Roads Department of the Ministry of Regional Development and Infrastructure of Georgia

Upgrading of the Sveneti – Ruisi Section (km 80 – km 95) of the East - West Highway

ENVIRONMENTAL IMPACT ASSESSMENT

July 1, 2009

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EXECUTIVE SUMMARY

Introduction

Due to its geographical position Georgia has gained the status of an important transport corridor connecting Europe and Asia and the development of the transport infrastructure has become a national priority. The Government of Georgia requested the World Bank to support modernization of the East-West Transport Corridor. Two projects for the improvement of the E-60 East-West Highway are ongoing with the Bank financing and the Third East-West Highway Improvement project is now under preparation. It will cover a section of the Highway between Sveneti to Ruisi. Future Investments will consist of Ruisi to Rikoti, as well as Rikoti tunnel. A Regional Environmental Assessment (REA) and an Environmental Management Framework (EMF) are being developed to cover the entire corridor Sveneti-Ruisi-Rikoti Tunnel. An Environmental Impact Assessment (EIA) has been carried out for Sveneti-Ruisi section of the Highway, including an Environmental Management Plan (EMP). The objective of the EIA for Sveneti-Ruisi section was to identify expected environmental impacts and risks of the proposed works, recommend measures for their mitigation, and develop a plan for monitoring environmental compliance during construction and operation of the section of E-60.

The present EIA has benefited from the Environmental Scoping Review undertaken by *BT Ltd*. in 2006 as a part of the project feasibility studies. *Kocks Consulting* and *Nippon Koei UK* are contributors to this EIA Report.

Technical and Environmental Standards and Regulations

Technical design of the highway improvement is in compliance with the Trans-European Motorway (TEM) standards. The project will be implemented in compliance with the Georgian legislation and environmental standards, as well as the World Bank's safeguards policies. These regulations required screening of the project with the purpose of its environmental classification, and determination of the scope and extent of its environmental assessment.

Environmental Screening

The proposed works for the improvement of Sveneti-Ruisi-Rikoti section of E-60 include widening of some parts of the existing carriageway for converting it from a two-lane into a four-lane motor road; construction of four-lane sections of road on a new alignment, reconstruction and construction of several bridges and construction of a new 800 m two-tube tunnel.. Road works of the described scope and scale determine classification of the Third East-West Highway Improvement project as a Category A for environmental

assessment purposes, requiring the conduct of a full scale EIA and development policies of an EMP.

Public Participation

The Bank policies and the Georgian legislation require meaningful public participation and involvement in the process of EIA and environmental management planning. The main principles of public consultation include:

- Disclosure of the draft EIA report to public through the convenient media in a national language;
- Announcement of the venue and time of stakeholder consultation meetings through central and local means of public communication;
- Invitation for written comments/questions on the draft EIA within 45 days from the document publication;
- Conduct of stakeholder consultation meetings no earlier than 50 days and no later than 60 days from the document publication. Provision of a free forum for expression of opinion and commenting on the draft EIA report;
- Incorporation of public feedback into the EIA report and re-disclosure of the finalized document.

The initial environmental overview of the project was carried out at the early stage of its preparation and the report with its findings was publicly discussed on September 20, 2007 in the office of Gori municipality (administrative center close to the project site). The meeting was attended by the representatives of the local government, project-affected communities, and the Ministry of Environment Protection and Natural Resources. Feedback received during this consultation was fully incorporated into the draft EIA report. In accordance with these requirements, the draft was posted on the web page of the Roads Department of the Ministry of Regional Development and Infrastructure of Georgia (RD) on April 14, 2009. Several hard copies of the document were made available at the Department's office and Gori municipality. RD organized second round of public consultation meetings on June 29 and 30, 2009. One meeting was hosted by RD office in Tbilisi and the second meeting was held again in Gori municipality. Present EIA report was finalized with incorporation of the feedback received through these consultations.

Sensitive Environmental Receptors and Potential Impacts

The Sveneti-Ruisi section passes mostly through the significantly transformed landscape, away from protected areas and biodiversity hotspots. The main environmental impacts are expected at the construction phase and come from clearing of the right-of-way (RoW); establishment/operation of work camps and temporary access roads; operations/

servicing of construction machinery; sourcing of construction materials; earth works and works in waterways.

Clearing of the RoW will be required for widening of road in the sections where the highway alignment remains unchanged, and for cleaning a new route for the re-aligned sections. This would imply removal of topsoil, cutting of shrubs and trees, and clearing of some buildings. Extent of these impacts varies for various alternatives of the highway alignment. Based on a multi-criteria analysis it was decided to construct an 800 m two-tube tunnel. This will generally minimize impact on the vegetation, though cutting of trees will still be required near tunnel portals. Establishment of construction camps and access roads is associated with generation of solid waste and waste water, compression of soil, and noise disturbance for nearby population as well as animals. Parking, operating and servicing of construction machinery will carry the risk of operational spills of oils and lubricants and generation of noise, vibration, dust, and emissions. Supply of the highway construction with asphalt, stones, gravel, and send may carry the risk of disturbance of landscape as soil as well as of hazardous emissions and generation of noise. Construction works will also have important implications for the occupational health and safety of workers/personnel.

Impacts of the improvement of the Sveneti-Ruisi section during its operation phase are much less significant and diverse. Three environmental aspects of the highway operation will be air pollution from automobile emissions, noise, and pollution of soil and surface water with litter and drainage from the highway. Finally, traffic safety will be an important issue with health, social, and environmental implications.

Project Alternatives

Various alignments of the highway carry different levels of environmental risks, which has been critical in environmental analysis of project alternatives.

No “showstoppers” have been identified during EIA and the anticipated impacts can be managed by application of adequate construction standards and good environmental practices. Nonetheless, a “do nothing” option was considered as one of the project alternatives. While it has no environmental and social impacts resulting from construction works, operating the highway in its current poor condition has negative environmental impacts from traffic jams, noise, low speed, high emission, and an unattended landslide section between km 87+000 and km 88+000 near village Ortasheni. Under the "do nothing" scenario local communities would loose opportunity of benefiting from all positive effects associated with the highway improvement, including profits resulting from increased cargo turnover and tourism. Therefore, as the potential positive

impacts of the project surpass its possible negative impacts, the "do nothing" option was discarded.

Out of the seven considered alternative alignments two were identified as the most preferable and one of them was adopted for implementation. This entails construction of a tunnel and its advantages are given below:

- Minimal impact on the natural vegetation and fauna;
- No constraint for movement of animals;
- Outside of any active landslide and no associated risks in construction and operation phases;
- Low risk of erosion;
- Least damaging for topsoil and subsoil;
- Medium extent of agricultural land loss and
- Low impact on industrial and trade facilities.

Project Description

The length of Sveneti-Ruisi section of the E-60 Highway is 14.7 km. It is a part of a larger program for reconstruction of the Tbilisi-Leselidze motor road. The project will support expansion of the existing two-lane road into a four-lane road, as well as construction of four-lane sections on a new alignment where re-routing is necessary. Several bridges will be reconstructed and some new bridges constructed. The project will also include construction of an 800 m two-tube tunnel.

Improvement of the highway is designed to TEM standards. The role of these standards is to ensure that the planning and design of the motorway provides for the adequate traffic flow at minimum operating cost, while ensuring harmonized conditions for motorway users, proper level of service, safety, speed and driver comfort over medium and long distances.

The standard cross section will be dimensioned as follows: Carriageway width 7.5 m with two lanes 3.75 m each; verge 3.75 m with shoulder 3 m of which 0.75 will be paved using the same structure at the right lane (a rumble strip could be placed to separate the carriage way from the verge) and 2.25 m will be made of light structure with aggregate instead of bituminous pavement and with standard overlay and 0.75 m berm; left hard strip: 1 m each with concrete barriers used in the median strip; median strip: not less than 3 m including barriers to separate physically the traffic flow. The median strip can contain sign supports, drainage, bridge piers and landscaping elements. Exception can be granted to the cross section for specific locations and for large bridges.

Environmental Impact Assessment Methodology

The EIA of Sveneti-Ruisi is comprised of (i) determination of the scope of the work; (ii) collection of the detailed baseline data; (iii) assessment of expected impacts; (iv)outlining of mitigation measures; and (v) development of environmental management and monitoring plans.

The EIA process was a combination of desk work and field work, comprising of literature review, data collection from various agencies, visual observation and fact finding along the RoW, collection and laboratory testing of samples, and analysis of all collected information. For the purpose of EIA the RoW was divided into linear units that are characterized by homogenous physical environment. The assessment was undertaken for each unit. Impacts of the project activities to be implemented outside the RoW - such as construction camps, temporary access roads, etc. - have been fully considered as well.

Information on the climate and meteorology was obtained from the Gori hydro-meteorological station of the Environment Agency under the Ministry of Environmental Protection and Natural Resources of Georgia. For supplementing the existing geological data, a geophysical survey of the areas adjacent to the proposed tunnel through the Gori pass was carried out. The background hydrological data were complemented with laboratory testing of water samples from the RoW area to specifically evaluate levels of water aggression against concrete. Due to lack of air quality monitoring points along the highway, the background data available on air quality and pollution was insufficient. Therefore, an air quality modelling software program was applied for building the baseline. It was used to calculate air quality around four most populated sections of the highway based on the meteorological and climatic characteristics of the area, as well as the technical parameters of the sources of pollution. Quite recent and high quality scientific information was available on the soil types and characteristics. In addition, erosion levels and rates were studied through visual examination and evaluation by Morgan rating method. Information on the flora and fauna of the project area was mainly obtained from literature and supplemented with fieldwork. Data on the human settlements and assets in and around the RoW, as well as on the historical and archaeological sites, were obtained through literature, field work, and the aerial photographs.

Environmental Baseline

The environmental baseline data were collected to identify the types of potential impacts on the environment. Physical environment around the proposed RoW is pretty diverse, but not rich in its biodiversity. The baseline studies included the following components:

- Climate and meteorology;

- Geology, geomorphology;
- Engineering geology;
- Hydrogeology;
- Seismic conditions;
- Soils and land use;
- Ambient air;
- Noise;
- Flora and fauna; and,
- Archaeological and cultural monuments.

The assessment of the social background was undertaken within a 200 m wide zone on both sides of the RoW. The information about existing social conditions was collected through the survey and focus group meetings. Comprehensive information on the social environment is presented in a separate report attached to the Resettlement Action Plan.

Public Attitude towards the Project

Generally the majority of the local population is optimistic about improvement of the E-60 highway and expects direct and indirect benefits from the project. According to the social survey, the prevailing expectation is a benefit from the employment. One common concern expressed by the majority of respondents residing along the right-of–way is a possible growth of noise levels in result of increased traffic volumes. Overall, the most critical issue for the affected population is the expected resettlement. The local communities attach high importance to the compensation scheme to be applied during land acquisition.

Expected Impacts and Mitigation

The results of the EIA show that majority of the potential environmental impacts of the project are associated with the construction phase and are temporary in nature. The main approach of the EIA was to provide adequate recommendations for the prevention or mitigation of negative environmental impacts of the project. These recommendations are applicable during road design, construction, and operation phases. Taking into account the location and sensitivity of human settlements and environmental receptors, the following mitigation measures were developed for mitigating the main risks associated with the project implementation:

- Impact on vegetative cover: Clearing of RoW, especially close to the tunnel portal, will imply removal of vegetation, including cutting of trees. Loss of vegetation will be kept at the possible minimum. The trees removed from the State owned areas will be compensated through re-planting along the RoW a ratio 1:1.5, and those cleared from private land plots will be compensated in accordance with the Resettlement

Action Plan. Selection of species for planting will be based on the natural composition of local flora. Greening of the construction sites along the RoW and the tunnel portal, as well as maintenance of the re-planted areas for a year will be included in the assignment of a works contractor. Further maintenance will be contracted out by RD throughout report.

- Disturbance of local communities: Movement of construction machinery, location of the temporary work camps, and temporary storage of construction materials and waste will be planned to avoid or minimize barriers for free movement of the local population. Deterioration of the air quality near populated areas will be controlled through oversight on the technical condition of construction machinery. Operation of engines in idle regime will be discouraged. In the event of existence of especially sensitive receptors, operation of construction machinery will be limited to the regular working hours.
- Operation of work camps and access roads: The EIA selected and recommended two potential sites for the establishment of work camps. The selection was made with full consideration of environmental criteria. If a construction contractor needs additional camps, the sites will be chosen following the same principles of avoiding sensitive environmental receptors. Work camps will be organized to have designated areas for storage of materials and waste, and will be equipped with septic tanks for the primary treatment of waste water. Areas designated for fuelling/servicing of machinery and for storing of hazardous substances will be provided with ground lining and barriers preventing release of spillage.
- Operation of construction machinery: The technical condition of the construction machinery will be checked on regular basis to minimize air pollution from exhausts oil and soil/water pollution from leakage of fuel. The risk of operational and emergency spills of fuel and lubricants will be mitigated by designation of special parking and servicing sites, to be located away from waterways and other sensitive environmental receptors.
- Earth works: Prior to excavation, top soil will be removed and stored separately for later reinstatement of the area. Landscape restoration will be carried out to ensure stabilization of slopes. This would include seeding of grass and planting trees.
- Construction and reconstruction of bridges: Works in the waterways will be planned to avoid construction during fish spawning periods. River banks will be checked for stability in the course of works and reinforced as necessary to minimize erosion. Barriers of inert materials will be used to avoid sedimentation from terraced sides of river beds. Working time will be minimized during filling the bridge footings with concrete. If temporary re-direction of river stream becomes necessary, piping, channels, and fish-passes will be arranged to allow alternative water flow and fish movement. Technical condition of machinery operated in and near waterways will be checked on daily basis to avoid leakage and operational spills of fuel and lubricants.

No stockpiling of construction materials and waste will be allowed in or nearby the waterways.

- Accumulation of construction waste: Temporary storage of waste will be organized by separating construction debris, household solid waste, and hazardous waste. The latter will be kept in a closed and isolated storage. Out transportation of waste from the construction sites will follow a time-bound schedule. Local authorities will be contacted for instructions on the final disposal sites.
- Operation of quarries and borrow pits: Purchase of inert construction materials will be allowed only from the licensed legal and/or physical bodies. Extraction of these materials will also be allowed on the grounds of a special license. Opening of new borrow pits will be avoided if those already in operation can be used instead. Operation of quarries and borrow pits, as well as extraction of gravel from river terraces will be carried out strictly in accordance with the conditions of a license issued by the State authority, enforced by the Environmental Inspectorate of the Ministry of Environment Protection and Natural Resources.
- Historical, cultural, and archaeological sites: All known historical and cultural monuments along the RoW were identified and mapped during the EIA. The Highway alignment will not cause physical damage to these monuments. If construction works will affect aesthetic value of sites around the historical/cultural sites, the area will be reinstated accordingly. There is a high likelihood of chance finds during earth works. Provisions for the course of action along with explicit division of responsibilities of parties involved are incorporated into the civil works contracts for the highway improvement, reflecting requirements of the national legislation and the Bank safeguard policies.
- Occupational health and safety: Work camps will be established and operated to ensure the maintenance of adequate hygiene and sanitation. Workers and other personnel involved in the project will be provided with personal protection equipment and gear. They will receive training on the safety rules and course of action in case of emergencies. Special safety regulations will be provided and conformed during works in waterways. They will receive training on HIV/Aids prevention.

Environmental Management Plan

This EIA report contains the EMP with a full set of the proposed mitigation measures, as summarized above, and monitoring indicators. It also describes the role of RD in overseeing adherence of construction works with the recommended mitigation measures and identifies the needs for RD's technical and institutional capacity building for ensuring full environmental compliance of the project. A supervision consultant will be hired by RD to provide technical control and quality assurance of civil works. Environmental monitoring will be an integral part of the consultant's assignment and information on the compliance with EMP will be included into the supervisor's regular

reporting to the RD. RD will have an overall responsibility for ensuring due environmental diligence. This will include ensuring quality of the supervision consultant's performance, site inspections, timely response to any issues identified by the consultant or by RD inspectors, and record keeping on all environmental aspects of the project implementation.

Before commencement of works the selected works contractor will be asked to develop and agree with the RD a plan of traffic management for the period of works. The works contractor will also develop and agree with the client a plan of greening and landscape reinstatement at a relevant stage of contract implementation.

Operation of the Highway

The improvement of the E-60 highway aims at minimizing the need of interventions during its operation and maintenance. Ensuring safe and good environmental performance will be a high priority at the operations stage and will comply with the requirements of the national legislation and the best international practices. The tunnel to be constructed will be equipped with modern systems of air quality monitoring and ventilation. Reliable mechanisms of fire control will also be installed. RD, through an outsourcing arrangement, will permanently maintain and, in a longer term, improve greening along the RoW to be provided by the construction contractor for landscape reinstatement and as a compensation for trees removed during works. Regular collection of solid waste will be organized along the RoW. Rapidly increasing technical and institutional capacity of the newly established Environment Agency of Georgia will be used to improve monitoring of the quality air and water along the E-60 highway. The State technical control of the highway through regular oversight and inspection will be provided.

CHAPTER 1: INTRODUCTION

This document was prepared based on contributions from Kocks Consulting and Nippon Koei., UK.

Due to its geographical position Georgia has gained the status of an important transport corridor connecting Europe and Asia and the development of the transport infrastructure has become a priority issue for the Georgian government. The Government of Georgia has requested the World Bank to support modernization of the E-60 East-West Transport Corridor and has received financing to upgrade and widen some sections of the East-West Highway from 2 to 4 lanes.

Motor roads are one of the most important forms of transport infrastructure, due to its role in freight service. The increased demand on freight service necessitated improvements of the existing roads and construction of new safe sections.

The present Environmental Impact Assessment (EIA) report is for the Sveneti-Ruisi section of the E-60 East-West Highway.

The objective of this EIA is to address the environmental impacts, mitigation measures and environmental management issues associated with the proposed project. The EIA Report, which includes an Environmental Management Plan (EMP), addresses the needs of applicable laws and regulations of Georgia and considers the relevant provisions of the World Bank's safeguard policies.

The Sveneti-Ruisi section of the Tbilisi-Senaki-Leselidze motorway is located in the central part of Georgia between points 80 km and 95 km on the E-60 highway.

From the administrative point of view, the targeted section is located in the Gori and Kareli districts. It starts from the Sveneti village, passes the villages: Berbuli, Ortasheni, southernmost part of Tedotsminda, and ends at the eastern limit of the village Ruisi (see map).

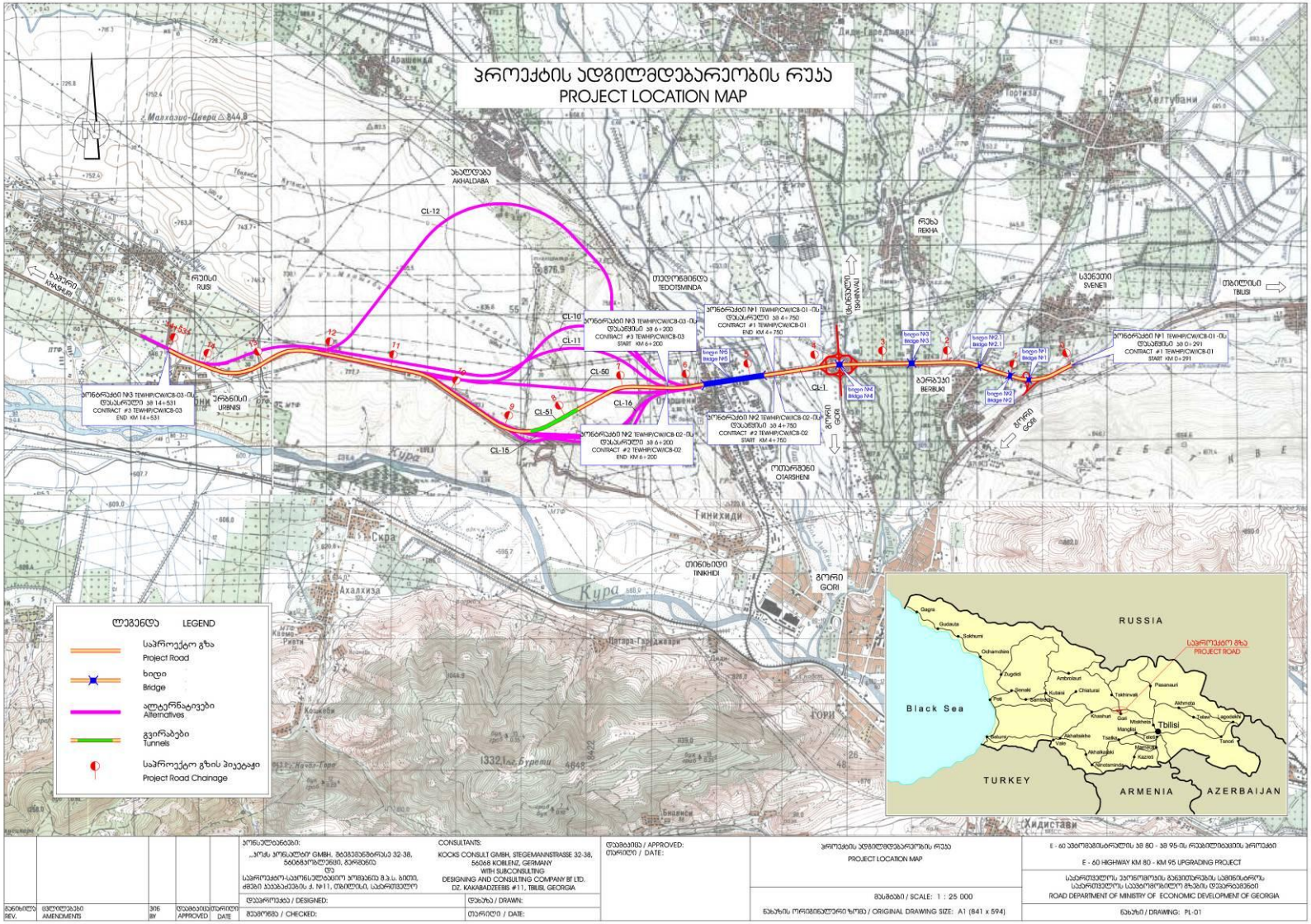


Fig. 1.1 Location of the Project

CHAPTER 2: POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 The Necessity and Purpose of Environmental Impact Assessment

According to the Law of Georgia on Environmental Impact Permits, activities to be financed under the proposed project are subject to the State ecological expertise and environmental permitting (Chapter II, Article 4). For this purpose the Roads Department of the Ministry of Regional Development and Infrastructure of Georgia (RD) is obliged to carry out an Environmental and Social Impact Assessment.

The EIA report must include environmental monitoring and management plans. The purpose of the EIA process is to identify and analyse all project related adverse impacts on natural and social environment at each phase of the project (design, construction and operating) and develop/provide mitigation and compensation measures to avoid or minimize the likely impacts to acceptable levels. Prior to commencement of activity, the contractor is required to prepare a site plan with a detailed information on the location of work camps; arrangements for water supply, sanitation, vehicle and machinery servicing, storage of construction materials and waste, final disposal of waste; location of quarries and arrangements for mitigating impacts from gravel/sand extraction.. During the whole process of implementing the works the contractor will be responsible for ensuring the compliance of works with environmental management and monitoring plans through application of internal environmental supervision and quality control systems.

According to the Georgian legislation, the Ministry of Environment Protection and Natural Resources of Georgia (MEPNR) is responsible for monitoring project implementation and compliance with the standards and commitments provided in the EIA, as well as with the conditions stated in the conclusion of the State Ecological Examination (basis for issuing the Environmental Permit by the MEPNR). Monitoring of performance compliance against Environmental Management Plans (EMPs) is an important element of the World Bank requirements. The World Bank guidelines stress the role of EMPs, which are important for all categories of projects and the RD has included a monitoring scheme into the EMP. Following this requirement, the proposed institutional arrangements are presented in the section "Management and Monitoring". These institutional arrangements cover the supervision and monitoring role of the RD, outline supervision of the scheme by the RD, and provide recommendations for ensuring environmental compliance of works contractors through inclusion of specific environmental requirements into bidding documents.

