responsible Agency	Monitoring
	acquisition of private land						
31.	Restriction upon haphazard disposal of spoil along hill slopes, vegetated areas, water bodies and other environmentally sensitive areas	Haphazard disposal of spoil	Field visit along alignment Corridor, photographs, GPS coordinates	Along highway Corridor	Construction contractor	Proponent Contractor / and PMSC	DCID-DOR/ and PMSC
32.	Stockpiling of construction materials	Placed stocks along the road in designated sites	Field visit along the alignment corridor, photographs, GPS coordinates	Along highway Corridor	Construction contractor	Proponent Contractor / and PMSC	DCID-DOR/ and PMSC
33.	Enforce use of recommended disposal sites	Regular monitoring of spoil loading, transportation and dumping at designated places and status of disposal sites	Observations, Interview, Photographs	Designated Sites of spoil disposal	Construction contractor	Proponent Contractor / and PMSC	DCID-DOR/ and PMSC
34.	Stockpiling of excavated materials and construction materials	Regular monitoring on materials handling at earthworks	Observation, Interview, Photographs	Designated Sites of spoil disposal	Construction contractor	Proponent Contractor / and PMSC	DCID-DOR/ and PMSC

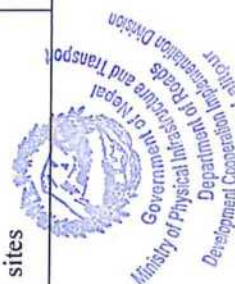


Sn.	Parameters/ Impact	Verifiable Indicators	Verification methods	Locations	Implementing Agency	Responsible Agency	Monitoring
35.	Status of quarry sites; vegetation cover, drainage system, initiated erosion, affected aesthetic value, forest, and agricultural land	Regular monitoring of quarry sites operation if any	Observation, Interview, Photographs	Designated Sites for quarry	Construction contractor	Proponent Contractor / and PMSC	DCID-DOR/ Contractor / and PMSC
36.	Adoption of explosive management and handling plan by Contractor, safe transportation, storage, use and dispose of explosive and toxic materials	Procedures for safe storage and use of explosives and toxic materials	Site observation and discussion with local residents, workers. Public alert; Contingency planning.	Project alignment with rocky boulders areas and quarry sites	Construction contractor	Proponent Contractor / and PMSC	DCID-DOR/ Contractor / and PMSC
37.	Regular water sprinkling to arrest construction-related dust and vehicle maintenance to minimize gaseous emission	Water sprinkling during construction and availability of water sprinkling vehicles	Site observation and discussion with locals, photographs	Project construction sites especially near settlement areas	Construction contractor	Proponent Contractor / and PMSC	DCID-DOR/ Contractor / and PMSC
38.	Slope protection measures, such as, retaining walls; installation of rock	Bio-engineering, adoption of slope	Site observation and discussion with	Location where mass cutting is required as per design estimate	Construction contractor	Proponent Contractor / and PMSC	DCID-DOR/ Contractor / and PMSC

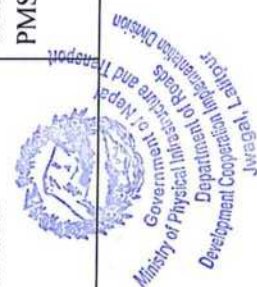


Sn.	Parameters/ Impact	Verifiable Indicators	Verification methods	Locations	Implementing Agency	Responsible Agency	Monitoring
	bolts, sort-creeds, etc.	protection measures in time	locals, photographs, GPS coordinates				
39.	Relocation and rehabilitation of affected infrastructures	Relocated infrastructure is placed in beneficial places, status of using the relocated infrastructure by locals	Site observation and discussion with locals, photographs	Along the highway alignment	Construction contractor	Proponent Contractor / and PMSC	DCID-DOR/ and PMSC
40.	Rehabilitation and restoration of work camps and labour camp(s), spoil disposal sites, etc.	Erosion, land slide, drainage, closure of latrines and pits, sanitation, and vegetation cover	Site inspection, discussion with workers and local people, photographs.	Proposed camp site locations and along the highway alignment	Construction contractor	Proponent Contractor / and PMSC	DCID-DOR/ and PMSC
41.	Local labourers employed and skill training launched	Percentage of Local labours in the project, awareness and training	Site inspection, discussion with workers and local people.	Along the highway in all working sites	Construction contractor	Proponent Contractor / and PMSC	DCID-DOR/ and PMSC
42.	Operation and closure of quarries and borrow pits	Executed requirements related to location, vegetation, soil protection, soil conservation, erosion control	Site observation, discussion with local people, observe spoil disposal practice of Contractor, photographs	Along the highway alignment	Construction contractor	Proponent Contractor / and PMSC	DCID-DOR/ and PMSC
43.	Integration of local people's	Opinions and suggestion	Review design reports, discussion	Proponent office	Construction contractor	Proponent Contractor / and PMSC	DCID-DOR/ and PMSC

Sn.	Parameters/ Impact	Verifiable Indicators	Verification methods	Locations	Implementing Agency	Responsible Agency	Monitoring
	environmental concerns	collected during public consultation and hearings of EIA	with local stakeholders.				
44.	Safety construction	Statistic of accidents, instructions, on-job training for workers, personal protective equipment, safety signs, emergency plan and first-aid kits	Observations, field visits, photographs, records keeping, etc.	In the every construction site along the road	Construction contractor	Proponent Contractor / and PMSC	DCID-DOR/ Contractor / and PMSC
Biological Environment							
	Impact on the forest habitats	Forest Clearing and Management Plan prepared by Contractor/DFO	Review of EIA Document, Enquiry with project office/DFO	Project office/ Contractor office/DFO	Construction contractor	Proponent Contractor / and PMSC	DCID-DOR/ Contractor / and PMSC
	Preparation for cutting trees and clearing vegetation and excavated slopes	Compensatory Plantation Plan and Bio-engineering Plan prepared and placed	Review of EIA Document, Enquiry with project and DFO	Project office, contractor office	Construction contractor/ DFOs, CFUGs and local NGOs	Proponent Contractor / and PMSC	DCID-DOR/ Contractor / and PMSC
	Using of forest resources/ illegal	Impact on existing forest, use of firewood near	Observation, interview with local,	Along the alignment, campsites, construction sites	Construction contractor	Proponent Contractor / and PMSC	DCID-DOR/ Contractor / and PMSC



Sn.	Parameters/ Impact	Verifiable Indicators	Verification methods	Locations	Implementing Agency	Responsible Agency	Monitoring
	harvesting/ hunting and poaching	camps or for other construction purposes	field visits and photographs				
	Number of trees felling; Estimated number of trees required for felling during construction	Allocated adequate budget for tree cutting, transportation and stockpiling; Affected trees identified and marked;	Review of EIA, Observation and field visit	Proponent office and forested areas along the alignment (Tables above chapters)	Construction contractor	Proponent Contractor / and PMSC	DCID-DOR/ Contractor / and PMSC
	Major wildlife habitats along the road	Availability of species and habitats, trees with nests, wildlife richness and abundance, etc.	Observation and field visits, discussion with CFUGs	Along the alignment	Construction contractor	Proponent Contractor / and PMSC	DCID-DOR/ Contractor / and PMSC
45.	Impact on fish and aquatic wildlife	Fish and aquatic animals in the project area	Sampling in the area near bridge construction and in upper-stream	Around bridge construction and in river-crossing areas	Construction contractor and PMSC	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC
46.	Wildlife habitat fragmentation, disrupted movement corridors	Cross-road structures, adapted culverts and bridges	Field surveys along the road by early morning in project sites	Along the alignment in forest areas	Construction contractor and PMSC	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC



Sn.	Parameters/ Impact	Verifiable Indicators	Verification methods	Locations	Implementing Agency	Responsible Agency	Monitoring
47.	Degraded forests in the RoW and DIA	Compensatory plantation in the ratio of 1:10 and its protection	Site observation, field visits, discussion with nursery/plantation workers, photographs	Planned nursery sites and sites selected for re-plantation	Construction contractor	Proponent Contractor / and PMSC	DCID-DOR/ Contractor / and PMSC
48.	Fire hazard	Fire- extinguishers, instruction, trained personnel, Emergency Plan in place	Visit of campsites, review of documents, photographs, etc.	Along RoW of road alignment	Construction contractor	Proponent Contractor / and PMSC	DCID-DOR/ Contractor / and PMSC
Social Environment							
49.	Land area and properties acquired for the project	Procedures regarding land acquisition and compensation have been properly set out and followed; preparation of RAP and VCDP, Infrastructures inventory.	Review of EIA Document, Enquiry with project office	Project office and at CDC office of the Districts	Construction contractor	Proponent Contractor / and PMSC	DCID-DOR/ Contractor / and PMSC
50.	Potential loss of land, properties and business	List of affected households	Review and verification of RAP and VCDP, field visit, interview with affected people	Along the alignment	DCID-DoR	Proponent Contractor / and PMSC	DCID-DOR/ Contractor / and PMSC


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Sn.	Parameters/ Impact	Verifiable Indicators	Verification methods	Locations	Implementing Agency	Responsible Agency	Monitoring
51.	Resettlement of affected households, compensation to PAFs and SPAFs	PAFs and SPAFs identified in VCDP and EIA, resettlement plan, distribution of compensation	Review of EIA and VCDP, number of households obtained compensation	Along the alignment	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC
52.	Affected land and properties (loss of productive land, land and property acquisition)	Documented relocation & resettlement area. Allocation of adequate budget for land, property and agri-product compensation	Review of final design, VCDP, project specification. Field visit, interview with affected people and with SPAF	Proponent office and resettlement area, project vicinity, along the highway route.	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC
53.	Temporary acquisition of private land	Allocation of budget in Acquisition plan and distribution of compensation	Review of final design document and project specification, site observation, discussion with locals and interview with SPAFs	Proponent office/ project area/ field verification	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC
54.	Noise and other sensitive impacts on health and community life.	Blow of pressure horns in immediate sensitive receivers of the project	Site observation, discussion with locals and interview	Closely to settlements, schools, hospitals and other community places	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC


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Sn.	Parameters/ Impact	Verifiable Indicators	Verification methods	Locations	Implementing Agency	Responsible Agency	Monitoring
55.	Conflict between labour force and local communities	Employment of local labours during construction, job training organized	Site observation, discussion with locals and interview with labours	Along the proposed road alignment	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ and PMSC
56.	Health and sanitation issues in the labour camps	Provisions for health and sanitation facilities at work camp.	Site observation, discussion with locals and interview with labours	At camp sites and work camp sites	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ and PMSC
57.	Occupational health and safety measures	Ensure Life Insurance of the labours, use of safety measures by workers	Review of Contractor's document and insurance paper of labours	Project sites, Contractor's office	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ and PMSC
58.	Gender issues in the labour environment	Wage paid not minimizing the wage fixed by the concerned district to both male and female labours.	Review of Contractor's documents, interview with labours	At construction site, labour camps	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ and PMSC
59.	Occurrence of communicable diseases	Health of construction labours	Observations, medical statistic, interview with labours	At construction site, labour camps	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ and PMSC
60.	Impact on local indigenous communities	Statistics of impacted indigenous communities	Site observation, discussion with locals and interview with SPAFs	Along the new alignments	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ and PMSC

Sn.	Parameters/ Impact	Verifiable Indicators	Verification methods	Locations	Implementing Agency	Responsible Agency	Monitoring
61.	Impact on local economy	Living standard and Economic status of the SPAFs and other locals	Statistics, site observation, discussion with locals and interview with SPAFs	Settlements along the existing road and new alignments	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC
62.	Impact on community life and wellbeing	Launching of skill training, and public awareness Activities	Minutes of trainings, list of participants of trainings, benefit of trainings	Project area	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC
63.	Destruction and damage of historical, cultural sites and natural habitats	Replaced and restored structures and affected natural sites	Site observation, discussion with locals (Table - Annex)	Project area	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC
B. Impact Monitoring							
64.	Physical Environment						
65.	Work camp sites operation	Sanitation facilities and drainage condition, proper siting of food stalls, etc	Observation and interview with locals and camp workers	Camp sites along the alignment	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC
66.	Asphalt mix plant and crusher plant sites	Measurement of emissions, impact on air, water, land and noise pollution	Observation and measurement	Batch mixing and crusher plant sites	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC


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Sn.	Parameters/ Impact	Verifiable Indicators	Verification methods	Locations	Implementing Agency	Responsible Agency	Monitoring
67.	Impact upon private property and land due to dispose of roadside drain	Location of roadside drainage facilities and dispose of drain water	Observation and interview with locals	Along the alignment	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC
68.	Blockage of natural drainage and erosion of adjacent land of natural drainage	Assessment of Existing Drainage and watershed conditions	Observation and interview with locals	Along the alignment	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC
69.	Impact of blasting upon human and physical structures	Proper use of explosives/blasting	Observation and interview with locals	Along the alignment	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC
70.	Damage of top soil and landscape	Storage of excavated materials and top soil	Observation and interview with locals	Along the alignment	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC
71.	Impact of landscape due to disposal of excavated materials and other construction wastes	Use of identified tipping sites with protection and toe walls	Observation and site inspection	Along the alignment	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC
72.	Instability of hill slopes, soil erosion	Nos and plant species selected for bio-engineering by protective function	Site inspection, field observations, photographs, GPS points	Along the alignment at landslide area and tipping site rehabilitation area	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC



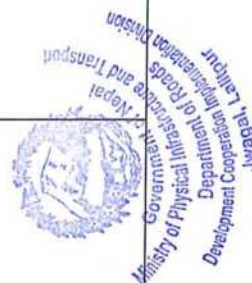
Sn.	Parameters/ Impact	Verifiable Indicators	Verification methods	Locations	Implementing Agency	Responsible Agency	Monitoring
73.	Impact upon adjacent lands and community infrastructures	Side tipping of excavated soils and wastes; safeguard of affected community infrastructures	Observations, field visits, photos	Along the alignment	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC
74.	Impact of operation and rehabilitation of quarry sites	Water ponding, landslide, erosion, impact upon private properties near the quarry sites	Observation	Along the alignments	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC
75.	Landslides and unstable slopes, erosion, vulnerable landslide areas, new cut slopes	-Number, location and extent of slope failures and road subsiding effects -Analysis for slope failure -Area (ha) of land, forest and properties affected -Nos and extent of gully erosions and pavement failures and suitability of corrective/bio-engineering measures	Site Observation, photographs, GPS points, Review of records	Along the alignment	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC



