**Roads Department,**
**Ministry of Regional Development**
**and Infrastructure (RDMRDI)**

# Preparatory Survey for East-West Highway (E-60) Development Project (Phase 2) in Georgia

# Final Report

## Appendix – Volume 2

**September 2018**

**JAPAN INTERNATIONAL COOPERATION AGENCY**

**PADECO Co., Ltd.**
**Oriental Consultants Global Co., Ltd.**

| |
|---|
| 3R |
| CR(7) |
| 18-007 |

# <Appendix List>

## (Appendix - Volume 1)

| | |
|---|---|
| Appendix 4.1 | Design Drawings of Super Structure for Steel Bridge |
| Appendix 4.2 | Alignment Design Change History of Mountainous Side (from FS to final DD version) |
| Appendix 4.3 | Inter-Change Design Change History (from FS to final DD version) |
| Appendix 4.4 | Topography and Tunnel Location |
| Appendix 4.5 | Additional Geotechnical Investigation |
| Appendix 6.1 | Evidence for the calculation results of Construction Cost by Construction Period |
| Appendix 7.1 | F4-Bill of Quantities (Final Version) |

## (Appendix - Volume 2)

| | |
|---|---|
| Appendix 8.1 | EIA (Final Version) |
| Appendix 8.2 | LARAP (Final Version) |
| Appendix 12.1 | Team Member List |
| Appendix 12.2 | Minutes of the Meeting – Extract the main ones - |

# Appendix 8.1

# Environmental Impact Assessment (EIA)

# Environmental Impact Assessment

Final – March 2018

Environmental Impact Assessment of Section F4 of the Khevi-Ubisa-Shorapani-Argveta Road (E60 Highway)
Republic of Georgia.

# Table of Contents

## Figures

## Tables

## Appendices

**Appendix H** Noise Barrier Cost Estimate
**Appendix I** Vibration Analysis

# Abbreviations and Acronyms

| | |
|---|---|
| ADB | Asian Development Bank |
| BAP | Borrow Pit Action Plan |
| BAT | Best Available Technology |
| BGL | Below ground level |
| CAREC | Central Asia Regional Economic Cooperation |
| CAP | Corrective action plan |
| CFC | Chlorofluorocarbon |
| CIS | Commonwealth of Independent States |
| CO | Carbon monoxide |
| $CO_2$ | Carbon Dioxide |
| Cr | Chromium |
| dBA | decibel |
| DD | Detailed Design |
| EA | Executing Agency |
| EIA | Environmental Impact Assessment |
| EHS | Environmental Health and Safety |
| EMP | Environmental Management Plan |
| EM | Environment Manager |
| ERP | Emergency Response Plan |
| ES | Executive Summary |
| EWH | East West Highway |
| FE | Iron |
| GAA | Georgian American Alloys |
| GDP | Gross Domestic Product |
| GEL | Georgian Lari |
| GHG | Greenhouse Gases |
| GoG | Government of Georgia |
| GOST | Technical Standard |
| GRM | Grievance Redress Mechanism |
| ha | Hectare |
| IBA | Important Bird Area |
| IBC | Intermediate bulk storage containers |
| IFC | International Finance Corporation |
| IEE | Initial Environmental Examination |
| IES | International Environmental Specialist |
| IUCN | International Union for Conservation of Nature |
| km | Kilometer |
| $Km^2$ | Square kilometer |
| mg/l | Milligram per liter |
| $mg/m^3$ | Milligram per cubic meter |
| $m^3/s$ | Cubic meters per second |
| $m^3/d$ | Cubic meter per day |
| m | Meter |
| $m^2$ | Square meter |
| $m^3$ | Cubic Meter |
| MAC | Maximum Allowable Concentrations |
| MoENRP | Ministry of Environment and Natural Resources Protection |
| MPE | Maximum Permissible Emission |
| MPD | Maximum Permissible Discharges |
| NES | National Environmental Specialist |
| NGO | Non-Governmental Organization |
| $NH_4+$ | Ammonium |

| | |
|---|---|
| $Nm^3$ | Normal cubic meter |
| NOx | Nitrogen oxides |
| $NO_3$ | Nitrate |
| Ni | Nickel |
| OHS | Occupational Health and Safety |
| PAH | Polycyclic aromatic hydrocarbons |
| PCR | Physical and cultural resources |
| Pb | Lead |
| PM | Particulate matter |
| POPs | Persistent organic pollutants |
| $PO_4$ | Phosphate |
| PMU | Project Managing Unit |
| PPE | Personal Protective Clothing |
| PPTA | Project Preparatory Technical Assistance |
| PPM | Parts per million |
| SPM | Suspended Particulate Matter |
| SniP | Construction Standards |
| STD | Sexually transmitted diseases (such as HIV/AIDS) |
| SSEMP | Site Specific Management Plan |
| $SO_2$ | Sulfur Dioxide |
| TEM | Trans-European North-South Motorway |
| TOR | Terms of Reference |
| TSP | Total Suspended Particulates |
| UNEP | United Nations Environment Program |
| USAID | United States Agency for International Development |
| USD | United States Dollar |
| WB | World Bank |
| WHO | World Health Organization |
| WMP | Waste Management Plan |
| °C | Degrees Celsius |
| $\mu g/m^3$ | Micrograms per cubic meter |

Currency Exchange Rates as of 13th January, 2018:
1 US$ = 2.56 (GEL)
($ refers in this report to US-Dollars)

# Executive Summary

## 1. Introduction

1. This Environmental Impact Assessment (EIA) is part of the process of compliance with the ADB guidelines and JICA Guidelines for Environmental and Social Considerations (April, 2010) in relation to the construction of Section F4 of the new Khevi-Ubisa-Shorapani-Argveta section of the E60 Highway, or more simply, the "Project". The Project road is approximately 14.7 kilometers long and for construction purposes will be divided into two construction packages, or 'Lots'. The first Lot extends from KM0.00 to KM5.6 with the second Lot covering KM5.6 to the end of the Project road at KM14.7.

2. The EIA provides a road map to the environmental measures needed to prevent and/or mitigate negative environmental effects associated with the project. More specifically, the EIA:

- Describes the existing socio-environmental conditions within the Project area;
- Describes the extent, duration and severity of potential impacts;
- Analyzes all significant impacts; and
- Formulates the mitigation actions and presents it all in the form of an Environmental Management Plan (EMP).

3. Based on the existing ADB Environmental Safeguards Policy (2009), this Project falls under ADB's project **Category A** and **Category A** under JICA Guidelines for Environmental and Social Considerations (April, 2010).

## 2. Project Background

4. The Government of Georgia is endeavoring to make Georgia a regional and logistics hub and more attractive for businesses. The East West Highway (EWH), stretching 410 km from Sarpi on the Black Sea, at the border with Turkey, through the center of the country to the capital Tbilisi and on to the border with Azerbaijan, is the main inter-regional and international route between western and eastern Georgia, as well as its neighboring countries. Representing about 2% of Georgia's road network and one fourth of its international roads, the EWH serves 8,000 to 10,000 vehicles per day and carries over 60% of the country's international trade. The EWH will be an integral part of one of the six key CAREC corridors providing the shortest transit link to connect Central Asia with Europe and East Asia.

5. In light of the traffic growth on EWH, the high percentage of truck traffic, and the difficult terrain and resulting geometric profiles, capacity expansion of the current 2-lane mountainous section between Chumateleti and Argveta is crucial to realizing full potential of the EWH with improvements to the highway either completed or underway on each side of this section.

6. Therefore, the Government has requested the Asian Development Bank (ADB) and several other development partners to finance the remaining bottleneck sections (Chumateleti - Argveta) on the EWH. A feasibility study financed under a World Bank project for the Chumateleti Argveta section (comprising four sections F1 through F4) of the EWH was completed in 2015. The detailed design of Section F1 has been completed and selection of the construction Contractor is on-going. Detailed design of sections F2, F3 and

F4 is now on-going and this report forms the EIA for detailed design phase of section F4 which will be followed by sections F3 and F2.

## 3. Project Description

7. The Project involves construction of a new road section of the E-60 highway located in Imereti Region of central Georgia (see **Figure ES-1**). Section F4 forms the Shoropani – Argveta portion of the Khevi-Ubisa-Shorapani-Argveta section of the E-60. The length of the Project road is as follows:

- Right lane **(TA)** - 14.778 km;
- Left lane **(AT)** - 14.726 km.

**Figure ES-1: Road Location Map**


8. The Projects geometric design standards have been selected based on traffic flow, road category and relief to ensure safe and unimpeded traffic flow. The road design is based on Georgian National Standard SST 72: 2009 “Standard on Geometrical and Structural Requirements for the Public Motor Roads of Georgia” and TEM (Trans-European North-South Motorway) Standards.

9. The main technical parameters adopted in the detailed design are as follows:

- Design speed - 100 km/h;
- Number of traffic lanes – 4;
- Width of traffic lane - 3.75 m;
- Width of each carriageway - 7.5 m;
- Width of paved shoulder (emergency lane) - 2.5 m;

- Width of verge – 1.0 m;
- Width of central reserve- 5.0 m;
- Width of paved shoulder at the central reserve - 1.0 m;
- Total width of each paved platform – 11.0 m
- Width of road bed - 27.0 m;
- Carriageway cross-fall on straight sections - 2.5%;
- Minimum radius of horizontal curve - 400 m;
- Maximum longitudinal gradient - 4%;
- Minimum convex curve - 15 000 m;
- Minimum concaved curve - 15 000 m.