2.2 Environmental Policy and Legislation of Georgia

According to the Georgian legislation, during the planning and implementation process the investor/project proponent is obliged to take adequate measures for reduction or elimination of the expected negative impacts on the environment and human health.

Below is a brief overview of Georgia's environmental legislation as it pertains to the proposed project:

The Law of Georgia on Environmental Protection is also called framework law (adopted on December 6, 1996) that regulates the legal relationship between the bodies of the state authority and the physical persons or legal entities in the scope of environmental protection and in the use of nature. It applies to all Georgia's territory including its territorial waters, airspace, continental shelf and special economic zone.

The Law discusses the aspects of environmental education, environmental management; describes the economic sanctions, licensing, standards, results of Environmental Impact Assessment; it also discusses the various aspects of protection of natural ecosystems, habitats to be protected, the issues of global and regional management, protection of the ozone layer, protection of biodiversity, protection of the Black Sea, and aspects of the regional cooperation.

On December 14, 2004 a number of changes have been introduced into this Law. According to Article 35, the term "environmental permit" has been changed to "environmental impact permit" and therefore the new version of the Article 37 of the Law says: Environmental Impact Assessment shall be carried out prior to issuing environmental impact permit for the proposed activity to prevent or minimize the harmful impact on the environment.

The Law of Georgia on Environmental Impact Permits has been prepared on the basis of changes introduced into the Law of Georgia on Environmental Protection and is active since January 1, 2008. The Law establishes the procedure of obtaining environmental impact permits. In particular, the Article 4 deals with the activities subject to ecological expertise and bodies authorized for granting rights on implementation of the activities. The Article describes the procedure of obtaining environmental impact permits, including: public discussion of the EIA report; rules for documenting the results of public discussion of the EIA report; the list of documents required for obtaining permits; the rule of issuing permits; the EIA procedure and the requirements for the content of the EIA

report; exemption of the activity from EIA; duties and responsibilities of the project proponent; duties and responsibilities of the permit issuing authority; etc.

The Law of Georgia on Ecological Expertise (active since January 1, 2008) replaced the Law of Georgia on State Ecological Expertise. The Law defined the basic principles of ecological expertise; identifies organisations responsible for ecological expertise, determines their duties and responsibilities; establishes the rules for conducting ecological expertise; identifies independent experts; determines the conclusion of ecological expertise; establishes the duties and responsibilities of those involved in the process of ecological expertise, etc.

The Law of Georgia on Protection of Atmospheric Air regulates the issues of protection of atmospheric air from harmful human impact on the whole territory of Georgia. On January 1, 2008 the Law of Georgia on Introduction of Changes and Amendments into the Law of Georgia on Protection of Atmospheric Air has been enacted as a result of which a number of issues described in Articles 30, 36, 45, 48 and 50 have been clarified.

The Law of Georgia on Water regulates the use of water resources; determines the rights and responsibilities of water users; establishes the types and rules of licensing on water use, describes the conditions and rules for issuing licenses; determines the conditions for their suspension, cancellation, withdrawal and change; and regulates water discharges.

Environmental standards and regulations

According to the updated set of environmental standards, the environmental norms include quotas on the use of natural resources, which are to be established at the State level taking into account the principles of sustainable use of natural resources.

Qualitative standards of the state of the environment determine the requirements for the qualitative state of the environment and define the maximum allowable concentrations of substances harmful for human health and the environment in water, air and soil.

2.3 Environmental Impact Permitting

Paragraph 1 of Article 4 of Chapter II of the Law of Georgia on Environmental Impact Permits determines activities subject to ecological expertise, which require obtaining environmental impact permit, issued by the MEPNR.

According to the legislation, a project proponent shall be required to prepare and submit an EIA report to obtain the environmental impact permit. EIA is the study and investigation procedure of the planned activity aimed at the protection of certain elements of the environment, people, landscape and cultural heritage.

EIA identifies and describes the direct and indirect impacts on human health and safety, flora and fauna, soil, air, water, climate, landscape, ecosystems and historical monuments or combination of the above-listed factors, including the impact of these factors on the cultural values (heritage) and social and economical factors (for infrastructure projects).

Development of mitigation measures for the above-listed impacts, as well as preparation of environmental management and monitoring plans is an essential element of the EIA process. Thus, if the proposed activity requires environmental impact permits, the EIA report shall be presented to make a decision on permitting.

The Georgian environmental regulations take into account almost all aspects established in the international principles and relevant requirements of the World Bank with regard to the environmental and social requirements. Taking into account the above-mentioned, the present report consists of the three interrelated issues of environmental and social security policy:

- The environmental overview which covers the general overview of environmental issues and the project related potential impact;
- The concept of environmental management, which defines the approach to be applied to the assessment of environmental and social issues; the environmental assessment and the consultation process shall be carried out with participation of all stakeholders; the information about project implementation shall be published on a regular basis;
- The resettlement policy, which covers the issues of involuntary resettlement and administration of land resources.

2.4 Main Environmental Requirements for Construction of Roads

The current Construction Norms (Standards) and Rules (Construction Norms and Rules, 2.05.02) set all environmental conditions to be met at the first stage of construction of roads of Category I. In particular:

- for Category I roads the distance from both edges of the carriageway to the nearest settlements shall be no less than 200 m;

- when selecting the routes of roads and road construction options the aspects of the environmental impact in both the construction and operation phases shall be taken into account together with technical and economical indices; the value of land resources shall also be taken into account;

- when selecting the routes for access roads and the sites for construction camps and other necessary temporary buildings related to the road construction, the conditions of preservation of natural landscapes shall be taken into account;

- topsoil shall be cut and stored separately before using land plots along the road, construction related temporary infrastructural buildings and access roads. After completion of construction works the lands used under temporary buildings and access roads shall be reinstated. As for topsoil cut from the road alignment, it can be used for upgrading unfertile agricultural lands;

- if the road is being constructed in areas adjacent to settlements and noise caused by vehicles exceeds the maximum allowable noise levels established by the sanitary standards, the implementation of special noise dampening activities (arrangement of noise dampening hills or other facilities, planting of fast-growing trees) shall be considered to ensure the decrease of noise levels to the allowable level;

Other environmental aspects are discussed in Chapter 7: Environmental Impacts and Mitigation.

2.5 Public Consultations

The Law of Georgia on Environmental Impact Permit determines the timeframes and participation procedures for public consultation. In particular, the project proponent shall be required:

- to carry out public consultations prior to submitting the EIA report to the permitting authority;
- for the purpose of public discussion of the EIA report, publish information about the proposed activity in central newspapers, as well as in printed media of that self-governed administrative unit where the activity is to be implemented;
- submit hard and electronic copies of the EIA report to the permitting authority within 1 week after publication of information on proposed activity in printed media;

- receive and discuss written comments and suggestions of the general public within 45 days after publication of information on proposed activity in printed media;
- carry out public consultation on the proposed activity not earlier than 50 days and not later than 60 days after publication of information on the proposed activity in printed media.

Representatives of the general public have the right to attend the EIA public consultation. The public consultation has to be organized in the administrative centre of that self-governed unit where the proposed activity is to be implemented.

Figure 2.1 shows the disclosure process:

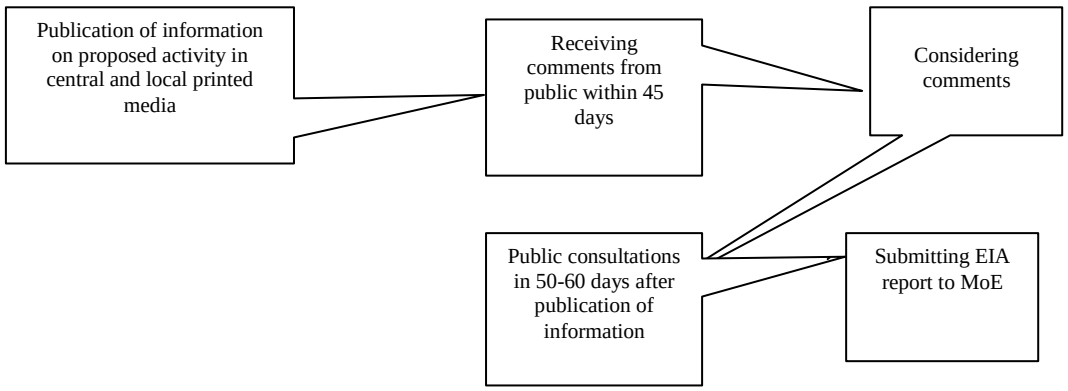


Fig. 2.1 Disclosure of EIA for public consultation according to Georgian Law

CHAPTER 3: APPROACH

The methodology used in this EIA study follows the provisions given in the TOR and relevant international principles as documented in the World Bank's technical papers and in the European Union Council Directive 97/11/EC on the assessment of the effects of certain public and private projects on the environment. The EIA also addresses the requirements of applicable laws and regulations of the Government of Georgia and considers the relevant provisions of the World Bank safeguard policies.

During the feasibility study of the Project, an Environmental Scoping Report was prepared for Sveneti-Ruisi section of the highway. The results of this Environmental Scoping Report were used for preparation of the present EIA report.

Based on the baseline information and the legal framework, the EIA examines the Project's potential negative and positive environmental impacts and recommends measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and to improve environmental performance.

The purposes of the EIA were to:

- examine the project's potential negative and positive environmental impacts and recommend any measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and to improve environmental performance;
- provide technical information and recommendations for selection and designing of the best option from several alternatives;
- develop an Environmental Management Plan, which will include: mitigation programme, monitoring plan, and assessment of institutional capacity for its implementation..

Environmental work carried out for this Project complied with the guidelines provided in the following documents:

National standards

- Relevant Georgian Laws and instructions and orders of the Georgian Government.

International standards

- General information on the WB safeguard policies: http://nweb18.worldbank.org/ESSD/sdvext.nsf/52ByDocName/SafeguardPolicies

- OP/BP 4.10 Environmental Assessment, Handbook on Environmental Assessment and Environmental Management Plan: http://lnweb18.worldbank.org/ESSD/sdvext.nsf/52ByDocName/EnvironmentalAssessment

- OP/BP 4.12 Involuntary Resettlement: http://lnweb18.worldbank.org/ESSD/sdvext.nsf/52ByDocName/InvoluntaryResettlement

- OPN 11.03 Management of Cultural Property in Bank-financed Projects: http://lnweb18.worldbank.ogp/ESSD/sdvext.nsf/52ByDocName/CulturalProperty

- The World Bank Procedures on Information Disclosure http://www1.worldbank.org/operations/disclosure/

- The World Bank Handbook on Information Disclosure http://www1.worldbank.org/operations/disclsure/documents/disclosurehandbook.pdf

- The World Bank document "Transport Strategy for Improvement of Access Roads in Developing Countries"

- Other project related guidelines and manuals of the World Bank (Handbook on Environmental Assessment, technical document 376, Handbook on Roads and Environment).

As this EIA relates to the upgrading of a major section of road, special attention was given to the following environmental aspects:

- impact of noise generated during construction and operation of the motorway;
- expected impact on ambient air during construction and operation of the motorway (emission/exhaust of vehicles);
- expected changes in soils in connection with the natural drainage of underground water, as well as risks of pollution of surface waters;
- changes in landscape (road structures, cut and filled areas), visual intrusion into human settlements;
- possible losses of flora and fauna;
- impact on monuments of cultural heritage;
- impacts on property and land (e.g., expropriation, rearrangement of crossings of secondary roads, etc.).

CHAPTER 4: ANALYSIS OF ALTERNATIVES

4.1 Selection of the Main Alternative Route

4.1.1 Basic Principles

At the 87 km point of the existing motorway is a well-known landslide and regularly closes the road. For this reason the safety conditions at this section of the motorway have deteriorated. This information is especially noteworthy since the design speed after road reconstruction will be 120 km/h even in conditions of hilly relief.

Considering this information and the complex geological situation at this location it was decided to select a new main alternative route from the village Ortasheni to the village of Ruisi, which will be acceptable both from the environmental and economic point of view.

For implementation of linear projects such as motorways the most important issue from the point of view of minimizing potential negative effects on the environment is the selection of the least sensitive route. For successful implementation of a road project of any category the most important issue is to adequately identify those conditions which could facilitate mitigation or prevention whenever possible of the negative impact on the components of the environment (air, water, noise, erosion, land resources, flora, fauna, etc.) and social conditions of the population.

Considering the engineering-geological conditions existing at the project site and the route selection methodology given below, one main environmentally acceptable alternative route was selected from the seven alternative routes. It is noteworthy that when selecting the alternative routes the economic factors have also been taken into account.

4.1.2 Route Selection Methodology

Selection of economically and environmentally acceptable new routes within 79+600 - 95+200 km points of the main road was a complicated process. The criteria used in the process can be summarized as follows:

- Environmental and social issues, including flora, fauna, hydrology, landscape, atmospheric air and noise, livelihood, cultural heritage, etc.;
- Assessment of geological hazards (tectonic faults, landslide, slope stability, etc.);
- Negative impact on RoW and the lands to be allocated for temporary use (construction camps and temporary access roads), including agricultural lands; complex rehabilitation/reclamation of the territories; and,
- The impact on the rivers and river gorges caused by the construction of bridges, etc.

A unified approach has been applied to each stage of the route evaluation. Below are given the means that have been used at each stage of selection of alternative routes:

- Geological, hydro-geological and engineering-geological maps, aerial maps;
- Review of available literature and archived data;
- Desk studies;
- Baseline study; and,
- Field testing and surveys.

The desk and field studies at the each stage of the mentioned process have been undertaken by the relevant specialists.

4.2 Selection of the RoW

On the basis of a preliminary study and visual assessment for the purpose of selecting the RoW for new routes within the Sveneti-Ruisi section, seven alternative and one existing (LC-1) routes have been discussed. These routes are indicated on the attached map under the following indices: existing road (LC-1); northern alternative (LC-10); northern alternative (LC-11); northern alternative (LC-12); southern alternative (LC-15); southern alternative (LC-16); alternative of tunnel section (LC-50) and alternative of tunnel section (LC-51).

Before discussing all alternatives in detail it should be noted that the starting section of all routes from the village of Sveneti to the village of Ortasheni coincide with (LC-1), which is the main existing road. Replacement of this section with an alternative option will be a difficult task from environmental, social and economic points of view.

Among potential environmental impact within this section is the creation of potential negative conditions at new locations, specifically river terraces and flood plains as a result of implementation of rehabilitation-widening works of bridges over the rivers (Tortla, Pshana, Mejuda, especially Didi Liakhvi). Especially since the underground waters of the terraces of the Liakhvi River is the main source of water of Gori and surrounding villages.

Relocation of this section of the road to the north is impossible due to existence of compacted settlements (villages Sveneti, Berbuki, Ortasheni) and important agricultural lands in these areas. Gori is located south of this section. For the purpose of prevention of negative impact of the road on the Gori population the existing road was relocated to the north in the 1980’s. Therefore its relocation to the south is not deemed appropriate.

Considering the abovementioned, the alternative routes were selected from the western part of the village of Ortasheni to the village of Ruisi.

Pic. 4.1 Probable starting area of an alternative route at the village of Ortasheni

Below are summarised the brief characteristics of all alternative routes:

4.2.1 Northern Alternative Route (LC-10)

The length of the route is 14.5 km; maximal inclination is 5%; maximal depth of the cut is 39 m. The route does not require construction of a tunnel. This alternative route starts at the village of Ortasheni from KP 85 + 500, goes to the north-west, passes between the height marks H=744.9 m and H= 747.6 m, then goes to the west and from the height mark H=832.0 m goes down to the south-west at the height mark H=809.9 m. At a distance of 200 m it goes to the west and at KP 90+500 joins the existing LC-1 main motorway. It coincides with the existing road up to the village of Ruisi. At KP 88+50 the LC-10 option crosses about a 100 m thick stripe of fragments of natural forests. Farther are private agricultural land plots up to KP 90+500. The section of the route from KP 90+500 to the village Ruisi coincides with the existing LC-1 main motorway. Conservation of perennials and shrubs growing within the wind belts on the right side of the existing road from KP 90+500 up to Ruisi village is reasonable.

4.2.2 Northern Alternative Route (LC-11)

The length of this route is 14.5 km; maximal inclination is 5%; maximal depth of the cut is 53 m. The route does not require construction of a tunnel. This alternative route starts north-west to the village of Ortasheni at KP 85+600, goes north-west almost in parallel

with the LC-10 route up to KP 86+800, then changes direction to the south-west and from KP 87+800 goes about 90 m through natural forest. Then the route goes through private agricultural land plots in parallel with the existing LC-1 motorway 150 north from KP 90+400 up to turn to Urbnisi village. At that point the route joins the LC-1 existing motorway.

4.2.3 Northern Alternative Route (LC-12)

The length of this route is 16.6 km; maximal inclination is 5%; maximal depth of the cut is 53 m; and again the route does not require construction of a tunnel. The route starts north-west to the village of Ortasheni at KP 85+500 and goes north in the direction of Tedotsminda village (500 m west) and at KP 80+500 reaches H=744.9 m altitude above sea level. 800 m from this point to Akhaldaba village the route has a latitudal direction, while 1 km from the height of H=825.9 m it goes west. At H=735.2 m the route passes around so-called "Malkhazi Kedi" from north-east to north-west, goes at a distance of about 200 m from Akhaldaba village and then to the west. It passes between height marks H=816.6 m and H= 821.1 m, 3 km from H=816.6 m are directed to the south-west to the LC-10 route. At KP 92 + 300 the route changes direction and goes in parallel with LC-11 up to turn to the village of Urbnisi (KP 94 + 000).

It should be noted that 5 km of the route from the south of Akhaldaba village up to the turn to Urbnisi village go through private agricultural land plots. However, this route does not cross natural forested areas.

4.2.4 Southern Alternative Routes (LC-15 and LC-16)

The length of the both routes is 14.8 km; maximal inclination is 5%; maximal depth of the cut is 23 and 24 m accordingly. Neither of them requires construction of a tunnel. The route starts at KP 86 +300, goes in parallel with the existing LC-1 motorway at a distance of 150 to the north up to KP 88 + 500. From that that point up to Ruisi village they coincide with the existing LC-1 route. None of the routes crosses agricultural lands and natural forests; however a wind belt comprised of perennials falls within the widening zone from KP 86+300 up to KP 94+700 on the right side of the existing motorway.

The weakness of the both alternatives is the fact that both routes will pass through the active landslide area at KP 87+200.

4.2.5 Alternative Route (LC-50)

The length of the route is 14.8 km; maximal inclination is 5%; maximal depth of the cut is 20 m. The route requires construction of a 1860 m long tunnel, which starts at KP 87+250 (H=746.4 m) and goes to the west up to KP 89+100. At a distance of 500 m from

the tunnel (KP 90+400) the route joins the existing LC-1 motorway and goes up to the village of Ruisi.

In this case the 1600 m long section of the route passes through private agricultural land plots from KP 86+000 up to KP 87+250 and from KP 89 +100 up to KP 40+300. It should also be noted that a windbreak falls within the widening zone from KP 90+400 up to KP 93+700 on the right side of the existing motorway.

The strength of this alternative is the tunnel which will be 1860 long and therefore this section will have no contact with surface vegetation and fauna. Moreover, the route will be protected from landslide which will make transportation safe. However, from the economical point of view this option is more expensive.

4.2.6 Alternative Route (LC-51)

The length of the route is 14.7 km; maximal inclination is 5%; maximal depth of the cut is 20 m. The route requires construction of an 800 m long tunnel, which starts at KP 87+300 up to KP 88+100. At KP 89+000 the route joins the existing LC-1 motorway and goes up to Ruisi village. This option does not cross agricultural lands, except its 1 km long section from KP86+000 to KP87+300. Like LC-50 route, the strength of this option is the tunnel which will be 800 long and therefore this section will have no contact with surface vegetation and fauna. Since the route goes under the landslide through the tunnel, transportation on the motorway will be safe. From the economic point of view this option is more acceptable in comparison with the LC-50 option.

The table below shows the types of impacts on natural and social environment according to which one relatively acceptable option should be selected from the seven proposed options. The impacts are graded as low, medium and high according to their level and magnitude.

Table 4.1 Environmental and Social Appraisal of Alternatives

Impact types	Alternative routes							
	CL-10	**CL-11**	**CL-12**	**CL-15**	**CL-16**	**CL-50**	**CL-51**	**Notes**
Environmental impact								
Impact on soils	high	high	low	medium	medium	medium	medium	High grade is conditioned by the impact on natural forest. Medium grade is for the impact on certain parts of wind breaks.
Impact on fauna	medium	medium	medium	low	low	low	low	
Likelihood of generation of hazardous geological processes	medium	high	high			low	low	Mainly development of erosion processes may be expected
Impacts caused by tunnel construction	-	-	-	-	-	medium	medium	
Impact on surface water objects	-	-	-	-	-	medium	medium	
Impact on topsoil and subsoil.	medium	medium	high	medium	medium	low	low	
Social impact								
Impact caused by reduction of agricultural areas	low	high	high	low	low	medium	medium	
Impact caused by increased level of noise	high	medium	medium	high	high	high	high	
Impact caused by air pollution	high	medium	medium	high	high	high	high	

Impact types	Alternative routes							
	CL-10	**CL-11**	**CL-12**	**CL-15**	**CL-16**	**CL-50**	**CL-51**	**Notes**
Impact caused by reduction of existing industrial and trade facilities	low	low	low	medium	medium	low	low	

The magnitude and character of environmental and social impacts of the seven alternative routes show that option LC-51 is more acceptable from the environmental point of view. Its advantages are manifested in the following aspects:

- does not pass and therefore has no contact with the natural forested areas;
- does not create an artificial barrier for movement of animal species within 800 m;
- is not under the influence of active landslide, therefore creates all conditions for safe movement;
- designed depth of maximal cut is 20 m, which is less than in case of other routes except LC-50, therefore the risk of development of erosion processes is relatively low;
- will have less contact with topsoil and subsoil, which reduces impact on the environment;
- requires use of agricultural lands to lesser degree than in case of other routes except route LC-50; and,
- LC-51 and LC-50 are more acceptable from the social and environmental point of view than the other options. The major aspect determining the advantage of LC-51 is its economical reasonability.

From the point of view of impacts on the social and natural environment, the two options LC-50 and LC-51 are the most acceptable among all proposed alternatives. As for economic characteristics, the more advantageous is LC 51; so this was adopted for the project.

4.3 Additional Considerations regarding the Existing Motorway

Poor horizontal geometry is observed along the existing motorway as evidenced by very dangerous “blind curves/black spots”, coupled with several reversed bends and narrowing to single lane road widths, eventually leading to potential vehicular accidents. Further

aggravating the horizontal geometry, depriving safety to the traveling public, are the absence of required road signs.

The recommended solution for this section is to update the existing road for the above mentioned road conditions with corrections of dangerous horizontal and vertical geometry. Wherever possible, the alignment will lay along the existing road with the scope to reduce the earthworks and consequently the cost of the highway or adopting some variants.

CHAPTER 5: PROJECT DESCRIPTION

5.1 Background

The project proposes to upgrade the existing E60 road to two one-way carriageways with two lanes each (2x2), with a central reserve and full control of access according with the European standards. This will include some construction in a new alignment, reconstruction of bridges, and construction of an 800 m two-tube tunnel. The section is located between the village of Sveneti of the Gori district and the village of Ruisi in Kareli district (from KP 79+600 up to KP 95+200).