Sn.	Parameters/ Impact	Verifiable Indicators	Verification methods	Locations	Implementing Agency	Responsible Agency	Monitoring
		-Nos of days and nature of traffic delays due to slides					
76.	Vibration impact on local community and private structures	Cracks of physical structures, impact on health of locals during excavation	Observation, discussion with locals and interview	Along the alignment	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC
77.	Quality of surface water, and groundwater level changes, impact from car washing practices in rivers, water pollution due to unsafe disposal of waste and spoil, damage to farm lands due to water shortage or pollution; blockage of waterways - extent and secondary impacts	-extent of water-logging at operative and/or decommissioned construction sites -Incidents & trends in development of waterborne diseases -Trend analysis for local fisheries -Records of seasonal groundwater fluctuations -Laboratory tests for drinking water quality, determining pH, particulars, turbidity, BOD,	Observations and measurement, field visits, lab statistics	Along major river crossings, and major settlement areas and service sites	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC



Sn.	Parameters/ Impact	Verifiable Indicators	Verification methods	Locations	Implementing Agency	Responsible Agency	Monitoring
		fecal bAacteria, NH _x , NO _x , SO _x , PO ₄ , hydrocarbons, selected heavy metals.					
78.	Air pollution, vehicular emission, noise, traffic volume along the alignment	Air quality measurements in dB (A) at settlement sites/sensitive spots for noise level at 2, 5 and 15 m from road shoulder; Qualitative analysis of dust development at selected sites	Measurement, lab tests	Along the major settlement	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC
79.	Solid pollution and waste impact on landscape aesthetics	Maintenance of roadside drain and road structures; waste management.	Observation, Photographs	Along the alignment	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC
80.	Surface flow interruption and its consequences along river due to direct disposal of spoil if any.	Direct disposal of spoil into major river along the highway	Observation	River along the highway alignment	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC



Sn.	Parameters/ Impact	Verifiable Indicators	Verification methods	Locations	Implementing Agency	Responsible Agency	Monitoring
81.	Road Safety	-Speed measurements at selected spots -Road accidents recorded in the Traffic Police/DO and in local health service centers -Local road signs, zebras, cross-road structures	Site inspection and review of documents. Records on public road safety awareness campaigns	Along the alignment	DCID-DoR, PMSC	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC
Biological Environment							
82.	Impact on forest habitat, illegal felling of trees	Assessment of forest land cover along the road; volume of wood trade, location of timber depot, fuel wood sale	Observation and measurement, photographs; analysis of forest cover trend	Forest area along road alignments, checkpoints, market and settlement areas	DCID-DoR, PMSC, DFOs, CFUGs, NGOs	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC
83.	Encroachment along the road/degradation of forest, over-exploitation of resources.	Density of forest, species composition, presence of valuable timber species; observations and	Sampling and field surveys, photographs, monitoring reports	Along the highway alignment	DCID-DoR, PMSC, DFOs, CFUGs, NGOs	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC



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Sn.	Parameters/ Impact	Verifiable Indicators	Verification methods	Locations	Implementing Agency	Responsible Agency	Monitoring
		handling of invasive species; extents and causes for forest fires					
84.	Damage of aquatic habitats and species	Fish spawning sites, number of species, assessment of habitat conditions	Aquatic sampling in up-stream and down-stream near bridges	Near bridges and in river sides, which road crossing	DCID-DoR, PMSC, DFOs, CFUGs, NGOs	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC
85.	Damaged and lost forest habitats	Roadside/compensatory plantations: statistics and site observation	Records, area and number of tree assessment, observation and photographs	Project sites, Community Forest area, re-plantation area	DCID-DoR, PMSC, DFOs, CFUGs, NGOs	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC
86.	Fragmented, damaged and lost natural habitats	Bioengineering, offsets, habitat rehabilitation	Site observation and surveys, analysis of satellite imagery	Along the high cut slopes	DCID-DoR, PMSC, DFOs, CFUGs, NGOs	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC
87.	Wildlife: Hunting, tapping and poaching, trade of animal parts	Cases and record of animal parts confiscated in project area by police and other security forces, availability of dry meat, hides and furs of wild animals in project area; DFO	Interview with CFUGs and locals, Observation and review of police records and record of DFO and other security forces, if any	Project sites, road checkpoints, market and settlement areas	DCID-DoR, PMSC, DFOs, CFUGs, NGOs	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC



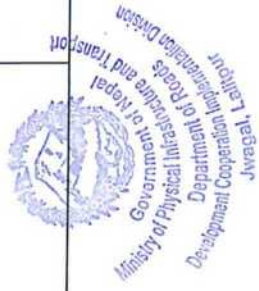
Sn.	Parameters/ Impact	Verifiable Indicators	Verification methods	Locations	Implementing Agency	Responsible Agency	Monitoring
		records of illegal wildlife trade					
88.	Barriers for wildlife and livestock movement	Number of cross- road structures built, herpetile tunnels, bridges and culverts adapted for wildlife and livestock movement	Wildlife cameras for observation of animal movement through crossing structures; roadkill data collection	Forested areas along highway with remained wildlife habitats	DCID-DoR, PMSC, CFUGs, NGOs	Proponent/ Contractor / and PMSC	DOR/ and PMSC
	Socio-Economic and Cultural Environment						
89.	Impacts on agricultural land due to spoil disposal/soil erosion/water logging due to construction.	Direct disposal of spoil upon private cultivate lands, steep slopes, side tipping	Observation, photographs, records, interviews with farmers	Along the alignment, near the affected sites in the result of road works	DCID-DoR, PMSC,	Proponent/ Contractor / and PMSC	DOR/ and PMSC
90.	Impact on local utilities; destruction of physical structures, effect on cultural and religious sites	Relocation of affected local infrastructures and its proper use by community	Observation of relocated sites and infrastructure, interview with locals, checklists	Project area (RoW, DIA)	DCID-DoR, PMSC,	Proponent/ Contractor / and PMSC	DOR/ and PMSC



Sn.	Parameters/ Impact	Verifiable Indicators	Verification methods	Locations	Implementing Agency	Responsible Agency	Monitoring
91.	Ribbon development settlements along ROW and market establishment	Nos of constructed houses and physical structures for personal benefits	Observation, statistics and interview with locals, record of construction permission by Municipality/ rural municipality	Project area, in places with potential beneficial resources	DCID-DoR, PMSC, municipalities	Proponent/ Contractor / and PMSC	DOR/ PMSC
92.	Damage to private properties and community lands due to spoil disposal and operations	Assessment of sites, where materials were disposed and property affected, number of registered grievances application	Observation and interview with locals, photographs, GPS points, responded number of grievances application	Project area, campsite areas, etc.	DCID-DoR, PMSC,	Proponent/ Contractor / and PMSC	DOR/ PMSC
93.	Livelihood and income generation of locals	Economic Activity after road construction and opportunities available to local people	Observation and interview with locals, Checklist, Questionnaire	Along existing and especially new alignments	DCID-DoR, PMSC,	Proponent/ Contractor / and PMSC	DOR/ PMSC
94.	Impact on Socio-economic status of project area and its change	Change in local economy: - Demographic, economic and education data;	Survey and Interview with locals, Checklists, Questionnaires	Along existing and especially new alignments	DCID-DoR, PMSC,	Proponent/ Contractor / and PMSC	DOR/ PMSC



Sn.	Parameters/ Impact	Verifiable Indicators	Verification methods	Locations	Implementing Agency	Responsible Agency	Monitoring
		-Nos and extent of new settlements /types and ethnic groups -Nos and extent of new businesses -Nos and extent of new services and utilities					
95.	Resettled Households and livelihood restoration	-HH and site analysis of the area receiving the resettlers -Income situation and opportunities for the resettlers	Verification of compensation and assistance to resettlers. Interview with locals, Checklists, Questionnaires	Resettled area	DCID-DoR, PMSC,	Proponent/ DoR/ Contractor / and PMSC	
96.	Increase in sell and use of alcoholic production, HIV/AIDs and other diseases, trafficking and increase in prostitution	Nos of beneficiaries having received awareness training against the spread of HIV/AIDs and girl/boy trafficking. Records from locals and local police concerning social conflicts, Number of active NGOs and	Observation and interview with locals, Checklist, Questionnaire Community awareness programs, number of active NGOs and CBOs	Entire Project Area and project affected VDCs	DCID-DoR, PMSC,	Proponent/ DoR/ Contractor / and PMSC	



Sn.	Parameters/ Impact	Verifiable Indicators	Verification methods	Locations	Implementing Agency	Responsible Agency	Monitoring
		CBOs against HIV/AIDS and girl/boy trafficking					
97.	Migration and immigration	Statistics	Statistics of municipalities and CBS	Project area, especially along new alignments	DCID-DoR, PMSC,	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC
98.	Increase in accidents	Records from local police and hospitals regarding road accidents. Nos/quality of signboards, zebras, crossroad structures, etc. in project area.	Statistics, Checklist, Questionnaire, Community awareness programs about safety on roads, collection and review registered the accident data by traffic police	Entire Project Area and project affected municipality/rural municipality	DCID-DoR, PMSC,	Proponent/ Contractor / and PMSC	DOR/ Contractor / and PMSC



Table 11-12: Employer's Environmental Management Plan

Sn.	Activities/ Issue	Responsible agency for		Verification		Verifiable Indicators	Frequency
		Implementation	Monitoring	Methods			
	Pre-Construction Stage						
(i)	Review whether the measures mentioned in the EIA are incorporated in the BOQ.	DCID	DCID	Review and observation		BOQ and other project document	As and when required prior to construction
(ii)	Review of Contract documents for the safety measures required during construction are included in it.	DCID	DCID	Review of contract documents		Contract documents and specifications	As and when required prior to construction
(iii)	Ensure tree-cutting procedure are well undertaken and approval for tree cutting and transfer of forest land completed and seek approval from Ministry of Forests and Environment after cabinet decision prior to cut all affected trees along the alignment.	DCID	DCID	Follow up with MoFE		Approval letter from MoFE	Weekly with MoFE
(iv)	Review for the measures mentioned in the EIA are incorporated in the BOQ.	DCID	DCID	Review and observation of BOQ		Measures in EIA included in BOQ and contractor area aware about it.	Monthly
(v)	Review about the fulfilment of land acquisition procedure and ensure all the affected land parcels along the alignment are acquired.	DCID	DCID	Observation and Review		Cadastral map with road alignment in place	Prior to construction daily
(vi)	Ensure the all the land donors receive compensation and their living standard are improved /maintained or not less than prior to acquisition.	DCID	DCID	Observation and interview with land donors		Land ownership certificate of landowner after donation.	Prior to the construction as required.

Sn.	Activities/ Issue	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
		Implementation	Monitoring			
	contractor prior to construction and its approval by supervision consultant.					
(xiv)	Ensure adequate vulnerable support allowances received by vulnerable groups during construction.	DCID	DCID	Observation and interview	Document and record of allowance provided to vulnerable groups	Weekly
(xv)	Ensure affected communities are aware about livelihood program under the implemented project.	DCID	DCID	Observation and interview	Training and orientation conducted by supervision consultant	Monthly
(xvi)	Review of spoil disposal sites and ensure all the disposed spoil are safe.	DCID	DCID	Observation	Protection and rehabilitation carried out at disposal site	Weekly
(xvii)	Review of stock piling area and ensure the all the area are safe from any hazard.	DCID	DCID	Observation	Protection carried out at site	Weekly
(xviii)	Review the location from where the contractor is getting construction material.	DCID	DCID	Observation, interview and meetings	Contractor's quarry and borrow sites; or construction material purchase bill and related documents.	Monthly
(xix)	Review monthly progress report from supervision consultant.	DCID	DCID	Review and observation	MPR from supervision consultant	Monthly
(xx)	Monitoring of additional mitigation measures implemented if any by construction contractor.	DCID	DCID	Observation and meetings	Documentation and meetings with contractor and supervision consultant	Monthly
(xxi)	Review of energy used by contractor for the construction and operation of camps.	DCID	DCID	Observation	Use of energy of lighting, cooking, and heating etc.	Weekly

Sn.	Activities/ Issue	Responsible agency for		Verification Methods	Verifiable Indicators	Frequency
		Implementation	Monitoring			
(xxii)	Review of traffic management plan and its implementation during the time of construction.	DCID	DCID	Review and observation	Traffic management plan in place and implemented accordingly	Daily
(xxiii)	Ensure contractor provides equal wages to male and female workers for similar types of work during construction.	DCID	DCID	Observation and interview with labourers	Daily attendance record and payment records	Monthly
(xxiv)	Review of grievance redress mechanism established during the time of construction.	DCID	DCID	Observation and Review	Establishment of GRC	Monthly
(xxv)	Ensure the contractor and supervision consultant settles all social and environmental grievances raised during the construction amicably.	DCID	DCID	Review, observation and interview	Record keeping of GRC and its hearing frequency	Weekly
(xxvi)	Review of waste generated ensuring safe disposal practice of waste along the alignment.	DCID	DCID	Observation	Waste generation and practice of handling	Weekly
(xxvii)	Monitoring and auditing of the project area as per provisioned in the EIA document	DCID	DCID	Field monitoring and observation	Records of monitoring by supervision consultant	Monitoring and Daily Auditing after 2 years



11.7 Budget for Environmental Monitoring

Budgets for the Environmental Monitoring are presented in the Table below.