10. Five long span bridges and one short span bridge will be constructed during the project works. The total length of the five bridges is 4,912 meters, the longest of which is 941 meters. The bridges are grouped into the following main typologies:
- Steel-concrete bridges - bridges 1,2,4: maximum span length up to 60 m for bridges 1 and 2 and up to 72 meters for bridges 4-AT and 4-TA.
- Precast concrete bridges – bridges 3 and 5: maximum span up to 34m

11. Six tunnels will be constructed with double tubes with length from 399 m to 1166 m.

12. To construct the roadbed in the project section concrete retaining walls and reinforced concrete support structures will be required on several sections due to the difficult relief conditions of the project section. Reinforced concrete retaining walls are required at the beginning of the project section from:
- KM 0.00 to KM 0.25
- KM 8.63 to KM 8.71
- KM 8.84 to KM 8.94

13. There are four interchanges planned in F4 Section.

14. The following types of culverts will be constructed:
- Underpasses for rural roads, which are construction of cast in situ reinforced concrete structures of closed contours cross sections 6.0x4.5 m - 6 units for passing rural roads is envisaged in the design.
- Cattle passes, which ensure cattle cross the project road. Construction of cast in situ reinforced concrete structures of closed contours cross sections 4.0x2.5 m - 4 units is envisaged in the design.
- Culverts, for which cast in situ reinforced concrete culverts cross section 2.0x2.5 m - 17 units, 4.0x2.5m - 2 units is envisaged in the design to provide water discharge from ravines and canals.

15. Eight underpasses will be constructed using reinforced concrete culverts. One overpass will be constructed at km 11+854 with a length of 40 meters.

16. Two different pavement structures will be used:
- Concrete pavement structure for the motorway and interchanges; and
- Asphalt pavement structure for all Slip Roads and all Minor Roads and bridges.

## 4. Alternatives

17. The “No Action” Alternative in this instance is defined as a decision not to undertake the proposed construction of the Project Road. The “No Action” Alternative would result in the continued deterioration of the road, bridges and drainage structures along the RoW,

thereby impeding the economic development of the Project Area and the Imereti region. All positive benefits would be foregone. The relatively minor, less than significant environmental impacts (such as noise and short-term air quality impacts due to maintenance activities) and inconveniences (such as traffic diversions) would be avoided in the short-run. In the long run, however, the steadily declining state of the roadway would severely hamper economic development in the area. In light of these considerations, the "No Action" Alternative is deemed to be neither prudent nor in the best interest of Georgia or those with an interest in, and attempting to assist restoration of, Georgia's well being.

18. Given the complex topography of the region and Georgia in general, there are no other feasible alternative corridors that would be able to compete with the existing corridor in terms of travel times. In addition the Project forms part of the overarching program to upgrade the E-60 motorway which includes many sections that have recently been upgraded, or are in the process of upgrading (or detailed design), including the sections of road joining the start and end points of the Project road.

19. As noted above, the Project forms part of a program upgrading the E-60. The Khevi – Argveta section of the E-60 (including section F4) if one of the last remaining sections of the road requiring upgrading. Accordingly, the Project is focusing on the upgrading of the E-60 and will not consider any other transport mode as an alternative.

20. During the Projects Feasibility Phase a number of alignments were considered that broadly follow the existing E-60 corridor. The result of the Feasibility Report was a draft final corridor which the detailed design would use as a basis for the final road alignment (horizontal and vertical). During the detailed design phase a number of factors were taken into account to determine the final alignment, they included the consideration of potential resettlement issues and social aspects such as access and noise.

21. Only one pavement type was considered for the main pavement; rigid concrete mainly due to the fact that concrete pavements are already constructed on preceding sections of the E60 Highway. Asphalt pavement structure will however be used for all Slip Roads, bridges and all Minor Roads and bridges.

# 5. Description of the Environment

22. Within the Project area the main sources of air emissions are from transport, including vehicles on the existing Project road, and large scale industrial facilities including the Georgian American Alloys (GAA) manganese processing plant which is located almost adjacent to the southern boundary of the Project road between KM 11 and KM 12. Air quality monitoring was carried out at nine different locations during August, 2017 to characterize the current air quality within the Study Area. The results of the ambient air quality monitoring show that in all instances the parameters monitored were below national, and where applicable, IFC standards. The most noticeable factor was the higher levels of PM recorded at the first four monitoring stations which are adjacent to the existing road. This suggests that these levels $PM_{10}$ and $PM_{2.5}$ are attributable to vehicle movements on the existing road.

23. Annual precipitation in Zestafoni is around 1,200 mm. Rainfall is highest in the Winter, Autumn and Spring, although rainfall can still be observed during the hotter summer months. The monthly temperature for Zestafoni which ranges on average, from 5 °C in the winter months to around 25 °C in the summer. The dominant wind direction is from the east. However, strong winds from the west are also experienced quite frequently.

24. No site-specific data has been found relating to climate change. However, given the general overview for Georgia it can be assumed that there will be an increase in average

annual temperatures of between 1 and 1.5 °C over the next 30 years and that precipitation will decrease. The number of hot days may increase, and as such, consideration of suitable pavement types shall be given.

25. The Project area is located to the west of the Likhi Range which connects the Greater and Lesser Caucus Mountains. The Project corridor is set within a landscape of mountains, rolling hills and valley plain. The existing road is located within the bottom of the river valley and as such elevation only varies between 200 and 170 meters above sea level.

26. Within the Project area a few areas prone to landslides have been identified. Generally, the landslides do not affect the project alignment, except for the mass movements identified above around KM 0.6 affecting TUN 4.0.01-TA/AT and its eastern and western portals. According to the Seismic Hazard Map of Building Norms and Rules effective in Georgia the study area is located in the 8-point earthquake zone (MSK 64 scale).

27. Two main rivers can be found within the Project area, the Kvirila and the Dzirula. The confluence of the two rivers is in Shorapani adjacent to the Project road at Km 5.0. Other small tributaries within the are include the Borimela River (which the Project road crosses at KM 3.5), and the Ajamura and Samanishvilisghele rivers, both of which located on the south bank of the Kvirila river more than 1.3 km from the Project road. To assess the status of water quality in the Project area, including the Kvirila and Dzirula rivers, monitoring of surface water was undertaken in September 2017. The results of the monitoring exercise show that both the Dzirula and Kvirila rivers meet the national Maximum Allowable Concentrations (MACs) for surface water quality, although the levels of manganese in the Kvirila sample was above the recommended standards for drinking water, this is due to the presence upstream of manganese mining operations.

28. The soils in the Project area are very productive and range of crops are grown in the region which is well known for its wine production. However, hazardous wastes generated by the GAA, Chiatura manganese enrichment plant, and many small-size smelters operating in various settlements of Imereti are sources of soil pollution in the region. To assess the status of soil quality in the Project area, specifically around the Georgian American Alloys Plant (GAA) plant, soil samples were taken and analyzed. The results of the sampling show that all parameters are within the current Georgian limits with the exception of Arsenic and Lead. However, these limits are considered outdated, stemming from old regulations developed during Soviet times. Assessing the results against EU limits (Italy and the UK), the results of all parameters sampled are well within the limits for residential areas. In addition, the results are also well within the proposed Georgian maximum allowable concentrations recently developed by the MoENRP which should come into force in 2018. Most importantly, all parameters are also below the proposed Georgian preventive limits of risk elements in agricultural soil, which is an important facor considering that much of the spoil material may be disposed of at the Kutaisi bypass which borders on an area of agricultural land. Additional analysis of PAHs shows that both samples meet the Dutch target levels meaning that the soil is considered a sustainable soil quality and will have negligible risk to the ecosystem.

29. The project corridor crosses forest areas, agricultural land plots, hilly forest slopes, residential areas and riparian ecosystems. 17.3 hectares (ha) of the municipality of Zestaphoni is covered by forest and shrubbery. Due to human pressures natural vegetation has been taken over by agricultural crops and other human development. In these areas arable lands and pastures have developed. Some of the animal species typical for the area have moved to other areas in away from human activity. Over the time the fauna of the region has changed significantly. Animals currently found in the area of interest are mainly presented by those species that live in forested areas and/or can tolerate presence of humans.

30. A study of flora within the Project area showed that the corridor could be split broadly into six sections, most of which were classified as a mix of 'high' and 'low' status. The low status areas were mainly classified in this was due to the absence of any unique flora in these areas and the generally degraded nature of the landscape due to human interference. The 'high' status areas were classified as such primarily due to the presence of a number of tree species fund on the Georgian Red List.

31. According to available information there are two species (Caucasian squirrel and Eurasian otter) considered as vulnerable in Georgia (Georgian Red List) that may be found within the Project area. As part of a fauna survey the bridge locations were checked with particular care and no otters were noted. During the survey trees within the RoW of the new alignment (with exclusion of the areas where tunnels are planned) have been checked. Neither burrows, nor squirrels have been registered in the survey area. The review of the habitat along the alignment indicates that it is not optimum for existence of the Caucasian squirrel.

32. The nearest protected area to the Project road is the Ajameti Managed Reserve, which is located approximately 5 kilometers south west of the end point of the road (km14.7). The nearest Important Bird Area (IBA) to the Project road is the Adjara-Imereti Ridge more than twenty kilometers south of the Project road.

33. Viticulture is the main economic activity in the municipality of Zestaphoni providing 80% of agricultural output. Its development is supported by favorable soil-climatic conditions. GAA is the largest company in Zestaphoni. GAA produced over 187,000 metric tons of silico-manganese in 2012, however the mining and production of the manganese is not without its environmental problems, including impacts to air quality and impacts to the water quality of the Kvirila River. The Project road passes almost adjacent to the north of the plant for around 2 kilometers between KM 9.7 and KM 11.8.

34. Agricultural land plots cover 7,027 ha of the municipality or 46% of the whole territory. 5,159 ha out of the above-mentioned area are arable lands. Other than grapes, melon and maize are predominant crops grown in the region and have been noted within the Project corridor, specifically from KM 7.0 onwards.