The project is divided into three lengths:

Section 1 – from Sveneti (KP 79+600) to the start point of the 800 m long tunnel at Ortasheni (including the section from KP 79+200 to KP 85+800 and a 1550 long section of the new road);
Section 2 – from the start point to the end point of the tunnel – 780 m in total;
Section 3 – from the end point of the tunnel to Ruisi (KP 95+200).
Upgrading of the east-west motor road to four lanes was envisaged in the 1980's and some works regarding culverts, retaining walls and bridges were started at certain locations. As for land resources the RD owned almost all lands including those located within the current right of way (RoW). At present the major part of land parcels located on both sides of the Sveneti-Ruisi section of the road still belongs to the RD. Therefore the existing 2-lane road can be expanded to a 4-lane road most likely within the current right of way (RoW).

The standards used to design the 15.6 km long Sveneti-Ruisi section motorway are TEM standard Third Edition (February 2002). These standards were elaborated under technical guidance provided by the countries participating in the Trans-European North-South Motorway Project (TEM). The role of these standards is to ensure that the planning and design of the TEM motorway provide for adequate traffic flow at minimum operating cost, while ensuring harmonized conditions for motorway users, proper level of service, safety, speed and driver comfort over medium and long distances.

Within the framework of the road rehabilitation project the standard cross section will be dimensioned as follows: Carriageway width 7.5 m with two lanes 3.75 m each; verge 3.75 m with shoulder 3 m of which 0.75 will be paved using the same structure at the right lane (a rumble strip could be placed to separate the carriageway from the verge) and 2.25 m will be made of light structure with aggregate instead of bituminous pavement and with standard overlay and 0.75 m berm. Left hard strip: 1 m each with concrete

barriers used in the median strip. Median strip: not less than 3 m including barriers to separate physically the traffic flow. The median strip can contain sign supports, drainage, bridge piers and landscaping elements. Exceptions can be granted to the cross sections for specific locations and for large bridges.

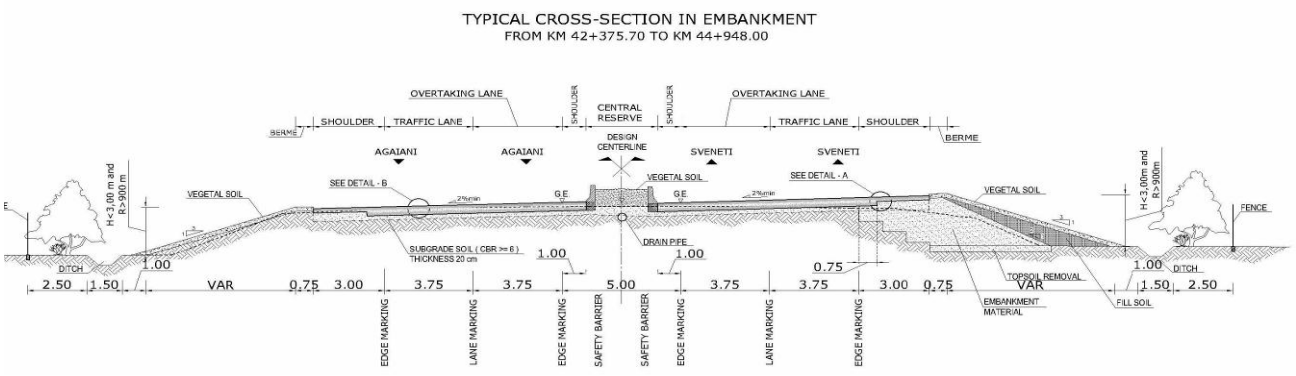


Figure 5.1 Typical Cross Section

The berm of the embankment will be built with 0.75 m width when no guardrail is required; if a guardrail is installed, it will add a round of slope radius R = 1.00 m.

5.2 The Route and Profiles

The minimum radius at level terrain will be 600 meters. If the radius is more than 1,600 m, superelevation will not be mandatory. The maximum grade for superelevation will be 7% (radius 600 m) and the minimum 2% (radius 1,600 m) the superelevation for intermediate radius will be calculated using a linear formula. Regarding profile, the maximum gradient will be 5%, the minimum radius for sags will be 5,000 m and the minimum radius for crests will be 15,000 m.

The geometrical elements as bends and straight elements will be linked with clothoidic elements following the optic parameters. The design speed adopted is 120 km/h with the minimal design speed 100 km/h – 80 km/h. These geometrical standards will be adopted as minimum standards; wherever possible, higher standards will be adopted.

Where the existing road cannot be improved, a variant of the alignment is proposed, as shown in Figure 5.2. Detailed design maintains the existing geometrical characteristics. In the transition points curves and sight distances match the design speed of the last section. For instance, Figure 5.2 shows the linking in B between an updating alignment (AB) and an existing one. The curve and the sight distance in C will be designed to the speed design of the section.

Figure 5.2 Alignment Variant

Such variants are mostly combined with two level interchanges. The solution provides four benefits:

- Easy solution for the correction of alignment and building a two level interchange;
- Using the existing road as secondary road to link with the local network;
- Low costs due to avoiding necessity of dismantling the existing road; and,
- Low environmental impact due to the use of existing road with less mitigation problems (as resettlement and replacement of the materials rejected by demolitions).

In addition, the site between the existing road and future motorway will be used as a road construction site during the works and can be rehabilitated and used as a bus stop, or an economic area and commercial area in the future. This area can also be used as resettlement area for kiosks.

5.2.1 Sveneti-Ortasheni

This section covers the portion of the existing motorway (KP 79+600) up to the eastern portal of the tunnel, i.e. KP 85+700 and about 1750 m of the new road section from KP 79+200.

Construction of eastern portals of two parallel tunnels is planned at the end of this section. An engineering-geological study has been undertaken for the 1750 long new road section on the basis of which the geotectonic state of the area has been assessed as satisfactory. The major part of the area is under agricultural lands.

The motorway section from Sveneti (KP 79+600) within the KP 85+700 point located near Ortasheni is almost linear except for one curved section (at the turn to Gori). This section up to the village of Ortasheni crosses the rivers Pshana, Tortla, Mejuda and the wide riverbed of Liakhvi via bridges. This route passes near the villages Sveneti, Berbuki and Ortasheni.

The design softened the sharp curve existing at the turn to Gori in accordance with the standards and aligned road in such a way to pass the existing bridge.

At this section two two-level interchanges with the right and left banks of the Liakhvi River will be built. These interchanges are very important and useful for this section. They will be placed along the existing and future roads and play the role of a connector with the Gori-Tskhinvali secondary roads. The bridge over the Loakhvi River will be replaced by a new bridge meeting all technical requirements.

During implementation of construction works within the optimal route of the motorway additional detailed geological and archaeological surveys will be required.

5.2.2 Tunnel

Development of new landslides within the old sliding relief of the Ruisi plateau makes it necessary to build a tunnel. When the landslide had affected the motorway going up to the Gori pass the issue of designing of a new road became urgent. The RD decided on construction of two parallel tunnels. The projected length of tunnels was 800 m. The starting point of the eastern portal on the tunnels was the end of the 1750 m long new road section to be built from KP 85+700 north-west to the existing motorway. The distance between the axes of two parallel tunnels will be 39 m. According to the projected technical specification:

The width (section) of the tunnel	11.98 m
The height of the tunnel from the road surface to the outermost point	8.15-8.35 m
Number of lanes in each tunnel	2
Number of ventilating shafts in each tunnel	2

The length of the new motorway to be laid from the ending western portal of the tunnel to the KP 89+100 of the existing motorway to the south-west will be 600 m. The general data on engineering-geological conditions of the tunnel is given in Section 6.1.6 below.

Probable location of the eastern portal of the tunnel

5.2.3 Western Portal of the Tunnel –Ruisi Village

This section starts at KP 89+100 of the existing motorway. Its 5 km long section along the meridian of eastern periphery of the village Ruisi (Ruisi plateau) coincides with the route of the existing motorway up to KP 94+600. However, within this section the route undergoes insignificant alterations for the purpose of reduction of radii of existing curves. In particular, from KP 92+600 to KP 98+800 the route will be relocated to the north at a distance of about 50 m, and from KP 93+150 to KP 93+600 – to the south at a distance of 60 m. From KP 93+600 up to the end of the projected motorway KP 94+600 the route will go in the vicinity of Urbnisi.

5.3 Rest Areas

The best solution to relocate kiosks is to create “full service areas” including commercial activities, bus stop and fuel service station. During the site visits it was already observed areas available near existing fuel stations and other structures were observed.

For bus stops two solutions have been selected:

- bus stop areas along the highway with acceleration and deceleration lanes; and,
- relocation of bus stop areas out of the highway in correspondence with interchange/commercial area system using entrance and exits of interchanges and using the existing road as a local connection.

5.4 Construction or Rehabilitation of Bridges and Tunnel

The project considers reconstruction-widening of existing bridges and construction of new ones to meet the requirements of road reconstruction-modernization project with regard to bridges: two one-way carriageways with two lanes each with a central reserve. The bridge (so-called Dry Bridge) located on the way to Gori, the bridge over the Tortla River and the bridge over the Mejuda River will be rehabilitated-widened, while the dry bridge located on the way to Tskhinvali, the bridge over Liakhvi and the bridge on the railroad connecting Tskhinvali will be replaced by new bridges. The present technical data on bridges is given in the table below.

Environmental requirements for bridge construction are similar to those for reconstruction-widening. Special attention shall be paid to erosion processes that may develop during construction works within the riverbeds and river terraces, deterioration of water quality that may take place when working in the riverbeds, which in turn will have negative impact on the river ichthyofauna. Serious impacts are expected during temporary change of watercourses and riverbeds.

The mentioned issues are discussed further in Chapter 7 below.

Table 5.1 Technical characteristics of existing bridges

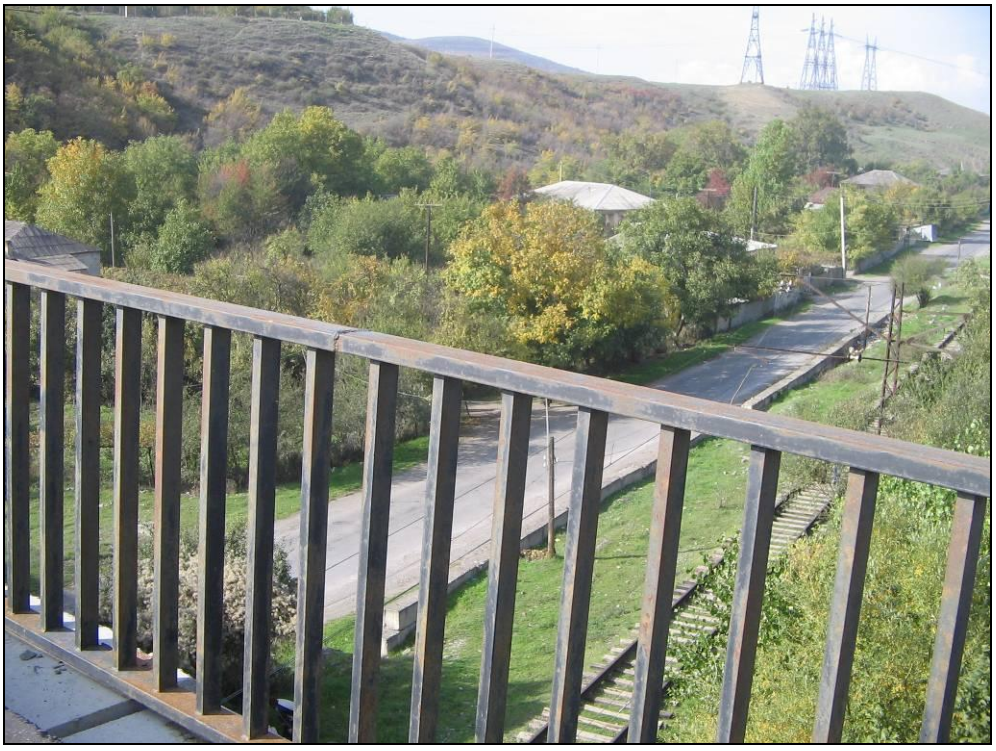
Bridge No.	Location KP	Bridge (next step)	Number of span	Length of the bridge	Width of the bridge	Length of the span
1	0+662	Bridge at the road connecting Gori. Requires reconstruction-widening	1	28.70	15.15	21.60
2	1+019	Bridge over the Tortla river. Requires reconstruction-widening	1	43.22	15.00	21.60
2,1	1+410	Bridge upper the projected motorway on the road connecting Mejvriskhevi. Requires reconstruction	3	59.35	10.73	16.20/21.60 /16.20
3	2+600	Bridge over the Mejuda river. Requires reconstruction-widening	2	57.13	14.88	21.60
4	3+634	Bridge on the road connecting Tskhinvali. Construction of new bridge	3	61.59	18.01	16.20/21.60 /16.20
5	4+822	Bridge over the Liakhvi river. A Construction of new bridge	7	167.99	14.01	21.60

Bridge No.	Location KP	Bridge (next step)	Number of span	Length of the bridge	Width of the bridge	Length of the span
6	5+295	Road on the railway going to dead-end siding. Construction of new bridge	2	50.20	14.02	21.60
7	5+661	Bridge on the railway connecting Tskhinvali. Construction of new bridge	3	96.45	14.41	21.60

In addition, certain strategically important roads pass under (cross) the existing motorway, in particular:

- Sveneti – Gori
- Gori – Mejvriskhevi
- Gori – Tkviavi – Tskhinvali
- Gori – Nikozi – Tskhinvali

Two railway lines go under the motorway. One of them goes to Gori – Nikozi – Tskhinvali direction (KP85+685) and the second one is a branch line going to industrial and warehouse located north-east to Ortasheni village.



Pic. 5.1. Dry bridge at the Gori-Tskhinvali railroad

5.5 Pre-construction Preparation Works

Preparation works to be implemented on the area specified by the project documentation consider leveling activities with strict observation of limits established by the project. If clearing from vegetation is required, topsoil will be cut, transported and stored at sites identified in advance. The rules for storage and further application of topsoil are discussed in detail in the Land Reinstatement Plan. Preparation works include arrangement of temporary camp sites for implementation of bridge reconstruction-extension works. This first of all considers planning of the area, arrangement of drainage canals around the area, cutting of topsoil, its transportation and storage at a specific site, arrangement of a sewage tank, installation of boarding cars for workers, arrangement of canteen and showers, construction of an administrative building, provision of a parking place for vehicles and road machinery, arrangement of fuel tanks in accordance with environmental requirements, and arrangement of a temporary machine shop and warehouse.

Preparation works for construction of tunnel and provision of temporary camp sites shall be implemented in accordance with environmental requirements. First of all the vertical planning of the area shall be undertaken, after which the drainage canals will be built around the site. It is also important to identify areas for temporary storage of debris removed from the tunnel until transferred to final disposal area. For this purpose the areas where soils will not be washed by rainfall shall be considered.

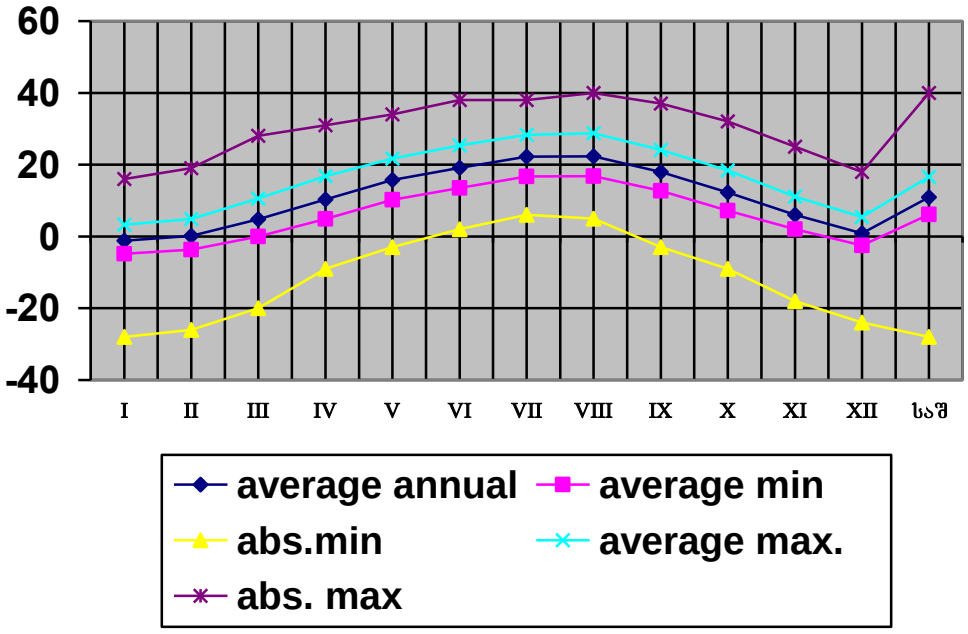
CHAPTER 6: BASELINE DATA

6.1 Physical Conditions

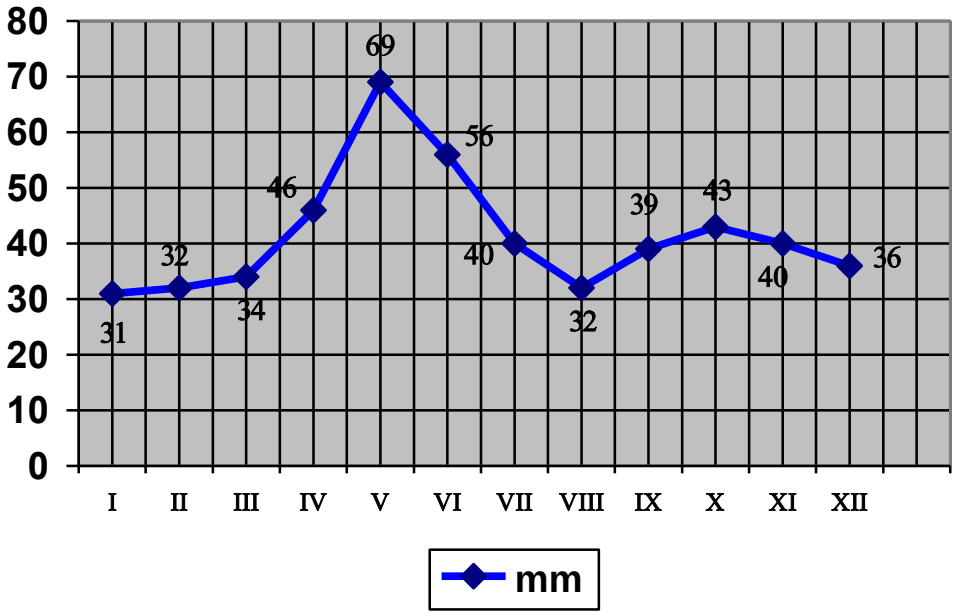
6.1.1 Climate and Meteorology

Climatic characteristic is one of the major components in the study of background information in the project zone. The central-eastern region of Georgia (Khashuri-Gori-Igoeti) is situated at a height of 500-600 m above sea level. Cold winters and long hot summers are characteristic for this area. The maximum temperature reaches $+40^0$C. The minimal temperature – 16^0C is recorded in January. Annual precipitation varies within 450-500 mm. The minimal level of precipitation is recorded in winter while the maximal level in summer, which is characteristic for a dry subtropical climate. There are 40-50 snowy days during a year. The thickness of the snow cover does not exceed 16 sm. Like air temperature, the minimal temperature of soils is recorded in December-January. Relative humidity corresponds to the level of precipitation, especially in summer, when relative humidity is 55-68%. Mean annual temperature of topsoil is $+12\text{-}13^0$C, which is the lowest index for dry subtropical zone. The temperature of soil at a depth of 2m is correspondingly low. Intensity of solar radiation, long periods of sunny days and small number of cloudy days dictate the temperature regime in summer. Meteorological and climatic data are based on information provided by the Gori station of the Hydrometeorological station.

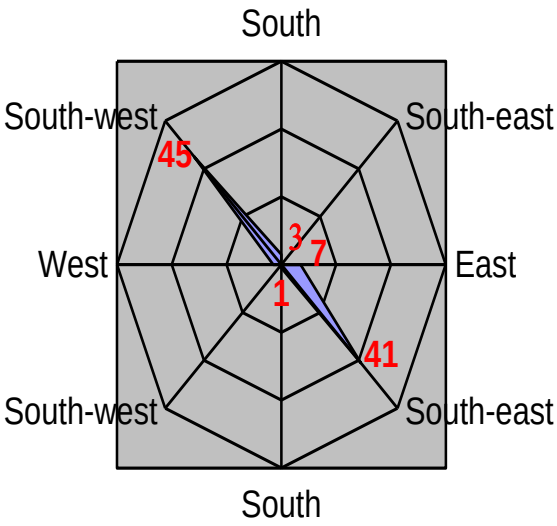
Average Monthly Temperatures



Precipitation



Wind Rose



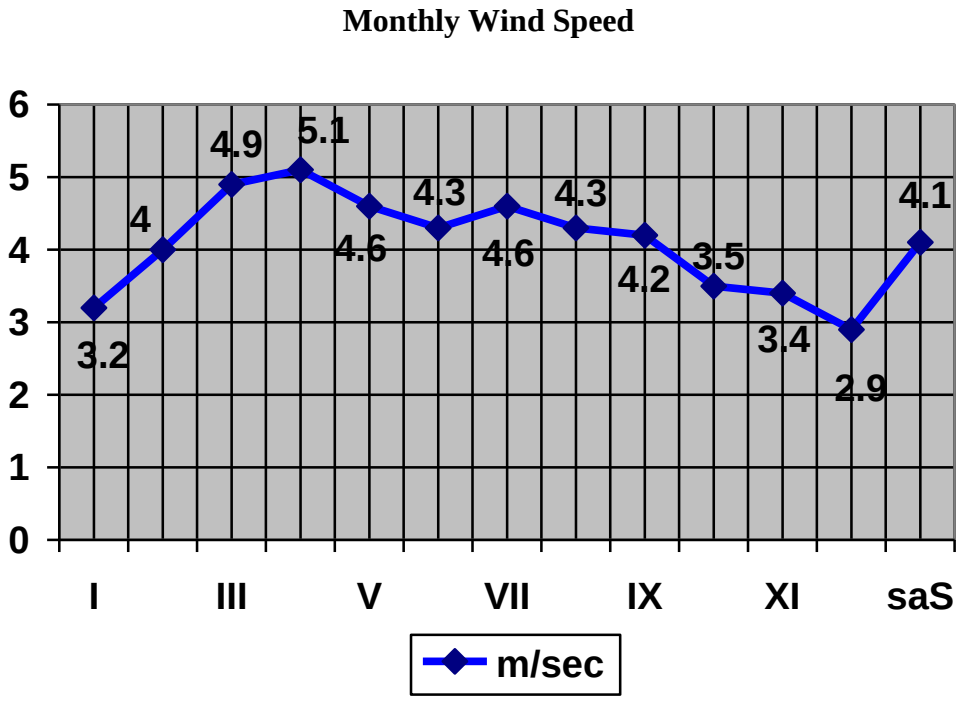


Fig. 6.1 Average Climate Data for the Study Area

6.1.2 Geology

Tectonically the study area is located on the Tiriponi-Mukhrani block of the Shida Kartli plunging zone of the Georgian fault and partially on the north-eastern peripheral areas of the central sub-zone of the Achara-Trialeti folded zone. The Sveneti-Ruisi section is built mainly of upper palaeogene, miopliocene and quaternary sediments. The oldest sediments are exposed south of Urbnisi and in its south-easternmost edge. They are upper Palaeogene age and presented in the form of Khadum layer rocks (P ch). This layer is built by alternation of sandstones, clays and marls. Their thickness reaches 80-100 m.