Table 11-13: Environmental Monitoring Cost of KNM

S.No.	Particulars	Man-month	Rate in Rs.	Total in Rs.
A.	Pre-construction Phase			
	<i>Baseline Monitoring along KNM, Sisnekhola-Dharke section and Bishaltar-Phisling Section</i>			
	Manpower Cost			
	Environmentalist	1	150,000.00	150,000.00
	Sociologist./Socio-economist	0.5	60,000.00	30,000.00
	Biologist/Ecologist	0.75	100,000.00	75,000.00
	Support Staff (4 no. of Research Assistants/Enumerators)	0.75	20,000.00	60,000.00
	Laboratory Analysis Cost for air quality, water quality, and noise	LS	200,000.00	200,000.00
	Logistics	0.75	100,000.00	75,000.00
	Total Baseline Monitoring Cost			590,000.00
B.	Construction Phase			
B1	<i>Compliance Monitoring along KNM, Sisnekhola-Dharke section and Bishaltar-Phisling Section</i>			
	Manpower Cost			
	Environmentalist	2	250,000.00	500,000.00
	Sociologist	2	200,000.00	400,000.00
	Biologist/Ecologist	2	200,000.00	400,000.00
	Support Staff (6 no. of Research Assistants/Enumerators)	2	60,000.00	720,000.00
	Logistics	1	200,000.00	200,000.00
	Sub-total			2,220,000.00
B2	<i>Impact Monitoring along KNM, Sisnekhola-Dharke section and Bishaltar-Phisling Section(for 4 Years)</i>			
1	<u>Manpower Cost</u>	-	-	-
a.	Environmentalist	48	250,000.00	12,000,000.00
b.	Sociologist	48	200,000.00	9,600,000.00
c.	Biologist/Ecologist and Watershed Management Specialists	48	200,000.00	9,600,000.00
d.	Compensation and Resettlement Officer	48	200,000.00	9,600,000.00
e.	Public Relation Officer	48	200,000.00	9,600,000.00
f.	Legal Office	48	200,000.00	9,600,000.00

g.	Administrative officer	48	200,000.00	9,600,000.00
h.	Account Offer	48	200,000.00	9,600,000.00
i.	Field Technicians/Civil engineer	48	200,000.00	9,600,000.00
j.	Support Staff (4 no. of Research Assistants/Enumerators)	24	40,000.00	960,000.00
k.	Logistics	48	100,000.00	4,800,000.00
l.	Data Management Specialist	24	30,000.00	720,000.00
2	Field Measurement and Lab tests (4 times a year)			-
a.	Air quality and Noise	16	100,000.00	1,600,000.00
b.	Water quality	16	200,000.00	3,200,000.00
3	Miscellaneous			
a.	Transportatin	48	100,000.00	4,800,000.00
b.	Report Preparation	L.S.	L.S.	200,000.00
			Total	105,080,000.00
4	Contingencis 10% of subtotal			10,508,000.00
	Sub-total of B2			115,588,000.00
	Sub-total of B			117,808,000.00
	Total of Impact Monitoring Cost (A+B)			118,398,000.00

Environmental Monitoring Cost of KNM Highway for first 5 year after operation

C.	Operation Phase			
C1	<i>Monitoring</i>			
	Manpower Cost			
	Environmentalist	65	250,000.00	16,250,000.00
	Sociologist	65	200,000.00	13,000,000.00
	Biologist/Ecologist	65	200,000.00	13,000,000.00
	Support Staffs (10 no. of Research Assistants/Enumerators)	65	50,000.00	3,250,000.00
	Laboratory Analysis cost	20	60,000.00	1,200,000.00
	Logistics	65	500,000.00	32,500,000.00
	Sub-total			79,200,000.00
	Total Cost			197,598,000.00

Note: Remuneratio of technical person will be increased yearly with 10% yearly increment. However, long term review will be required in the remuneration after 4 years.

The estimated cost for environmental monitoring for KNM is one hundred ninetyseven million five hundred ninety-eight thousand only for construction and operation period.



11.8 Environmental Audit

The effectiveness of EIA will be successful only when that causes minimal damage to environment and benefit to social life with the implementation of project. The Environmental Auditing will be recommended that to examine and evaluate performances of the KNM road upgrades and new Sisnekhola-Dharke and Bishaltar-Phishling constructions in term of protection of the relevant environment and social life in the project area. Audit will be undertaken after two years of the project operations. Whereas, audit will be carried out by Department of Environment, Ministry of Forests and Environment together with proponent team.

11.8.1 Objective of Auditing

The main objective of the auditing is to monitor and assess environmental parameters, which are most significant with the implementation of road upgrades from Kathmandu to Mugling and construction of new alignments in Sinekhola-Dharke and Bishaltar-Phishling. Whereas, the specific objectives of auditing are as follows:

- To assess actual environmental impacts;
- To evaluate the accuracy of prediction of impacts;
- To assess the effectiveness of environmental impact mitigation and augmentation measures; and,
- To evaluate the functioning of monitoring mechanisms

11.8.2 Scope of Auditing

The scope of auditing will not be only focused into the 50-meter ROW of the project alignment. Assessment will be aimed to focus upon the examination of actual environmental impacts that have changed from the baseline conditions in terms of physical, biological and socio-economic and cultural environment. Further the auditing will aim to assess the overall performance of the project upon environmental protection and management.

11.8.3 Framework for Environmental Auditing

Environmental auditing will be carried out to define the pre-and post project changes on natural resources and the environment in the project area. The auditing will help to evaluate the Actual environment impacts, accuracy of prediction, and effectiveness of environment management plan and functioning of the monitoring mechanisms. Environmental auditing will further help to evaluate the project compliance status and identify new environmental problems, if occurred. Auditing will use the information of compliance and effectiveness of mitigation measures and will compare with the pre-project condition of environmental resources.

According to Rule 14 of the EPR, 1997 requires MoFE to undertake an environmental audit of a project subjected to EIA after two years of the commencement of service. As per this Rule, MoFE is responsible for carrying out environmental auditing and maintain the updated records. In addition, Schedule 6 of the EPR, 1997 requires the project proponent to develop auditing format in the EIA report.



In case of existing Kathmandu – Naubise – Mugling Highway and new Sisnekhola – Dharke and Bishaltar-Phishling alignment, a full impact and compliance audit of the project might be needed two years after the completion of project. Moreover, the Impact audit and predictive technique audit will be further required to be carried out in the interval of 3 years after the completion of first auditing. Audit team shall review all the monitoring records that should be kept by the proponent during the Pre-construction, Construction and Operation Phase. The cost required for Environmental Auditing is presented in the Matrix below.

11.8.4 Auditing Parameters, Methods and Indicators

Table 11-14: Matrix of Environmental Auditing for Kathmandu-Mugling Road and Alignments

S.N	Parameters	Location	Methods	Indicators
A. Physical Environment				
1.	Land use	Entire project area	Observation, spatial analysis of changes in land use. Review of previous monitoring records	Change in land cover types and land use pattern within RoW, DIA and IIA
2.	Disposal of Construction Spoils	Designated Sites of spoil disposal	Observation, Interview, Photographs. Review of previous monitoring records	Status of disposal sites, vegetation cover, drainage system, initiated erosion, affected aesthetic value, forest, and agricultural land
3.	Side tipping of excavated soils and wastes	Along the road alignment	Observation and Interview	Initiated Land Erosion, impact upon local drainage
4.	Landslides and unstable slopes	• Steep slope area along the alignment • Natural drainage sites • River crossing areas • River banks • Roadside leadoff drain disposal area • Spoil Disposal area • Quarry Site areas	Observation and measurement, Review of previous monitoring records.	Landslides and erosion areas along the alignment, rock fall areas, unstable slopes identified, impact upon adjacent agricultural areas due to land slide and disposal of leadoff drain if any.
5.	Natural flow of Existing Drainage and	Drainage crossings at the entire project	Observations, measurement and photographs,	Obstruction in natural flow of drainages

S.N	Parameters	Location	Methods	Indicators
	watershed conditions	area, along the alignment	review of previous monitoring records.	
6.	Water quality, Air quality, Noise	Along the road alignment especially at Sites studied during EIA	Measurement of air quality and noise, analysis of water samples	Water quality parameters studied during EIA, air quality and noise level studied during construction monitoring
7.	Vibration on Structures	Construction sites, rocky areas and locations where huge cuttings was necessary and proposed in design estimate of the project	Review of design estimate and other project documents available at the office of consultant and proponent, interviews, observation and photos	Any case of hearing impairment, crack existed in houses, loss of life and property and compensation
8.	Relocation and rehabilitation of affected infrastructures	Along the highway alignment and its adjoining areas	Interview, observation, and photographs	Existing status of relocated infrastructures such as electric poles, irrigation canals, water taps, tanks and pipelines; Their use by local people and benefit

B. Biological Environment

9.	Status of Forests adjacent to alignments	At entire project alignment where forest existed	Analysis of forest cover trend	Volume of fuel wood trade, location of timber depot, fuel wood sale, in project area
10.	Number of trees felled	At entire project area	Interview, Measurement	Number of stumps of cut trees in nearby area forest
11.	Compensatory Re-plantation	Areas provided by CFUGs of affected community forest and areas where plantation carried out as compensatory measure	Observation and Photographs Visit nurseries and plantation sites	State of plant available in the plantation area and nurseries
12.	Energy supplied	Project sites and Rural Municipalities	Interview, observation, photographs	Volume and type of fuel used in the project area

S.N	Parameters	Location	Methods	Indicators
13.	Wildlife: Hunting, tapping and poaching, Trade of animal parts	Major forest areas as presented in EIA report, Project sites, market and settlement areas	Interview with CFUGs and locals, Observation and review of police records and record of DFO and other security forces, if any	Cases and record of animal parts confiscated in project area by police and other security forces, availability of dry meat, hides and furs of wild animals in project area
14.	Wildlife & livestock crossroad corridors	Cross-road constructions along existing road and Bishaltar-Phisling section	Analysis of data, obtained from wildlife cameras, roadkill data	Efficiency in using constructions by wildlife and livestock (number of records and observations)

C. Socio-Economic and Cultural Aspect

15.	Compensation paid to SPAFs for house and land and their status	Entire project area	Observation and interview, verifying the compensation paid data	Legal deeds and land ownership certificate, living standard of displaced people, educational status and availability of service facility with each family
16.	Resettlement of SPAFs and its success	Outside and adjacent to the KNM road	Observation and interview, income analyses, grievance records	Land ownership certificate provided to SPAFs, Status and living condition
17.	Living standard and Economic status of the SPAFs and other locals	Resettled areas	Observation and interview	Types of facilities and technologies that has been utilizing by the SPAFs. Livelihood status and education
18.	Road safety and accident	At entire project alignment	Observation, official records and interview, adopted road safety measures	Number and type of accident and deceases, constructed/established number of road safety measures
19.	Relocation of affected infrastructures, cultural and religious sites	At entire project alignment. Affected religious and cultural sites and other small	Observation and interview, verifying the relocated structure data	Status, benefit of relocated infrastructures to locals and use of cultural and religious sites, number of relocated structure

S.N	Parameters	Location	Methods	Indicators
		sites as mentioned in EIA report		
20.	Livelihood and income generation of locals	At entire project area	Statistics, observation and interview	Economic Activity of the local people and opportunities available to local people, increased number of new business holders
21.	Socio-economic Change	Entire Project Area	Survey and Interview	Change in local economy (changes in standard of living)
22.	Alteration in commodity price at project sites	Entire Project Area	Survey and Interview	Price of essential commodities as compare to prior the project construction
23.	Involvement of locals in income generation activities and establishment of industries	Project and adjoining municipality/rural municipality	Records from project office and development site inspection	Involvement of local people into such projects, number of locals benefited from such activities, standard of living in comparison to prior the project
24.	Trade commerce and industry	Along the project area, service area, along the local roads and foot trails that linked to Kathmandu-Mugling alignment	Observation, Interview and Photographs	Number of shops, industries, rental houses, involvement of locals in business and commerce, number of freight transportation ply per day, amount of revenue generated per day, increase and decrease in the price of commodity transported through Kathmandu-Mugling



CHAPTER 12. Review of Policies and Regulatory Frameworks

12.1 Constitution of Nepal

Article 30 Right to clean environment; of The Constitution of Nepal proclaims that; (1) Every citizen shall have the right to live in a clean and healthy environment. (2) The victim shall have the right to obtain compensation, in accordance with law, for any injury caused from environmental pollution or degradation. (3) This Article shall not be deemed to prevent the making of necessary legal provisions for a proper balance between the environment and development, in development works of the nation.

Article 34 Right to labour; of The Constitution of Nepal proclaims that (1) Every labourer shall have the right to practice appropriate labour. (2) Every labourer shall have the right to appropriate remuneration, facilities and contributory social security and (3) Every labourer shall have the right to form and join trade unions and to engage in collective bargaining, in accordance with law.

Article 35 Right relating to health; of The Constitution of Nepal proclaims that (1) Every citizen shall have the right to free basic health services from the State, and no one shall be deprived of emergency health services. (2) Every person shall have the right to get information about his or her medical treatment. (3) Every citizen shall have equal access to health services. (4) Every citizen shall have the right of access to clean drinking water and sanitation.

Further, **Article 51 Policies of the State;** (g) Policies relating to protection, promotion and use of natural resources proclaims (1) to protect, promote, and make environmental friendly and sustainable use of, natural resources available in the country, in consonance with national interest and adopting the concept of intergenerational equity, and make equitable distribution of fruits, according priority and preferential right to the local communities, (2) to make multi-purpose development of water resources, while according priority to domestic investment based on public participation, (3) to ensure reliable supply of energy in an affordable and easy manner, and make proper use of energy, for the fulfillment of the basic needs of citizens, by generating and developing renewable energy, (4) to develop sustainable and reliable irrigation by making control of water-induced disasters, and river management, (5) to conserve, promote, and make sustainable use of, forests, wildlife, birds, vegetation and bio-diversity, by mitigating possible risks to environment from industrial and physical development, while raising awareness of general public about environment cleanliness, (6) to maintain the forest area in necessary lands for ecological balance, (7) to adopt appropriate measures to abolish or mitigate existing or possible adverse environmental impacts on the nature, environment or biological diversity, (8) to pursue the principles of environmentally sustainable development such as the principles of polluter pays, of precaution in environmental protection and of prior informed consent. (9) to make advance warning, preparedness, rescue, relief and rehabilitation in order to mitigate risks from natural disasters. Article 51 -(14)- (H) is ensured easy and equal access of all citizens to transportation service and increasing investment in transportation sector, motivating transportation prioritizing environment friendly technologies. Similarly, **(i) Policies relating to labour and employment**



states (1) to make competent and professional the labour force that has remained as the main socio-economic strength of the country and enhance employment within the country, while ensuring a situation enabling all to work. Similarly, (I) **Policies relating to tourism** proclaims to develop eco-friendly tourism industries as an important base of national economy by way of identification, protection, promotion and publicity of the ancient, cultural, religious, archaeological and natural heritages of Nepal, to make environment and policy required for the development of tourism culture, and to accord priority to local people in the distribution of benefits of tourism industries.