35. Zestaphoni is not considered an important or significant area for tourism and recreation. A recent study of foreign visitors to Imereti region indicated that less than 2% of the visitors visited Zestafoni for recreation or vacation.

36. The road network in the Project area is dominated by the existing E-60 which links Tbilisi with Batumi. Numerous local roads feed onto the E-60 in Zestafoni, and these roads vary in condition from good to very poor. The main railway line from Tbilisi to Batumi runs broadly parallel with the Project road until it reaches Zestafoni. In fact, in the first section of the road, between KM 0.0 and KM 6.0 the railway line and the road are only separated by a couple of hundred meters, with the road running south of the railway line. At one location, the new road alignment passes within 20 meters of the railway line (KM 2.5) and eventually passes over the railway line at KM 6.3 as the road heads northwest to start its bypass around Zestafoni.

37. The Project road is located within Zestaphoni Municipality, which covers a total area of 423 square kilometers and includes the towns of Zestaphoni and Shorapani as well as numerous small villages. The following settlements have been identified within the Project area.

- Kveda Tseva (KM 0)

- Shorapani (KM 4.0 – 6.0)
- Zestaphoni (KM 6.0 – 11.0)
- Kveda Sakara (KM 11.0 – 12.0)
- Argveta (KM 13.0 – 15.0)

38. According to the most recent census data (2014), Imereti has a population of 533,906, which is a significant decrease from the 2002 census when the population was recorded as 699,666.

39. Data provided by the Road Department of the Ministry of Regional Development and Infrastructure (RD), shows that during the period 2012 – 2016 there were 2,713 collisions, 471 persons killed and 4,913 persons injured spread over the E-60 corridor. Focusing the analysis on the Khevi – Argveta section, 351 collisions occurred, 78 persons were killed and 648 persons were injured. Finally, along the F4 section 130 collisions occurred, with 30 persons killed and 218 persons injured.

40. The social survey undertaken as part of this Project found that the average wage of the population in the target villages is 650 GEL. The majority (70%) of those surveyed state that the main source of income is wage, 20% of the surveyed families said that main source is pension / allowance, only 5 % said that it is self-employment.

41. Previously there was a landfill site in Zestafoni adjacent to Kvaliti village. The area of the site was 2.2 hectares and received 15,000 $m^3$/year of waste. However, the Solid Waste Management Company of Georgia closed the Zestaphoni municipal landfill in 2016 due to the fact that it was overloaded. No other landfill has been observed in Zestaphoni.

42. Within the Project area a number of physical cultural resources (PCR) have been identified including the Shoropani Fortress. None of the identified PCR, including the Shoropani Fortress is within close proximity of the Project road itself, with the exception of a cemetery and a small natural spring located to the north of the GAA.

43. Noise and vibration within the Project corridor can be discussed in two parts, firstly the parts of the corridor that broadly follow the existing alignment, and secondly the part of the corridor that bypass to the north of Zestafoni more than 500 meters north of the existing road. Noise levels within the first part are predominantly a result of vehicle traffic on the existing road. Very little commercial, residential or industrial activities can be observed in these areas that would give rise to significant noise levels. In the second part of the corridor the alignment traverses a predominantly rural / residential landscape with the exception being the portion of the alignment that passes just to the north of the GAA facility. Noise and vibration monitoring has been undertake in both parts of the road for this EIA. Vibration values in the monitoring locations are currently too low to cause any structural or cosmetic damage and/or cause nuisance of the residents. According to the national standard the values are ranked as weak and non-perceptible. Noise monitoring results show that noise levels close to the existing road are elevated above IFC daytime and nighttime standards. However, as the Project corridor enters the rural bypass around the north of Zestafoni noise levels get lower and are within IFC guideline limits for daytime and nighttime noise.

# 6. Impact Identification

44. The following provides a summary of the potential impacts associated with the roads:

**Design / Preconstruction Phase**

45. Air Quality – lack of foresight in the siting of construction camps, rock crushing plants, concrete batching plants and borrow pits in the pre-construction phase could lead to significant air quality impacts in the construction phase, especially to sensitive receptors.

46. Soils – Productive soils can also be impacted without due consideration of their value when locating borrow pits, access roads, camps, plant, etc. Soil erosion can also occur on embankments and around structures if adequate consideration of this issue is not taken into account in the design phase. Soil samples taken to the north of the GAA plant have indicated that this area does not comprise levels of soil contamination above Dutch Intervention Levels or Italian standards for residential areas. Arsenic and Lead were identified in the samples above the current national limits, but within proposed new national limits and other international limits (UK and Italy). However, only two soil samples were taken in this location and it is possible that soil contamination could still exist in the area north of the GAA. The Project road runs parallel to the GAA plant for approximately 1.3 kilometers, but the potential for any additional pollution is considered to be confined to a smaller area, around 500 meters in length, and is focused around large two piles of waste material sited on the northern boundary of the GAA. In this portion of the Project road the road level will be raised on an embankment. An average of 50 cm of topsoil will be stripped from an area more than 40 meters wide over this 500 meter section, that equates to around 10,000 $m^3$ of top soil to be removed. Although the two soil samples taken as part of this EIA did not show significant levels of contamination it is considered prudent to undertake additional sampling of these soils to determine if any additional actions for soil monitoring and disposal would be needed during the construction phase.

47. Natural Hazards - Generally, landslides in the Project area do not affect the project alignment, except for the mass movements identified above around KM 0.6 affecting TUN 4.0.01-TA/AT and its eastern and western portals. The impacts from the landslides are not expected to be significant enough to warrant major mitigation measures as part of the detailed design. However, minor mitigation measures e.g. safety nets have been included in the design. The project is located in a seismically active area. The Detailed Design Consultants have experience of designing roads in seismically active areas and have ensured that all designs are compliant with the relevant seismic standards of the GoG.

48. Land Use - As the road involves construction of an almost entirely new alignment land acquisition and resettlement could be anticipated to be extensive. However, the approach to design the road bypassing to the north of Zestaphoni and the fact that large portions of the road run beneath ground reduces the level of resettlement and compensation that would otherwise be expected if the existing alignment was being upgraded.

49. Hydrology - Inadequate assessment of the hydrological conditions in the Project Area and poor design could result in the failure of some of the Project structures, including bridges and culverts. This in turn would result in several impacts including cost to rebuild the structures, potential flooding and impacts to surface water quality.

50. Health safety – Failure to incorporate a full range of safety measures into the road design may result in accidents and even deaths on the road, especially close to schools.

**Construction Phase**

51. Air Quality - During construction of the road, air quality may be degraded by a range of operational activities including; exhaust emissions from construction machinery; open burning of waste materials; and dust generated from borrow pits, haul roads, unpaved roads, exposed soils, material stock-piles, etc. This can lead to health impacts to locals and impacts to ecology and crops.

52. Soils - Potential soil contamination is a possibility in the construction phase resulting from poorly managed fuels, oils and other hazardous liquids used during the project works. It is also possible, that without adequate protection measures soil erosion could occur on road and bridge embankments.

53. Surface Water – Impacts to surface water and groundwater could occur through improper operation of construction camps, asphalt plants, etc. Poor construction management around bridges and close to surface watercourses could also lead to pollution incidents. Without due care temporary drainage structures may also fail, or get obstructed with construction debris, leading to flooding of property and access roads. Technical water may be sourced from the Dzirula and Kvirila rivers. The required amounts, potentially 200 $m^3$ per day (0.002 $m^3/s$) are insignificant given the flow rates of these major rivers.

54. Groundwater – Impacts to groundwater include spills and leaks of hazardous liquids used at construction sites and camps and potential impacts to groundwater resources during tunnel construction (discussed in more detail below).

55. Bridge Construction - Bridge construction activities may increase silt load in the river during construction at bridge sites and may result in accidental spillage of concrete and liquid waste into the river. This may impact upon the ecology of rivers and aquatic wildlife.

56. Flora & State Forest Fund – A number of trees will need to be cut within the Project area, both on private land and within State Forest Fund areas. In addition, other trees (potentially including Georgian red-listed species) are located adjacent to the boundary of the site and may be damaged accidentally by construction works. A total of 7,232 trees have been identified in State Forest Fund areas. Of these, 204 are Georgian Red-listed species greater than 8cm in diameter and 411 are Georgian Red-listed species less than 8cm in diameter. The trees cut in these areas will need to follow the procedures for de-listing, cutting and removal as described below. Trees that will be cut located on private land will require compensation to be paid to the landowners. The compensation will be made according to the Project LARP.

57. Fauna - Impacts during the construction phase may occur, including; a) As a result of vegetation cover removal and earthworks habitats (nests, holes) may be lost. Tree and vegetation cutting will also affect the food base, b) Small-sized animals may fall in trenches and pits and may be injured, c) During the movement of construction vehicles and construction equipment, collision with animals may be expected, d) Emission of noise, dust and combustion products, as well as human intensive activities will cause animal disturbance and migration to other places, e) Unsystematic spread of waste, improper management of waste (change in environmental quality indicators) will cause a further deterioration of the living conditions of terrestrial and aquatic animals, f) Night lighting systems at construction camps may cause disturbance of animals and disorientation of birds, g) There may be the cases of poaching by staff, h) Temporary impacts on fish may occur due to sedimentation and water turbidity in the immediate vicinity of the construction work area, and the potential for minor introduction of pollutants from construction operations; and i) Bridge works could impact upon the habitat of otters.

58. Protected Areas - The nearest protected area to the Project road is the Ajameti Managed Reserve, which is located approximately 5 kilometers south west of the end point of the road and is unlikely to be impacted by Project works.