These sediments are covered with the 50-80 m thick stack of Sakaraulo age comprised of sandstone, gravelite and noncarbonated clay sub-layers. Then comes the 100-130 m thick stack of Kotsakhuri age (N1 kc) comprised of jarosite containing non-carbonate clays and greywacke sandstones. These sediments are covered with 50-100 m thick stack of Chocrack layer (N1 c) built of alternated sub-layers of conglomerates, sandstones, marl and sandy clays. A 55-70 m thick stack of Karagan layer (N1 kr) built of limestone, marl, sandstone and conglomerates comes next. A 50-60 m thick stack of Conck age (N1 kn) is found upper. It is built mainly of sandstone, caly, marl and sandstone-marl layers.

Sarmatian rocks are relatively more widespread. They are comprised of lower, middle and upper sarmatian layers. Lower Sarmatian (N1 s1) sediments are 400-500 m thick and are presented in the form of alternating clays and sandy clays where the inclusions of conglomerate sub-layers and lenses are often found. Middle Sarmatian (N1 s2) sediments

are less thick (250-300 m). They are presented in the form of a stack built of alternating conglomerates, sandstones, clay sandstones and marls. Upper Sarmatian stack is presented in the form of Natskhor rocks (N1 nc). The Natskhor rocks are arranged in lower and upper sub-layers due to their lithological diversity. The Upper sub-layer rocks (N1 nc2) are presented mainly by conglomerates with participation of clay sandstone and clay strata. Their thickness varies within 300-400 m. The lower sub-layer is comprised mainly of clay and clay-sandstone strata. Their total thickness varies within 400-500 m.

These sediments are overlaid by the Dusheti rocks of meotic-pont age. According to the level of refinement and conglomeration they are divided into four sub-layers: The lower (N_{1-2} ds_1) and upper (N_{1-2} ds_2) Dusheti sub-layers, which in turn are divided into two parts: the lower and upper strata of the lower part of the Dusheti layer and the lower and upper strata of the upper part of the Dusheti layer. The lowest sub-layer (N_{1-2} ds_1) is 250-350 m thick. It is built of fine gravel, well-ordered and consolidated conglomerates in which clay and sandstone sub-layers are found. The second lower sub-layer (N_{1-2} ds_1) is 300-390 m thick. It is built of well-ordered consolidated medium gravel conglomerates in which clay and loam sub-layers are found. The thickness of the third part, i.e. the lower sub-layer of the Dusheti upper layer (N_{1-2} ds_2) varies between 350-450 m. It is comprised manly of weakly consolidated coarse gravel conglomerates. Sandstone and clay sub-layers are found rarely. The thickness of the top sub-layer (N_{1-2} ds_2) reaches 400-500. This is built of unconsolidated coarse gravel conglomerates. The clay and loam lenses are rare.

Among quaternary sediments (Q_{II-IV}), the most widespread are terraced alluvial-proluvial and proluvial-deluvial rocks. Their total thickness reaches 200-250 m. They are presented in the form of either unconsolidated or weakly consolidated conglomerates built of pebble and gravel of various sizes and alternating sandstone and sand. Clay sub-layers are rarely found in these sediments.

6.1.3 Geomorphology

From the geomorphological point of view this section of the motorway is located on the Tiriponi-Saltvisi section of the Liakhvi river basin and the Shua Kartli plain. It starts from the Kvernaki range in the south-east and ends at the outermost south-western part of the Ruisi (Malkhazi Tsveri) plateau in the north-west.

The four rivers: Tortla, Mejuda, Pshana and Didi Liakhvi, flow from the north to south cross the Tiriponi-Saltvisi plain which is slightly inclined to the south. The Gori depositional plain is developed within the Tortla-Liakhvi section. Its relief characterized

by the abundance of terraces inclined to the south, built mainly of prolluvial-alluvial sediments.

The northern slope of the Kvernaki range is presented in the form of low mountainous, slightly dissected denudational-erosive relief. South of the motorway the prolluvial-deluvial trains are developed. Westward, on the right slope of the Didi Liakhvi River 5 sculptural treads characterized by different thickness and widespread are observed. The lowest terrace is 1.5-3 m thick and starts from the riverbed; while the upper one is 50-60 m thick and located at 100-130 m above the river water level. On the western side the sub-lateral Malkazi range is stretched. The highest mark is located at 875 m. Southward a strip of hills of almost similar height is located (see points 855.6 m, 840.3 m, 844.0 m).

Generally, the relief in the study area is mild and slightly gullied. The altitudes vary between 620-875 m. The highest mark corresponds to the Malkhazistsveri, while the lowest point indicates the height of the Liakhvi riverbed.

6.1.4 Geophysical Survey of Tunnel Area

Geo Ltd. carried out a geophysical survey of the areas adjacent to the proposed tunnel of the Gori pass. On the basis of geological-geophysical interpretation of obtained data the following has been concluded:

- the road up to north-eastern portal of the proposed tunnel of the Gori pass will be laid in geophysical layer, presented by clays and loam with shingle and gypsum inclusions. A 6-8 m interval of the layer is watered. According to the geophysical information the level of watering is decreased in 10-20 m intervals and the occurrence of pebble inclusions in clays is increased.
- The area adjacent to the north-eastern portal of the proposed tunnel is characterized by complex geological structure. In the upper part of its geological-geophysical profile there is a layer comprised of loose cobble of various sizes with clay aggregates. This layer covers the humid layer comprised of clays and loams with shingle-pebble and gypsum inclusions. According to geophysical data a tectonic fault may exist at this section.
- According to geophysical study the proposed tunnel will pass through conglomerates. Conglomerates at this section are not even; clays, lenses, sub-layers and humid zones of various level of humidity may exist there. Stronger conglomerates may exist at certain locations, while the presence of less strong conglomerates within KP400-KO720 section is expected. A thick (2-4 m) sub-layer of clay may exist in the conglomerates at a depth of 57-65 m within KP420-KP700.

- 5-14 m thick exhausted conglomerates with clay lenses and sub-layers overlay conglomerates within the KP180-KP680. II geophysical layer is covered by the 5-18 m thick I geophysical layer comprised of clay with pebble inclusions.
- The area adjacent to the north-eastern portal of the projected tunnel is built of clays and loams with shingle-pebble and gypsum inclusions. Within this section the existence of a partially watered zone at a certain depth is expected. According to geophysical data a tectonic fault may exist within the KP760-KP800 section.

Detailed information relevant to the above conclusions is given in "The report on Geophysical Survey of the Site of the Projected Tunnel of the Gori Pass within 80-95 km Section of the Tbilisi-Senaki-Leselidze Motorway" prepared by Geo Ltd.

6.1.5 Hydrogeology

According to the hydrogeologic zoning of Georgia the study area belongs to the Kartli artesian water basin, which in turn is a central part of the artesian basins of the Georgian intermountain plain. The hyrdogeologic conditions of the above artesian basin are determined by geological-structural, geomorphological and other characteristics.

Within the Kartli artesian water basin, including the study area, shallow and deep circulation underground waters are found. Shallow circulation waters are linked with the areas of modern tertiary sediments and the upper part of the miopliocene sediments profile, while the deep circulation waters are connected with main rocks of the tertiary era.

Underground waters are fed mainly by precipitation and infiltration of irrigation waters at certain locations. Water-bearing horizons within the study area can be distinguished by geological formations, in particular:

- water-bearing horizon of modern alluvial sediments;
- water-bearing horizon of modern and upper quaternary deluvial-proluvial sediments; and,
- mio-pliocene water-bearing horizon.

The characteristics of each water-bearing horizon are as follows:

1. Water-bearing horizon of modern alluvial sediments (aG 1v) is widespread throughout the study area and is connected with the areas of distribution of the flood-plain and above flood-plain sediments of the rivers Liakhvi, Tortla and Mejuda. These underground waters are fed mainly by precipitation and irrigation water. Alluvial sediments found in

the gorges of the rivers are saturated with river water. Underground waters found in modern alluvial sediments are characterized by hydrocabon-sulphate-calcium-natrium chemical composition. This is a considerable resource of water that can be used for drinking and other purposes due to its physical and chemical features.

2. The distribution of upper quaternary and modern delluvial-prolluvial sediments (pd G 111-1V) within the study area is not even, They are found both in the form of water permeable detritus and clay formations. Penetrated water discharges in foothills and ravines. The volumes of water in these sediments are not large. The temperature of water of water-bearing horizons varies between 9-13^{0}C. It depends on the depth of circulation and air temperature. These waters are characterized by hydrocabon-calcium-magnesium-natrium, rarely sulphate chemical composition. They are often used for drinking.

3. The Mio-pliocene continental sediments (N 1+2) and their water-bearing horizon are widespread within the study area. They are comprised of clays, conglomerates and sandstones, rarely gravelites. From the hydrogeological point of view this is a compact formation containing rather strong water-bearing horizons and linked to the sandstone and conglomerate distribution areas. Waters are characterized by hydrocabon-calcium-magnesium-natrium hemical composition.

Laboratory examination of samples of water within the motorway construction corridor showed that waters actually do not express aggression against concrete.

6.1.6 Engineering Geology

According to the geomorphological zoning, tectonically the Sveneti-Ruisi section of the motorway is located within the Tiriponi-Mukhrani sub-region of the Shida Kartli plunging zone of the Georgian fault - on the Tiriponi depositional valley. The Tiriponi and Mukhrani depositional valleys are separated by the Igoeti tectonic block.

The Tiriponi depositional plain is built of quaternary deluvial-alluvial sediments. From the lithological point of view the deluvial sediments are presented by clay-loam-soil ground. The alluvial sediments that fill the Tiriponi valley are comprised of sandy-pebble and shingle-gravel materials. In the geological profile they are gradually substituted by alluvial sediments.

To study the areas located along the Sveneti-Ruisi section of the road reconnaissance surveys have been carried out. The explorations considered the general engineering geological and hazardous geological processes in the areas adjacent to the projected route and identified those unstable sites which require further detailed engineering-

geological (geotechnical) investigations as well as identification and implementation of necessary mitigation measures.

Within the Sveneti-Ruisi section the motorway passes the surface of terraced relief of the depression, in particular, the motorway crosses the surfaces of depositional reliefs of Mukrani-Tiriponi built by low terraces, Gori-Ruisi plateau and the Ruisi-Doghliauri depositional plain. The surface of the relief is dissected by the three left tributaries of the Mtkvari river: Tortla, Mejuda, Liakhvi, and irrigation canals.

Below is a brief assessment of engineering and geological conditions of the construction corridor s:

Section 1 from Sveneti to the easternmost part of Berbuki geomorpologically goes through the I accumulation terrace of the river Tortla. The terrace is well developed on its right side, while its left side joins the foot of the northern slopes of the Kvernaki range. The latter is built of the Dusheti layer conglomerates on the lower layers of which the surfaces of Pleistocene terraces of paleorivers are well observed. Their relative heights vary within 50 m from the motorway level. The terraced surface is dissected with dry ravines, the sediments brought by which, cover the peripheral part of the left terrace of the river Tortla. Since the river banks are built of alluvial sediments characterized by low level of water-resistance, the process of river bank washing is observed. Therefore the river Tortla has almost no terraces. It should be noted that high waters caused deformation and damage of protecting concrete slabs. Other hazardous geological processes are not observed in this section.

Section 2 near Berbuki is about 550-600 m long. Geomorphologically this is a high terrace of a paleoriver. The relative height of the terrace from the Tortla riverbed is 15-20 m, from the motorway level – 8-10 m. The surface of the terrace is plain. It is oriented from south-west to north-east. Its south-western direction joins the bottom of the northern slope of the Kvernaki range, while the north-eastern part stretches in the direction of Rekhi village. Morphology of the terrace and its rocks suggest that this may be a case of an elevation between the two tectonic faults.

Section 3 from the left side of the Mejuda river to the right side of the Liakhvi river (up to the village of Ortasheni) is about 4 km long. From the morphological point of view the section is a flood-plain and depositional plain of the above flood-plain terrace developed by the rivers Mejuda and Liakhvi. Its surface is absolutely flat with certain minor depressions. It is crossed by the riverbed of the same rivers. This relief stretches to the west up to the bottom of the second terrace of the Liakhvi river. Geological structure and engineering-geological conditions of this section are studied due to natural

cuts. The section is built of modern fluvial sediments in the form of loam with pebble intrusions and sandy aggregates. At certain locations, especially in the northern part of the motorway wetland areas are recorded. This may be caused by a mound which creates an artificial barrier for surface run-off into the river. The process of river bank runoff in the case of the Mejuda river is insignificant, while the Liakhvi river intensely washes its banks. Deformation of the protecting walls of the bridge piers on the left side of the river can serve as a proof for this. Other hazardous geological processes are not observed in this section.

Section 4 from the right bank of the Liakhvi river (from Ortasheni) up to the plateau located east to Ruisi is about 3 km long. This section is characterized by elements of hazardous geological processes. Construction of the new road to the Gori pass through sliding relief of the southern slope of the Ruisi plateau caused activation of the existing landslide. Although a number of slope stabilization measures had been undertaken, the process could not be stopped and the slope is still active.

This situation conditioned the necessity for new options and construction of the 800 m long tunnel through the elevated part of the plateau has been considered as the most suitable option. For the purpose of construction of the tunnel field studies have been undertaken to assess engineering-geological conditions. On the basis of this study 5 engineer-geological elements (EGE) have been distinguished: the first, the second, the fourth, the seventh, and the eighth.

- The first EGE are clays with tertiary slope and miopliocene sediments;
- The third EGE are loam of strong and semi strong plastic consistency;
- The fourth EGE are loam of strong plastic consistency;
- The seventh EGE is semi consolidated conglomerates; and,
- The eighth EGE is shale with pebble, sand and clay aggregates.

Pic. 6.1. Landslide at the Gori pass

Section 5 goes along the meridian of the eastern periphery of Ruisi (the Ruisi Plateau). Its length is 5 km. From the morphological point of view it covers the last section of the western slope of the above-mentioned plateau which gradually turns into the slightly inclined Khashuri-Doghliauri depositional-terraced relief. The section is built of middle sarmatian coastal marine sediments, conglomerates of Dusheti layer of miopliocene age and alluvial sub-layers of the Mtkvari river and its left tributaries. The eastern part of the Khashuri-Doghliauri depositional-terraced relief, which is passed by the motorway, is built of upper quaternary and Holocene alluvial rocks in the form of loose and semi consolidated shale covered by delluvial sub-layers. There is not a high risk of development of hazardous geological processes at this section. Only at certain locations, surface washing, gullying and weakly developed process of accumulation is observed.

The conclusions of the engineering-geology study area as follows:

- The study corridor is of category II (medium difficulty) in accordance with the Annex 10 of Construction Norms and Rules 1.02.07.-87.

- From hazardous geological processes the following is observed within the construction corridor: washing of river banks (especially in the case of Liakhvi river), swamping of separate areas, insignificant gullying, surface wash-off and weakly developed accumulating effects.

- Rocks found within the construction corridor have been assigned to a special category in accordance with the table 1 of Construction Norms and Rules IV-5-82
- In accordance with the requirements of the state standard 10178-76, waters found within the study section are not aggressive against any waterproof concrete made from Portland cement and steel armature.

- According to the Corrected Scheme of Seismic Zoning of Georgian Territory of the Ministry of Architecture and Construction of the Georgian Republic, the construction corridor belongs to the 9_2 seismic zone according to the Richter scale (index 2 means 2 times in 1000 years)

6.1.7 Hydrology

Four large rivers, two ravines, two springs and nine irrigation canals cross the Sveneti-Ruisi section of the motorway. A brief hydrological description of rivers and dry ravines is given below. This does not include irrigation canals and springs, as significant increase of water level in canals and springs and consequent damage of the road under rehabilitation is not expected.

The rivers: Western Tortla (Kirbalula), Mejuda, Pshani (Adzula) and Didi Liakvi cross the motorway within the Sveneti-Ruisi section.

The Western Tortla river (Kirbalula) has its source at a height of 1440 m above sea level to the south-west of the Kveda Tsolda village, at a distance of 2.5 km. It flows into the Mejuda river from the left side near Gori. Its length is 31 km, overfall – 813 m, inclination – 26.2, the average height of the watershed is 750 m above sea level and the catchment area is 197 km^2. Some small tributaries flow into the river. The watershed is composed mainly of tertiary sediments covered with clay and loamy soils. At river sources mainly deciduous forests are found. The major part of downstream areas is under crops.

The river gorge is narrow at the sources, but it becomes wider downstream. Within the Shida Kartli Plain the riverbed is meandering and not branched. Within this section the width of the river varies within 2-6 m, depth within 0.1-0.6 m and the speed within 0.4-1.0 m/sec. The Western Tortla river is fed by underground water and seasonal precipitation. High waters are observed in spring, flash floods in fall, and unstable low waters in winter and summer. The river provides water to some local small irrigation canals built by the local population.

The motorway crosses the Western Tortla river via a bridge in the village of Berbuki. The length of the river up to the crossing the motorway is 29 km, total overfall is 782 m, mean inclination is 27.0, catchment area is 191 km^2.

The Mejuda river rises on the southern slope of the mountain Dzirisa (2594,6 m) at a height of 1940 m. The river flows into the Didi Liakhvi river from the left side near Gori. The length of the river is 46 km; total overfall - 1356 m; mean inclination – 29.5; catchment area 651 km^2; mean altitude of the catchment area 1040 m. 79 tributaries of various sizes with total length of 278 km enter the river. The most important among them are Adzula (26 km long) and Western Tortla (31 km long).

The relief of the river basin from sources to the village of Mejvriskhevi is of a hilly nature; while downstream it becomes completely plain. The hilly part of the relief is built of limestone, shale, marl and conglomerates. The Shida Kartli Plain is built of delluvial and alluvial sediments. Mainly clay and loamy soils are found within the river basin. Deciduous forests are growing in the areas located from sources to the village Andoreti; downstream areas are occupied by crops.

The river gorge from sources to the village Andoreti is V-shaped, between the villages Gromi and Mejvriskhevi it takes the form of a trapezium, while in downstream areas up to flowing into Didi Liakhvi the gorge has no specific shape. The riverbed is moderately meandering and branched only downstream. The width of the river at sources is 2-5 m; downstream Mejvriskhevi reaches 8-11 m. The depth varies between 0.2-0.7 m, the speed of the flow from 1.8-1.0 m/sec (at the sources) to 0.8-0.5 m/sec (on the plain). At the sources the riverbed is blocked with lumps and therefore is not even, downstream the bottom is flat covered with pebble.

The river is fed by snow, rain and underground water. The water regime of the river is characterized by spring high waters and unstable low waters during other seasons. 53.7% of annual discharge falls in spring, 20.7% in summer, 11.6% in fall and 14.0% in winter. Observations have been carried out at the hydrological station located near the village Gromi. The river provides water to some local small irrigation canals built by the local population.

The length of the Mejuda river up to crossing the motorway is 42.4 km, total overfall is 1322 m, mean inclination is 31.0, catchment area is 255 km^2.

The Pshani (Adzula) river rises on the south-western slope of the western branch of the Kharula range at a height of 1090 m. The Pshani river flows into the Mejuda river from the right side near Gori. The length of the river is 26 km; total overfall - 495 m; mean inclination – 19.0; catchment area 197 km^2. The main tributary is the 33 km long

Charebula river. It should be noted that at present the Charebula river is being discharged into the Didi Liakhvi river through special channel, therefore the catchment area of the Adzula river is decreasing. The river basin relief is divided into mountain and plain parts. The mountain part covers 50% of the basin. It is heavily dissected with ravines and the gorges of small tributaries. The plain part is located on the Shida Kartli Plain, where the relief is heavily dissected with the distribution canals of the Tiriponi irrigation system. The mountain part is built of sandstones and conglomerates covered with clay and loamy soils. The plain part of the basin is built of shale and conglomerates covered with loamy soils. Deciduous forests are found on mountain relief, while the plain areas are almost under the crops.

The river gorge is narrow within the mountainous zone, but it becomes wider downstream. The riverbed is moderately meandering and not branched. Within this section the width of the river varies between 1-2.5 m, depth between 0.1-1.0 m and the speed between 0.1-0.2 m/sec.

The water regime was not studied. According to the local population the river is characterized by spring high waters and unstable low waters during other seasons. The river provides water to some local small irrigation canals built by the local population.

The length of the Pshana (Adzula) river up to the motorway crossing is 23.2 km, total overfall is 472 m, mean inclination is 20.0, catchment area after discharging the Charebula river into Didi Liakhvi is 68.0 km^2.

Pic. 6.2 The Mejuda river

Pic. 6.3. The Pshana river

The Didi Liakvi river rises at the village of Goluata at a height of 2337 m. The river flows into the Mtkvari river from the left side at a height of 972 m above sea level near Gori. The length of the river is 98 km; total overfall - 1755 m; mean inclination – 17.9; catchment area 2440 km^2; mean altitude – 1590 m. 591 tributaries of various sizes with total length of 1800 km enter the river. The most important among them are Patara Liakhvi (63 km long) and Mejuda (46 km long).

The river basin is located on the southern slope of the Greater Caucasus range. The Racha and Surami ranges border the river basin in the west, Kharula range in the east, and the Mtkvari river plain – in the west. From the geomorphological point of view the whole basin, which occupies areas from 380 m up to 580 m, is divided into high mountain, foothill and plain.

The high mountain area was subject to glaciations in the past, evidenced by the abundance of kars, trogs and moraines. Within the Great Caucasus range there were 12 glaciers with total area of 5.5 km^2. The high mountain region of the basin is built of sandstone and shale, white the plain is built of old and new alluvial sediments.

The following soils are found within the basin: brown, dark grey, forest grey, mountain-meadow and alluvial soils.

The vegetation of the basin is characterized by vertical zoning. Within the plain mainly shrubbery is widespread, while mixed forests dominate in foothill zone at a height of

1000-1100 m. The high mountain zone is characterized by sub-alpine and alpine meadows. 32% of the area is covered by forests. The length of the river from its source to the village Kekhvi is 56 km. The river gorge is terraced. The surface of terraces is even, slightly dissected. They are built of shale and sandy soils and covered mainly by grasses and shrubs.

Flood-plains are found along this section of the river. Generally they are dry and covered with shrubbery at certain locations. They are only covered with water for 2-3 days during spring floods. The riverbed is moderately meandering and not branched. The width of the river varies between 4-32 m, the depth between 0.3-2.4 m, and the speed of the flow between 1.4-3 m/sec.

The length of the second part of the river from the village of Kekhvi to its entrance into the Mtkvari river is 42 km. The river gorge is trapezium shaped there. The slopes of the gorge are terraced. Vegetation is comprised of deciduous trees. Terraces are under vegetable and fruit gardens and arable lands.

The flood-plain is two-sided. Its major part has no vegetation cover. Water covers the flood-plain for 1-5 days during spring floods. The riverbed is moderately meandering and branched. The width of the river varies from 4 m (village Shindisi) to 40 m (Gori), the depth varies between 0.1-0.7 m to 1.1-2.6 m, the speed of the flow between 0.2-2.5 m/sec.

The river regime is characterized by spring high waters and winter low waters. To prevent flooding, stone dams are being constructed. The river is fed by rain, snow, glacier and underground waters. Annual discharge of the river by seasons is as follows: 30-39% of annual discharge falls in spring, 37-42% in summer, 14-16% in fall and 8-9% in winter.

The Didi Liakhvi river is used for irrigation. On its left tributary, Patara Liakhvi the Zonkari reservoir has been built for irrigation purposes. It total capacity is 40.3 million m^3. The river provides water to Kekhvi, Tiriponi, Saltvisi, Zeda Ru irrigation systems and many small local irrigation canals.

The length of the Didi Liakhvi River up to the motorway crossing is 93.5 km, mean inclination 18.8, catchment area after discharging the Charebula river into Didi Liakhvi is 1777 km^2.

The dry ravine # 1 rises 2 km south-west of the village of Tedotsminda at a height of 820 m. The ravine crosses the motorway north-west of Urbnisi. The length of the ravine up

to the motorway crossing is 2.25 km; total overfall - 110 m; mean inclination – 49.0; catchment area 4.28km^2. Clay soils are found within the basin of the ravine. Vegetation is composed of grasses and separate deciduous trees. A small part of the basin is under grain-crops. Water in the ravine appears only during snow-melt or heavy rains.