Hence, the project and contractor will take the Constitution of Nepal into their account to retain right of everybody to live in clean and healthy environment as well as to conserve, promote, and make sustainable use of natural resources while constructing KNM Highway.

12.2 Plans and Policies

Approach paper of 15th Periodic Plan

The government is preparing to unveil a five-year periodic plan after a gap of 12 years, which will include the country's development vision and growth targets for the next five years. The main objective of the plan is considerable enhancement in socio-economic aspect of the country with fast alleviation of poverty by generating productive opportunity and incrementing high economy.

The concept paper of the five-year periodic plan states that the country can achieve economic growth of between 9.4 per cent and 10.1 per cent every year in between fiscal years 2019-20 and 2023-24. Similarly, the draft of the periodic plan envisions that the country's agriculture sector can witness an average growth of 5.6 per cent per annum in the next five years while the industrial sector can witness average growth of 17.1 per cent per annum. Likewise, the services sector is expected to witness 9.9 per cent growth per annum in between fiscal years 2019-20 and 2023-24. The draft of the 15th five-year plan also states that the contribution of the services sector in the gross domestic product (GDP) can reach 57.6 per cent by fiscal 2023-24. Similarly, the contribution of the agriculture sector and industrial sector in the national GDP can reach 22.1 per cent and 20.3 per cent, respectively. The 15th five-year periodic plan will be based on the slogan of 'Generating Prosperity and Happiness.'

The government is planning to spend a huge amount of Rs. 9,246 billion during the 15th plan period with a focus on improving the industrial sector. The contribution of the industrial sector will be increased to 19.1 per cent from 14.2 per cent (last fiscal year), that of the agriculture, forest and mine sector will be reduced to 23 per cent from 28.2 per cent (last fiscal year) and that of the service sector will be increased to 58.7 per cent from 57.6 per cent (last fiscal year). In a liberal and open-market economy, the role of the private sector cannot be under estimated. The government and the private sector should go hand in hand to make any development plan successful. Following this spirit of development planning, the government has involved the private sector so much so that the private sector will cover 55.5 per cent of the total investment, whereas the government will bear 39.1 per cent with the remaining 5.4 per cent going to the cooperative sector. The plan also aims to spend a considerable amount on developing infrastructure related to



energy, road, air travel and information and communications besides strengthening the country's social security and social protection systems. Moreover, focus has been laid on cross-cutting issues such as gender equality, inclusive society, environmental protection and capacity development of different institutions.

National Environment Policy 2076 (2019)

Protection of natural environment is necessary with the prevention, mitigation, and minimizing adverse impact upon environment arise due to anthropogenic development activities with the integrated management of environmental and socio-economic development issues in order to achieve the motto of Prosperous Country, Happy Nepali from environmental perspective.

National Environment Policy 2076 has set goal to ensure rights of the people to live in clean and healthy environment controlling pollution, managing solid waste, and enhancing greenery. Hence, the policy has set different objectives for the protection, control, and minimization of impact on water, air, land, noise, and due to electric and magnetic field, chemical and radioactive. Managing waste generated from household, industrial, and service sectors; promotion of greenery and development of parks in urban and city area; mainstreaming environmental issues in all development aspects; ensuring environmental justice to pollution victim; people's participation in environmental protection and sustainable management of natural resources; sustainable utilization of sources; enhancing capacity, research and investigation for the protection and management of environment; utilization of land with land use planning; and re-cycle and reuse of resource as far as possible are the other objectives of the policy.

The major policies established are for the protection, control, and minimization of pollution, environmental mainstreaming, environmental justice, participation, sustainable development, good governance, investigation, and capacity development. The strategies set in fulfilling the policies are for the protection of environment are to implement standards and guidelines for the prevention of pollution on water, air, land, noise and due to electric and magnetic field, chemical and radioactive. Establishment and operation of quality measurement centers in major cities and industrial states for air, water, and noise with mapping; promotion of energy efficiency building; formation and implementation of concentration-based standards and load-based standards for the control of pollution; use of dispersion modeling; source apportionment, and preparation of emission field mapping are the strategies set under the policy.

Similarly, the other strategies established in fulfilling the policy are; safe disposal of non-recyclable waste in landfill site, hazardous waste landfill; and incineration plant as required; incentive to use of clean energy vehicle; special attention for the construction of physical structures and pollution control at the upstream of seasonal stream; effective management of acid battery, computers, mobile and other electronic devices used in motor vehicles etc.

Policy document of DoR on Environmental Assessment in the strategic road network, 2000

The purpose of the policy document is to ensure that development improves the way of life for the people affected, without damaging the natural surroundings. Sometimes a degree of damage is



inevitable. In such case, an environmental assessment should find ways of reducing or compensating for the damage. The policy document suggested five types of environmental assessment activities viz. Screening, Initial Environmental Examination, Scoping, Environmental Impact Assessment, and Monitoring.

20 Year Road Plan, 2002-2022

The Government of Nepal (GoN) has formulated a 20 Year Road Plan. One of the main objectives of the Plan is the development of Strategic Road Networks (SRN). The implementing strategies of the Plan include all weather road connection to the District Headquarters (DHQ) and provision of road linkages from the DHQ to the adjacent road network of the neighboring districts and countries. The strategy adopted by the 20 Year Road Plan is aligned with the priorities set out in the Tenth Five Year Plan (2002-2007) as that plan gives priority to constructing feeder and strategic roads connecting North to South.

National Forest Policy, 2075

This policy implies whenever any development project directly or indirectly impacts on the forest resources. The vision of the policy is to enhance prosperity in economic, social, and cultural aspect of Nepal through well-managed forest area and balanced ecosystem. The objective set to achieve the vision is; production and justified distribution of forest related goods and service through sustainable and participatory management of forest, protected area, watershed, bio-diversity, wildlife, and species.

Policies established are; (1) ownership of forestland will be under provincial government, (2) sustainable, participatory, and accountable management of forest resource, (3) development of green entrepreneur and contribution in national prosperity, (4) protection of biodiversity, (5) integrated management of watershed, environmental service and REED+, (6) motivation for the development and propomotion of national forest and other forest providing soft loan, (7) enhancing research and capacity development for the formation of sectoral policy, formulation of plan and management works, and (8) establishment of social security, inclusion and good governance through all types of forest management.

National Climate Change Policy, 2076 (2019)

The 2019 policy has the objectives of advancing capacity on climate change adaptation (CCA), developing ecosystem resilience, promoting green economy by adopting low carbon economic development concept, mobilising national and international financial resources, making effective the information service, mainstreaming climate change into relevant policy, strategy, plan and programmes, and also mainstreaming gender and social inclusion, including in climate change mitigation and adaptation programmes. The Climate Change Policy (2019) approaches towards ensuring, developing or creating or promoting food security, nutrition and livelihood improvement, sustainable environmental services, energy security, climate-friendly rural and urban construction, climate resilient economic development, conservation of natural, cultural and



social heritage, conducive environment for health, and damage minimisation from climate-induced events.

Land Use Policy 2072 (2015)

Land Use Policy (LUP) based on the spirit and letters of sub-Section (e) under Article 51 of the Constitution of Nepal, 2015. In devising of Land Use Plans (LUPs), this Policy has adopted three principles such as: the Promoting Complimentary Land Use principle for encouragement, the Maintaining Competitive Land Use principle for maintaining balance and Avoiding Conflicting Land Use principle for discouragement. The vision of this Policy is to make optimum use of available Land and Land Resources (LLRs) in pursuit of sustainable social, economic and ecological developments and prosperity of the country as well. Entire lands of the country shall be basically classified into Land Use Zones (LUZs). Those zones could be sub-classified into Land Use sub-Zones as per necessity: a) Agricultural Zone, (b) Residential Zone, (c) Commercial Zone, (d) Industrial Zone, (e) Mines and Minerals Zone, (f) Cultural and Archaeological Zone, (g) River and Lake-Reservoir Zones, (h) Forest Zones, (i) Public Use and Open Space Zone, (j) Building Materials (Stone, Sands, Concrete) Excavation Zone, (k) Other Zones as specified as per necessity.

National Land Policy 2075 (2019)

National Land Policy is considered a strong step forward for Nepal on good land governance. It intends to directly address the issue of land administration and land management reforms under six major and key pillar objectives such as a. Security of tenure, b. Access to land, c. Land Use, d. Land Valuation, taxation and land market, e. Land acquisition, and f. Modernization of land administration services. Secondly, it is underpinned by a strong inclusive agenda that considers the issues affecting the land rights of women and vulnerable groups. This includes: a. Rehabilitation of landless, squatters and informal tenure-holders for improved housing, b. Access to land and security of tenure, c. Tenure security for landless peasants for farming, d. Women's access to land ownership, and e. The optimum use of land for sustainable housing. The policy is forward looking and considers key environmental challenges related to food security, infrastructure development, and the application of Fit-For-Purpose techniques in land administration.

National Transport Policy, 2001

The principal objective of the National Transport Policy is to develop a reliable, cost effective, safe facility oriented and sustainable transport system that promotes and sustains the economic, social, cultural and tourism development of the Kingdom of Nepal as a whole. For the attainment of these objectives the following strategies will be followed:

- (i) The Government shall clearly indicate the limit and scope of work to be done from the central level and take responsibility of transport structure to be constructed from the central level.



(ii) Making the decentralized governance system more strengthened and by maximum utilizing the source and means of local level, the development and promotion of transport system shall be done from the local level itself.

(iii) Maximum private Sector involvement will be encouraged in the expansion and preservation of the transport system.

The policy focuses on the development of transport infrastructure in the local level to carry out in accordance with the short term, medium term and long-term planning and high priority in completing the construction of roads connecting all 75 District Headquarters of the Country to the main road network.

National Biodiversity Strategy and Action Plan (2014-2020)

The NBSAP contains seven chapters, including: (i) introduction, (ii) the national context, (iii) threats to biodiversity in Nepal, (iv) efforts, outcomes and gaps in the management of biodiversity, (v) strategy for management of biodiversity, (vi) arrangements for implementation of the strategy, and (vii) framework for Local Biodiversity Strategy and Action Plan. The description and analysis of past efforts and achievements, and formulation of strategies and actions are focused around six thematic areas: (a) Protected Areas, (b) Forests outside Protected Areas, (c) Rangelands, (d) Wetlands, (e) Agriculture, and (f) Mountains. Fifteen cross-cutting themes, including gender and social inclusion, and climate change impacts and adaptation have been dealt with separately. Strategies and priority actions have been clustered into the six themes and prioritized by taking into account the links between them and with reference to key biodiversity threats, gaps and issues. Quantitative targets have been set against each priority action, where appropriate. The arrangement for implementation of the strategy presented in Chapter 6 highlights the key aspects of institutional, capacity, technology, communication and extension, funding, and monitoring and evaluation that are required for successful implementation of the NBSAP. The framework for Local Biodiversity Strategy and Action Plan highlights key aspects of biodiversity management at the local level, which is intended to serve as a guide to the municipalities in preparing their own strategy and action plan for management of local biodiversity.

12.3 Acts and Rules

Environment Protection Act, 2076

The Act focuses on that development project before implementation, requires either Brief Environmental Examination or Initial Environmental Examination or Environmental Impact Assessment depending upon the location, type and size of the projects [(Schedule 2 (10))]. It has provisioned for the preparation of Environmental Management Plan (EMP) [Schedule 2 (10)] and Supplementary Environmental Impact Assessment (SEIA) [Schedule 2 (11)].

Environment Protection Act, 2053 (1997)

Nepal has enacted a comprehensive and umbrella type environmental act, the Environment Protection Act (EPA) 1997. This act is the principal regulatory frameworks to make the



development programs and projects environment-friendly, which are now enforced through appropriate regulatory measures. The law contains several provisions to internalize environmental assessment system and to maintain a clean and healthy environment by minimizing the adverse impacts on human beings and other life forms and physical objects. The act highlights that any development project, before its implementation has to pass through environmental assessment, which will be either IEE or EIA depending upon the location, type and size of the projects.

Section 3 of the Act requires the proponent to conduct an IEE and EIA in relation to the prescribed proposals. Section 4 of the Act prohibits implementation of development proposals without prior approval of the concerned agencies or Ministry of Forests and Environment (MoFE) as specified by the Act. Section 5 of the Act provides that all the IEE/EIA of the development proposals should be presented to the concerned agencies for approval. Under section 7 of the Act, industries or any others development projects owners are required not to discharge, emit or dispose waste, sound, radiation or any such acts which will cause pollution or to allow pollution to be caused in a manner which is likely to have significant adverse impacts on the environment or to harm human life or public health. Further, the section stipulates that causing pollution or allowing such pollution to be caused a punishable act.