59. Infrastructure - The main impacts resulting from Project works will be road diversions and some temporary blocking of access routes. However, the road has been designed in a

way so that it has relatively little impact upon the existing road, or other local roads due to the fact that it is a new alignment often passing through tunnels and over bridges. In some locations road closure will be needed and may occur for periods between one and two hours and as such is not a significant issue as long as the local population are given notice of the delays and suitable detours are provided. The new alignment also crosses above and adjacent to the existing railway line at a number of locations. The bridge works above the railway line at KM 13.1 may cause specific issues due to its close proximity to railway.

60. Utilities - Medium and low voltage power lines, water supply and gas pipes are located within the Project corridor. It is possible that these utilities will need to be temporarily removed during construction.

61. Waste - Road construction will inevitably generate solid and liquid waste products including inert waste (e.g. concrete, wood, plastics, etc.) and hazardous waste (e.g. waste oils, batteries, etc.). In addition, uncontrolled discharges of sewage and 'grey water' (e.g. from washrooms and canteens) from construction sites and worker's camps may also cause odors and pollute local water resources.

62. Tunnel & Embankment Spoil Material - A large volume of spoil material will be generated from the tunneling works. Estimates provided by the Projects Tunnel experts indicate that as around 1,027,200 $m^3$ of spoil material will be generated from the tunneling. Another 1,184,100 $m^3$ of cut will be generated from excavation works on slopes, etc. Where practical the spoil will be re-used as embankment material at the Project site (for example on the embankments behind Zestaphoni). Estimates indicate that approximately 1,519,800 $m^3$ can be re-used as embankment material, which would leave approximately 691,500 $m^3$ as static balance. Assuming that most of the embankments associated with the Project are located in the bypass area to the north of Zestaphoni, the average journey distance to transport the spoil material from tunnels to the embankment areas may be around 8 kilometers. To transport material to the embankment areas approximately 250,000 truck journeys will be required, or an average of 277 a day over the 30 month construction period. Disposal of the static balance would require an area of 82,980 $m^2$ with a height of 10 meters if they were to be disposed of in one spoil disposal location. Preliminary investigations with the RD indicate that the spoil material could be re-used as embankment material at the Kutaisi Bypass where material is required to construct a further two lanes of the bypass. A field visit to the Kutaisi area did not indicate any sensitive land uses in this area which has already been acquired by the RD for the future construction works in this area. Disposal of spoil material in this location will require close coordination between the contractors of both projects and the RD. To transport this volume of material to Kutaisi Bypass over 115,250 truck journeys will be required, or an average of 128 per day over the 30 month construction period. The distance to the Kutaisi site is around 35.5 kilometers.

63. Construction Camps - Construction camps constitute a temporary land use change and raise issues related to activities such as impacts to air quality; poor sanitation arrangement and improper methods used for disposal of solid wastes and effluent; and transmission of communicable diseases to the local people by the construction workers due to inappropriate health monitoring facilities.

64. Borrow Pits - Opening and operating of borrow pits can result in multiple environmental and social impacts, including degradation of productive soils, elevated levels of noise, degradation of air quality, etc.

65. Tunnel Construction - The main typical environmental problems linked to the construction of underground works are; a) Triggering of surface settlements, structures collapses and slope instabilities, b) Drying up of springs and groundwater alterations, c)

Storage and use of excavated materials, d) Noise, e) Vibrations, f) Pollution of groundwater, mainly after the realization of stabilization works by injections.

66. Community Health and Safety – Construction activities may result in an increase in road traffic accidents between vehicles, pedestrians and vehicles and livestock and vehicles. There will also be short term impacts to noise and air quality, which may impact upon health. Migrant workers may also increase community health and safety risks, for example, through the spread of sexually transmitted diseases.

67. Occupational Health and Safety - Workers' rights including occupational health and safety need to be considered to avoid accidents and injuries, loss of man-hours, labor abuses and to ensure fair treatment, remuneration and working and living conditions.

68. Physical and Cultural Resources - No physical cultural resources have been identified within the Project corridor that are likely to be significantly impacted by Project works with the exception of one cemetery identified approximately 50 meters south of tunnel TUN 4.0.06-AT/TA and a small natural spring located to the north of the GAA.

69. Noise - The potential noise related issue during construction of the project is disturbance to sensitive receptors in the Project area. The main sources of noise and vibration during construction of the project included; a) Construction machinery, b) Drilling activities, c) Haulage and general vehicle movements, d) Concrete mixing and aggregate production systems; and e) Construction Camps / Ancillary Facilities.

70. Vibration - Vibration from the construction activities is a cause for concern to the community. The effects of vibration varies and depends on the magnitude of the vibration source, the particular ground conditions between the source and receiver, presence of rocks or other large structures in the area. The intensity, duration, frequency and number of occurrences of a vibration all play an important role in both the annoyance levels caused and the strains induced in structures. It is likely that construction works will impact upon structures within the Project area, potentially causing cosmetic damage and in extreme cases possibly structural damage.

**Operational Phase**

71. Climate Change - The transport sector is vulnerable to changes in climate variables, expected changes in the frequency and intensity of extreme weather events, and increased sea level. The following are a few examples of the potential effects; a) Changes in temperature—both a gradual increase in temperature and an increase in extreme temperatures—are likely to impact road pavements (for example, heat-induced heaving and buckling of joints), b) Changes in temperature will also impact the behaviour of permafrost and thus the infrastructure lying on permafrost, c) Changes in precipitation and water levels will impact road foundations, d) Extreme weather events such as stronger and/or more frequent storms will affect the capacity of drainage and overflow systems to deal with stronger or faster velocity of water flows, e) Stronger or faster velocity of water flows will also impact bridge foundations, f) Increased wind loads and storm strengths will impact long span bridges, especially suspension and cable-stayed bridges, g) High levels of precipitation may threaten embankment stability and h) Increase in scouring of roads, bridges, and support structures.

72. Hydrology – Run-off from bridge decks could pollute the waterways beneath them if they are allowed to drain freely without any filtration system.

73. Noise – A noise model developed for the EIA shows that there are many locations where IFC guideline limits for daytime and nighttime noise would be exceeded in 2037 given the predicted increase in traffic over this period. The model also shows that noise abatement, in the form of a 4 meter high solid noise barrier does help reduce noise levels, but in many instances, even with the noise barrier the road noise still exceeds IFC guideline limits, particularly the strict 45 dBA nighttime limit. The model is however, based on a range of variables, including traffic forecasts which may change in the future. Vehicle noise levels may also reduce with the advent of electric cars. Accordingly, while the model is useful in providing an indicator of areas where noise is likely to be an issue, it is not an end in itself.

74. Vibration - Highway traffic is not likely to have any measurable impact on the structures or on comfort.

75. Air Quality – The main source of air pollution during the operational phase will be vehicles moving on the highway. The main pollutants are: CO; $NO_X$; hydrocarbons (HC); $SO_2$; carbon dioxide ($CO_2$); and particulate matter (PM). An air dispersion model was prepared for this EIA to assess the potential operational impacts of the road on air quality in the future. The analysis suggests that there are no negative impacts on the environment. In addition to the fact that the maximum allowable limits are not surpassed, it must be taken into account that the road provides benefits in term of vehicular emission due to the smoother drive and optimized alignment. If a similar traffic flow should transit via the existing road, the emissions would be almost 20% higher. The new road will have a positive impact on the air quality in term of reduced emissions compared to a similar flow of traffic along the existing one. In addition it is reasonable to consider that in the next years a large part of the obsolete and aging vehicles now in circulation will be substituted by less polluting ones with additional benefits to air quality.

76. Health and safety – Rehabilitation of the road will result in numerous beneficial health and safety impacts, including; reduced dust levels, faster emergency response times; improved pedestrian crossing facilities and improved road geometry. However, higher speeds on the road could give rise to more traffic accidents, especially as speeds increase along with vehicle numbers.

77. Induced Impacts – Potential induced impacts include conversion of agricultural land to commercial, industrial and residential property, this in turn may lead to; a) Increased population living within the corridor which may lead to stress on social services, such as schools, hospitals, etc, b) Required upgrading or expansion of utilities, such as electricity supply, and c) Stresses on water availability, specifically groundwater.

# 7. Mitigation Actions

78. The summary mitigation measures for the potential impacts identified above for the Roads include:

**Design / Preconstruction Phase**

79. Site Specific Environmental Management Plan – To ensure that all of the potential mitigation measures are applied during the construction phase, the Contractor shall be responsible in the pre-construction phase for the preparation of his Site Specific Environmental Management Plans (SSEMP). The SSEMP shall include the following plans:

a) Waste Management Plan.
b) Traffic Management Plan.
c) Occupational Health and Safety Plan.
d) Emergency Response Plan.

e) Borrow Pit Management Plan.
f) Air Quality Plan.
g) Spill Response Plan.
h) Vibration Monitoring Plan.
i) Clearance, Re-vegetation and Restoration Management Plan.
j) Groundwater Management Plan.
k) Tunnel Blasting Plan.

80. The Construction Supervision Consultant (forthwith known as the 'Engineer') shall be responsible for reviewing and approving the SSEMP and its associated plans.

81. Permits – The Contractor shall be responsible for obtaining all of the required environmental permits prior to the start of construction. All permits will be reviewed by the Engineer before construction work commences.

82. Siting of Facilities – Locations for borrow pits, rock crushing facilities, concrete batching yards and asphalt plants will require approval from the Engineer, MoENRP and the RD during the Pre-construction phase. Efforts will be made to ensure that these facilities are as near to the Project road as practical to avoid unnecessary journeys and potential dust issues from vehicle movements during construction works on unpaved roads in urban areas. Haul routes will be prepared and submitted to the Engineer as part of his Traffic Management Plan (TMP). To prevent impacts arising from asphalt plants, construction camps, batching plants and rock crushing plants, they will be prohibited within 500 meters of any urban area or sensitive receptor (school, hospital, etc).