The basin of the dry ravine #2 is located north of ravine #1. Their watershed is a flat low hill. Ravine #2 rises 3 km north-west of the village of Tedotsminda at a height of 840 m. The ravine crosses the motorway north-east of Urbnisi near the crossing of the motorway with ravine #1. The length of the ravine is 2.38 km; total overfall - 191 m; mean inclination – 55.0; catchment area 11.6 km^2. Clay soils are found within the basin of the ravine. Vegetation is composed of grasses and separate deciduous trees. A part of the basin is under arable lands and grain-crops. Water in the ravine appears only during snow-melt or heavy rains.

6.1.8 Landscape and Land Use

As stated above the project site is located on the Kartli plain. Several vegetation zones are present in this area. Brown, meadow brown and alluvial-carbonate soils are found in the basins of the Liakhvi river and its tributaries. The area is occupied mainly by xerophilous plants. The scrub and steppe vegetation is well developed.

There are perennial fruit gardens in the eastern (Sveneti-Berbuki) and western (outskirts of Ortasheni-Tedotsminda and Ruisi-Urbnisi) regions of the study area. Perennial gardens are composed of apple, pear, peach, mulberry, plum and other drupaceous tree species. The rest of the area, in particular both sides of the river Liakhvi gorge, mount Malkhaziskedi and its western slope, as well as areas located on the both sides of the gorges of the rivers Pshana, Mejuda and Tortla are used mainly for annual plants (wheat, corn, cabbage, potato, tomato, etc.) or pasture.

6.1.9 Soils

6.1.9.1 Soil Types

Field studies have shown that various types of soils are widespread mainly within the 400 m wide (200+200) corridor. The description of soil types has a general character and is based mainly on recent scientific data (Sh. Sabashvili 1965; T. Urushadze 1977, 1977). Materials obtained through the field surveys and the results of chemical analysis of soils were also used. In addition to the visual examination and description of soils during field surveys, the erosion level and rate have been studied and evaluated. For this purpose the Morgan rating (2000) method applicable for the soils of Georgia was used.

According to the existing classification of Georgian soils mainly three types of soils: brown, brown-carbonate and alluvial-carbonate are widespread within the study area. The most widespread are brown soils. They cover about 50-55% of the area. Brown-carbonate soils (35-40%) are less widespread. Alluvial-proluvial soils occupy minor areas, especially along the gorges of the rivers Mejuda and Pshana in the form of a narrow strip.

a) Brown soils

This type of soil is the most widespread in the study area. It is formed in conditions of relatively mild and humid climate with little influence of underground waters.
In general the brown soils are characterized by a rather high level of differentiation. The concentration of humus varies between 3-10%. Their geochemical potential is characterized by acid reaction which decreases with depth and ultimately becomes neutral. Therefore these soils are characterized by a rather high coefficient of washing.

Brown soils are developed mainly on the hilly relief, which is characterized by an abundance of gullies and rills. These soils are formed by deluvial-proluvial materials which reflect the geological materials and remnants of the plants widespread in conditions of such relief. Areas of brown soils are covered with tree species characteristic for mixed forests (hornbeam, beech, rarely oak and conifers). For this segment the mixed deciduous forests, artificial fir stands and wind belts growing along the roads are characteristic. Generally these soils are characterized by intense process of exhaustion which is accelerated by anthropogenic impact – intensive use of soils for agricultural purposes.

b) Brown-carbonate soils

Like brown soils, brown-carbonate soils occupy rather large areas within the corridor. In certain areas they cover larger territories than brown soils (especially along the alternative options). The lithological composition of these soils is similar to those of brown soils, but in this case carbonate materials dominate, which is reflected in the name of these soils.

These soils are formed mainly by deluvial sediments. They are widespread mainly in foothill areas. The vegetation cover is formed by beech-hornbeam-oak forests, which is characteristic for these soils.

c) Alluvial-carbonate soils

The alluvial-carbonate soils are widespread on the both banks of the Liakhvi river and in the gorges of the Tortla river. This type of soil is rather diverse. Their basic mass, thickness of the profile, mechanical composition and concentration of carbonates, nitrogen and carbon as well as other characteristics often vary within a wide range. This is natural, since those parameters which determine the type of soil depend on river dynamics, the type of materials brought by rivers, lithilogical and mechanical (size, weight) composition of these materials and many other processes. These soils are characterized by the diversity of alluvial materials and high concentration of carbonates.

Alluvial-carbonate soils are divided into two sub-groups:

- soils developed on young terraces; and,
- soils developed on old terraces.

Soils developed in a short period of time are under the first group. Their profile is weak and less stable. The soils of the second group are characterized by a long time period needed for their development and profile stability, which is determined by the alternation of fine and coarse fractions.

6.1.9.2 Pollution Levels

To determine the level of pollution of soils within the corridor and the level of pollution of waters in the rivers crossing the motorway, the samples of soil and water have been taken from roadside areas. The assessment of the pollution has been made for determination of the background concentration of heavy metals and toxic elements in soils and waters. It should be noted:

- During the Soviet times almost no attention was paid to the possibility of soil and water pollution as a result of construction and operation of motorways. Despite the fact that during this period mainly ethylized fuel was used there are no background data on environmental (topsoil, subsoil) pollution of the RoW of the existing motorway with heavy metals; and,
- After putting the new motorway into operation, considerable growth of traffic volumes is expected. This will contribute to pollution of the ambient air with exhaust gases.

Samples of soil and water were taken from both sides of the RoW. Soil sampling was implemented at 1 m to 150 m from the road pavement. In total, nine samples of soil were

collected. Soil and water sampling is based on present international standards specified in SOIL - Inspection of Quality and Geological Safety According to International Standards (1997). Soil samples were processed and studied at the certified laboratory "Geoexpert" of the Caucasus Institute of Mineral Resources in Tbilisi. The main goal of the analytical study was to determine the presence of heavy metals in soil samples. The results of the analytical study were summarized and compared with European and other international standards.

The results show that high concentration of lead along motorways is directly connected with vehicle emissions. As for increased concentration of copper, this may be connected with agricultural activities undertaken in surrounding areas. Maximum allowable concentrations of heavy metals in soils are determined in accordance with Dutch and international standards. These indices are given in the Table 6.1.

Table 6.1: Standards of concentration of heavy metals in soils (mg/kg)

Symbol of chemical element	Metal	Background concentration of heavy metals in soils (Dutch standards 1985)	Background concentration of heavy metals in soils (international standards 2000)
Cu	Copper	36	2_50
Zn	Tin	140	10_300
Pb	Lead	85	0.1_20
Ni	Nickel	35	1_100
Co	Cobalt	20	1_50
Cd	Cadmium	0.8	0.01_1.0
As	Arsenic	29	1_50

Table 6.2. Background concentration of heavy metals in samples

# and road km/point	Heavy Metals (mg/kg)						Location
	Cu	Zn	Pb	Ni	Co	As	
1 (kp81+800)	36.2	127.8	41.7	56.0	23.0	0.17	10 m on the left of the road
2 (kp83+900)	41.7	121.7	29.1	51.8	25.3	0.28	1 m on the right of the road
3 (kp83+900)	32.5	196.8	27.1	48.7	24.1	0.33	200 m on the right of the road
4 (kp85+800)	43.6	151.3	32.4	47.4	21.5	0.41	1.5 m on the right of the road
5 (kp85+800)	52.2	97.7	34.1	53.8	33.1	0.23	150 m on the right of the road
6 (kp93+200)	22.5	111.7	27.3	27.1	19.1	0.36	1.5 m on the left of the road
7 (kp93+200)	33.1	72.3	97.1	43.5	24.3	0.81	250 m on the left of the road
8 (kp94+000)	31.3	99.1	40.7	51.6	21.9	0.31	1.5 m on the right of the road
9 (kp94+000)	26.1	61.9	21.5	49.4	23.1	0.25	200 m on the right of the road

Concentration of copper (Cu) is slightly high (2.2 mg/kg) in the sample #5. As compared with the international norms (0.1-20 mg/kg) concentration of tin (Pb) is relatively high in all 9 samples. It can be assumed that increased concentration of tin may be caused by use of ethylized fuel for a long period of time.

Thus, the field and laboratory studies of soils found three types of soils in this area: brown, brown-carbonate and alluvial-carbonate soils. Their chemical examination showed that concentration of heavy metals, except lead meets the requirements of the international soil standards.

6.1.9.3 Impact on Soils

The main impact on soils that may be expected during the Sveneti-Ruisi road construction is loss of topsoil, and compaction, erosion and contamination of soil.

Loss of topsoil can be minimised because all topsoil within the construction area will be removed, stored and reused as described in Chapter 7. Erosion may take place at the bottom of narrow gullies and along ravines, where deposits are washed off by temporary streams and taken down to the lower parts of the relief. At the rest of the area the surface is washed by run-off waters. Slope stability can be upset by creation of road cuttings. Spoil material from road cuttings can disturb vegetation and add to erosion and slope

stability problems. Diversion of natural surface water flows due to blocked ditches and damaged water control structures also increases the potential of erosion. Erosion of land may take place below the road bed receiving concentrated outflow from covered or open drains. Long-term degradation of soils is expected on the access roads, in the borrow pit sites, waste dumps, construction camps etc.

Pollution may take place due to spills resulting from accidents during transport, loading/unloading of goods, or at the workshops, etc., where hydrocarbons, toxic and corrosive matters are involved. These cases represent accidental pollution. Chronic Pollution covers all pollution resulting from traffic, maintenance and other activities, including:

- Waste resulting from the combustion of fuels: hydrocarbons, lead, etc.;
- Oil and coolant, leaking from trucks;
- Metal waste resulting from the corrosion of vehicles;
- Mineral oils and greases used for lubrication; and,
- Discharge of effluents to watercourses.

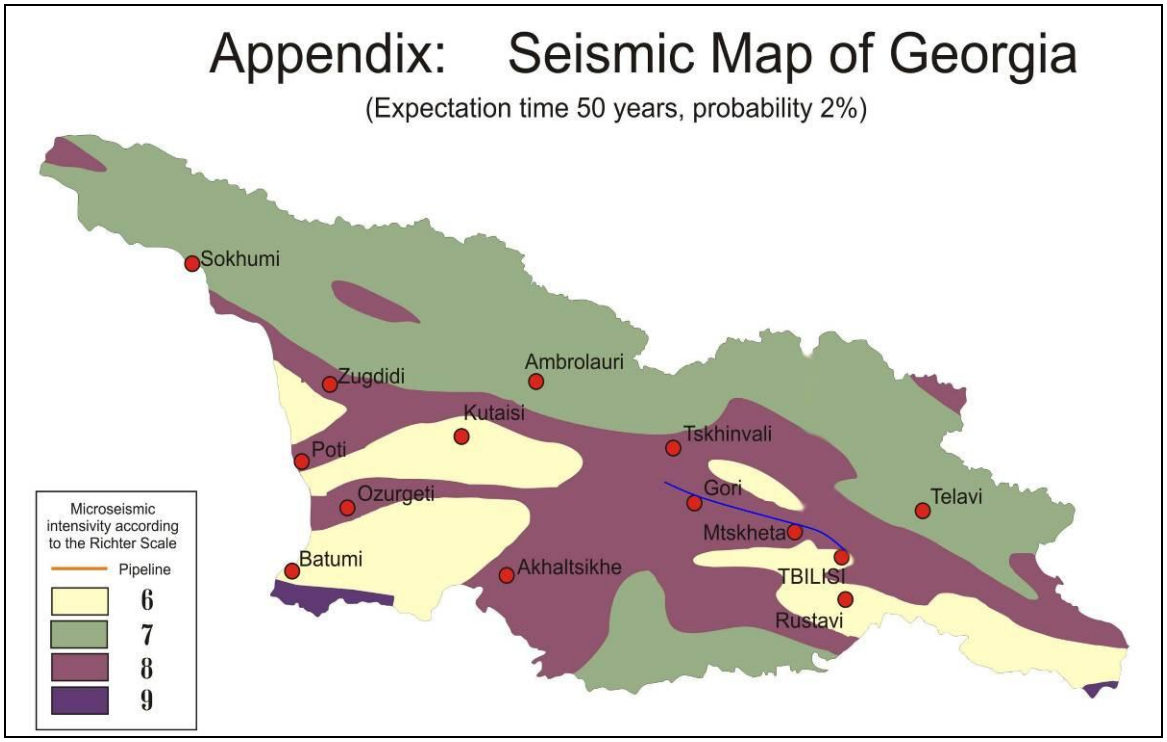
Soil pollution is linked with atmospheric and water pollution. Road transport is the main source which generates this kind of pollution. Heavy metals, PCBs, non-burnt hydrocarbons and dusts mainly cause this form of pollution. Pollutants settle on the leaves of plants or are absorbed by roots. Potential contamination of soils and watercourses as a result of improper disposal of liquid and solid wastes from construction activities will be a consequence of the road works.

6.1.10 Seismic conditions

Georgia is a part of the active seismic region of Caucasus and belongs in the seismic area of the Mediterranean Sea. Its seismic-technical movement and activity is connected with the African-Arabian seismic movement.

From the geo-structural point of view, the territory has a varied structure, so seismic activity has mosaic characteristic. This explains different levels of seismic risk in the territory of Georgia (see Fig. 6.2).

Fig. 6.2: Seismic Map of Georgia



Seismic regions are based on characteristics of geological structure, on determining seismic parameters and calculating effect of earthquake on earth surface. The blue color in Fig. 6.2 indicates the proposed highway. Maximal magnitude of tectonic zones shown in the map is calculated with 2% probability (for 50 years of expectancy) according to Richter scale.

As shown in this map Sveneti-Ruisi part of E-60 highway is situated in Richter magnitude 9 earthquake zone. Earthquake effect can be evaluated from two points of view:

- Earthquakes can damage completely the integrity of a highway (bridges, piers, tunnels), which will create obstacles and stop movement on the highway. It will have negative impacts on both natural and social environment; and,
- The integrity of ground layer can be destroyed due to earthquake, which can be followed by landslides in a short time, or other dangerous geological processes.

It is very difficult to determine the amount of loss caused by such events. Besides it will be very difficult to determine its possible negative impact on the social environment. In both cases damage of a road will depend on its quality. Thus constructing activities must be carried out according to construction norms by taking seismic risks into account.

6.2 Biological Conditions

6.2.1 Flora and Vegetation

A desk top review of literature sources (in particular, R. Kvachakidze, "Geological-botanical regions of Georgia, Tbilisi, 1996) was carried out to collect information on the main plant species in the Project area. Due to anthropogenic pressure Georgia is one of those countries in which habitats are damaged severely. The area to be evaluated is situated between Caucasus and Trialeti ranges. There are four rivers (Tortla, Mudjuda, Fshani, Liakhvi), two dry gorges and nine irrigation channels.

Flora of the region is complicated from the point of genetic and structural organization. Areas that were covered by woods in the distant past today are covered with secondary vegetation – hemi-xerophilous and xerophilous shrubbery and grass cenosis. Though on the right bank of the river Liakhvi at 200-250 meter and in the north of the highway near Tedotsminda there is forest zone of 80-100 meter width, where the following species occur: Georgian oak (*Quercus iberica*), European ash (*Fraxinus excelsior*), field maple (*Acer campestre*), Caucasian hornbeam (*Carpinus caucasica*), Caucasian lime (*Tilia caucasica*), Cornelian cherry (*Cornus mas*), hazel (*Corylus avellana*), red juniper (*Juniperus rufescens*), and dog-rose (*Rosa canina*). A large area is covered by agricultural fields. The following shrubs occur here: Christ's thorn (*Paliurus spina-christi*), spiraea (*Spiraea hypericifolia*), hawthorn (*Crataegus kyrtostyla*), etc. There is no long and permanent forest line across the river, but some small groups of trees grow across the river, such as: gray poplar (*Populus canescens*), black poplar (*Populus nigra*), willow (*Salix excelsa*), elm (*Ulmus foliacea*). There are following kinds of bushes: saltcedar (*Tamarix ramosissima*), raspberry (*Rubus sanguineus*) etc.

In the area that was evaluated there are no plants that are included in red list according to decree of president of Georgia, dated May 2, 2008.

Based on the design of works proposed under the Project, particular attention was given to a forested hill, through which an 800m long tunnel will be constructed. Impact of the construction works will be limited to the portal areas of the tunnel, clearing of which would imply cutting of trees. A field survey was carried out in that area to confirm literature data on the composition of tree species. No discrepancy with the above provided information was found in result of the field work.

Picture 6.6 Part of woods near the highway tunnel portal

6.2.2 Fauna

Georgia belongs to palaearctic region and is characterized by rich biodiversity and high level of endemism. Anthropological pressure is very high in this region. For this reason it is one from twenty-five so called "hotspots" that are under attention of the major environmental protection organizations of the world. Due to its geographical characteristics there are a variety of climates in Georgia and this causes diversity of flora and fauna. Several species of fauna are at the edge of extinction, which means that relevant measures must be taken to preserve the existing environment.

The Project area starts in Sveneti, Gori region, and goes across Tbilisi-Leselidze motorway; it passes the village Berbruki and the north part of Ortasheni. From Ortasheni the route goes through uninhabited areas and then on to Urbnisi. Most part of this area comprises agricultural lands. Only a small part of valleys is a steppe. As for the forested hill, through which a 800 meter tunnel will cut through, a limited and short term noise disturbance for fauna may occur during works, though operation of the tunnel is not expected to influence various species of fauna in a long term. Overall, according to literature sources, fauna is rather poor in this area. An expedition was organized to the highway corridor with the purpose of verifying literature data on the animal species composition and areals of their occurrence. A simple methodology of surveying animal footprints, droppings, and dwellings was applied to collect information on key species of

mammals and birds. Results of the field work confirmed species composition reported in literature and showed extremely little occurrence of animals along the selected route. More evidence of their presence was found in more remote locations.

The highway crosses four major rivers within the above mentioned corridor. These rivers are: Totla near Berbuki, Medjuda and Pshana westward from Berbuki and river Liakhvi in the north.

Below are tables with species of those animals that live along above mentioned corridor.

Table 6.3: Mammals Present in the Study Area

English Name	Latin Name	Biota
Gray Dwarf Hamster	*Cricetulus migratorius*	Fields
Meriones	*Meriones tristrami*	Open areas
Ground vole	*Terricola majori*	Open areas
Whiskered Bat	*Myotis mystacinus*	Open areas
Bat	*Vespertilio pipistrellus*	Open areas

Table 6.4: Birds Found in the Study Area

English Name	Latin Name	Biota
Pallid Harrier	*Circus macrourus*	Fields, Open areas
Common kestrel	*Falco tinnunculus*	Open areas
Quail	*Coturnix coturnix*	Open areas
Skylark	*Alauda arvensis*	Fields, Open areas
Yellow wagtail	*Motacilla flava*	Open areas
Barn swallow	*Hirundo rustica*	Open areas, settlements
Blackbird	*Turdus merula*	Fields, Open areas
Common Starling	*Sturnus vulgaris*	Open areas
Golden Oriole	*Oriolus oriolus*	River banks
Carrion crow	*Corvus corone*	Open areas
Rook	*Corvus frugilegus*	Open areas
Eurasian tree sparrow	*Passer montanus*	Anthropogenic landscape
House sparrow	*Passer domesticus*	Anthropogenic landscape

Table 6.5: Amphibians and Reptiles Found in the Study Area

English Name	Latin Name
European tree frog	*Hyla arborea*
European Green toad	*Bufo viridis*
Eurasian marsh frog	*Rana ridibunda*
European legless lizard	*Ophisaurus apodus*
Caspian green lizard	*Lacerta strigata*
Meadow lizard	*Lacetra praticola praticola*
Grass snake	*Natrix natrix*
Smooth snake	*Coronella austriaca austriaca*
Caspian whipsnake	*Coluber jugularis*
Blind snake	*Typhlops vermicularis*
European Cat Snake	*Telescopus fallax iberus*

Table 6.6: Fish Found in the Study Area

English Name	Latin Name
Roach	*Rutilus rutilus caspius*
Chub	*Leuciscus cephalus orientalis*
Kura nase	*Chondrostoma cyri*
Mtkvari gudgeon	*Gobio persus*
Bulatmai barbel	*Barbus capito*
Mtkvari Bleak	*Alburnus filippi*
Mtkvari stone loach	*Nemacheilus brandti*
Ginger Gobi	*Neogobius cephalarges*

6.3 Human Environment

6.3.1 Population and Communities

On the basis of field investigations and aerial photos, we have recorded the number and location of owner-occupied dwellings, land plots, enterprises and erections having different functions. For this purpose a 200-m wide corridor was examined on both sides of the highway (northwards and southwards).

During the field investigations the experts also recorded all the service and shopping centers built within the 200-m long right-of-way corridor on both sides of the road. Data collected are shown in Table 6.7 below.

Table 6.7: Land Use and Assets within the Existing Right of Way

			Gori Rayon	Kareli Rayon	Total
Private	Loss of Land	Affected Plots	52	28	80
		Affected Households	52	27	79
		Severely Impacted Households	28	16	44
		Affected Businesses	5	1	6
		Affected Area (m^2)	33,584	25,471	59,055
	Loss of Assets	Affected Buildings	2	1	3
		Affected Perennials	318	142	460
	Loss of Income	Affected Businesses	1	2	3
		Affected Employees	9	0	9
Public/State	Loss of Land	Affected Plots	7	1	8
		Affected Area (m^2)	130,939	7,572	138,511

6.3.2 Historical and archeological sites

According to visual evaluation carried out during field surveys, and from literature sources, information was gathered on those historical and archeological sites located on both sides of the existing highway. Full information about them is given in Table 6.8 below.