Public Road Act, 1974

The Public Road Act is the governing legislation for construction and operation of roads in Nepal. The Act prohibits the construction of permanent structures (buildings) in a defined distance from the rural road, i.e., the road agency has the authority over everything within the right-of-way. The act makes provision for cases where road projects temporarily require land and/or other properties during construction, rehabilitation and maintenance. A Compensation Fixation Committee CFC determines compensation in case of loss of assets, business or production. Provisions are also detailed for compensation for the extraction of construction materials. Article 19 of the Act mandates requirement of permission from the Department of Roads to carry out activities within the limits of the road boundaries. As per Article 29, local governmental offices have to give notice to the DoR prior to the start of activities in the limits of the public roads. The Act empowers DoR to acquire any land on a temporary basis (for storage facilities, construction camps, etc.) during road construction and upgrading. The temporary acquisition of land containing any buildings (e.g. houses, sheds, temples and schools) is avoided wherever possible. The Act also empowers DoR to "lift earth, stone or sand from any adjoining land" during construction and upgrading works.

The Act does not provide for leasing of land. However, DoR is required to pay compensation for any damages caused to buildings, crops and trees, where the farming activity of the landowner is interrupted, and where the landowner has to incur expenses to restore the land after its return. Compensation is determined between DoR and the titleholder, or through mediation, involving officials from the relevant District.

The GoN may prohibit, through notification in the Nepal Rajapatra (Government Gazette), the construction of any permanent structure (other than walls) within 6 m of the road formation edge.



Forest Act, 2076

This act mainly focuses on the utilization of forest land area for the national prioritized project, national pride project. Forest Act considers forests as “resources oriented” rather than “use oriented”. Schedule 12 (Section 42) of the Act empowers the government to provide the parts of the forest areas to implement national priority project and the project approved from Investment Board for Investment only if the project activities donot create adverse impacts on environment after study of Environmental Impact Assessment of the project. This Section has provisions like; the project should be of national priority, there is no alternative other than to use the forest area, and the project should not have significant impact on environment. Thus, if there is no alternative except the use of forest land is available for the implementation of the project, given it a national priority, the Government of Nepal can permit forest use, where there will be no adverse effects on the environment. These criteria must be fulfilled for the implementation of project of any sector in any category of forest areas. The project should carry out compensatory plantation activity in national forest close to the project area having similar terrain and topography if plantation area within the project is not available. Project shall bear required cost for the protection and survival of planted saplings for 5 years. Article 5, 6, 7, 8 of the Act empowers GoN to use any forest. Government of Nepal may give assent to use any part of Government Forest as Community Forest, Partnership Forest, Lease hold Forest or Religious Forest for the protection of forest.

Article 15 Section 49 of the Act prohibits reclaiming lands, setting fires, grazing, removing or damaging forest products, felling trees or plants, wildlife hunting and extracting boulders, sand and soil from the National forest without the prior approval. The Act has provision of inprensonment of up to 5 years and fine of up to 50 thousand Nepali Rupees if such wrong doing are identified by any one.

Local Government Operqation Act, 2074 (2017)

The Act, 2074 (2017) provides more autonomy to District Coordination Committees, Municipalities and Rural Municipalities. The Act provides the functions, rights and duties of the Ward Committee. Act requires the ward to help for protection of environment through plantation over the bare land, cliff and mountains. It has mentioned the functions, rights, and duties of RMs, Municipalities and DCC. The RMs are required to protect the environment, nature and natural resources. The act empowers RMs/MC/DCC to levy taxes on utilization of natural resources. Apparently, natural resources include mineral resources and thus, RMs have an absolute authority over the natural resources. Thus, this act empowers the local bodies for the conservation of soil, forest, and other natural resources, and implements environmental conservation activities.

The Act empowers all local bodies of the country for the conservation of soil, forest and other natural resources and implements environmental conservation activities. The Act provide the Rural Municipalities (RM) and Municipalities a legal mandate to formulate and implement programs related to protection of environment and bio-diversity. Similarly, the Act provide that the District Coordination Committees (DCC)-are liable-to formulate and implement programs related to protection of environment and give adequate priority for protection of environment during



formulation and implementation of district level plan (s). As this is the national level priority road project, the respective RMs and DCC can regulate soil and water conservation activities that support to stabilize the road slopes and minimize likely adverse impacts on the road and by the road.

Soil and Water Conservation Act, 2039 (1982)

The mismanagement of watersheds leads to the degradation of valuable land by flooding, water-logging, and accelerated silt in storage reservoirs. In order to properly manage the watersheds of Nepal, the Soil and Watershed Conservation Act (SWCA) was enacted in 1982.

Section 3 empowers Government of Nepal can declare any area of Nepal as a conserved watershed area, specifying the borders thereof. Section 4 provides that a watershed conservation officer has the authority to implement the following works in protected watershed areas:

Construct and maintain dams, embankment, terrace improvements, diversion channels and retaining walls, protect vegetation in landslide-prone areas and undertake afforestation programs, and Regulate agricultural practices pertinent to soil and watershed conservation.

Section 13 empowers The Watershed Conservation Officer may prohibit the commission of any acts that may cause soil-erosion or soil cutting in a land where any of the acts has been done under Section 4 and in vicinity of such land.

Plant Protection Act 1972

Under Section 3 of the Plant Protection Act (1972), the GoN, by notification in the Gazette of Nepal may impose the prohibitions/restrictions in the import of plant or plant product, transport from one district to another district of any plant or plant product.

Aquatic Life Protection Act, 1961

The Aquatic Animals Protection Act, 1960 (AAPA) indicates an early recognition of the value of wetlands and aquatic animals. Section 3 renders No person shall knowingly use any kind of electric current, explosive substance or poisonous substance with intention of catching and killing any aquatic animal in any water. AAPA has been in effect since 1961, yet both noxious and explosive materials are increasingly used in water bodies throughout Nepal. There is no reported case of prosecution for a breach of AAPA. This demonstrates the government's ineffectiveness in developing a surveillance system for conserving aquatic life.

Under section 4, the government is empowered to prohibit catching, killing and harming of certain kinds of aquatic animals by notification in the Nepal Gazette. However, any notice under this Section has never been published by the government.

Act to control international trade of Endangered Species of Wild Fauna and Flora, 2073 (सङ्कटापन्न वन्यजन्तु तथा वनस्पतिको अन्तराष्ट्रिय व्यापार नियन्त्रण ऐन, २०७३)

This Act provides a framework to be respected by each Party, which has to adopt its own domestic legislation to ensure that CITES, is implemented at the national level. The act prohibits on Trade



or Transaction of Threatened or Vulnerable wild fauna or flora or specimen thereof: No person shall purchase, sell, possess, use, plant, rear, captive breed, transport, import, export, or cause to be done so a threatened or vulnerable wild fauna or flora or a specimen. However, a threatened or vulnerable wild fauna or flora or a specimen thereof may be purchased, sold, possessed, used, captive bred, transported, imported or exported for the purposes as follows, having obtained a license. This Act was enforced for the enactment of Convention on International trade in endangered species of wildlife flora and fauna being Nepal is parties country of Convention. This acts states about the regulation and control of international trade of such endangered flora and fauna species. The species are protected by CITES against over exploitation and they are listed in three CITES Appendices I, II, and III for different levels or types of protection. Appendix I lists species that are the most endangered among the CITES listed animals and plants. These are threatened with extinction and CITES prohibits commercial international trade except for scientific research. Appendix II lists species that are not threatened with extinction at present but may become so unless trade is closely controlled. Appendix III lists species that are included at the request of a Party that regulates trade and that needs cooperation of other countries to prevent unsustainable or illegal exploitation.

Water Resources Act, 2049 (1992)

The objectives of the Water Resources Act, 1992 is to make legal arrangements for determining beneficial uses of water resources, preventing environmental and other hazardous effects thereof and also keeping water resources free from pollution. The Act strives to minimize environmental damage to water bodies, especially lakes and rivers through environmental impact assessment studies.

Under Section 19, it is clearly mentioned that No one shall pollute water resource by way of using or putting any litter, industrial wastes, poison, chemical or toxicant to the effect that the pollution tolerance limit of the water resource as prescribed pursuant to Sub-section (1) is exceeded.

Land Acquisition Act, 2034 (1977)

Land Acquisition Act 2034 (1977) is the main legislation to guide the involuntary acquisition of land in the country. Government can acquire land at any place in any quantity by giving the compensation pursuant to the Act for the land required for any public purpose or for the operation of any development project initiated by government or government authorized institution (sections 3 and 4).

Land Use Act 2076 BS (2019)

The Land Use Act, 2019 has come into force in Nepal. The new legislation has also classified land into 10 categories viz; agricultural, residential, commercial, industrial, mining and mineral, forest, river, stream, pond and wetland, public use, cultural and archaeological, and others. It adds that land use plans should clearly indicate locations of industrial corridors, special economic zones, national projects, inter-province projects, natural and cultural heritage sites of national importance, religious and cultural sites that are internationally recognise or are revered by people, schools or

academic institutions, delicate areas in terms of national security, disaster-prone zones, areas designated to protect biodiversity, roads, health institutions and irrigation canals, and other areas identified by the government.

The land classification is based on the composition and use of the land. The classification has not clearly pinpointed guthi land, which is religious land in the name of temples or shrines, from the revenue of which the religious ceremonies or festivals associated with the temples or shrines are celebrated and the repairs and maintenance of the temples or shrines are carried out. The main aim of the act is to ensure that land is properly used and managed and that land set aside for one purpose is not used for other. The act introduces the concept of land bank for the first time, classifies land into various categories and gives permission to authorities to impose fines if land is not used for specific purpose.

The law allows the government to slap a fine of up to Rs. 100,000 if the agricultural land is left barren for a period of up to three years without informing the local government, a fine of up to Rs 200,000 if anyone does not allow land use survey drawing and land use plan, and a fine of up to Rs 300,000 if land is not used for designated purpose.

The act has assigned the responsibility for implementing the act to not only the federal government but also to the provincial and local governments. As per the act, three tiers of the government should constitute councils to bring provisions of the act into implementation. The federal government should draft maps of all the local levels and ensure that all the local governments are abiding by provisions of the act. The local governments, on their part, should ensure that the people are adhering to provisions of the act. For this, they will have to form implementation committees under the leadership of the heads of the local governments. The act has provided for a land bank, which is itself a new concept in the country. Under the concept, land belonging to various people will be pooled together and leased out to those who are willing to invest in agriculture. The investors can even embark upon collective farming, which will give a shot-in-the-arm to agricultural production and productivity.

Labour Act 2017 (2074)

It was certified by the President on 4 September, 2017 (19 Bhadra, 2074) and has been effective immediately upon certification. Section 64 of Labour Act states the obligation of main employer is No employees can be obtained from the labor supplier where the employer or employer's proprietor or director or family members are engaged, Ensure the employees are provided minimum remuneration and facilities, Arrange for occupational health and safety measures, If the rate of minimum remuneration or facilities is altered after the conclusion of agreement with the Labor Supplier, the main employer should pay such additional amount to outsourced employees. Main employer must obtain the employees from licensed labor supplier. If outsourced employees are not from the licensed labor supplier, they are deemed to be employees of the main employer.

According to the Act no person may be engaged in work without providing an employment agreement to the employee. A written employment agreement is not required for casual employees.



The employment agreement should specify the remuneration and other facilities of concerned employee and the terms and conditions of service. The employment agreement may provide for benefits to be provided to managerial level employee in lieu of any overtime hours he/she is required to work.

Section 28 of the act states 8 hours a day and 48 hours a week is the maximum working hours. Whereas section 30 states 4 hours a day and 24 hours a week could be a maximum overtime working hours. Section 31 states the payment for overtime is 1.5 times the basic remuneration. Section 34 states the minimum remuneration should be as prescribed by the Government of Nepal. Similarly, Section 36 states remuneration should have increment once a year at the rate of ½ day of basic remuneration. Section 40-48 states about leave and holidays and states 1 day holiday every week and 13 public holidays including May day every year. 1 day employees additional to female including International Women Labor Day is allocated for female worker. Further, the act also provisioned for annual leave of 1 day for every 20 worked days (18 days in a year); sick leave with fully paid for 12 days and mourning leave of 13 days. Further section 45 states for Maternity and Paternity leave of 98 days with fully paid 60 days and 15 days with fully paid respectively. Special leave is not provisioned in the new labour act which was provisioned in act 1992. Accumulated annual leave up to 90 days and sick leave up to 45 days can be encashed at the time of discontinuation of service. Any unused annual or sick leave in excess of the limit of accumulation shall be en-cashed at the end of each year.

Section 53 of the act provides terminal benefits to labour with 8.33% of basic remuneration every month as a rate of gratuity and shall be deposited in Social Security Fund by employer. Section 54 of the act ensures medical insurance of at least one hundred thousand rupees (Rs. 100,000) per year for every worker. Similarly, section 55 provisioned for coverage of accident insurance with at least seven hundred thousand rupees (Rs. 700,000) for every worker. An employee can be suspended for the period he/she is imprisoned or for up to three months during the investigation for misconduct for which the service can be terminated.

Section 113-115 states about the settlement of dispute. Labour can submit a written application to the employer. Employer should settle the dispute by negotiating with the employee within 15 days of receipt of application. Upon failure to settle the dispute or if the employer does not provide notice for negotiation, an application should be filed to Labor Office. Labor Office should settle the dispute through discussion between the parties within 21 days. Upon failure to settle dispute through discussion, Labor Office issues the decision within 15 days.

The new Labor Act provides recognition to institutional level collective bargaining which had been in practice before. The trade union federations of the entrepreneurs, service sector, tea estate, travel, tourism, labor suppliers, construction entrepreneurs or industries of similar nature may from an institutional level present a collective bargaining demands to the employers' federation. Section 121 states the The Collective Bargaining Committee can strike for the settlement of collective dispute only in the following conditions: in the absence of compulsory requirement for arbitration, failure of arbitrators to arbitrate, failure to constitute arbitral tribunal within 21 days, after the

submission of application to the Ministry for settlement of collective dispute, failure to arbitrate within the prescribed time, rejection to implement the arbitral award by the employer or legally challenging the arbitral award, and disagreement of either of the parties to the arbitral award except where the arbitration is compulsory. The Labor Act has also prescribes the limits for weight lifting which is (a) 55 kg for adult male, and (b) 45 kg for adult woman. This weight lifting limit is not applicable for lifting of sacks jointly.