83. Air Quality - To adequately manage air quality impacts the Contractor will be responsible for the preparation of an Air Quality Plan.

84. Climate Change - Most climate change impacts are projected to occur slowly over a long period of time and as such providing mitigation measure for topics such climate change impacts on pavement design need to be taken over time and cannot be determined in a study like this. Notwithstanding the above a number of simple measures can be taken to ensure that in the short term that extreme precipitation events do not result in significant impacts to the Project, they include; a) Increase ditch and culvert capacity, b) Maintain positive cross slope to facilitate flow of water from surface, c) Increase resistance to rutting, d) Reduce splashing/spray through porous surface mixtures, e) More frequent use of elevated pavement section, f) Improve visibility and pavement marking demarcation, and g) Ensure that all embankments are seeded to help increase stability.

85. Contaminated Soils – An additional four samples will be taken as part of this EIA (from recently excavated boreholes close to the GAA) and the results presented as an addendum to this report. If the results show that the monitored parameters are within the proposed national limits and the Dutch target values no further soil sampling will be considered necessary. Should the results of the monitoring indicate any elevated levels of contamination further testing of the excavated soils in this area will be required during the construction phase by the Contractor. The procedure for any construction phase testing is as follows:

1. The Contractor shall identify a temporary storage area for excavated material.
2. The Contractor shall strip the topsoil in batches of 2,500 $m^2$ and store the mixed material in the temporary storage area (the stockpile).
3. The Contractor shall then divide the stockpile into quadrants of 250$m^3$.
4. The Engineer will hire a certified laboratory to take a soil sample from each of the quadrants for further chemical analysis.

5. If the results show the all of the samples are within the proposed national limits and the Dutch target values the material can be removed from the stockpile area and disposed of as non-hazardous material.
6. If any of the ten samples show elevated levels of contamination the material from the respective contaminated quadrants will be disposed of as hazardous waste. Any other non-contaminated quadrants may be disposed of as non-hazardous waste.

85. Alternatively, the Contractor may wish to explore alternative methods to treat the contaminated waste so that it can be disposed of as non-hazardous waste. If the Contractor chooses this option he will be responsible for the preparation of a Contaminated Spoil Treatment Plan that will outline the procedures and methods for treating the waste. spoil

86. Bridge Design - Bridge designs should ensure that drainage from bridge decks over 50 meters does not discharge directly to the watercourses beneath the bridges. Discharge waters should lead to an oil/grease interceptor tank or filter pond adjacent to the bridge in order to trap oil and grease run-off. In addition, the bridge design and layout must be aesthetically pleasing and in harmony with the existing environment.

87. Drainage Design - Consideration in the design phase has be given to the issue of drainage and culverts to ensure that drainage patterns are improved from the existing conditions and that increased run-off does not occur or result in flooding of areas previously undisturbed or in those areas identified as flood prone by the Project FS. During design, all drainage works have been designed based on the historical flood data and flood forecasting. A design discharge of 50 years return period is considered for culverts, and 100 years of bridges.

88. General Tree Protection - Prior to the commencement of works the Contractor shall stake the boundary of the entire work site, including intersections and areas under bridges (this excludes within rivers and tunnels, but not tunnel portals). The Contractor shall then identify through a site survey if any Georgian Red-listed tree species are located within 5 meters of the site boundary. This survey will form part of the Contractors Clearance, Re-vegetation and Restoration Management Plan. If any of these trees are identified the contractor will be required to place wood fencing around the tree in order to protect the tree during construction works, including its root zones. The Engineer will inspect all of the tree protection measures on a regular basis.

89. Cutting of Trees – Cutting of trees can be addressed under two headings:

- Private Land - Compensation shall be paid to all affected tree owners as per the Project LARP.
- State Forest Fund – An inventory of the species to be de-listed has been prepared as part of this EIA. The RD is responsible for supplying this information to the National Forest Agency in writing in order to complete the de-listing process. The RD shall also apply to the MoENRP in writing regarding the identified Red-List species in the project area so that they may also be de-listed from the SFF. The RD have estimated that a compensation payment of approximately 10,400 GEL (4,200 USD) will be made for the trees cut as part of the Project. This payment is based on the criteria of Table 2 of Appendix 7 of The Resolution No.242 of Government of Georgia on Approval of Rules for Forest Use taking into account the area of used land. The payment shall be made before beginning of forest usage. No compensation in the form of re-planting is required under this resolution unless specified by the MoENRP in the Conclusion of Ecological Expertise.

90. Infrastructure - A road condition survey will also be conducted by the Engineer prior to construction in order to gauge the damage to the road as a result of the intensive heavy

traffic. Before completion of the Project the Engineer shall repeat the survey to determine which, if any roads need to be repaired by the Contractor.

91. Waste Management – The Contractor shall prepare and submit a waste management plan outlining measures to manage and disposal of all waste streams, including hazardous waste and methods for recycling waste. The plan will clearly identify how and where hazardous wastes will be disposed of.

92. Spoil Disposal – The responsibility for identifying the final disposal areas for tunnel and embankment spoil material lies with the Contractor. Initial consultations with the RD indicate that the remaining static balance of 691,500 $m^3$ could be re-used at the Kutaisi Bypass. However, Spoil material from F4 will be generated at different times and in different volumes throughout the construction phase. At this stage of the Project the construction schedule for F4 is not known and as such it is not possible to draw up plans for the disposal of spoil material at the Kutaisi bypass. If the Contractors for F4 and Kutaisi bypass can, in coordination with RD, agree to re-use the materials F4 Contractor will be responsible for preparing a Spoil Disposal and Re-use Plan specifically for the Kutaisi bypass site.

93. If there is no agreement between the Contractors of F4 and the Kutaisi Bypass regarding the re-use of the materials the Contractor will be responsible for the preparation of a separate Spoil Disposal Plan for Arrangement of Spoil Disposal Area and a Re-cultivation Plan for a separate site which will be indicated and provided by the RD. The Plan will also be provided to the RD and the Engineer as part of his SSEMP. No spoil storage will be allowed until the RD and the Engineer have approved the plan.

94. Borrow Pits - If the Contractor intends to use borrow pits operated by an independent organization then a due diligence review will be carried out by the Engineer to confirm that the new site identified for use by the Contractor is indeed operating or operable in an appropriate manner. For any new borrow pit to be opened and operated by the Contractor, the Contractor will be responsible for the preparation of a Borrow Pit Action Plan (BAP).

95. Tunnels – The Contractor will develop a ground water management plan for each tunnel under which shall be submitted for approval by the Engineer at least four weeks prior to the start of tunnelling works. The plan shall include routine monitoring of the groundwater levels in wells against baseline water levels (measured by the Contractor before the start of tunnel works) in the Project area which will be undertaken on a weekly basis by the Engineer within the vicinity of each tunnel he is excavating.

96. Emergency Response - The Contractor will be responsible for preparation of an Emergency Response Plan (ERP) which will include sections relating to; a) Containment of hazardous materials, b) Oil and fuel spills, c) Fire, gas leaks and explosions, d) Work-site accidents; and e) Earthquake and other natural hazards.

97. Loss of Land and Property - Under JICA Guidelines for Environmental and Social Considerations (April, 2010), the Employer must prepare the Land Acquisition and Resettlement Plan (the LARP) before dispatching the appraisal mission of JICA. Then, the Employer will implement the plan and acquire the land before the commencement of the construction works at any part of the site.

98. Noise - Correct siting of construction camps and ancillary facilities will reduce the potential for elevated noise levels to affect sensitive receptors. Locating these facilities more than 250 meters from residential or sensitive receptors will mean that the noise generated by these facilities will be lower than IFC daytime and night-time guideline limits at this distance. Locating these facilities more than 500 meters downwind of sensitive receptors will further

limit potential noise impacts. In addition to the above, prior to the start of construction, and as part of his SSEMP, the Contractor will develop a noise management plan.

99. Vibration - The Contractor will develop a detailed Tunnel Blasting Plan (TBP) as part of the overall construction schedule. The TBP shall specify, to a reasonable level of accuracy, the schedule for boring of each tunnel and will include the results of all of the surveys undertaken. The TBP will also include a vibration monitoring plan to monitoring vibration levels and frequency around the blasting sites.

**Construction Phase**

100. Air Quality - Proper control, siting and maintenance of equipment, including concrete batching plants, shall mitigate emissions impacts. Spraying of roads with water during dry periods and covering of friable materials will also help prevent dust impacts.

101. Soils – Standard measures are outlined within the EMP to reduce the impacts of potential spills and leaks. They include storing hazardous liquids in special storage areas within concrete bunds and the provision on spill kits in these areas. Erosion control measures and measures to preserve topsoil are also recommended within the EMP.

102. Surface water – Proper design, siting and management of facilities (including construction camps and concrete batching plants) will help reduce impacts to water quality. Accidental spills could occur and provisions are recommended in the EMP to manage such accidents. Temporary drainage in villages will be kept clear of construction debris to prevent flooding at work sites.

103. Drainage and Flooding - During the construction phase the Contractor will be required to construct, maintain, remove and reinstate as necessary temporary drainage works and take all other precautions necessary for the avoidance of damage to properties and land by flooding and silt washed down from the works. Should any operation being performed by the Contractor interrupt existing irrigation systems, the Contractors will restore the irrigation appurtenances to their original working conditions within 24 hours of being notified of the interruption. The Contractor will also be responsible for ensuring that no construction materials or construction waste block existing drainage channels within the Project corridor. The Engineer will be responsible for routine monitoring of drainage channels to ensure they remain free of waste and debris.