Table 6.8: List of Historical and archaeological Monuments in the ROW Corridor

Km	Name	Geographical area and its location with regard to the highway	Monument Period	Brief description of the monument and its state
79+750	Mother of God Church in Sveneti (monument of architecture)	The east of the village North from the highway	late feudal epoch	Hall-type building (7.5x5m), cobble-stone construction. heavily damaged
79+700	Mother of God Church in Sveneti (monument of architecture)	The east of the village North from the highway	late feudal epoch	Hall-type building (9.6x5.8m), built of cobble-stone, crushed stone and rarely used quarrels. damaged
80+200	Mother of God Church in Sveneti (monument of architecture)	The south of the village South from the highway	late feudal epoch	hall-type building (5.4X3m), built of cobble-stone and crushed stone
81+00	Sveneti-Tskhiagora settlement remnants (Archeological monument)	At the village outskirts-South-west from the highway North	Stone cultural layers dated to the third millennium., Upper layer-latter Bronze age and Early Iron age	Settlement remnants. Building remainder of ancient village. Fragments of clay floor. Remainder of a backed brick barrier.
81+00	Grave and barrow situated south from Sveneti-Tskhiagora settlement remnants (Archeological monument)	At the village outskirts- 200 south of Tskhiagora monument North from the highway	Unstudied	Unstudied
82+100	Berbuki fortress Architectural monument)	In the south of the village In the south of the highway	Late Feudal epoch	Cylindrical (diameter 7.7 m), Built of cobble-stone and quadrels. Three-storied. Partially damaged.
82+200	Berbuki Archangel Church (Architectural monument)	In the south of the village, to the South from the highway	yr. 1830	Hall-type (11.7x7.5m),built of cobble-stone and quadrels
85+400	St. George's Niche in the village of Otarasheni (Architectural monument)	North-eastern part of the village, south of the highway	Undated	Hall-type (3.8x3.2m),built of cobble-stone, 0.7 m-walls still remaining
85+500	Fortress of the Amilkhvari in the village of Otarasheni (Architectural monument)	North-eastern part of the village, south of the highway	18th century	Cylindrical (diameter 10.5 m), built of cobble-stone with rarely used quadrels. Three-storied. Partially damaged.
85+700	settlement remnants in Otarasheni (Archaeological monument)	Village centre south of the highway	Late feudal epoch	remainder of foundations built of cobble-stone
85+700	Otarasheni fortress(Architectural monument)	Village centre south of the highway	Late feudal epoch	Cylindrical, tumbledown

Km	Name	Geographical area and its location with regard to the highway	Monument Period	Brief description of the monument and its state
94+800	Settlement remnants in Urbnisi Kvatskhelebi, Telepia Hut (Architectural monument)	3 kilometers west of the village south of the highway	3rd millennium BC, Ancient Epoch and early feudal epoch	3 cultural layers are visible (7 building levels)
94+600	Settlement remnants in Urbnisi Khizanaantgora. (Archaeological monument)	Southern part of the village, south of the highway	4th millennium BC	consists of 4 cultural layers (13 building levels can be singled out)
94+500	Remnants of an ancient town in Urbnisi (Archaeological monumnet)	Central part of the village south of the highway	Late Bronze era, BC	Cultural layers and remains of monuments (sepulchers, wine-cellar, bath-house, fragments of a fortress walls, supply and irrigation canal
94+500	Sioni Church of Ubnisi (Architectural monument)	Central part of the village south of the highway	5th -6th centuries	Three-nave basilica (32.1 X22.4m), built of well cut and fitted sandstone broad stones
95+300	Mother of God Church in Ruisi (Architectural monument)	Central part of the village north of the highway	19th century	With a cross-type dome (14.15X9.2m), built of alternating brick and coble-stone
95+500	Mother of God Temple complex (Architectural monument)	Central part of the village north of the highway	6th, 7th-9th centuries	With a cross-type dome (27.3X19.6 m) built of well-cut invisible green and lilac sandstones of equal size
95+500	St. Marine Church of Ruisi (Architectural monument)	Central part of the village north of the highway	early feudal epoch	Hall type (5.6X4.15m), heavily damaged

Pic. 6.5: Sioni Church of Urbnisi

6.3.3 Noise

The project will build a Class I motorway with two lanes in both directions. Speed limit is 120 km/per hour for cars and 90km/per hour for trucks. According to construction norms and rules (2.05.02-85 "motor ways") such a highway must be built far from inhabited areas.

Noise characteristics of Sveneti-Ruisi part of Tbilisi-Leselidze highway was studied in October 2006 (from 11 a.m. to 17 p.m.). Measuring activities were carried out by means of equipment of 00026 type according to state standard (ГОСТ 20 444-85) methods. Results are given in the following table:

Table 6.9: Noise characteristics of the Existing Highway

Settlement	Sound equivalent level (dB)	Transport flow intensity (car/per hour)	
		Cars, mini buses	Trucks, buses
Sveneti	76.1	624	54
Sveneti (at Gori turn)	75.5	612	54
Berbuki (at Mejvriskhevi turn)	75.6	591	62
Berbuki - Ortasheni (at Tskhinvali turn)	77.5	632	58
Ortasheni	77.1	606	52
Urbnisi	76.5	653	61
Ruisi	77.6	732	70

The results show that during daytime with existing transport flow conditions, noise level is 75.5 to 77.5 dB on the existing motorway. Noise level equals to 60 to 69 dB in the houses that are located in 50 -100 meter distance from the highway, which exceeds the limit by 5 dB.

According to evaluation of preliminary data, it is expected that noise characteristics of the highway will increase together with increasing of transport flow intensity and speed limit and it will reach 85dB. There will not be any significant increase in transport flow at the beginning, but speed limit will go up. We expect increase of cargo transportation, especially during night hours. These changes are connected with rising of noise characteristics in nearest future by about 2-3 dB.

Picture 6.6 Houses in village Berbuki, which are within the RoW

Picture 6.7 Multifamily houses in village Berbuki, which are within the RoW

6.3.4 Air Quality

6.3.4.1 Background

This section gives a brief description of atmosphere protection issues during construction works of Sveneti-Ruisi part of Tbilisi-Senaki-Leselidze highway according to Air quality guidelines for Europe, 2nd ed. Copenhagen, World Health Organization Regional Office for Europe, 2000 (WHO Regional Publications, European Series No. 91).

According to WHO, road facilities are divided into three ecological classes according to international requirements:

- I class – Huge facilities, which have important impact on environment – motor highways of I and II categories, with four transport flow lanes and separate bridges;

- II class – Facilities that have significant impact on environment - highways of I and II category with flow of 2000 cars per day and with different artificial constructions located on them; and,

- III class - Facilities that have local impact on environment - highways of I and II category with flow of 2000 cars per day and with transport constructions located on them.

Environmental safety evaluation of motorways should include the following groups and kinds of influence, which differ according to their sources of origin:

- **Transport pollution (emission):** –emissions, transport noise, dust, products of road wear that pollute air, land and water of nearby areas.
- **Technological impact of construction and other kinds of works:** Pollution of atmosphere, land and water during these works, industrial noise, spreading of dust etc.

Highway routes should be selected to keep all environment, land, water and forest protection requirements as envisaged by legislation. All construction conditions must be studied for all possible and recommended alternatives. Possible sources of environmental impact include:

- Evaluation of existing and possible level of pollution across highway;

- Brief description of inhabited areas, which are located along the highway;
- Considering location of quarries and their capacity that are needed for road construction works;
- Evaluation of impact of construction works on environment (probability of risk creation, its characteristics, scale, zone etc), also forecasting of ecological, social and economical outcome;
- Determining of events, which guarantee elimination of negative impacts and evaluation of their effectiveness in case of their implementation; and,
- Evaluation of residual impacts and carrying out of result assessment at all stages of implementation of envisaged activities. Preparation of statements about carrying out of ecological monitoring.

Below are the main concepts used during calculation of likely air pollution levels:

- Impact zone - area, where direct or indirect influence of natural system is revealed. Transport pollution exceeds average annual indicator, but it does not exceed impact permitted ratio (ipr).
- Protective line - area, where transport pollution can exceed ipr.

Table 6.10: Orientation sizes for impact and protection lines

Territory that is under impact	Distance for different ecological classes of roads		
	I	II	III
Impact zone	3000/1500	2000/1000*	600
Protective line	250/150	150/90	60/30

*Note – first number indicates influence conditions – free spreading; the second number envisages landscape obstacles, agricultural parts with width not less than a half of the highway.

Table 6.11: Potential Impacts and Mitigation

Impact Type	Possible Mitigation	Conditions, when impact must be considered
1	2	3
Air pollution	Road planning, which ensures optimal schedule of transport flow; planting of protective plants;	For the roads of I and II categories;
Dusting of territory	Road planning by means of non dust cover; planting of trees along the road line	For planning of dusty cover near inhabited areas and agricultural lands of high value

Air pollution by asphalt concrete and cement concrete factories and other enterprises	Providing emission sources with cleaning equipment	In case of existence of industrial enterprises along the road in projects
Environment pollution during working of construction cars and mechanisms	Usage of ecologically less dangerous modern construction cars and mechanisms .	For lands needed for agricultural works, also during usage of construction cars and mechanisms, which produce great amount of emissions

Road coverage is divided into dusty and non dusty categories. Non dusty covers include asphalt and concrete. Dusty materials include aggregate, priming etc.

Table 6.12: Permitted concentration of atmospheric constituents

Name of substance	ipr (mg/m3)	
	Maximal one/time	Average daily
Nitrogen dioxide	0.2*	0.04
Nitrogen oxide	0.4	0.06
Soot	0.15	0.05
Sulphur oxides	0.5	0.05
Carbon	5.0	3.0
Dust	0.5	0.05
Carbon hydrogen (petrol fraction)	5.0	1.5
Carbon hydrogen (naphtha fraction)	1.2	-
Formaldehyde	0.035	0.003
Benzpyrene	-	0.0000001

Table 6.13 Danger level of polluting substances regarding to human health

Substance	Class of danger	Concentration (mg/m3)		
		Causes danger	Dangerous	Too dangerous
Dust	III	0.15	0.75	3.75
Sulphur oxides	III	0.05	0.2	1.8
Nitrogen oxide	II	0.2	0.255	0.765
Carbon	IV	5.0	10.0	25.0
Carbon hydrogen (petrol fraction)	IV	1.5	7.5	37.5
Soot	III	0.05	0.25	1.25
Phenol	II	0.04	0.1	0.16
Sulphur hydrogen	II	0.008	0.024	0.072

The main technical parameters of the motorway regarding atmosphere are as follows:

- Considering intensity of transport flow and СниП 2.05.02 – 05, this length of the road belongs to I category;
- Speed limit 120 km/per hour; Total length– 15 km;
- Construction materials will be obtained locally; and,
- Road cover construction is adopted according to transport operation characteristics, road importance, transport flow intensity and consistence.

6.3.4.2 Air Quality Observations

In several towns and regional centers (11 towns) there are special Hydrometeorology Department units for monitoring the environment, where observations of air quality are carried out on a regular basis (on general and specific polluters). But during recent years frequency of observation is limited due to economical instability and insufficient supply of observation equipment.

It is important to obtain current information about air quality in order to evaluate all chances of impact, which are connected with atmosphere pollution in highway area. This section refers to assessment of air quality near the motorway as only these areas are under impact of atmosphere pollutions.

The condition of air quality during the tunnel construction needs particular observation, which should be under permanent control and monitoring. Special environmental activities are required such as application of relevant equipment for air filtration.

As there are no observation units near the proposed motorway, we have worked out theoretical way of its assessment, which is based on modern approaches of calculation of dispersion of dangerous substances in the air. This uses an air quality modeling program. The program calculation algorithm fully complies with requirements of environmental legislation of the state. This approach gives an opportunity to calculate the maximal concentration of any dangerous substance and its dispersion in any point or area by means of wind. The calculation is made by means of considering eruption from point, linear and area sources and by considering their geometric and aerodynamic meteorological and climate characteristics. The program is used for polluting sources of all types.

Climate characteristics, vertical division of temperature has significant influence on dispersion of dangerous substances in the air (territory of former USSR was divided into zones according to these data and it varies from 140 to 250. For Georgia this indicator

equaled to 200). For calculation the wind speed is needed. Where probability of exceeding given speed is 5% and which is made according to climate data.

Dangerous substances erupted from their sources have their parameters. These are criteria of air quality (permitted concentration – mg/m^3). By comparing the size of concentration of specific dangerous substances with its quality criteria, they make conclusion about exceeding the concentration from a given source.

The program uses technical parameters of eruption source. During calculation of atmosphere pollution program uses so called "calculation parameters", which are obtained from technical parameters by means of calculation.

Parameters include:

- Height of point source from ground level (m);
- Pipe diameter of point source (m);
- Average speed of flow from point source (m/sec);
- Temperature of flow (C0); and,
- Flow capacity – amount of substance spread in the air within given period of time (gr/sec).

"Calculation parameters" of eruption source is characteristic of dispersion of these substances:
Cm – maximal ground level concentration, which is achieved from the source by given substance;
Xm – distance from the source, where maximal ground level concentration is achieved (m);
Um – Wind speed, where maximal ground level concentration is achieved (m/sec);

A survey was carried out on those parts of highway which are near inhabited areas. Such areas were villages Sveneti, Berbuki, Ortasheni, Urbnisi.

Modeling is carried out by considering the direction of wind.

The calculation is based on the assumption that transport flow intensity in the 15 km length part of highway will be stable and thus it is possible to admit that graphical description of spreading of polluting substances for given specific short part of the highway (500m) can be used in connection with any inhabited area located near the highway. The modeling results are shown in the Working Paper 2 to this EIA report, and discussed in Chapter 7 below.

CHAPTER 7: ENVIRONMENTAL IMPACTS AND MITIGATION

This chapter discusses the expected environmental impact for different stages of Sveneti-Ruisi project. This includes: the stage of contractor mobilization (creating temporary camps, temporary roads, car parks etc.) and the stages of highway construction works and motorway operation.

Mitigation measures are also discussed which are important for elimination of potential impacts. If such impact is not eliminated completely such an impact is discussed as a residual.

7.1 Impacts of Construction

7.1.1 Clearing the RoW

Construction will begin with the clearance of buildings, trees and bushes from the RoW. This will include: cutting of trees near tunnel portals; buildings are dismantled and heavy parts are carried away by means special transport; destabilization of upper layers of soil, changing of landscape near tunnel portals, etc.

7.1.2 Preparing the RoW

During preparation of corridors in the area of the new part of the highway, the surface must be prepared to ensure safe work of constructing machines. Excess soil must be taken away. It is very important to store it properly. The following events are expected during these works: impact on plant species, as in several areas they might be cut down; impoverishing of fertile soil; noise impact on population and on wild animals in non-inhabited areas; changing of landscape on mountainous area and slopes, soil erosion.

7.1.3 Construction of Temporary Buildings

These works include temporary camps that are needed during motorway construction. It also includes temporary roads needed for accessing working sites.

Different kinds of impacts are expected during setting up of temporary camps (parking areas for cars and machines, temporary dwelling and office buildings, storing area). Adjacent land may have impacts from water gathered in selected area; impact on plants that exist in given area; noise impact on population and on wild animals in non-inhabited areas; impacts caused by inadequate storage of waste.

7.1.4 Building New Bridges

Impact of building of bridges on the river banks and fish fauna including the rivers West Tortla, Medjuda, Liakhvi (reconstruction-enlargement): movement of special construction machines in the banks of the river, leakage of oil products into the rivers.

7.1.5 Impact from Sourcing of Construction Materials

Highway construction works require mainly asphalt, stones, sand and obtaining these materials can pollute the environment. For example asphalt factories pollute air as they use hard substances that may include sulphur. They also disperse toxic air in large quantities. Significant emissions are characteristic of stone quarries that can cause serious health problems to those people who work there. If the quarry is situated near the inhabited area it will be dangerous for the health of population too. Stone breaking factories cause noise and produce dust. Obtaining sand and aggregate can destroy structural stability of river banks and have negative influence on ecology and hydrological conditions of the river. Thus it is very important to keep safety standards of environment protection.

7.1.6 Other Impacts Caused by Temporary Works

Creating work camps and temporary access roads can have other impacts. These include: compression of soil and ground, pollution of underground and surface water by oil and lubricants, especially during repairing of machines and equipment. Mechanical workshops, oil storage areas may become serious sources of pollution. Waste can also be considered as a serious source of hazard.

7.1.7 Impact on the Plants from Widening the Existing Highway

Plants that are located near the highway can have several impacts. The number of plant diseases and parasites may increase. These diseases and parasites may spread to adjacent gardens, fields and woods unless relevant measures are taken. Environment protection management must consider relevant mitigation and compensation measures.

7.1.8 Impact on cultural and archeological heritage located within the RoW

Construction or widening of a road involves significant excavation, so there is a serious risk of damaging both known and as-yet unknown archaeological material and other sites and monuments of cultural importance.

7.1.9 Safety of Employees

Issues that are connected with personnel safety include: sanitary – hygiene conditions, collection and disposal of waste, drinking water, storage of materials, HIV/Aids, traffic safety, etc. Construction work itself also involves many inherent risks, particularly when work is conducted on a new or existing main road.

7.1.10 Impact on the air

Two kinds of problems – atmosphere and noise impact, must be considered.

Construction and other kinds of machines that are used during the construction process must comply with ecological and sanitary requirements – ГОСТ 17.2.2.02-86 regarding emission and CH 2.2.4/2.1.8.562-96 regarding noise.

A list of machines and other equipment that is used during construction process, also calculation of dispersion of polluting substances from machine engines is given in the Working Paper 2 for this EIA Report. Expected duration of construction works is two years. These machines will be located along the highway. Their maximal concentration is expected near bridge areas where their total number will exceed 5-6 vehicles and only 2-3 of them will work simultaneously.

Calculation of polluting substance dispersion from machine engines is given in the Working Paper 2 for this EIA Report. Modeling of air quality is made considering meteorological conditions. Graphical form of its spreading in given below and table of relevant calculations is given in the Working Paper 2.

The modeling shows the area dispersion of polluting substances. This indicates that concentrations of total impact (3301+304+330) and nitrogen dioxide (code – 3301) can reach a distance of 100 meters in both directions, but concentration of other substances will not exceed established standards. It should be noted that construction impact has short period and cumulative impact is not expected.

During execution of tunnel works there is the air pollution, particularly dust and exhaust gas concentration. With regard to this environmental impact special measures such as operation of limited (just necessary) number of construction equipment in the tunnel, installation of special air filtration equipment, as well as provision of individual protective respirators to the workers is required.

The tunnel is located in an area of relatively low initial level of pollution due to the fact that the next main source of air pollution (factory) is located 3 km away from the tunnel area.

Considering the relative short length of the tunnel and the initial low pollution level, no severe level of air pollution at the tunnel portals are expected.

Besides, populated areas are located about 1.5 km from the tunnel portals and therefore residential areas are not affected.

7.2 Impacts of Motorway Operation

In the motorway operation stage the main attention was paid to the two main aspects of environment connected with an operating road, to noise and ambient air.

7.2.1 Air Quality

Data for a 500 m section of the 14.5 km designed highway are as follows (transport unit/h):

14000 units/day /24sT = 583 units/h; k = 2.27; 583 * 2.27 = 1324

Table 7. 1: Transport Method and Probable Intensity of Movement

Vehicle types	In both directions	%
Passenger cars on petrol	662	50
Passenger cars on diesel	530	40
Trucks and buses on diesel	132	10
Total	1324	100

Due to the fact that the regulation of ambient air is carried out only for the settlements, the calculation has been carried out for the 500 m section alongside the settlement while taking into consideration likely futurevehicle movements.

Table 7. 2 : Pollutants and Emissions

Substance	Code	Emission (g/sec)
Carbonic acid	337	0,50176389
Nitrogen dioxide	3301	0,17864889
Nitrogen oxide	304	0,02903044
Hydrocarbons (petrol)	2704	0,06574028
Hydrocarbons (Oil fraction)	2732	0,07750347
Soot	328	0,01134431
Sulphur dioxide	330	0,0130325
Formaldehyde	1325	0,00074028
Benzapyrene	703	0,00000005

The calculation of pollutant dispersion as spatial distribution plots are provided in Working Paper 2 for this EIA Report.

This shows that the formed concentrations in respect of sulphur dioxide and the net effect of the group (nitrogen oxide+ nitrogen dioxide+sulphur dioxide) reach maximum values at about 50 m from the axis of the motorway in both directions (the permitted rate of influence) and for the other substances does not exceed ambient air standardsfor the settlement and should therefore not have a negative effect on the living conditions of the population and the environment.

7.2.2 Noise

Design data was used to calculate the noise characteristics of the new motorway. With the view of the future development of the economy of the country it can be expected that the design capacity of the new road will be used in full.

The calculation of motorway noise characteristics has been carried out while taking into consideration the following conditions:

- In the peak hours the intensity of movement can reach the level of 3000 units an hour. Passenger cars will move at 110km/h and trucks and buses at 90 km/h; the number of cars and trucks in the common flow will equal 10-20%.

- In the first (the most noisy) hours of the night (from the midnight till 2 o'clock), when the intensity of movement decreases 2-3 times as compared to the daytime rush hours, it is probable that 800-1000 units will be moving along the motorway in an hour. The speeds of movement are also reduced.

While taking into consideration all of the above, the following results have been reached: In the daytime rush hours the noise characteristics of the motorway will constitute 82 dB, and in the noisiest period of the night noise characteristics can reach up to 76 dB. Since concrete slabs are used as the surface of the new motorway, it is expected that the given features will increase by 3 dB.

After road reconstruction the acoustic situation will change in the villages along the motorway covered with asphalt concrete. The calculated results are shown in Table 7.3.

Table 7.3: The equivalent levels of expected sound on the motorway

Distance from the motorway to the point of calculation, m	Day/night	Equivalent level of Sound, dB	Exceeding the admissible levels, (1) dB
50	day night	70-73 64-67	15-18 19-22
100	day night	65-67 60-62	10-12 15-17
200	day night	60-62 55-57	5-7 10-12

The calculation has been done for the cases when there are no fences or green plantations along the road and the land surface is covered with grass.

In the conditions of the usage of the existing vehicles the maximum levels of sound will not change close to the motorway or will be maintained within 88-92 dB in the daytime as well as night hours. While taking into consideration the maximum sound levels, the same values of exceeding the standards are expected as shown in the Table 6.9 above for the equivalent levels of sound.

This situation requires the consideration of all possible noise protection measures. Most widely are used the sound baffles (barriers) and the green plantation lines, protecting the population from noise. This is discussed further in Section 7.4 below

7.2.3 Drainage

During rainfall and snow melt water will drain from the roadway towards the rivers within this section (Pshana, Mejuda, Tortla and Didi Liakhvi). This will cause a negative influence on the soil and surface waters, since the storm drainage is mainly characterized by physical pollution (suspended particles), the source of which is the dust disseminated in the air and vehicle exhaust.

The source of pollution can also be the rubbish accumulated on the surface, the products created as a result of the damage of road surface.

While taking into consideration the expected movement of trucks as well as passenger cars, it is probable that within 10 minutes from the start of the rain the concentration of suspended particles will be up to 200 mg/l. According to the calculation provided in Working Paper 5 for this EIA Report, there is expected to form 14190 m^3 of storm water on the Sveneti-Ruisi section.

7.3 Mitigation Measures: Construction Stage

7.3.1 Biodiversity Protection

Rationale. Within any sections of the Sveneti-Ruisi road, especially along the forest zone at the 87+400 mark of the RoW, from where it is proposed to start the construction of a tunnel, in the process of carrying out clearing operations before the start of construction, there must be carried out additional research to determine if it is necessary to transplant any important species of flora which exist here.

Since due to the existing situation felling of trees can not be completely avoided, they can be handed over to the local authority for the purpose of selling the removed trees. For the reinstatement of the RoW and for maintaining an ecological balance, each removed tree will be compensated through replanting along the RoW of at the rate of 1:1.5. Species typical for the local fauna must be selected for replanting. These measures pertain removal of trees in the State owned areas. Removal of fruit baring or other trees growing in the private plots, compensation will strictly follow the RAP.

Requirements for the contractor. Species of trees proposed for planting in compensation of the trees removed in the process of clearing RoW must be agreed with the RD prior to commencement of the greening program.

Additional requirements. When choosing and planting the necessary species of flora the contractor shall take into consideration the time of working out the construction plan. The measures for mitigating environmental effects shall be agreed with the regional services of the Ministry of Protection of the Environment and Natural Resources of Georgia.

7.3.2 Reducing Disturbance of Communities

Rationale. During construction woks special attention shall be paid to the aspects effecting the populated environment, in particular: during the transport movement on the roads with only pavement subgrade in settlements, watering or temporary roads should be arranged for necessity.

In order to mitigate the effect on ambient air it is necessary to:

- Repair the existing subgrade road layers;
- Regular watering of both types of pavement subgrade in dry weather;
- Regular check of transport and exhaust gases; and,
- Vehicles with non-standard emission shall not be allowed.

In connection with the influences caused by noise and vibration:

- In order to carry out any work equipment should be used which will minimize the associated noise and in addition, the technical maintenance will be conducted to reduce the levels of noise and vibration;
- The works must be carried out in view of a background noise. It should not be allowed to leave the equipment and machines in idling. Their engines must not work in idle regime without necessity;
- In the event of the existence of sensitive receptors, the duration of noisy work must be minimized and be within the normal working hours.

Requirements for the contractor. The responsibility for the timely and quality carrying out of the measures for mitigating environmental effects shall lie with the contractor. Apart from that he also must establish direct contact with the local population in the zone of construction influence in order to receive information connected with the population requirements in time, which will lessen the possible conflicts.

7.3.3 Temporary Camps and Access Roads

Rationale. When gathering background information within the RoW, two areas suitable for temporary construction camps were identified. These are:

- A territory of about 200 m long, width- 100 m, with the area of 2.0 hectares in about 500 m from village Ortasheni, on the right side of Igoeti-Sveneti-Rusi road at KP 87+800. There are no trees on the territory; the given areas can be used

within the whole period of the construction of the road, as well as the bridge on river Liakhvi. There is no sewage of any usage on the territory.