Child Labour (Prohibition and Regulation) Act, 2056 (1999)

The Child Labor (Prohibition and Regulation) Act is the main legal expedient to prohibit engaging children in factories, mines or similar risky activities and to make necessary provisions with regard to their health, security, services and facilities while engaging them in other activities. Under the Section 3 of the Act, child having not attained the age of 14 years is strictly prohibited to be engaged in works as a laborer. Equally, under Section 4, engagement of child in works as a laborer against his/her will by way of persuasion, misrepresentation or by subjecting him/her to any influence or fear or threat or coercion or by any other means is prohibited. Under Section 6, in case any Enterprise, engaging a child in works, must get an approval from the concerned labor office or any authority or official prescribed by that office and form the father, mother or guardian of the child.

Children's Act 2075

On 18th September 2018, the Government of Nepal endorsed a new Children's Act 2075, paving the way to respect, protect and fulfil the rights of children in Nepal. The act provisions the children's fundamental rights provided in the constitution, into a legislative provision, which then allows children to exercise their rights legally. it recognises that children are entitled to these rights - and the state has an obligation to uphold their rights. It also recognises three-fold obligation such as - the need to respect the rights, protect the rights and fulfil the rights of Nepal's children. The Act provides a framework to design and implement child-focused programs that hold duty bearers accountable to children. Further, any child under the age of 14 are not allowed working in hazardous labour or the worst form of child labour. Children now have an absolute right to be protected against all types of corporal punishment.

12.4 Rules and Regulations

Environment Protection Rules 1997

Under the provision of Environment Protection Act, 1997, HMG/N has enforced the Environment Protection Regulation (EPR) on 1998. The proposals requiring EIA studies are broadly listed in Schedule 1 under Rule 3 of the EPR enforced under the provisions of EPA. An EIA study of upgrading of national highway is a legal requirement according to Act 3 of Environmental Protection Act, 2053 B.S (EPA, 2052 B.S) and Schedule 1-D-6 pertaining to Rule 3 of Environmental Protection Rule, 2054 B.S (EPR, 2054). As per Rule 5, proponent of both IEE and EIA proposals has to prepare Terms of Reference (ToR) of the proposal for approval.



Rule 7 of EPR provides that the proponent shall, on the basis of the approved work schedule pursuant to Rule 5, prepare the report of EIA in the format as indicated in Schedule 5, and the report. Under sub rule 2, Whilst preparing the EIA report, the proponent shall affix a notice in the concerned VDC or Municipality, Office of the District Development Committee, school, hospital and health post requesting the VDC or Municipality and District Development Committee or concerned individuals or institutions to offer their written opinions and suggestions within 15 days with regard to the possible impact of the implementation of the proposal on the environment where the proposal is to be implemented and prepare a Deed of Public Enquiry (Muchulka) of that deed. The prior 15-days notice shall also be published in a national level daily newspaper. After publication of such notice, the opinions and suggestions received shall also be included in the final report. Rule 12 of EPR stipulates that the proponent is obliged to follow the terms of conditions set by concerned agencies or MoFE in the approval letter during project implementation and operation. Rule 13 provides that the concerned agency to be responsible for the project monitoring.

Water Resources Regulation, 1993

It is mandatory under Rule 17(e) of the rule that appropriate measures should be taken to lessen the adverse effects due to the project on the overall environment. Measures are to be taken for the conservation of aquatic life and water-environment and for mitigating social and economic effects of the project in the concerned area.

Forest Rules, 1995

Rule 65 of the regulation oblige the proponent to bear the amount of compensation to be paid for any loss or harm to any local individuals or communities. Correspondingly, the entire expenses for the cutting and transporting of forest products for the use of the project should be borne by the proponent. The rules also provide absolute authority to local communities to manage the forests and get all the benefits from the forests.

Labour Rule 2018 (2075)

The Government of Nepal ("GoN") has framed the Labor Rules, 2075 (2018) ("Labor Rules") by exercising the power conferred to it under Section 184 of the Labor Act, 2074 (2017) ("Labor Act") which was passed by the Council of Ministers on May 28, 2018 (Jestha 14, 2075).

Section 11 (3) of the Labor Act provides for the employment contract and the matters to be covered under the employment contract. Section 11 (3) of the Labor Act requires the employment contract to include (a) remuneration, (b) benefits, and (c) terms of the employments of the Employee and such other matters as prescribed. Rule 4 of the Labor Rules requires the Employment Contract to cover (a) nature of employment, (b) primary work of the Employee and his/her position, (c) statement that the Employees' Service Rule will be integral part, (d) date, time, place of contract and its effective date, (e) Other important terms and conditions related to the work or service of the Employee.



Rule 16 of the Labor Rules provides flexibility to the Employer to determine the work hours. The Employer can determine the work hours on the basis of the nature of the work of the entity. The notice of the work hours however, should be given to all the Employees. The Labor Rules also provides that the Employer may put the Employee to work on rotation based on nature of its work. It seems that the Labor Rules envisages to put the Employee in different shifts. The Labor Rules requires the Employer to provide additional rest period for certain female Employees. The Employer should provide half an hour additional time for female Employees (a) who has baby below 3 years for breast feeding, and (b) who is pregnant. The rest period can be taken at once or at short intervals. The female Employee is required to submit the birth registration certificate to the Employer within three (3) months from the date of expiry of the maternity leave. The Employee may also submit the birth certificate issued by the concerned hospital or health post in absence of the birth registration certificate.

Employers are required to maintain an occupational health and safety policy. The policy should cover different measures in accordance with the entity's nature of business. The policy should be drafted in a way which includes provisions related to arrangements Employee's safety and security, Employee's health, probable accident in workplace, precautions to be taken while operating devices and machines in workplace and precautions to be taken while using chemical substances. The Employer is required to (a) make necessary arrangements to take the Employee to the hospital or health center in case of sickness or accident while working (b) inform the Labor Office regarding the fulfillment of obligations towards the Employees regarding occupational safety and health. The Labor Rules has laid down the works, duties and rights of the safety and health committee. It is further required for the safety and health committee to convene meetings at a time and place decided by the Coordinator at least 4 times a year. The Labor Rules has provided the detail safety measures to be followed by Employer such as for the safety of eyes, for the operation of pressure plants, prevention from fire, chemical substance, testing pressure plant and boilers, safety from hazardous machine and equipment's etc.

The Labor Rules has also specifies certain requirements for work place in terms and health and safety. The requirement include, among others (a) proper cleanliness, (b) passage of fresh air, proper light and temperature, (c) solid waste management, (d) sound control measures, (e) 15 cubic meter space to Employees to the extent possible as per the nature of work, (f) healthy drinking water, (g) bathroom or modern toilet, (h) tobacco free zone, (g) mandatory medical checkup for the entities undertaking health hazardous activities, and (i) provide appropriate time for the lunch/tiffin to the Employees. Employer or the representative of Employer should provide notice, within 7 days, to the Labor Office in case any Employee meets accident which results injury or death of such Employee. Such notice should include the details including the date, time, reason and place of accident, and the name, address of the Employee including the name of hospital where treatment takes place. As per the Labor Rules the Employer should maintain personal and attendance record of the Employees. The record should include name, address, family details, copy of citizenship certificate, contact number, email address and other important details of the Employee working with the Employer. The Employer is required to retain the records of

Employee's remuneration and attendance for at least five (5) years. The Labor Rules provides that domestic workers are entitled to twelve (12) day paid public holiday and one (1) day paid weekly off every week. If the worker is engaged in work on weekly off or public holiday, the Employer should provide replacing holiday within 21 days or overtime payment for such work. The Labor Rules requires the Employer to establish an enterprise level welfare fund to deposit seventy (70) percent of the amount remaining after distribution of bonus.

12.5 Manuals/Guidelines/Directives

Environmental management guidelines for roads and bridges, DoR, July, 1999

This Guideline consists of environmental mitigation measures to be incorporated into DoR projects, procedures for public participation, and socio-economic consideration. The Environmental Mitigation Measures are broken down into 12 categories or activities and a method for implementation is given for each mitigation measures. The 12 categories are i) Quarries, ii) Borrow Pits, iii) Spoil and Construction Waste Disposal, iv) Work Camp Location & Operation v) Labor Camp Location & Operation, vi) Earthworks/Slope Stabilization vii) Use of Bitumen viii) Stockpiling of Materials ix) Explosive, Combustible and Toxic Materials Management x) Setting Up and Operation of Stone Crushing Plants xi) Water Management and xii) Air & Noise Pollution. These environmental mitigation measures should be used in conjunction with good engineering design, construction and operation practices. The guideline also suggests considering the various socio-economic issues like land acquisition and compensation, economic impacts and cultural heritage. The various implementation strategies are also suggested in the guideline.

National EIA Guidelines, 1993

This guideline assists several mechanisms for identification of projects requiring EIA, processes selecting alternatives, and mitigation measures including monitoring and evaluation. The guideline provides important reference such as a checklist of environmental parameters, as well as numerous diagrams, tables and flow charts. The basic intent is to provide mechanism to optimize development benefits without degrading environmental quality and natural resources, and to integrate environmental considerations within the project planning cycle.

Forest clearance guideline 2076 (राष्ट्रिय प्रथमिकता प्राप्त आयोजनाको लागि राष्ट्रिय वन क्षेत्र प्रयोग गर्ने सम्बन्धी मापदण्ड सहितको कार्यविधि, २०७६)

Government had formulated "Working-procedure on procurement of Forest land for other provision, 2063 BS (2006)" as per the provision mentioned in Forest Act, 2049 schedule 68 (1); in order to ease or simplify the permission procedure utilizing forestland for hydropower, road, water supply and different other infrastructure projects. According to the working procedure, government could provide permission for a project utilizing forestland if there is no other options and the implementation of such project will not have any significant adverse impact upon environment. However, in order to maintain more balance between the conservation of environment and development of infrastructure the government had formulated "Work procedure together with guideline for the use of national forest area for national priority project 2076 BS.

The work procedure regarding the use of national forest area for national priority projects allows the projects



to pay the government in cash in case of its inability to provide compensation in the form of land for the used forestland. With the endorsement of the work procedure, projects can use forestland by paying certain amount to the government. The land however, will automatically go under government's ownership after the expiry of the agreement. In addition, the developers are required to plant 10 times the number of trees felled in the leased forestland. Hence, 10 number of trees required to be planted for each tree (>10cm diameter) felled or affected due to implementation of proposed project. The major procedures mentioned are as follows;

- Same area of affected forestland should make available by a project as a compensation of affected forest areas with the implementation of profit oriented project. If it is required and appropriate, Ministry of Forest & Environment should forward the project to the Government of Nepal to get approval for the implementation of project utilizing national forest.
- If it is possible; feasibility study shall be carried out avoiding national forest area as far as possible.
- Carry out Initial Environmental Examination or Environmental Impact Assessment. The study report should include impacts and its mitigation measures.
- If a project is implements aiming to generate income such as road, irrigation, water supply etc. and is a national priority project, a project shall be implemented along with the mitigation measures mentioned in the approved EIA document. However, project shall compensate plantation and its protection for five years in the area provided by the Division Forest Office and the area shall be handed over to Division Forest Office after five years. If the project is not willing to carry out such activities; project shall conduct plantation in the given area and shall provide compensation cost as per norms to the Division Forest Office for its protection for five years.
- Project shall obey mitigation measures mentioned in the IEE or EIA document. The cost for the measures of mitigation should be borne by the project itself.
- Department of forest and soil conservation will have agreement with such project mentioning all the obligations to be fulfilled by the project after the Government of Nepal grants permission for the implementation of project utilizing national forest.

Guidelines for Inventory of Community Forests 2057 BS

Guidelines for Inventory of Community Forests (MoFSC 2057 BS) of the Ministry of Forests and Environment (earlier, Ministry of Forests and Soil Conservation (MoFSC)) details the processes and procedures for evaluating the forest stock and it's harvesting potentials with an objective to ensure sustainable harvesting by limiting the extraction with the annual increment. The guidelines identified trees being all those with Diameter at Breast Height (DBH) greater than 30cm, below which to a dimension of 10cm being poles and below which up to a DBH of 4cm being saplings. All the woody species below 4 cm DBH being regeneration.

The guideline followed a systematic strip sampling techniques with a mosaic plot design with a 1% sampling intensity. Largest of the plot designed to measure trees is 500 m² and a 100 m² for poles. Saplings and regeneration being measured in a 25 m² plot. This plot is also used to sample the NTFPs available in the forests. If regeneration is profuse a reduced sized sample plot of up to a 1m X 1m is used. The guideline has proposed a rectangular plot, however a circular plot could also be used if one is confident and the radii are 12.62, 5.64 and 2.82 for tree pole and saplings (and regeneration) respectively.



Environmental Assessment in Road Sector, 2000

The purpose of the policy document is to ensure that development improves the way of life for the people affected, without damaging the natural surroundings. Sometimes, a degree of damage is inevitable. In such cases, an environmental assessment should find ways of reducing or compensating for the damage. The policy document suggested five types of environmental assessment activities viz. Screening, Initial Environmental Examination, Scoping, Environmental Impact Assessment, and Monitoring.

Environmental Social Management Framework of DoR, 2008

This Environmental and Social Management Framework report (ESMF) is prepared for the Department of Roads (DoR) to compile in an overview and guidance manner, various safeguard and compliance aspects of environmental and social issues related with the Sector Wide Road Program and the Priority Investment Plan Study for Nepal's Strategic Road Network (SRN) planning for 2007 to 2016.

The ESMF intends to provide technical and managerial inputs and guidance into the design of the strategic roads (both designated for rehabilitation and, to lesser extent, to new construction, through identification of key environmental and social issues related to the foreseen projects (hereunder referred as "SRN sub-projects"), mitigate potential impacts and concerns and, devise opportunities to enhance the benefits. The framework integrates in a step-wise approach the most important environmental and social consideration into all stages of project preparation, implementation, monitoring and operation and is applicable to all future sub-projects funded under the SRN program.