104. Flora – it is recommended that re-planting of the 615 red-list species is undertaken as an additional compensation measure. The Contractor should coordinate with the National Forest Agency to identify a site, or sites, within the Project area where these trees can be re-planted. Plant maintenance will be carried out for at least two years. The Contractor will be responsible for the maintenance. If the maintenance period extends after the completion of the Contractors contract period the RD will be responsible for contracting an operator to maintain the trees for the remaining period. During the Construction phase the Engineer will undertake monthly monitoring of the re-planted areas and report on the success rate of the re-planted trees, which should be above 80%. If the success rate falls below 80% the Contractor will re-plant on a 1:1 basis to compensate for losses. The Contractor will be responsible for paying for any compensational re-planting.

105. Fauna - Prior to the start of construction in river beds, or close to river embankments (within 10 meters), the Contractor shall undertake a site survey (using a local ecologist) to ensure that there are no otter burrows in these areas. If burrows are found in these areas the Contractor will prepare a method statement for the management of these areas which will be sent to the Engineer for review and approval. Poaching of wildlife shall be strictly prohibited.

106. Protected Areas - No construction activities, including camps, borrow pits, haul routes, etc. will be allowed within, or through protected areas, or reserves.

107. Infrastructure - To mitigate the potential impacts the Contractor will submit a Traffic Management Plan to local traffic authorities prior to mobilization and include the plan as part of his SSEMP. The Contractor will also provide information to the public about the scope and schedule of construction activities and expected disruptions and access restrictions and allow for adequate traffic flow around construction areas via diversions or temporary access roads. To prevent potential environmental, health and safety issues arising whilst working in the area above the railway line at KM 6.3 and at Bridge BR 4.0.1.AT/TA, the Contractor will be responsible for the preparation of an Environmental, Health and Safety Method Statement for working in these areas.

108. Utilities - During construction all utilities in the Project area shall be kept operational, particularly during the winter months.

109. Waste Management - The Contractor will be responsible for the safe collection and removal of all waste materials from his site. Accordingly, he shall prepare contracts with a suitably licensed waste management contractor for the removal of inert and hazardous wastes from his sites. The Contractor as proof of the shipment of these wastes shall also keep waste manifests.

110. Borrow Pits – The Contractor will be responsible for following all of the borrow pit requirements outlined in this EIA along with the borrow pit regulations of the GoG.

111. Asphalt Plants, Concrete Batching Plants and Construction Camps – The EMP provides a range of detailed mitigation and management measures for these facilities. All of these measures are based on international best practice.

112. Bridge Construction – A range of measures are provided in the EIA to prevent impacts occurring at bridge construction sites, including for example; ensuring no waste materials are dumped in the river, including re-enforced concrete debris, ensuring that no hazardous liquids are placed within ten meters of the river, providing portable toilets at bridge construction sites to prevent defecation by workers into the river and provision of areas where concrete mixers can wash out leftover concrete in the form of a lined settling pond at each bridge site. In addition, the Contractor, through his Environmental Manager, will be responsible for consulting with MoENRP to establish the fish spawning period in relation to the bridge construction works to ensure that all works are undertaken in periods least likely to affect the fish spawning period.

113. Tunnels - Routine monitoring of the groundwater levels in well in the Project area will be undertaken on a weekly basis by the Contractor within the vicinity of each tunnel he is excavating. The monitoring shall continue for a two month period after the tunnel is sealed. If drawdown levels in wells are significant the Contractor will provide a temporary source of potable water to the affected persons until the groundwater levels are recharged. The Contractor will pass all drainage water from the tunnel through a settlement tank. Weekly monitoring of the water quality from the tank will be undertaken by the Contractor to assess for any pollution. If the drainage water meets drinking water standards it can be considered for re-use in any potentially depleted wells during the construction phase. The Contractor shall continue to monitor the water levels in the affected wells for a period of two months after construction is completed. If the wells begin to recharge to their pre-construction levels no further actions will be necessary. However, if the water fails to re-charge to pre-construction levels new boreholes will be constructed for the affected persons.

114. Blasting - The Project will conduct construction blasting consistent with Georgian and international safety standards. Blasting will be conducted using standard mining industry practices and procedures to ensure safety of personnel and equipment. This includes establishing a safety zone around the blast area, say to a distance of 500 m (actual distance will be established by the Contractor and approved by the Engineer based on the safety standards) and evacuating it. In addition, no blasting will be carried out within 100 m of the portal of the tunnel, blasting will be scheduled during the day only and local communities will be informed of blasting timetable in advance.

115. Community Health and Safety – The Contractor will be responsible for holding monthly community meetings within the Project area throughout the construction period. The monthly meetings will be held in the villages along the alignment and will provide a forum for locals to discuss specific issues, such as noise and dust, with the Contractor before making complaints formal through the Grievance Redress Mechanism.

116. Occupational Health and Safety - Health and safety plans, training and HIV/AIDS and vector borne disease awareness programs will be provided by the Contractor. The Contractor shall also be responsible for providing adequate Personal Protective Equipment for all workers, including sub-contractors and site visitors. If groundwater is to be used as potable water it will be tested weekly to ensure that the water quality meets the GoG drinking water standards.

117. Physical and Cultural Resources - The cemetery identified close to the Project road is unlikely to be impacted by construction works, however, it is required that during the construction phase the northern boundary of the cemetery be fenced off to ensure that there is no encroachment into this area by construction workers or equipment. A short section of noise barrier is recommended around KM 10.1 if it is not to be included as part of general noise mitigation measures. During the construction works the spring shall be fenced on the northern side to prevent construction works impacting upon the spring. In the event of any chance finds during the construction works procedures shall apply that are governed by GoG legislation and guidelines.

118. Noise & Vibration – The Contractor will be responsible for implementing the range of good practice measures outlined in this EIA and its EMP to limit construction noise impacts, including time and activity constraints. Specific measures have been proposed in this EIA to manage vibration issues during the construction phase, they include building surveys, consultations, real time monitoring, choice of tunneling techniques and defining damage risk zones..

**Operational Phase**

119. Noise - A review of the noise model results and the anticipated impacts to identified receptors in the Project area indicates that noise barriers in various locations along the alignment would help reduce noise levels below IFC limits (or very close to the limits) over the lifecycle of the Project. However, in other locations, even with the installation of a noise barrier, noise generated by traffic will still be elevated above IFC nighttime standards. Alternative noise abatement measures need to be considered for these locations, including for example:

- Fencing around individual properties;
- Planting of vegetation around the border of properties;
- Construction of earth embankments around groups of properties;
- Installation of sound proof windows in properties; and
- Expropriation.

120. However, it is also possible that residents may not be willing to accept these measures as they may consider them an inconvenience and would rather accept the elevated noise levels, especially in the case of expropriation.

121. Given that the noise model has been prepared based on a 2037 operating scenario the following mitigation measures are recommended for operational phase noise levels:

- Noise barriers – As part of the Detailed Design, ensure that the road is designed to accommodate all of the noise barriers recommended in this EIA. Within the first six months of operation (during the Defects Liability Period) daytime and nighttime noise monitoring will be undertaken by the Engineer at all of the identified receptors within the vicinity of these noise barriers. If noise levels are measured above IFC daytime or nighttime standards at these receptors the Engineer and RD will consult with the affected persons to determine if they want the noise barrier to be constructed. If any of the affected persons confirm they wish the barriers to be constructed the Contractor will be responsible for constructing the barrier. A budget shall be set aside from the Project to pay for the detailed design (which would specify the precise locations, dimensions and barrier material) and construction of these noise barriers. Noise monitoring at these receptors shall be undertaken and the same procedure will be undertaken every six months for the remaining eighteen months by the Engineer during the defects liability period.
- Alternative noise abatement – some properties are located in areas where, according to the model, noise barriers will not be able to reduce noise levels below 45 dBA by 2037. In these areas the Engineer (during the two year defects liability period) shall undertake annual noise monitoring at all of the potentially affected receptors in the Project area to determine actual noise levels at the receptors. If the noise levels in these areas are elevated above IFC guideline limits during this two year period the Engineer and RD shall consult with the affected receptors to determine what mitigation measures would be suitable for them, including the option of expropriation. In total around 120 receptors, or properties, could be affected, although in theory this figure will be lower (over 59 of the affected receptors are only between 1 and 5 dBA above the IFC nighttime guideline limit by 2037). A budget shall be set aside to pay for any potential expropriation of properties and will be included in the Project RAP.
- Other areas – Some of the barriers proposed in the model will only benefit one or two properties. The Engineer (during the two year defects liability period) shall monitor noise levels at each of these receptors annually, and if noise levels are above IFC guideline limits they shall consult with the affected receptor to determine what type of alternative mitigation is preferable, including noise proof windows, fencing, etc. Again, a budget shall be set aside for these minor items.

122. Induced Impacts – Although the EMP contains provisions controlling direct impacts of land takings for both the road and ancillary functions (asphalt plants, construction camps, etc.), control of the induced impacts is largely beyond the scope of the Project.

## 8. Monitoring Actions

123. To ensure that all of the above mitigation actions are completed according to the requirements of this EIA, monitoring shall be undertaken of Project works by the Engineer and by independent monitoring specialists. Specifically, both observational monitoring and instrumental monitoring shall be undertaken as follows:

124. Instrumental Monitoring – This shall be completed by independent specialists and will include:

- Routine air quality, water quality soil sampling and noise monitoring during the construction phase;
- Bi-annual noise and air quality monitoring during the first two years (with reporting to JICA); and
- Annual noise monitoring throughout the Project operational lifecycle at the receptors identified as part of the noise model.

125. Schedules, parameters, locations are indicated by the EMP. The Engineer shall be responsible for contracting independent monitoring specialists during the construction phase. In addition, the Contractor will be responsible for real time monitoring of vibration during the Construction phase of the Project. The RD will be responsible for operational monitoring, e.g. hiring independent monitoring specialists.