- The second area is along the territory envisaged for the vehicle tunnel at the KP 86+900 km. A small part of the territory is covered with sparse bushes. This area of the territory also makes up about 1.6 hectares (80x200). The given area can be used for the tunnel construction as well as construction of a bridge on the river Liakhvi. There is no sewage system on the territory.

In the event that a contractor needs other areas, he can additionally look for the territories acceptable for him. He will also be responsible for conforming to all the environment safety requirements in connection with the arrangement of construction camp, given below.

Significant attention must be paid to the question of temporary access roads since their incompetent choosing can increase a negative effect on social conditions.

Before the start of construction, the contractor should consider the possibility of leaving untouched the green plantations existing in that place (trees, bushes).

When evaluating in detail the relief of the chosen areas the opportunities of clearing the storm water and then their flowing into the running waters shall be considered.

The work shall be carried out along with removing the soil layer and placing it in the area chosen beforehand. The conditions of soil preservation shall conform to the Land Reinstatement Plan.

Before making the service waters created on the construction territory (shower, kitchen, toilet, etc) flow in the cleaning equipment they must be collected in special septic tanks, which should meet international standards required for such type of tanks, and has to be preliminarily approved by the engineer. After sedimentation and preliminary cleaning the water shall go through cleaning equipment the data on which are provided in Working Paper 4 for this EIA Report.

It is also necessary to take measures on mitigating the effect of the storage and distribution of mineral oils. These include:

- Around the tanks for storage and distribution of mineral oil a barrier of waterproof material shall be arranged;
- The area inside the barrier shall also be finished in waterproof material;

- For the operations of receiving-giving out of fuel by means of tank trucks the area is to be prepared with the view of the measures against spillage; and,
- Refuelling during the construction of bridges on the river Liakhvi is strictly prohibited in the stream channel of the river and its adjacent terraces.

When choosing a route for temporary access roads, as a minimum, the following two aspects shall be taken into consideration:

- They must be as far as possible from settlements; and,
- The motorway must be arranged as to be as far as possible from the places covered with significant species of trees and bushes.

The preparation works for temporary access roads must begin with the removal of the soil layer and its placement in the area chosen beforehand.

The additional land necessary for widening of the existing motorway as well as the area necessary for the designed motorway, comprise nearly 4500 sq. m. The soil layer to be removed will comprise 1125 sq.m. The given soil layer can be handed over to the local authorities for the improvement of poor soil.

The removed soil layer shall be stored temporarily along the RoW, in places chosen beforehand. In order to preserve the structure of the stored soil, it should be stored in a stable state, for which the following requirements are to be observed:

- The depth of the stored soil shall not exceed 2 m;
- The place chosen for storage must be on a higher relief, so that the precipitations coming from other area do not cause its washing away or erosion;
- Around the pile of the stored soil along the whole perimeter drainages shall be arranged.

Requirements for the contractor. Mitigation for temporary construction camps and access roads are the responsibility of the contractor. He can also choose another location, although the requirements set out in the measures for mitigating the effect shall be carried out in respect of any other areas.

Additional requirements. Since there have not been yet chosen the locations for the construction camps or the routes of the temporary access roads, the evaluation of the removed soil storage shall be carried out by the local authorities and the regional services for environment protection.

7.3.4 Bridge Construction or Widening

Rationale. In order to avoid sedimentation, barriers of inert material shall be used during straightening of the banks on the terrace side of the rivers (Liakhvi, w. Tortla, Mejuda). It is necessary to check the river banks and the close rocks for the falling of soil and soil layers in order to carry out the restoration and bank protection works if necessary. The construction works connected with bridges shall not be carried out in the period of spawning of fish, which lasts from April through mid September. When filling the bridge footings with concrete it is necessary to minimize the working time. No materials shall be deposited in or near the river.

The technical conditions of vehicles and machinery in rivers and streams and their terraces shall be checked daily in order to prevent the leakage of oil minerals in the water.

If it is necessary to temporarily re-direct rivers or streams in connection with the construction of bridges and protection works, it is necessary to arrange water-pipes, fish-passes, water-barrier channels for the free movement of fish and other organisms, as well as the preservation of water quality and flow.

Requirements for the contractor. The contactor shall be responsible for the measures mitigating the effects.

Additional requirements. The information on the measures for mitigation shall be notified regularly to the regional services for environmental protection.

7.3.5 Storm Drainage

Rationale. The storm runoff shall be accumulated by means of the accumulation channels (ditches) arranged on both sides of the roads, which while taking into consideration the relief topography (inclination) shall be connected with specially arranged drainage outflow systems after going through which the storm sewage shall flow mainly to the local relief and surface waters. This will prevent the development of erosion processes along the road.

In this connection for the effective work of the measures for decreasing the effect, the following works shall be carried out:

- Periodical cleaning of certain sections of ditches in order to provide oblong inclination of their bottom- not less than 10%;

- Carrying out works for the reinforcement- repair of certain damaged areas of ditches;
- Preservation of the water pipes in working condition; and,
- Periodical cleaning of drainage outlet equipment from soil, then the restoration of embankment and planting of the plants with well-developed root system.

Requirements for the contractor. The contractor shall be responsible for the measures of weakening the effect.

7.3.6 Health and Safety

Rationale. Providing the workers and employees with a detailed information on works, Considering health and environment protection conditions and carrying out the special instruction training and technology, equipping the personnel with personal protection equipment.

It is necessary to draw up a special regulation plan for the personnel working in the stream canal of the rivers (Liakhvi, w. Tortla, Mejuda), connected with the avoidance of the effect in case of a sudden flood and to carry out training connected with the plan.

Checking of the knowledge of the technical personnel engaged in the works (bulldozer and excavator drivers, special transport drivers, etc.) in safe action as well as the supply of special information on environmental protection for the personnel engaged in construction.

Requirements for the contractor. The responsibility for the measures connected with carrying out of the given weakening of the effects shall lie with the contractor. Special attention shall be paid to the trainings to be carried out in connection with labor safety.

7.3.7 Cultural Monuments and Archaeological Areas

Rationale. It is possible that at any stage of construction works new archaeological areas can be revealed, especially in the process of building new alternative sections. In this connection the personnel involved in construction must go through the training how to act in such a case. In the event of the discovery of an archaeological area the finding must be registered and the information shall be handed over to the archaeological services of Georgia who must monitor the construction works.

Project implementation will not have any physical impact on any cultural /historical monuments which are known to exist long the RoW. It is possible, though, that

construction works affect natural landscape around the monuments, thus influencing their aesthetic value. Landscape reinstatement plan will ensure that this issue is addressed adequately.

Requirements for the contractor. Before commencement of earth works, contractor will receive instructions from RD on the course of action in case of chance finds. Contractor will be obligated to strictly follow those instructions. Should an archaeological site is encountered, contractor must take works on hold and promptly notify RD and follow its further guidance. Works should resume after receiving a formal clearance from RD. Contractor will develop, agree with RD, and implement a plan of landscape reinstatement to ensure restoration of the functional and aesthetic elements of the Project area..

Additional requirements. The representative of the Service for the Protection of Archaeological and Cultural Monuments shall be invited to carry out training in connection with archaeological questions.

7.3.8 Construction Waste

Rationale. In the local and regional authority bodies, before the start of construction works the places shall be identified where the construction debris can be placed in accordance with its type in order to minimize the negative effect of all the types of debris. The plan for transporting the debris shall also be established. Before transporting construction waste to its final disposal site, it should be piled in special closed storage places for toxic and non-toxic debris, keeping them separately.

Requirements for the contractor. The responsibility for the safe placement of the debris of any kind lies with the contractor and subcontractors. The contractor shall get the necessary instructions for the construction waste disposal from the local authorities and strictly follow them. At all times waste must be protected from the storm water and placed away from watercourses.

7.3.10 Quarries and Borrow Pits

Rationale. The extraction of the material from the soil and rock quarries can be carried out only in the event that there is an appropriate license. The purchase of inert material can be done only form the licensed legal or natural entities. The following are the requirements to be followed when working on rock quarries. In connection with what is mentioned above, the contractor shall observe the following principles:

- Only the deposits approved by the environment protection body shall be used within the scope of the project;
- Rock quarries management (including the repair works carried out after the completion of each work) must be carried in accordance with all the relevant environment protections standards and principles;
- The excavation of rock quarry areas and their adjacent territories shall be carried out in full observation of environment protection and the requirements of environment protection institution of environmental protection supervision group of the RD or the construction supervision consultant acting on behalf of the RD.
- The upper humus layer of the soil removed as a result of making rock quarries/hollows and their further usage for planting of greenery in the rock quarries in accordance with the requirements of the local environment protection body and the RD. No additional rock quarries shall be opened until the old already used areas are restored.

In the event of opening trenches, new drainage channels and fillings deposits, the following measures for lessening the effect shall be carried out:

- Extraction, taking out, placement of soil shall be carried out in the territories determined by the legal documents of the Ministry of Environmental Protection and Natural Resources of Georgia. In any event, these places shall be at least 100m away from water flows;
- Methods against erosion shall be used like: planting plants in the used soil etc, on the channel slopes and places of soil storage so as to avoid the development of erosion. Also the principles for avoiding the pollution from heavy metals shall be also taken in consideration.

In the event of extracting gravel from river terraces the following environmental protection requirements shall be observed:

- From the environmental protection point of view first of all is advisable to use the resources already in operation, since as a result it will not cause the increase of excavation areas, and the control and repair works will be more controllable.
- In the event that it is necessary to open a new area of extraction of gravel, a research in order to reveal the deposits in the distance from the stream canals shall be carried out. In the event of extraction of gravel in these areas the usable soil shall be stored for its re-usage in repair works. The limits of the rock quarry shall be strictly defined. From the river side there shall be maintained a relevant distance. The depth of the excavation depends on the features of the area and the type of operation. The extraction of material from the level below the existing

water level shall be allowed only in the event that the technique fuel and oil does not get in the water that is at the depth of 1 meter. The usage of a dragline can be used to extract gravel from deeper layers.

- In the event that gravel extraction is allowed within the inner limits of riverbed, it shall not be allowed to extract gravel from the distance lesser than two meters from the upper layer of the existing water, so as not to distort the existing river canal.
- If the gravel is extracted in less sensitive shallow rivers, the material can be extracted to the level of stream canal. The relief profile shall be preserved and the working territory shall be protected by a low gravel embankment, width- 1-2 m.

Requirements for the contractor. Works contractor will be encouraged to obtain rock, gravel, and sand from the licensed providers. In case of a need to open and operate own quarries, contractor must obtain any permits and licenses which are required for such type of activity according to the national legislation. Regardless the terms of such permits/licenses, contractor must follow good environmental practice outlined above in this section.

7.4 Mitigation Measures: Operation Stage

7.4.1 Noise

The construction of new dwelling houses, polyclinics, ambulance stations, clinics, holiday homes, infant daycare facilities, schools, and libraries shall not be allowed in the distance closer than 200 meters to the edge line of the motorway, in accordance with the rules of construction (2.05.02-08, "Highways").

Since the allowed sound norms for the territories of hospitals and sanatoriums are 10dBA less than for the territories of residential houses, in case of a new construction of premises the optimal distance of such institutions from the category I highway should be recommended on the basis of a special study and calculation. For the provision of social and ecological safety of population, residents located in less than 50 m distance from the motorway should be encouraged to move out or be offered a compensation for relocation.

Current trend of Georgia's economic development suggests further "engagement" of the new transport corridor. Therefore, it is recommended to:

- Carry out the sound monitoring of the territory of the motorway after it enters in operation (check sound characteristics and the equivalent and maximum levels of sound in sensitive areas);
- Based on the results of the monitoring, as necessary, provide additional technical measures of sound protection, such as install sound screen walls, widen protection line of the green plantations, increase sound isolation of the walls and windows of the houses facing the motorway, etc.

Conclusion. After full activation of the Igoeti-Sveneti section of the motorway, there is expected that the equivalent noise level will rise by 5-6dBA.

7.4.2 Air Quality

Planting of green plantations and arrangement of sound baffles in the section of Igoeti-Svaneti along the road is envisaged as the main measure in order to lessen the influence of air pollution on dwelling areas, education, medical and public facilities. The forest lines and sound baffles along the road also lessen the concentration of concentrated pollution substances and prevent their spreading.

The following are possible indicators of the concentration of harmful substances while taking in consideration arrangement of various protection constructions and green plantations.

Event	Concentration decrease %
One line of trees with bushes, height 1,5 m, lawn line 3-4 meter in width	10
Two lines of trees without bushes on 8-10 m lawn	15
Two lines of trees with bushes on 10-12 m lawn	30
Three lines of trees with two rows of bushes on the 15-20 m lawn line	40
Four lines of trees with 1.5 m bushes on the 25-30 m lawn line	50
Full sound baffle, building walls with the height of more than 5 m from carriageway	70
Earth fills, sides when difference between marks in hollow 2-3 m when making the road.	50
The same when difference between the marks is 3-5 m.	60
The same when difference between the marks is >5 m.	70

CHAPTER 8: ENVIRONMENTAL MANAGEMENT PLAN

8.1 Basic Approach

EMP for the rehabilitation of Ruisi-Sveneti section of the highway outlines institutional set-up for its implementation, explains flow of information and reporting responsibilities for the period of EMP implementation, and establishes measures for enforcement of the EMP requirements. Table 8.2 carries a full set of the proposed mitigation measures and monitoring indicators. Table 8.2 gives the specific mitigation measures for particular locations along the entire alignment of the Ruisi-Sveneti section. The EIA and EMP were made available for bidders so that they can fully consider and incorporate their environmental responsibilities into their bid proposals. Table 8.3 gives the estimated cost of main measures of mitigations.

Before commencement of works the selected works contractor will be required to develop and agree with the RD a plan of traffic management for the period of works. The works contractor will also develop and agree with the RD a plan of greening and landscape reinstatement at a relevant stage of contract implementation. Instructions on waste disposal must be obtained from the local authorities prior to commencement of works.

8.2 Institutional Framework for EMP Implementation

Construction contractor is obligated to follow EMP and good construction practice. In order to meet this obligation, a contractor shall have at least one environmental specialist on the team, who is able to fully understand recommendations of EMP and professionally apply prescribed mitigation measures to the contractor's daily operations.

Technical supervisor of works commissioned by RD is responsible to establish strong field presence in the Project area and keep a close eye on the course of works. Along with ensuring consistency with the design and ensuring quality of works, the supervisor is mandated to track implementation of EMP by the contractor, reveal any deviations from the prescribed actions, as well as identify any unexpected environmental issues should they emerge at any stage of works.

RD provides a general oversight on the environmental compliance of works through ensuring quality performance of the technical supervisor and of the contractor. RD also liaises with the World Bank, ensures availability of all environmental information, and facilitates environmental supervision of the Project by the World Bank.

8.3 Main Environmental Requirements for Works Contractor

Biodiversity protection

In the process of clearing RoW avoid cutting tress wherever possible. Develop and agree with RD landscape reinstatement and greening plan, based on the principle that trees removed from the State owned lands must be compensated at 1:1.5 ratio and be planted along the RoW.

Reducing Disturbance of Communities

Establish contact with the local population in the zone of construction influence in order to receive information connected with the population requirements in time, which will lessen the possible conflicts. Develop and agree with RD traffic management plan for ensuring least inconvenience and safety of movement of local people in the Project area during construction works, as well as safety of vehicle transportation along the highway.

Temporary Camps and Access Roads

Arrange work camps and access roads in the locations recommended by RD or select locations where arrangement of camps and roads will require removal of least volumes of vegetation and cause least disruption of current land use and transportation patterns of local communities. Submit for clearance by RD a site map of work camps and access roads, depicting proposed placement of machinery servicing sites, construction material storage sites, arrangements for temporary storage of waste, arrangements for water supply and sanitation.

Bridge Construction or Widening

Install barriers of inert material during straightening of the banks on the terrace side of the rivers (Liakhvi, w. Tortla, Mejuda). Check river banks for potential of falling rocks and soil layers in order to carry out stabilization works if necessary. Do not carry out works in the waterways during the period of spawning of fish, which lasts from April through mid September. When filling the bridge footings with concrete, minimize the working time. Do not deposit any construction material near the river. Check technical condition of vehicles and machinery deployed in waterways and at their banks on daily basis in order to prevent the leakage of oil and lubricants to the water. If in the course of bridge reconstruction it is necessary to temporarily re-direct water flow, arrange water-pipes, fish-passes, water-barrier channels for the free movement of fish and for preservation of water flow and quality. Develop and submit to RD a plan of works in the waterways, detailing timeline and methodology of works, as well as measures for ensuring workers' health and safety, and for addressing emergencies.

Storm Drainage

Accumulate storm runoff in ditches arranged on both sides of the roads connecting with specially arranged drainage outflow systems. Periodically clean ditches in order to maintain inclination of their bottom at not less than 10%. Reinforce and repair damaged areas of ditches. Preserve water pipes in working condition. Periodically clean the drainage outlet equipment from soil.

Health and Safety

Provide all workers and employees with a detailed information on works. Deliver special instructions and training on any technologies and equipment deployment of which is associated with increased risk for workers. Ensure that all workers and other personnel wear proper clothing and protective gear. Obtain and check contact information for the cases of fire, health, and security emergencies.

Cultural Monuments and Archaeological Areas

Before commencement of earth works, receive instructions from RD on the course of action in case of chance finds. Strictly follow those instructions. Should an archaeological site is encountered, take works on hold and promptly notify RD, and follow its further guidance. Resume works after receiving a formal clearance from RD.

Construction Waste

Obtain instructions for the construction waste disposal from the local authorities and strictly follow them. At all times protected waste from the storm water and pile it away from watercourses.

Quarries and Borrow Pits

Purchase rock, gravel, and sand exclusively from the licensed providers. In case of a need to open and operate own quarries, obtain permit/license for such activity as prescribed by national legislation. Inform RD on the detailed plan of operation.

While operating rock quarries, remove upper humus layer of the soil to use it for landscape reinstatement. Carry out greening of quarries after their closure in the areas prone to erosion. Do not open additional rock quarries until the operated one is used up to the established limit and restored.

Select location of a new gravel quarry possibly distant from the water stream. Store upper layer of removed soil for reinstatement of quarries. When extracting material from the level below the existing water level, ensure that operational spills of oil and lubricants do not get below 1 meter depth. If gravel extraction is allowed within the inner limits of riverbed, do not extract it from the distance lesser than two meters from

the upper layer of the stream, so as not to distort the existing river bed. In less sensitive shallow rivers gravel can be extracted to the level of stream bed. Preserve relief profile and protect working territory with a low gravel embankment, width- 1-2 m.

8.4 Monitoring of EMP Implementation

Environmental monitoring will be carried out at the representative sensitive receptors of the Project area to indicate the status of EMP implementation and environmental performance at various stages of the Project implementation and operation. The technical supervisor will periodically go to the construction sites to collect data on indicators at sensitive receptors (including waster, air, and noise). Monitoring data will be submitted to the RD to control the performance of complying with the environmental regulations. Adverse environmental impacts due to peak Project activities or improper environmental practice can then be easily identified and the contractor can take prompt remedial actions.

More specifically, as the integral and critical part of the EMP, the environment monitoring program has the following objectives:

- Confirm the impacts forecasted in the EIA;
- Determine the actual extent of impact;
- Evaluate the effectiveness of the mitigation measures, implemented on site; and
- Identify and justify the additional mitigation measures against unexpected impact as may be necessary during Project implementation and operation.

Environmental impact monitoring during construction period consists of routine measurements on environmental quality parameters at the designated monitoring locations and the regular site inspections according to the Table 8.2 below. During the peak construction period or at the request from RD, the technical supervisor will also carry out additional measurements using hand-held equipment in order to monitor short-term impact. Should non-compliance with environmental quality performance criteria be identified, additional ad hoc monitoring will be carried out.

The equipment and test methods to be adopted for the monitoring works by construction team and supervision team will comply with the requirements stipulated in the relevant environmental quality standards. The monitoring equipment will be calibrated regularly. Calibration of equipment is required prior to the in-site measurement. All the calibration records and monitoring results will be submitted to RD.. RD will keep copies of all site records, reports, approvals, statutory documents, certificates, licenses or permits in relation to environmental matters for recording purposes. Table 8.1 below sets out the records that will be maintained by the RD.

Table 8.1 Typical environmental records to be maintained at the construction phase

Category	Record
General	• Environmental training records (e.g. attendance records for environmental awareness training, topics covered); • Environmental permits / licenses; • Site diary and site inspection records; • Environmental log-book, complaint log-book and environmental quality limits exceedances notification forms; • Construction program and schedule; • Equipment maintenance / repair records; • Correspondence with concerned parties and other parties in relation to environmental matters; • Meeting minutes.
Noise Control	• Updated list of Powered Mechanical Equipment currently on-site; • Details of examination periods and the results if any environmental sensitive receivers such as local schools, hospitals, resident villages may be affected.
Water Pollution Control	• Plans of construction site drainage; • Records of drilling mud reuse, reconditioning and disposal; • Records of maintenance and cleaning schedules for sediment and oil/grease traps; • Records of toilet sewage disposal (where connection to existing foul sewer main is not undertaken); • Records of the wastewater final discharge quantity and the pollutants concentration.
Waste Management	• Written designation of waste disposal sites and instructions for waste transportation from local authorities; • Records of quantities of reused and recycled waste; • Waste disposal records.
Atmosphere	• Route and the program of the construction material transportation; • Mitigation measures on the atmosphere effect such as watering; • The monitoring results of the atmosphere quality.
Culture Property	• Reports on any chance finds and documentation on their handling; • Log of construction near the Culture Property sites.
Land Contamination	• Preliminary analysis results of materials suspected to be contaminated (if any).
Dangerous Goods (DG) Storage	• Drawings of DG stores; • Log of DG inventories and consumption.
Chemical Storage	• Drawings of chemical storage facilities; • Log of chemical inventories and consumption.
Environmental Emergency	• Emergency incident reports; • Records on remedial actions taken.
Corrective and Preventive Action	• Corrective and preventive action request records; • Records on action clearance and implementation..

After completion of works, at the operation phase of Sveneti-Ruisi section of the highway, RM and MEPNR will continue monitoring of several environmental indicators and use obtained data for applying any corrective measures required. The critical environmental indicators for the operation phase are noise levels and air quality along the motorway, and indoor air quality inside the tunnel. RD will also control waste collection and disposal long the highway, condition of green plantations, and functionality of animal passages under the highway.

8.5 Reporting on EMP Implementation

Contractor, through the environmental specialist on the team, shall prepare monthly status reports on the EMP implementation. Such reports must carry information on the main types of activities carried out within the reporting period, status of any clearances/permits/licenses which are required for carrying out such activities, mitigation measures applied, and any environmental issues emerged in relations with suppliers, local authorities, affected communities, etc. Contractor's monthly status reports shall be submitted to the technical supervisor and RD.

Technical supervisor prepares monthly reports on the status of EMP implementation and environmental performance of the contractor. These reports shall be based on the contractor's reports and carry analysis of their contents. Technical supervisor shall assess how accurate is the factual information provided in the contractor's reports, fill any gaps identified in them, and evaluate adequacy of mitigation measures applied by contractor. Technical supervisor must highlight any cases of incompliance with EMPs, inform on any acute issues brought up by contractor or revealed by supervisor himself, and propose corrective actions.

RD must ensure that monthly reports from the contractor and from the technical supervisor are made available for the environmental specialists of the Department promptly upon their arrival in RD administration. The Department, through its environmental specialists, shall report each semester to the World Bank on the status of environmental compliance of construction works. Such reporting shall contain information on all violations identified and the actions taken for fixing of such cases. RD shall inform the World Bank on any major environmental issues at any time, independently from the schedule of regular reporting.