12.6 Environmental Standards

National Ambient Air Quality Standards (2003)

National Ambient Air Quality Standard, 2003 is presented in Table 12-1

Table 12-1: National Ambient Air Quality Standards for Nepal

Parameters	Units	Averaging Time	Concentration in Ambient Air, Maximum
TSP	$\mu\text{g}/\text{m}^3$	24 - hours	230
PM ₁₀	$\mu\text{g}/\text{m}^3$	24 - hours	120
PM _{2.5}	$\mu\text{g}/\text{m}^3$	24 - hours	40
Sulfur Dioxide	$\mu\text{g}/\text{m}^3$	Annual	50
		24-hours	70
Nitrogen Dioxide	$\mu\text{g}/\text{m}^3$	Annual	40
		24-hours	80
Carbon Monoxide	$\mu\text{g}/\text{m}^3$	8hours	10000
Lead	$\mu\text{g}/\text{m}^3$	Annual	0.5



Parameters	Units	Averaging Time	Concentration in Ambient Air, Maximum
Benzene	$\mu\text{g}/\text{m}^3$	Annual	5
Ozone	$\mu\text{g}/\text{m}^3$	8-hours	157

Nepal Vehicle Mass Emission Standards, 2069 (2012)

National Vehicular Mass Emission Standard 2069 has been enforced to enhance environmental cleanliness at the sites important from the cultural, religious and touristic perspectives, and to offer people an environment where they can inhale fresh air. This standard entailed about the types of documents related to positive ignition engines, type approval and conformity assessment requirements of imported petrol and diesel driven vehicles. The standards are designed on the adoption of EURO III norms. A four-wheeler vehicular means equivalent to the Euro 3 will only be operated as per the standard. Thus, this standard allows the movement of environment-friendly zero emissions vehicles complying with the Euro III standard and restricts the earlier Euro I vehicles.

National Standard for Sound Quality, 2069

National Standard for Sound Quality is established as per Rule 15 of Environmental Protection Rules, 2054. The maximum limit of sound for city and residential area is 55 decibels for daytime and 50 decibels for night hours. Whereas for the industrial area, the maximum limit of sound is 75 decibels for daytime and 70 decibels for night hours.

12.7 International Laws /Conventions

Biodiversity Convention, 1992

The objectives of this Convention, to be pursued in accordance with its relevant provisions, are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding.

Under the Article 14 of the convention, each contracting party should introduce appropriate procedures requiring environmental impact assessment of its proposed projects that are likely to have significant adverse effects on biological diversity with a view to avoiding or minimizing such effects and, where appropriate, allow for public participation in such procedures

Convention (No.169) Concerning Indigenous and Tribal Peoples in Independent Countries, 1991

The Article 7 of the convention provide right to the indigenous and tribal people to decide their own priorities for the process of development. However, for the national development plans and programs, it mandates consultation with them in the formulation of the plans and programs. Article 12, 13, 14 and 15 safeguards rights of the indigenous people in the land and natural resources in



territories traditionally occupied by them. In the event that the state retains the right of the natural resources in their territories, it mandates formulation of special provisions under the state legislation for participation in the decision-making process and resettlement process with full compensation of the resulting loss or injury (Article 16).

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), (1973 amended 1979)

The convention classifies species according to criteria where access or control is important (e.g. I - species threatened with extinction; II - species which could become endangered; III - species that are protected; E - Endangered; V - Vulnerable, R – Rare (CITES 1983). The project will have to minimize impacts to the CITES species as far as possible.

World Heritage Convention, 1975

This Convention aims at the identification, protection, conservation, presentation and transmission of cultural and natural heritages of outstanding universal value to future generations. When a property inscribed on the World Heritage List is threatened by serious and specific dangers, the World Heritage Committee (the Intergovernmental Committee formed under this convention for the Protection of the Cultural and Natural Heritage) considers placing it on the List of World Heritage in Danger. When the outstanding universal value of the property, which justified its inscription on the World Heritage List, is destroyed, the Committee considers deleting the property from the World Heritage List.

While fully respecting the sovereignty of the States on whose territory the cultural and natural heritage is situated; States parties to the Convention recognize the collective interest of the international community to cooperate in the protection of this heritage. States parties to the World Heritage Convention, have the responsibility to take appropriate legal, scientific, technical, administrative and financial measures to protect the heritage.

Convention on the Rights of the Child, 1989

This Convention acknowledges that every child has certain basic rights, including the right to life, his or her own name, and identity, to be raised by his or her parent within a family or cultural grouping and have a relationship with both parents, even if they are separated. The Convention obliges states to allow parents to exercise their parental responsibilities. The Convention also acknowledges that children have the right to express their opinions and to have those opinions heard and acted upon when appropriate, to be protected from abuse or exploitation, to have their privacy protected and requires that their lives not be subjected to excessive interference. States parties to the Convention are obliged to develop and undertake all actions and policies in the light of the best interests of the child.

Plant Protection Convention, 1952 (Second Amendment 1997)

This Convention directs the contracting Governments to adopt the legislative, technical and administrative measures of securing common and effective action to prevent the introduction and

spread of pests and diseases of plants and plant products and to promote measures for their control. It directs all the contracting Government to make provision for the inspection of growing plants and of plants, and plant products in storage and in transportation, particularly the inspection of consignments of plants and plant products moving in international traffic with the objective of preventing the dissemination across national boundaries of pests and diseases of plants and plant products and issue the required certificates as necessary.

United Nations Framework Convention on Climate Change (UNFCCC), 1992

This convention was signed in order to stabilize the greenhouse gas (GHG) in the atmosphere. UNFCCC was first initiated in 1992 and was officially enforced since March 14, 1994. In Nepal it was enacted from 31st July 1994 and several activities on research and for awareness raising programs were conducted in order to popularize this convention. In order to accelerate the implementation of UNFCCC, Kyoto Protocol was brought forth and signed by the participating Nations. Nepal has responsibility to abide by the rules & regulations of the Convention. Although Road development is not generating GHG, project implementation in Nepal requires clearance of forest area. Clearing/ degrading of the forest area reduces the carbon sequestration Capability of the forest.

United Nation Convention to Combat Desertification (UNCCD), 1994

Nepal acceded this Convention on 13 January 1997. The main objective of this convention is to halt the process of desertification and agriculture land degradation. In this context Nepal developed a number of programs to be implemented at national and local levels and Nepal prepared and presented status of the implementation of this convention in 2001. In the context of Road development, the project implementation is likely to degrade agriculture land due to project sitting and construction activities.

12.8 World Bank Policies

With respect to Environmental Strategies the World Bank pursues three interrelated objectives:

- (1) Improving the quality of life
- (2) Improving the prospects and the quality of growth
- (3) Protecting the quality of the regional and global environmental commons.

Concerning Safeguard Policies, the operations of World Bank are guided by a comprehensive set of policies and procedures, taking into account the Bank's core development objectives and goals, the instrument for pursuing them, and specific requirements for Bank financed operations. The core of this guidance lies in the Operational Policies (OPs) which are short, focused statements that follow from the Bank's Articles of Agreement, its general conditions and from policies specifically approved by the Board. Within the overall set of Operational Policies, Bank has identified key policies that are critical to ensuring that potentially adverse environmental and social consequences are identified, minimized and mitigated. These policies are known as the

“Environmental and Social Safeguard Policies” and receive particular attention during the Project preparation and approval process. These Operational Policies are short and focused statements that follow the Bank’s Article of Agreement, the general condition and policies approved by the Board. Safeguard policies are mechanisms for integration of environmental and social issues into decision making. It supports participatory approaches and transparency. They provide a set of specialized tools to support development processes as follows:

Environmental Assessment EA (OP 4.01)

The objectives of EAs are to (i) ensure that the projects proposed for Bank financing are environmentally and socially sound and sustainable; (ii) inform decision makers of the nature of environmental and social risks; and (iii) increase transparency and participation of decision makers in the decision-making process. To satisfy the Bank’s Environmental Assessment requirements, there are various instruments suggested including EIA, Environmental Audit, and Environmental Management Plan etc. Any World Bank project, which is likely to have potential adverse environmental risks and impacts in its area of influence, requires an Environmental Analysis, indicating the potential risks, mitigation measures and environmental management framework or plan.

For ascertaining which extent and type of environmental assessment is required, the Bank undertakes environmental screening of each proposed project. The Bank classifies the Project into one of the four categories depending upon the type (project or specific components have inherent environmental risks), location (proximity to environmentally, socially and culturally important areas), sensitivity (potential impacts may be irreversible or environment sensitive to changes, and scale (extent of environmental and social issues) of the project and the nature and magnitude of its potential environmental impacts:

- Category A: if it is likely to have significant adverse environmental impacts that are sensitive, diverse or unprecedented. These impacts may affect an area broader than the sites or facilities subject to physical works. This is where EIA is level study is needed.
- Category B: if potential adverse impacts are less adverse than those of Category A projects; these impacts are site specific; few in any of them are irreversible; and in most cases mitigation measures are readily designed. An IEE level study is needed here.
- Category C: If it is likely to cause minimal or no adverse environmental impacts. Here, no additional environmental assessment is needed beyond environmental screening.
- Category F: if it involves investment of Bank funds through a financial intermediary, in sub-projects that may result in adverse environmental impact. It requires appropriate environmental review for each sub-project.

Natural Habitats (OP 4.04)

Natural habitats are land and water areas where most of the original native plant and animal species are still present. Natural habitats comprise many types of terrestrial, freshwater, coastal, and marine ecosystems. They include areas lightly modified by human activities, but retaining their ecological functions and native species.

The Natural habitats policy is triggered by any project (including any subproject under a sector investment or financial intermediary loan) with the potential to cause significant conversion (loss) or degradation of natural habitats, whether directly (through construction) or indirectly (through human activities induced by the project).

The main objective of this OP is (i) safeguard natural habitats and their biodiversity; (ii) ensure sustainability of services and products which natural habitats provide to human society; (iii) Bank does not finance Projects that convert critical Natural Habitats; (iv) requires inclusion of mitigation measures if significant conversion or degradation of a (non-critical) natural habitat is needed to achieve project's objectives, includes establishing or strengthening an ecologically similar compensatory protected area.

Pest Management (OP 4.09)

The procurement of any pesticide in a Bank-financed project is contingent on an assessment of the nature and degree of associated risks, taking into account the proposed use and the intended users. With respect to the classification of pesticides and their specific formulations, the Bank refers to the World Health Organization's Recommended Classification of Pesticides by Hazard and Guidelines to Classification (Geneva: WHO 1994-95). The following criteria apply to the selection and use of pesticides in Bank-financed projects:

- (a) They must have negligible adverse human health effects.
- (b) They must be shown to be effective against the target species.
- (c) They must have minimal effect on non-target species and the natural environment. The methods, timing, and frequency of pesticide application are aimed to minimize damage to natural enemies. Pesticides used in public health programs must be demonstrated to be safe for inhabitants and domestic animals in the treated areas, as well as for personnel applying them.
- (d) Their use must take into account the need to prevent the development of resistance in pests.

Indigenous People (OP 4.10)

The key objective of the Indigenous Peoples Policy are to (i) ensure that the indigenous people affected by World Bank funded projects have a voice in project design and implementation; (ii) ensure that the indigenous peoples are afforded respect for their dignity and cultural uniqueness in the development process; (iii) do not suffer adverse effects; (iv) benefit from prior consultation and informed participation; (v) ensure that benefits intended for indigenous peoples are culturally

appropriate. An Indigenous Peoples Development Plan / Vulnerable Communities Development Plan is prepared to identify whether there are any adverse impacts on indigenous peoples and how these will be mitigated as well as measures to ensure consultation throughout project preparation and implementation.

Physical Cultural Resources (OP 4.11)

The procedure states that physical cultural resources may not be known or visible; therefore, it is important that a project's potential impacts on physical cultural resources be considered at the earliest possible stage of the project planning cycle.

The borrower shall inform the Bank of the relevant requirements of its legislation and of its procedures for identifying and mitigating potential impacts on physical cultural resources, including provisions for monitoring such impacts, and for managing chance finds.

Involuntary Resettlement (OP 4.12)

This policy is the principal social safeguard policies of the World Bank applying for resettlement. The key objectives of the policy on involuntary resettlement includes to (i) avoid or minimize involuntary resettlement and related disruption where feasible; (ii) explore all viable alternatives for project design; (iii) provide transparent compensation procedures for the involuntary acquisition of land; (iv) assist the affected and displaced persons in their efforts to improve their standards of living, income earning capacity, and production level, or at least in restoring them, implemented through a resettlement action plan; (v) encourage community participation in planning and implementing resettlement; (vi) provide assistance to affected people regardless of the legality of land tenure. The policy covers not only physical relocation but any loss of land or other assets resulting in relocation or loss of shelter; loss of assets or access to assets; loss of income sources or means of livelihood whether or not the affected people must move to another location. When the policy is triggered, a Resettlement Action Plan must be prepared. An abbreviated plan may be prepared when less than 200 people are affected by the project. In situations, where all the precise impacts cannot be assessed during project preparation, provision is made for preparing a Resettlement Policy Framework (RPF). The RAP/RPF must ensure that all the Bank's policy provisions detailed in OP 4.12 are addressed particularly the payment of compensation for affected assets at their replacement cost.

More specific and relevant to the SRN Program, the following provisions are given in this policy:

- The implementation of resettlement activities is linked to the implementation of the investment component to ensure that displacement does not occur before necessary measures for resettlement are in place. The measures (i. e. the RP) include provision of compensation and of other assistance required for relocation, prior to displacement, and preparation and provision of resettlement sites with adequate facilities, where required. Land and assets acquisition should take place only after compensation has been paid and, where applicable, resettlement sites and moving allowances have been provided to the DPs. The measures are implemented in accordance with the plan of action as part of the project.