126. Observational Monitoring – The Contractors actions shall be continually monitored by the Engineer throughout the Projects Construction phase. This will be achieved through weekly inspections of the Contractors environmental performance and his SSEMP by national and international environmental specialists engaged by the Engineer throughout the construction period. The Engineer shall have the right to suspend works or payments if the Contractor is in violation of any of his obligations under the EMP and this EIA.

## 9. Consultations

127. Two rounds of stakeholder consultations were undertaken in Zestaphoni. The first round of consultations helped define the scope of the EIA. The second round of consultations were then undertaken on the draft EIA. During the consultations a number of issues were raised, such as disposal of tunnel spoil material, tree cutting and replanting, access to properties during construction and identification of sites of cultural heritage.

128. All of the issues identified in the consultations have been included within the impact assessment portion of the EIA and where practical, measures have been proposed to reduce the significance of, or mitigate impacts. **Section 7** of the Report provides details of the consultation procedures and the main comments received.

## 10. Implementation

129. The EMP, its mitigation and monitoring programs, contained herewith will be included within the Project Bidding documents for project works. This ensures that all potential bidders are aware of the environmental requirements of the Project and its associated environmental costs.

130. The Bid documents state that the Contractor will be responsible for the implementation of the requirements of the EMP through his own Site Specific Environmental Management Plan (SSEMP) which will adopt all of the conditions of the EMP and add site specific elements that are not currently known, such as the Contractors final list of borrow pit locations.

131. The EMP and all its requirements will also be added to the Contractors Contract, thereby making implementation of the EMP a legal requirement according to the Contract. He will then prepare his SSEMP which will be approved and monitored by the Engineer. Should the Engineer, through routine monitoring by his national and international environmental specialists, note any non-conformance with the SSEMP the Contractor can be held liable for breach of the contractual obligations of the EMP. To ensure compliance with the SSEMP the Contractor will employ a national environmental specialist to monitor and report Project activities throughout the Project Construction phase.

132. A grievance redress mechanism (GRM) has also been prepared as part of the Project. The GRM provides a structure for stakeholders to make complaints and a mechanism for the complaints to be resolved both locally and centrally.

# A. Introduction

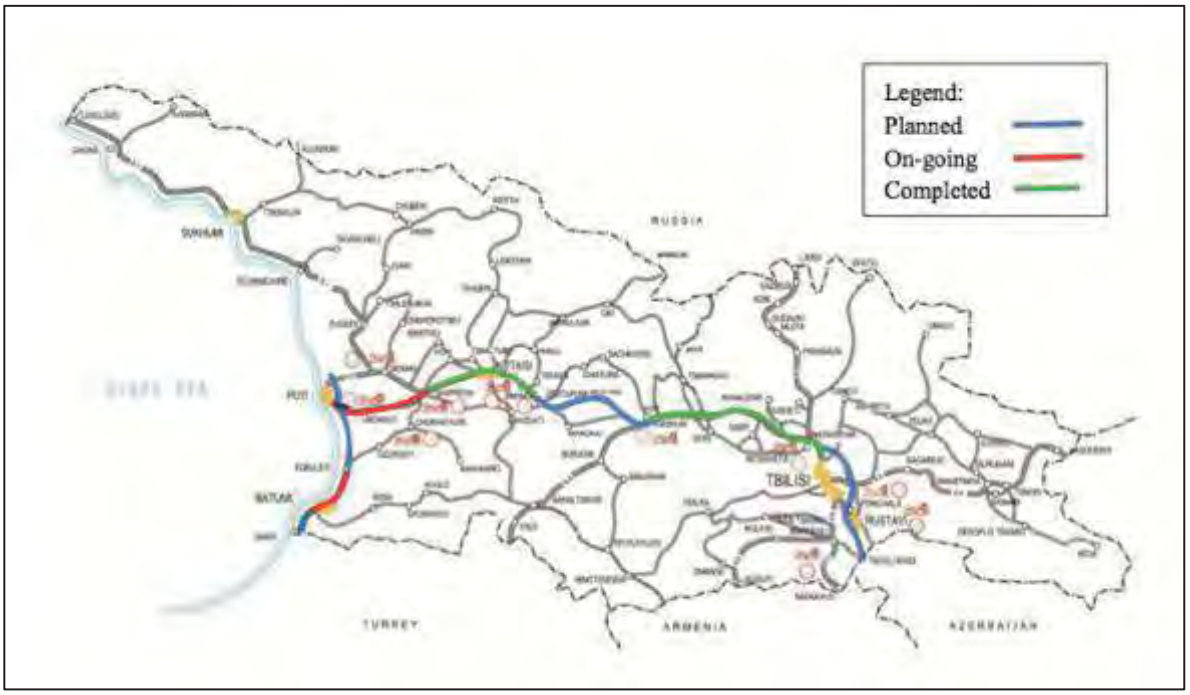
## A.1 General

133. This section of the report outlines the purpose of the EIA and provides a summary of the project identifies and the project proponent. In addition, this first section of the report describes the scope of the EIA and the methodology used to complete the assessment.

## A.2 Overview

134. The Government of Georgia is endeavoring to make Georgia a regional and logistics hub and more attractive for businesses. The East West Highway (EWH), stretching 410 km from Sarpi on the Black Sea, at the border with Turkey, through the center of the country to the capital Tbilisi and on to the border with Azerbaijan, is the main inter-regional and international route between western and eastern Georgia, as well as its neighboring countries. Representing about 2% of Georgia's road network and one fourth of its international roads, the EWH serves 8,000 to 10,000 vehicles per day and carries over 60% of the country's international trade. In anticipation of admission of Georgia to the Central Asia Regional Economic Cooperation (CAREC) program in 2016, the EWH will be an integral part of one of the six key CAREC corridors providing the shortest transit link to connect Central Asia with Europe and East Asia. **Figure A-1** illustrates the current status of road construction and rehabilitation projects in Georgia.

**Figure A-1: Status of Road Construction / Rehabilitation Projects in Georgia**




135. In light of the traffic growth on EWH, the high percentage of truck traffic, and the difficult terrain and resulting geometric profiles, capacity expansion of the current 2-lane mountainous section between Chumateleti and Argveta is crucial to realizing full potential of the EWH with improvements to the highway either completed or underway on each side of this section.

136. Therefore, the Government has requested the Asian Development Bank (ADB) and several other development partners to finance the remaining bottleneck sections (Chumateleti - Argveta) on the EWH. A feasibility study financed under a World Bank project for the Chumateleti Argveta section (comprising four sections F1 through F4) of the EWH was completed in 2015.

**Table A-1: Chumateleti – Argveta Road Sections**

| Road Section | Location | Length (km) | Funding Agency |
|---|---|---|---|
| F1 | Chumateleti-Khevi | 11.10 | World Bank |
| F2 | Khevi-Ubisa | 15.40 | ADB |
| F3 | Ubisa - Shoropani | 10.50 | EIB |
| F4 | Shoropani - Argveta | 15.80 | JICA |

137. The detailed design of Section F1 has been completed and selection of the construction Contractor is on-going. Detailed design of sections F2, F3 and F4 is currently on-going. This EIA focuses on Section F4.

## A.3 Purpose of the EIA report

138. This Environmental Impact Assessment (EIA) is part of the process of compliance with the ADB guidelines and JICA Guidelines for Environmental and Social Considerations (April, 2010) in relation to Section F4 of the Khevi-Ubisa-Shorapani-Argveta (E60 Highway route) Construction Project, or the "Project". The Project road is approximately 14.7 kilometers long and for construction purposes will be divided into two construction packages, or 'Lots'. The first Lot extends from KM0.00 to KM5.6 with the second Lot covering KM5.6 to the end of the Project road at KM14.7.

139. The EIA provides a road map to the environmental measures needed to prevent and/or mitigate negative environmental effects associated with the Project. The EIA provides a detailed description of the direct and indirect environmental effects associated with the proposed Project during key periods of work.

140. More specifically, the EIA:
- Describes the extent, duration and severity of the impacts;
- Analyzes all potential impacts, both positive and negative;
- Formulates the mitigation actions and presents it all in the form of an Environmental Management Plan (EMP).

## A.4 Category of Project

141. Based on the existing ADB Environmental Safeguards Policy (2009), this Project falls under ADB's project **Category A** and under Category A the JICA Guidelines for Environmental and Social Considerations (April, 2010). According to ADB this category is defined as "*A proposed project is classified as category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment is required."*

142. According to JICA *"Proposed projects are classified as Category A if they are likely to have significant adverse impacts on the environment and society. Projects with complicated or unprecedented impacts that are difficult to assess, or projects with a wide range of impacts or irreversible impacts, are also classified as Category A. These impacts may affect*

*an area broader than the sites or facilities subject to physical construction. Category A, in principle, includes projects in sensitive sectors, projects that have characteristics that are liable to cause adverse environmental impacts, and projects located in or near sensitive areas*."

## A.5 Scope of the EIA

143. Scoping is the process of determining which are the most critical issues to study in the EIA and involve community participation. The scope of the EIA in hand is based upon four factors; 1) the EIA requirements of the ADB and specifically the IRD/SPEA Terms of Reference (ToR) for the Project; 2) the findings of scoping consultations; 3) the defined Project Area; and 4) other best practice guidelines, e.g. IFC EHS Guidelines. The following section provides further details of each of these aspects.