8.6 Remedies for EMP Violation

RD, as a client of construction works, will be responsible for enforcing compliance of contractor with the terms of the contract, including adherence to the EMP. For

minor infringements, an incident which causes temporary but reversible damage, the contractor will be given 48 hours to remedy the problem and to restore the environment. If restoration is done satisfactorily during this period, no further actions will be taken. If it is not done during this period, RD will arrange for another contractor to do the restoration, and deduct the cost from the offending contractor's next payment. For major infringements, causing a long-term or irreversible damage, there will be a financial penalty up to 1% of the contract value in addition to the cost for restoration activities.

8.5 Institutional Capacity of RD

Within RD, the Division of the Project Analysis, New Technologies, and Environmental Protection under the Office of Technical Policy is responsible for environmental issues related to highway development. Currently there is one environmental specialist in this unit, who received professional on-the-job training as a part of the World Bank's technical assistance to the RD. Current environmental capacity of the RD needs strengthening to ensure full environmental compliance of the Project. Although day-to-day quality control of works will be outsourced to the technical supervisor of works, RD should have in-house human resources to oversee performance of such technical supervisor and to work out decision to address issues which the supervisor may bring up for RD's attention.

Table 8.2 Environmental Management and Monitoring Plan

Type of work	Building site	Expected influence	Mitigation measure	Monitoring measure	**Responsibility**		
					Responsible agency	Kind and periodicity of monitoring	Agency carrying out monitoring
1	2	3	4	5	6	7	8
CONSTRUCTION PHASE							
Site clean-up woks	On all the territories used for exclusion corridor and support infrastructure	Vegetation cover damage or cutting (loss). Destruction of shrubbery and grass cover. Influence on windbreaks – cutting or damage	Before beginning of work there should be carried out a research prior to clean-up to determine whether the plants should be cut or transplanted or what other measures are to be taken in respect of those species of flora (vegetation cover) which are on the verge of degradation and which may be subject to negative influence of clean-up woks within the exclusion corridor. During building of bridges (reconstruction and new) in the river riparian forests (Liakhvi, Mejuda, Tortla) to the west of the village of Ortasheni special attention should be paid to protection of the plant species existing in the forests adjacent to the road tunnel to prevent their damage or cutting without any necessity. When carrying out preparatory clean-up works along the exclusion corridor area, minimize removal of trees to the extent possible. As compensation for the trees cut there should be planted those species of trees which are a significant component of the local flora.	Inspection during the course of the whole construction process. Immediate cessation of further use of the territories and temporary approach roads unconfirmed by the project. Recovery of encroached territories	Contractor	Permanent monitoring for the whole period of construction After completion of recovery works	Roads Department of the Ministry of Regional Development and Infrastructure of Georgia

Type of work	Building site	Expected influence	Mitigation measure	Monitoring measure	**Responsibility**		
					Responsible agency	Kind and periodicity of monitoring	Agency carrying out monitoring
1	2	3	4	5	6	7	8
Construction camps, temporary construction sites and approach roads	Within the exclusion corridor, construction camps and temporary approach roads	Influence on vegetation cover, inadequate usage of land resources	After completion of works in ecologically sensitive areas to carry out recovery of initial state of the approach roads, also territories of other objects (temporary construction camps, storage territories and other) according to the requirements of the complex recovery plan given in this document. In ecologically insensitive areas it is possible to retain temporary roads with the purpose of using by the population if agreed with the local administrative bodies.	Inspection during the whole phase of construction process.	Builder/ Contractor	Monitoring prior to construction works. Afterwards periodically once a week. Full-fledged monitoring after completion of works. Inspection of the territory realized in accordance with the territory recovery plan	Roads Department of the Ministry of Regional Development and Infrastructure of Georgia Local administrative bodies
Management of water resources on construction camps and the objects used for infrastructure purposes	Construction camps and all the objects used for infrastructure	Pollution of water resources and ground, uncontrolled discharge of sewage and oil containing waters	Discharge of household sewage water from temporary construction objects (temporary construction camps, construction materials storage places) should not have any influence on surface water bodies. Accumulation of polluted water should take place in septic tanks and special sewage water collection pits. In case of filling there should take place their carrying over and discharge into the operating sewerage network (e.g. in Gori).	Inspection during the whole phase of construction process. Monitoring of carrying-out of requirements of "Plan of avoidance of accidental	Builder/ Contractor	Permanent monitoring for the whole period of construction works	Roads Department of Ministry of Economic Development

Type of work	Building site	Expected influence	Mitigation measure	Monitoring measure	**Responsibility**		
					Responsible agency	Kind and periodicity of monitoring	Agency carrying out monitoring
1	2	3	4	5	6	7	8
			With the purpose of creation of reserve of combustible and lubrication materials at the territories of temporary construction camps arrangement of installation place of reservoirs should take place according to environmental protection requirements, in particular, around the reservoirs there should be arranged discharge preventing stacking by means of water-conducting material (possibly by clay). The bottom of the reservoir and the internal area of stacking should be covered by water-conducting material. Fuelling of construction facilities and vehicles should take place at the territory specially arranged for that in accordance with requirements of "Pollution Prevention Plan"	discharge of oil products and relating reaction"			
Protection of the upper humus layer of soil, avoidance of soil erosion and deterioration of soil physical structure	Clean-up of the territory of the exclusion corridor and support infrastructure objects by the initial period of beginning of works	Degradation of soil quality, deterioration of its structure and decrease of productivity	Implementation of the complex recovery plan worked out for the exclusion corridor and other territories used taking into account the soil specific conditions and topography. Maintenance of the upper humus layer of the storage soil along the exclusion corridor in stable state in accordance with the requirements of the territory complex recovery plan.	Monitoring estimation in the process of the workflow. Periodical checkup with the purpose of estimation of state of the soil storage layer.	Builder/ Contractor	Monitoring once a week; Full-fledged monitoring after completion of works.	Roads Department of the Ministry of Regional Development and Infrastructure of Georgia
Safety of workers	At the whole territory of the	Safety of workers, machinists, drivers	Provision of the employed personnel with detail information on the activity specified by	Periodical inspection and	Builder/ Contractor/	Monitoring once a week;	Roads Department of

Type of work	Building site	Expected influence	Mitigation measure	Monitoring measure	**Responsibility**		
					Responsible agency	Kind and periodicity of monitoring	Agency carrying out monitoring
1	2	3	4	5	6	7	8
engaged in the works, also of transport vehicles and drivers and machinists of construction mechanisms	workflow including tunnel, bridges, construction camps and temporary approach roads	and special personnel	the project. Discussion of health and environment protection conditions. Halting works in tunnel in case of workers' exposure to CO goes above limit until the time of technical solutions found for improving air quality inside the tunnel Carrying out of trainings relating to safety actions according to specialties. Equipment of the working personnel with personal protection means. Construction of bridges or other engineering structures in the stream canal – in case of sudden falling into the water of the personnel engaged in reconstruction drawing up of a special evacuation plan and carrying out of the respective training. Checkup of knowledge of technical personnel (machinists, drivers and other) in respect of safety actions	preliminary discussion of special trainings. Tracking exposure of workers to high concentrations of CO during works in tunnel. Tracking safety of workers during bridge reconstruction, implying works in waterways.	Technical supervisor	Monitoring of carrying out of trainings. Daily instrumental measuring contents of CO in air inside the tunnel and insuring that exposure of workers is below 55 mg/m3 for 8h with max. limit of 229 mg/m3 at any time.	the Ministry of Regional Development and Infrastructure of Georgia Ministry of Environment Protection and Natural Resources of Georgia
Influence of construction works on water quality, river sediments,	Banks and channel parts of the rivers: Tortla, Mejuda, Pshana and Liakhvi	Possible deterioration of water quality, influence on ichthyofauna caused by the works	Levelling of configuration of the river banks (Liakhvi, Tortla, Mejuda, Pshana) and building of trenches necessary for the bridge breakers according to the project configuration data.	Inspection for the whole period of reconstruction and building of bridges and trestles.	Builder/ Contractor/ technical supervisor	Monitoring in the range of bridges and rivers on actions specified by	Roads Department of the Ministry of Regional Development and

Type of work	Building site	Expected influence	Mitigation measure	Monitoring measure	**Responsibility**		
					Responsible agency	Kind and periodicity of monitoring	Agency carrying out monitoring
1	2	3	4	5	6	7	8
ikhthyo-fauna and soils.		running in the river channel and changing the location (relocation) of the river channels. Activation of erosive processes on the river banks.	Rendering of temporary approach roads to the river channels taking into account the banks erosive state. Check-up of the river banks and nearby rocks with reference to ground and soil decay for timely recovery and consolidation Carrying out of construction works in non-spawning season in the rivers (excluding period between April and mid-September) Minimization of time of construction of the bridge breakers. Non-permission of stockpiling in the river channel of the material taken out of the trenches necessary for the bridge breakers Prior to works connected with construction of breakers in the trench prohibition of volley of the water pumped out of the trench into the river. In connection with construction of bridges in the river channels when temporary discharge of the necessary live channel arrangement of water conduits and canal with the purpose of creation of fish passage.	Tracking pollution of surface water with oil and lubricants. Tracking turbidity of waterways. Immediate cessation of works at the territories which are not specified by the project and at which there is running any activity and recovery of the initial state of the territory		the current project. Periodicity of monitoring – once a week. Weekly Measuring TSP and concentration of oil in water samples during pick of construction in the waterways and comparing measurements with the established permissible levels of 1.9 mg/l for TSP and 0.1 mg/l for oil	Infrastructure of Georgia Ministry of Environment Protection and Natural Resources of Georgia
Monitoring of water	The river channels, benches	Deterioration of water quality in the	Institution of control to prevent in the river channels, on benches and adjacent territories	Control for the whole period of	Builder/ Contractor	Monitoring for the whole	Roads Department of

Type of work	Building site	Expected influence	Mitigation measure	Monitoring measure	**Responsibility**		
					Responsible agency	Kind and periodicity of monitoring	Agency carrying out monitoring
1	2	3	4	5	6	7	8
quality in the rivers (Liakhvi, Tortla, Mejuda, Pshana)	and directly adjacent territories	rivers as a result of possible discharge of oil products.	filling of vehicles and mechanisms with fuel, which can be followed by accidental discharge in case of filling, To work out accidental discharge preventing measures. Prior to vehicles and mechanisms going down to the river area to check up possible sources (places) of discharge (hydraulic fluid receiver, fuel tanks and other)	fuel receiving, distribution and issue		phase of fuel turnover.	the Ministry of Regional Development and Infrastructure of Georgia Ministry of Environment Protection and Natural Resources of Georgia
Protection of water resources, soil and ground.	Surface water facilities, soil and ground in construction area.	Pollution of water resources, soil and ground by oil and other polluting substances.	Establishing of monitoring on fuel filling and possible leakage at the area of ground and surface waters Leakage reaction plan must be prepared by considering all stages of construction works.	Controlling of procedures of fuel reception, storage and giving away. Control during whole stage of creation of reaction plan and its implementation	Builder/contractor	Permanent monitoring on issues connected with fuel.	Roads Department of the Ministry of Regional Development and Infrastructure of Georgia Ministry of Environment Protection and Natural Resources
Protection of cultural and archaeologic	All works connected with construction	Landscape destruction, impact on cultural and	Landscape harmonisation plan must be worked out and approved before beginning of works according to relevant project given in	Controlling of all activities connected with	Builder/contractor	Permanent monitoring on activities	Roads Department of the Ministry of

Type of work	Building site	Expected influence	Mitigation measure	Monitoring measure	**Responsibility**		
					Responsible agency	Kind and periodicity of monitoring	Agency carrying out monitoring
1	2	3	4	5	6	7	8
al heritage of landscape Atmosphere, noise, vibration.	activities in alienation corridor including temporary access roads	archaeological heritage, deteriorating of air quality, noise impact on population	this document. In case of discovering new archaeological site, they must report about it to relevant bodies. All cars and construction machines must be checked regularly in order to prevent air pollution. Regular maintenance programs must be carried out for all mobile or other equipments. Dry ground must be watered during carrying out works on them	ground works, creation and implementation of landscape harmonisation plan		connected with land resources	Regional Development and Infrastructure of Georgia
Human beings and natural receptors	Transportation of materials along the territory envisaged for implementation of construction works.	Increased noise impact on people and natural receptors	Diminishing of operation of mechanism that produce too much noise until working hours.	Controlling of all technical equipment that produce noise and taking of relieving measures.	Builder/contractor	Permanent monitoring in settlements during all stages of construction works.	Roads Department of the Ministry of Regional Development and Infrastructure of Georgia
Protection of soil, ground, surface and ground water from pollution by remains.	On the territory envisaged for carrying out of works	Negative impact of remains that are left without control.	Management of remains according to two plans given in this document: pollution prevention and management of remains.	Permanent control on creation and storage of new remains in order to avoid their non controlled storage.	Builder/contractor	Permanent monitoring during all stages of construction works.	Roads Department of the Ministry of Regional Development and Infrastructure of Georgia

Type of work	Building site	Expected influence	Mitigation measure	Monitoring measure	**Responsibility**		
					Responsible agency	Kind and periodicity of monitoring	Agency carrying out monitoring
1	2	3	4	5	6	7	8
OPERATIONAL PHASE							
Tracking noise levels	Within 200m distance from the highway along the Project section.	Nuisance for communities residing within 200m distance from the highway.	Installing noise screening walls in the locations where noise level considerably exceed permissive levels, and/or improving green buffers	Measuring noise levels during 12 months after the section enters into full operation and comparing measures with the established permissive levels of 55dB by day time and 45dB by night time.	Builder / Contractor (during defect liability period of contract)	Quarterly instrumental measuring of noise levels by day and night times	Roads Department of the Ministry of Regional Development and Infrastructure of Georgia
Tracking air quality in the tunnel	Tunnel in the Sveneti-Ruisi section of the highway	Health hazard for people travelling through the tunnel	Improving air filtering system for the tunnel.	Measuring CO levels in the air inside the tunnel during 12 months after the section enters into operation and comparing measurements with the established permissive levels of 55 mg/m^3	Builder / contractor (during defect liability period of contract)	Quarterly instrumental measuring of CO levels	Roads Department of the Ministry of Regional Development and Infrastructure of Georgia
Tracking highway drainage water quality	In 4 locations of natural waterways closest to Sveneti-Ruisi section of the highway	Increased turbidity of surface water in the natural waterways and pollution with oil	Improvement of drainage system through design and installation of water purification facilities.	Measuring TSP in the natural waterways during 12 months after the section enters into operation and	Builder / contractor (during defect liability period of	Quarterly instrumental measuring of TSP and oil in water samples	Roads Department of the Ministry of Regional Development and

Type of work	Building site	Expected influence	Mitigation measure	Monitoring measure	**Responsibility**		
					Responsible agency	Kind and periodicity of monitoring	Agency carrying out monitoring
1	2	3	4	5	6	7	8
				comparing measurements with the established limits of 1.9mg/l for TSP and 0.1mg/l for oil	contract)		Infrastructure of Georgia
Tracking condition of green buffers	Along the motorway within the Project section	Deterioration of density of greed buffers due to fading of planted trees and bushes	Removal of faded plants and re-plating.	Visual observation	Roads Department of the Ministry of Regional Development and Infrastructure of Georgia	Monthly drive through the highway section	Roads Department of the Ministry of Regional Development and Infrastructure of Georgia
Ensuring air quality and fire safely in the tunnel.	Tunnel within Sveneti-Ruisi section of the highway	Accumulation of toxic gases in the tunnel; delayed notification on file breakouts	Regular and proper operation of air filtration and alarm systems	Tracking adherence to operation and maintenance rules of the air filtration and fire alarm systems	Roads Department of the Ministry of Regional Development and Infrastructure of Georgia	Quality control of the performance of personnel servicing the filtration and alarm systems	Roads Department of the Ministry of Regional Development and Infrastructure of Georgia

Table 8.3 Specific Mitigation Measures to be Undertaken by Contractor

Location (start, end)	Buildings / Structures	Specific Mitigation Measures
Gori crossroad 79+855-80+055 Tskhinvali crossroad 82+500_83+150 Road passage 85+026	Access ramp, Crossroads	Do not use these areas for temporary storage of construction materials or as a temporary accumulation site for construction waste to prevent blocking access to ramp. Do not locate construction machinery / equipment nearby access ramps. During construction activities avoid working in such areas during rush hours and place all relevant traffic control signs.
Access road to Gori 79|+600 Access road to Tskhinvali 82+855 Access road to Gori 82+855 85+155	Access roads (to houses)	Do not use these areas for temporary storage of construction materials or as temporary accumulation site for construction waste to prevent blocking access to houses / infrastructure. Do not locate construction machinery/ equipment near the access road. While working in populated areas contractor shall strictly keep normal working hour, maintain machinery/equipment in a good operational conditions to minimize noise, vibration and emissions or fumes; shut down machinery/ equipment when it is not directly in use. Road signs must be installed in order to ensure safety of pedestrians and control of the traffic.
79+551	Concrete chutes	Do not use this section for temporary storage of construction materials, collection of construction wastes, or parking of construction cars and equipment because leakage of construction materials may cause water contamination.
79+551 80+315 80+464 81+252 81+440 81+685 82+065 82+305 82+479 82+551 82+704 82+859 83+055 83+117 83+355	Pipe	While working in this section of the road do not store construction materials, construction waste, machinery and equipment, as this may result in pollution of water by construction run-offs or leakages.

83+667 83+744 85+026 85+111 85+047 85+420 87+803 88+919 91+610 92+203 92+216		
79+842 80+215 80+688 81+763 82+793 84+030	Bridge	While working in this section of the road do not store construction materials, construction waste, machinery and equipment, as this may result in pollution of water by construction run-offs or leakages. In order to avoid sedimentation when the terraced section of the river banks is being leveled and trenches necessary for installation of bridge piers are arranged in accordance with the project design configurations, it is necessary to arrange barriers from inert materials. Construction of bridge crossings must not be conducted during the spawning period of the fish (between April and mid September). During construction of the bridge piers and protective structures, the working hours necessary for filling concrete must be minimized; During the construction of bridge piers and structures it is prohibited to pile and store in the river bed the material excavated from the trenches; The technical condition of the machinery and special equipment working in the river bed and river terraces must be checked on a daily basis in order to avoid leakage of oil products into the water.
79+155 83+905	The access road to the land lot	Do not use this section for temporary storage of construction materials or collection of construction wastes, in order to avoid blocking up the access road to the field. Do not park construction cars and equipment near such roads.
86+905-87+685	Tunnel	Special environmental impact mitigation measures are required i.e. the number of machinery/equipment working inside the

		tunnel must be limited to the minimum (only strictly necessary) and special air filtration equipment must be provided. The working personnel must have special respiratory devices for personal protection. The air quality at the tunnel construction site must be constantly monitored and controlled. Special mitigation measures are required i.e. special air filtration equipment must be used.
87+400	Forest Area	Before starting the construction, while cleaning the territory, an additional research must be carried out in order to identify any important flora species that have to be transplanted, also which exist here and may occur within the right of the way area. Felled trees can be given to the local government bodies for further sale. In order to preserve ecological balance, trees will be planted at 1:1.5 ratio, in order to replace every tree felled within the right of the way area or on territory needed for arrangement of ground-based facilities. During the compensatory tree planting, important species of the local flora need to be planted. Concrete methodology of complex restoration of the territory has to be developed taking into account the erosion tendency of the soil at the particular section.
86+900	Temporary construction camp and temporary access roads	Before starting the construction it is necessary to investigate the possibility of leaving the flora (trees and bushes) intangible. Work must be started by removing the top soil from the territory and storing it at the site selected in advance. Waste water from the construction site (showers, kitchen, toilet etc.) must be accumulated in special septic tanks before directing it to the water treatment facilities. The water must be directed to the water treatment facilities only after settling and preliminary cleaning. Storage of oil products at the temporary construction base: o a barrier constructed from water resistant material must be arranged

		around the oil reservoir in order to prevent spill of oil products; o the territory inside the barrier must also be covered with water resistant material; o the territory used for distributing/receiving fuel by means of tank trucks must be arranged taking into account oil spill prevention measures; o it is absolutely forbidden to fuel special machinery and transport within the river bed and nearby terraces, during the construction of the bridge crossing over the Liakhvi River. While selecting the temporary access routs it is necessary to take into account that: o the routs must be as far from the populated areas as possible; o adverse affects on important species of trees and shrubs must be avoided as much as possible. Arrangement of temporary access roads must be started by removal of the top soil and its storage at the sites selected in advance.

8.6 Implementation Schedule and Cost estimates

There is given approximate expenses of relieving measures and monitoring plan in the table. Expenses of construction activities must be included in the contractor works package and the expenses, which will be needed for assisting of Roads Department of the Ministry of Regional Development and Infrastructure of Georgia for making of environment management plan and holding of relevant trainings, will be included in construction monitoring expenses.

Table 8.3. Environment Impact Relieving and Monitoring Expenses

№	Paragraph	Unit	Quantity	Item price $	Total
	Relieving measures described in the chapter 9.2[1]				
№1	Planting of trees in order to compensate their cut down.	Plant	1000	8	8000
№2	Measures for protection of adjacent settlements from noise and dust impact.	Day	300	125	37500
№3	Measures against landslide and erosion.	Technical project estimates are included			
№4	Selection of construction areas and arranging of temporary camps in accordance with environment principles Taking of humus soil layer, its storage and its usage for the second times.	Technical project estimates are included m^3	1125	7	7875
№5	Technical protection measures during construction of bridges.	Technical project estimates are included			
№6	Training of workers and personnel in the issues of safety and healthcare.	Total price	1	5,000	5000
№7	Accidental archaeological discoveries, training of workers in this issue.	Total price	1	3000	3000
№8	Restoration of the territory which was under impact, fertilization of soil and covering it with the layer of soil that was taken at the beginning.	Technical project estimates are included			
№9	Identification of areas for storage of remains. Keeping of procedures of treating remains.	Technical project estimates are included			
№10	Quarries, environment protection measures	Total price	1	20000	20000
№11, №12	Noise diminishing measures during the stage of highway planning and operation, acoustic screens	Technical project estimates are included			
№13	Planting of bushes and trees across the highway (on both sides on the road) as a measure against air pollution	Plant	50000	5	250000
№14	Measures of fighting against parasites and pesticides	Minimal			
	Monitoring described in the environment protection plan given in the chapter 10.5				
	Cleaning works in the area	Estimates of technical project /monitoring measures are included			
	Regular restoration of sensitive environmental areas that are used during construction works	Estimates of technical project /monitoring measures are included			
	Water resources management monitoring in construction sites	Estimates of technical project /monitoring measures are included			
	Monitoring of storage of humus soil layer	Estimates of technical project /monitoring measures are included			
	Protection of workers' safety and health / periodic monitoring of training	Hour	100	100	10000
	Surface water protection measures monitoring during implementation of construction works	Estimates of technical project /monitoring measures are included			
	Monitoring of underground water protection measures during implementation of construction works	Estimates of technical project /monitoring measures are included			
	Air and noise, regular checking of cars and construction machines	Estimates of technical project /monitoring measures are included			
				Total	**341375..00**

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1. Climate and meteorology,
2. Calculations of automobile emissions and its graphical modeling,
3. Inventory of Historical and Architectural Monuments,
4. Recommended filtering device for treatment of drainage,
5. Baseline data on noise pollution and recommendations on the installation of noise screening walls,
6. Calculation of annual drainage volumes for the Sveneti-Ruisi section of highway.

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4. Law of Georgia "On Ecological Expertise". Georgia Legislative Herald No. #47 26.12.2007.

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26. Statutory act of Georgia "Environment quality standards" SN 2.2.4/2.1.8. 000-00. Noise at working places, residential and public building premises and residential development territory . Georgia Legislative Herald No. 90, 2001, p. 186-194.

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