- Preference should be given to organize land-based resettlement program for the DPs whose livelihoods are land-based. In such case, the land should have combination of higher comparative advantage or at least equivalent to the land taken. If the land is not the preferred options of the DPs, or equivalent land could not be available, non-land-based options built around opportunities for employment/livelihood should be provided in addition to cash compensation for land and other assets lost. Cash compensation to the DPs should be sufficient to replace the lost land and other assets at full replacement cost in local markets.
- DPs and their communities, and any host communities receiving them, are provided timely and relevant information, consulted on resettlement options, and offered opportunities to participate in planning, implementing, and monitoring resettlement. Appropriate and accessible grievance mechanisms should be established for these groups.
- Infrastructure and public services are provided as necessary to improve, restore or maintain accessibility and levels of service for the DPs and host communities. Alternative or similar resources are provided to compensate for the loss of access to community resources.
- DPs who have formal legal rights to land and those who don't have at the time of census survey but have a claim to such land or assets or become recognized through a process identified in the resettlement plan are provided compensation and other assistance for the land they lose. In the case of DPs who have no recognizable legal right or claim to the land they are occupying are provided resettlement assistance in lieu of compensation for the land they occupy, and other assistance as necessary, if they occupy the project area prior to a cut off date. Any encroachers settling after the cut-off date are not entitled to compensation or other form of resettlement assistance.

Forests (OP 4.36)

This policy is triggered by forest sector activities and other Bank sponsored interventions which have the potential to impact significantly upon forested areas. The Bank does not finance commercial logging. Instead, the Bank aims to reduce deforestation, enhance the environmental contribution of forested areas, promote afforestation, reduce poverty and encourage economic development. It is the objective of the OP that (i) forests are managed in a sustainable manner; (ii) significant areas of forest are not encroached upon; (iii) the rights of communities to use their traditional forest areas in a sustainable manner are not compromised.

The World Bank requires environmental assessment (EA) of projects proposed for Bank financing to ensure that they are environmentally sound and sustainable, and thus to assist in decision making. Developers seeking financing from the World Bank are required to comply with the applicable environmental and social safeguards, Operational Policies (OPs) and Bank Procedures (BPs) mentioned above. A summary of the key safeguard policies and their applicability to the proposed road development projects are presented in Table 12-2



Table 12-2: World Bank Policies and their applicability

Policy	Description	Applicability
OP/BP 4.01 Environmental Assessment	Provides the framework for World Bank environmental safeguard policies and describes project screening and categorization to determine the level of environmental assessment required. The Bank classifies the proposed project into one of four categories (A, B, C or F1) depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts. For a Category A project, the borrower is responsible for preparing a report, normally an EIA.	Development of KNM road section would require an EIA. Depending on the findings of the ESA.
OP 4.04 Natural Habitats	Outlines of the World Bank policy on biodiversity conservation taking into account ecosystem services, natural resource management and use by project affected people. Projects must assess potential impacts on biodiversity and the policy strictly limits circumstances, under which conversion or degradation of natural habitats can occur as well as prohibiting projects which are likely to result in significant loss of critical natural habitats.	Triggered. The project has potential to cause significant conversion of forest habitats and impair associated ecological functions. These potential adverse impacts and possible mitigation measures are examined as part of the EIA.
OP 4.20/OP 4.10 Indigenous People	Recognizes that indigenous peoples may be exposed to different types of risks and impacts from development projects. The policy requires projects to identify whether indigenous peoples are affected by the project and, if so, to undertake specific consultation activities and to avoid or mitigate impacts on this potentially vulnerable group.	The resettlement planning surveys would determine whether this policy is triggered.
OP 4.11 Physical Cultural Resources	Sets out the World Bank requirement to avoid or mitigate adverse impacts resulting from project developments on cultural resources. The following projects are classified as Category A or B, and are subject to the provisions of this policy: (a) any project involving significant excavations, demolition, movement of earth, flooding, or other environmental changes; and (b) any project located in, or in the vicinity of, a physical cultural resources site recognized by the borrower.	Environmental field surveys would determine the impact on physical cultural resources.
OP 4.12 Involuntary Resettlement	The World Bank aims to avoid involuntary resettlement where possible. Where necessary or acquisition of land or other assets is necessary, the policy sets out requirements for participation in resettlement planning, mandates compensation for assets at replacement cost, and expects the borrower to see that incomes and standards of living of affected persons are improved or at least restored to what they were prior to displacement.	As this policy will be triggered in both development proposals resettlement plans will be prepared. Social impact surveys would determine the number of PAPs and the extent of property to be acquired.

Policy	Description	Applicability
OP/BP 4.36 Forests	This policy recognizes the need to reduce deforestation and promote sustainable forest conservation and management in reducing poverty.	Forest areas will be acquired for required widening of the road sections. These are community owned forests and buffer zone sections.
Policy on Access to Information	Documents (safeguard assessments and plans related to environment, resettlement) prepared or commissioned by a member country/borrower are to be made available to the public as a condition for doing business with the Bank. The borrower provides such documents to the Bank with the understanding that the Bank will make them available to the public.	EIA, ESA and RAPs will be disclosed to the affected community through public disclosure meetings.

World Bank Group Environmental Health and Safety Guidelines

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice. When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards. These General EHS Guidelines are designed to be used together with the relevant Industry Sector EHS Guidelines which provide guidance to users on EHS issues in specific industry sectors.

Environmental, Health, and Safety Guidelines

IFC General EHS Guidelines, 2007

The IFC General EHS Guidelines 2007 document provides guidance to users on common EHS issues potentially applicable to all industry sectors. The general EHS guideline is organized into 4 chapters highlighting protection of environment, occupational health and safety, community health and safety, and construction and decommissioning highlighting information about common techniques for emissions management that may be applied to a range of industry sectors. This guideline provides an approach to the management of significant sources of emissions, including specific guidance for assessment and monitoring of impacts. The EHS guidelines also provide guidance on prevention and control of community health and safety impacts that may occur during new project development, at the end of the project life-cycle, or due to expansion or modification of existing project facilities. The guideline highlights general approach to the management of EHS issues at the facility or project level. The guideline is established for the effective management of environmental, health, and safety (EHS) issues entails the inclusion of EHS considerations into corporate and facility-level business processes in an organized, hierarchical approach highlighting with the identification of EHS project hazards and associated risks. The guideline also established for the involvement of experience EHS professionals to assess and manage EHS impacts and risks and to carry out specialized environmental management functions including the preparation of project or activity-specific plans and procedures. Further, understanding the likelihood and

magnitude of EHS risks, prioritizing risk management strategies with the objective of achieving an overall reduction of risk to human health and the environment. This will incorporate engineering and management controls to reduce or minimize the possibility and magnitude of undesired consequences when impact avoidance is not feasible. The approach also include for preparing workers and nearby communities to respond to accidents, including providing technical and financial resources to effectively and safely control such events. The guideline also intended improving EHS performance through a combination of ongoing monitoring of facility performance and effective accountability.

Environmental, Health, and Safety Guidelines Toll Roads, 2007

The EHS Guidelines for Toll Roads include information relevant to construction, operation and maintenance of large, sealed road projects including associated bridges and overpasses. The guideline highlights the environmental issues specific to construction and operation of roads include the habitat alteration and fragmentation, storm-water, waste, noise, air emissions, and wastewater. The Guidelines also highlights occupational health and safety, community health and safety, and performance indicator monitoring of environment and occupational health and safety.

Occupational health and safety issues associated with the construction and operation of roads primarily include physical hazards, chemical hazards, and noise. The guideline has highlighted the management practices to prevent and control physical hazards that include;

Workers' accommodation: processes and standards. A guidance note by IFC and the EBRD, 2009

There are no universally applicable international regulations relating to workers' accommodation standards in general. However, there are some international standards/guidance on food safety, water sanitation, and waste management that should be applied, and national or local building regulations that must be complied with. Applying appropriate standards to the construction and operation of worker housing falls within the performance requirements on labour issues expected of clients by both organizations. The Standard workers accommodation comprises planning and assessing the requirements for workers' accommodation as it is important to first be aware of the international, national, and local regulatory framework. Further, the guideline also comprises standards for and management of workers' accommodation and provides the principles and standards applicable to the location and construction of workers' accommodation, including the transport systems provided, the general living facilities, rooms/dormitories facilities, sanitary facilities, canteen and cooking facilities, food safety, medical facilities and leisure/social facilities.

Finally, the document consists checklist on workers' accommodation in order to access general regulatory framework of established accommodation, to assess the need for workers' accommodation, to assess impacts of workers' accommodation on communities, standards provided for workers' accommodation, managing workers accommodation etc.

Construction contractor for KNM will follow the Environmental, Health, and Safety Guidelines related to IFC and WB during the time of construction.



CHAPTER 13. CONCLUSIONS

Historically, the significant trade of Nepal is connected to its closest southern neighboring country – India. The trade has increased last decades and continue to expand, dictating needs in the improvement of existing roads. The major road corridor from Kathmandu to Birgunj connects the capital city with national border to India. Road improvement, upgrades and construction of new alignments will be inevitable to maintain good transportation system, enhancing road safety and improvement of freight transportation, correspondingly, minimizing and reducing time and costs of transportation, resources and energy on the way from Kathmandu to the national border with India in Birgunj. The improvement of Kathmandu – Mugling section of existing highway is one of major strategic projects, ensuring efficiency of the entire road system, having enormous value for national economy. This section of the road is one of the key elements, providing connectivity not only to Terai Region on the way to Indian border, but also to one of the magnificent places of touristic destinations in the country: Pokhara and Annapurna Conservation Area. More tourists will be able to visit this area, likely, after improvement of the existing road and improved accessibility of the one of the major touristic destinations in the country. Further, improvement of Kathmandu- Naubise – Mugling highway will facilitate development of physical infrastructures, thus, contributing to local and regional development, economic initiatives, and improvement of local wellbeing.

Existing highway from Kathmandu to Mugling is going along the left bank of Trishuli River; proposed widening of highway into 4-laned is impossible due to rugged landscape and vast existing zone with fragile and unstable hill slopes, which just relatively recently were fixed by bio-engineering measures. Construction of two new alignments: Sisnekhola – Dharke and Bishaltar – Phishling – will be very significant to improve road safety and enhance freight transportation. However, construction of new alignment in Bishaltar-Phishling still will need to solve the problems of soil fragility and unstable steep slopes, especially closely to Krishnabhir and Jogimara landslide area. New alignments cross-fertile agricultural lands and natural forest areas.

Therefore, Environmental and Social Impact Assessment of KNM Highway was carried out, examining overall existing environmental conditions as well as likely significant impacts due to the implementation of proposed project. During EIA process, the number of beneficial and adverse impacts was predicted after literature review, conducted field studies, and consultations with interested stakeholders and local communities. The measures to enhance beneficial impacts and effectively mitigate predicted and anticipated adverse impacts were also proposed, considering human being especially locals of the project area as a center of development. Permanent change in existing land use, permanent loss of existing forest area and generation of huge amount of spoil will be required during the existing road sections upgrades and construction of new alignments. All these and other direct, indirect, and cumulative impacts were analyzed and addressed in the mitigation chapter.



The significant impact on physical environment in the project area during construction will be on air quality due to increase in fugitive dust emission, road excavations, quarry and crushing plant operations, nuisance due to increased noise from heavy equipment operations and construction works; land use change in the result of establishment of campsites borrow-pits, stockpiling of materials, construction of access roads, disposal of spoil and other project activities, especially considerable in the new proposed alignments, where the top-soil and agricultural activities might be impacted. Requiring safe disposal is one of the conditions, identified especially with the implementation of proposed Sisnekhola-Dharke and Benighat-Phisling alignment within the project area. The significant impact might be in the fragile areas with slope stability issues along existing highway and in several spots along new alignments. Traffic safety will be one of the major issues during upgraded highway and new alignment operations. However, there are planned to provide many upgrades along the road that to make it safe for drivers and pedestrians. Waste management is another issue, which should be solved through coordination of activities between various stakeholders and campaigns to ensure sustainable road operations, supported by NGOs and local communities.

The project area does not content any wildlife critical habitat, national park, and wildlife reserve or conservation area. However, 5 globally threatened mammal species and 16 globally threatened bird species were found within the area (along existing alignment and in Bishaltar- Phishling area). Several of those species – such as Common Leopard (Vulnerable), Chinese Pangolin and Hispid Hare (both Critically Endangered), Himalayan Goral and Terai Gray Langur (both Near Threatened) need special mitigation measures such as crossroad structures, ensuring their safe movement through landscape. Such crossroad structures have been proposed in several places, especially along the natural habitat in the Benighat-Phisling alignment. Crossroad structures will benefit too many other forest creatures, inhabiting natural landscapes, which do not have yet specific conservation status such as many amphibian and reptile species (frogs, toads, turtles, lizards and snakes). Significant number of trees and other vegetation will be affected and cut during construction. Likewise, compensatory re-plantation in the ratio of 1:10 of lost trees is proposed with appropriate conservation packages further identifying re-forestation land area available within the project vicinity. Most of the forest existed along the proposed road alignment are community managed forest and are in degrading condition; however, some are in good condition due to use of LPG gas stoves instead of fuel wood by the user groups for cooking purposes. Correspondingly, monitoring activities during construction and operation phase will be executed as per EMAP maintaining environmental mitigation measures for the anticipated impacts including remedial actions to address identified new impacts due to its implementation. Illegal harvest and trade of trees and wood logs are likely to be increased significantly after the construction and operation of the project.

Appropriate packages for compensation and resettlement for affected land and house owners will be designed by the project. Substantial road networks might be developed to interlink adjacent villages as well as other district municipalities after the development of strategic road along the

right bank of Trishuli River. Flow of people from all over the adjacent Municipalities of Gorkha district will be substantially increased along the KNM Road.

The Environmental and Social Impact Assessment of the area highlighted existing issues, analyzed possible beneficial and adverse impacts, and proposed mitigation measures, responding to each highlighted issues in accordance with mitigation hierarchy framework. Site-specific environmental management plans were identified and proposed, addressing all serious and significant issues of impacts on physical, biological, socio-economic, and cultural environment.

Establishment of new proposed alignments and improvement of KNM strategic road will further enhance all the existing means of transportations and ensuring low and affordable transportation costs.



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