### A.5.1 Scoping Consultations

144. Scoping consultations were held in June, 2017 in Zestafoni. Participants in the consultations were given an overview of the proposed project and then asked what they thought may be the significant issues that would require detailed study as part of an EIA. The following summarizes the key comments received:

- In previous road projects in the region there were bad experiences with disposal of spoil material, especially from tunnels. Locations were selected, but there was too much spoil material and as such locals were paid to allow spoil material to be dumped on their land. This issue needs to be carefully managed.
- Landslides are a problem in this region, the project must carefully manage this issue.
- For every tree cut, at least three must be replanted as part of the project.
- Access to properties and land needs to be maintained during both phases.
- Will the Contractors repair access roads after construction works are completed?
- There are lots of cultural heritage sites along the corridor. They need to be protected.

145. **Section I** provides the full details of the scoping consultations. **Section F** discusses these potential impacts in more detail and provides mitigation measures where warranted.

### A.5.2 EIA Project Area

146. The Project area **Table A-2** indicates the assessment boundaries, or the 'Project area' adopted for the EIA.

**Table A-2: Assessment Boundaries adopted for this EIA**

| Terrestrial Environment | Aquatic Environment | Air Shed | Acoustic & Human Environment |
|---|---|---|---|
| 200 m on either side of the road.<br><br>50 m around construction camps and ancillary facilities, e.g. asphalt plants.<br><br>5 m either side of new access roads. | 50 m upstream and 250m downstream of any project road crossing a river (not including irrigation or drainage channel) and of construction camps and ancillary facilities. | 200 m from center line of road (and rising 100 m from the road centerline).<br><br>500 meters from construction camps and ancillary facilities. | 250 m from centerline of road.<br><br>250 meters from construction camps and ancillary facilities. |

### A.5.3 ADB Requirements

147. According to the ADB Terms of Reference (ToR) for the Detailed Design (DD) Consultants (IRD/SPEA), the following actions are required:

1/ Based on the findings of the feasibility study, the Consultant shall identify the nature and scale of the potential environmental and social impacts of the road construction and operation and confirm that the proposed works fall under Environmental Category A as defined. The output of the Consultant's work will be an EIA report, including Environmental Management Plan (EMP). The Consultant shall review relevant sources of information to identify presence of any known archaeological sites within the road corridor.

The Consultant's assignment will comprise of the following tasks for preparation of EIA report:

- Identify sensitive environmental, social, and cultural heritage receptors within the corridor of East-West highway Khevi-Ubisa – Shorapani -Argveta, point out risks to the natural and social environment and to the cultural assets associated with the anticipated construction works in this section, and describe their nature and scope;
- Cooperate with the engineers in the process of defining exact alignment of the highway with the purpose of integrating environmental, social, and cultural heritage perspectives into the selection of the optimal route;
- Provide a set of detailed mitigation measures aimed at avoiding or decreasing expected negative impacts of construction on the natural, social, and cultural environment, and develop an environmental management plan including mitigation and monitoring plans;
- Produce an EIA report, including an environmental management plan, satisfactory to the RD and the ADB; and
- Assist the RD, as requested, during public consultations on the draft EIA report and through the process of obtaining an environmental permit from the Ministry of Environment and Natural Resources Protection (MoENRP).

2/ Key issues environmental and social issues may include:

- Describe Noise and Air emissions modeling using the traffic projections of the detailed design;
- Impacts of noise, vibration and air pollution near inhabited areas during construction and operation;
- Risks of uncovering archaeological material during excavation works;
- Risks related to temporary storage and final disposal of construction waste and excess material;
- Risks of soil degradation and erosion from cutting slopes and borrowing construction materials;
- Identify the territories for spoiled soil disposal temporary and constantly storage, according to the Georgian Legislation;
- Risks of Landslide;
- Risks of ground water flows; and
- Risk of water pollution from construction near rivers and streams.

### A.5.4 Best Practice

148. The International Finance Corporation (IFC) have prepared Environmental, Health and Safety Guidelines for a range of topics including noise, water quality, air quality, occupational health and safety, community health and safety, etc. Where relevant, the Project will include the recommendations of the IFC guidelines to ensure that the Project meets international best practice.

## A.5.5 Scope of the Report

149. Given the findings of the scoping consultations, the recommendations of the ToR, best practices guidelines and the defined Project area the following scope has been followed as part of the EIA:

1. Overview of the Legal and Institutional Framework

Prepare an overview of the legal and institutional framework based on recent EIA reports prepared for the previous East West Highway Improvement Projects (EWHIPs).

2. Collection of Baseline Data

Collect baseline data describing the existing biophysical environment in the area likely to be affected by the proposed project including:

- **Physical**: geology; topography; soils; climate; air quality; noise; surface water; groundwater; seismicity and natural hazards.
- **Biological**: flora and fauna; rare and/or endangered species (Red List species); critical habitats and ecosystems; protected areas. Particular attention shall be given to the presence of land plots registered as the State Forest Fund.
- **Human**: population; communities; demographics; employment and socio-economics; land use; infrastructure (including local access roads); transport; public health; cultural heritage; archaeology; waste management; tourism.

Surveys shall be conducted to address important gaps in the existing data and to collect up-to-date information on topics and areas where significant negative impacts are expected, specifically, flora, fauna, noise, air quality and water quality.

3. Impacts and Mitigation

Internationally accepted best practice shall be used throughout the EIA study, including in the process of identifying impacts and assessing their significance. This shall include numerical modeling of noise, vibration and air quality to assist in predicting impacts and planning mitigation in these fields. The consultant should also ensure that the design team is informed in a timely manner of mitigation measures that need to be included in construction contracts. For each identified risk a set of mitigation measures explaining how these impacts will be mitigated or/and avoided will be provided. In the case of legal/institutional weaknesses, recommendations of ways for closing the gaps will be made.

4. Analysis of Alternatives

The EIA shall include a systematic comparison of the feasible project alternatives (in terms of location, technology, design and operation), including the “no project” scenario.

5. Cost Estimates

EIA report shall include an estimated cost according to the **“Environmental risks and impacts”** (if any), which should be considered in Bill of Quantities.

6. Grievance Redress Mechanism

A section describing the grievance redress framework (both informal and formal channels), setting out the time frame and mechanisms for resolving complaints about environmental performance will be provided.

7. Environmental Management Plan

The EIA report shall include an environmental management plan comprising of an Environmental Mitigation Plan and an Environmental Monitoring Plan. The Environmental Mitigation Plan shall:

- Clearly identify what specific potential impacts may various types of works have on the sensitive receptors;
- Provide concrete actions prescribed for managing these impacts, including location and timing of these actions;
- Provide cost estimates for the main discrete mitigation measures (those that are unlikely to be part of a construction company' corporate policy and will not necessarily be included into general pricing of the contract);
- Give measurable criteria for identifying how adequately are the mitigation measures being applied and how effective they are; and
- Specify responsibility for the implementation of each mitigation activity.

The Environmental Monitoring Plan shall:

- List out of all prescribed mitigation measures by types of construction activities;
- Provide selected criteria of monitoring implementation of mitigation measures;
- Specify methods for measuring outcomes of applied mitigation measures (visual, instrumental, survey, etc.);
- Identify location and timing/frequency of monitoring mitigation measures by the prescribed criteria;
- Give cost estimates of monitoring mitigation measures by the prescribed criteria;
- Specify responsibility for tracking each monitoring criterion.

8. Disclosure, Stakeholder Consultation and Participation

Disclosure and stakeholder consultation on the draft EIA report will be conducted according to national legislation and the ADB policies.

## A.6 Methodology

150. The methodology is based on the ADB, Safeguard Policy Statement (2009) and the joint experience of the International and National environmental consultants involved in the EIA. Background data and information was obtained from published and unpublished sources, e.g., on: climate, topography, geology and soils, natural resources, flora and fauna, agriculture, and socio-economic data.

151. Several site inspections were conducted by the International Environmental Specialist during 2017. The project area was reviewed and areas of potential environmental significance assessed carefully.

152. In addition, several surveys were undertaken to collect additional baseline data by a Local Consulting Firm (LCF) specializing in environmental and social studies. They include:

- Instrumental Noise and Vibration Monitoring.
- Instrumental Air Quality Monitoring.
- Instrumental Water Quality Surveys.
- Soil sampling and analysis.
- Flora and Fauna Surveys.
- Physical and Cultural Resources Surveys.
- Socio-economic Surveys.

153. Modeling of noise and air quality was also undertaken by a firm of international experts.

154. Formal discussions were held with a number of stakeholders (see **Section H**) in order to determine their perceptions of the level of impact from road works. Data and information obtained have been included where appropriate in the EIA Report, and also as Appendices to this report.

155. **Table A-3** provides a summary of the methodology used for this EIA.

**Table A-3: Summary of Methodology of Environmental Assessment**

| Socio-environmental aspects | Methodology for collection of baseline data | Methodology for Impact Assessment and Mitigation Measures |
|---|---|---|
| **Physical Resources** | | |
| Geology | Geological maps were collected and geological information from the FS reviewed and incorporated into the report. Discussions with the Engineering team were also undertaken to discuss the geological conditions within the Project area based on information collected during the detailed design phase. | Where potential problems were identified, appropriate mitigation measures were developed to minimize the impacts. |
| Topography | The topography of the project area was assessed using Google Earth and Topographical maps. | Where potential problems were identified, appropriate mitigation measures were developed to minimize the impacts. |
| Soils | Soils maps were collected and soils information from the FS reviewed, including areas prone to landslides. Soil samples were also taken around the Georgian American Alloys factory (GAA) to determine the presence or otherwise of contaminated soils. | Project activities were assessed for their potential impacts on soil erosion, soil contamination and impacts to productive soils. Mitigation measures were determined wherever necessary. |
| Climate & Climate Change | Meteorological data, including atmospheric pressure, air temperature, relative humidity, precipitation, wind speed and direction, were collected from secondary sources. Recently completed climate change studies compiled by USAID and the World Bank were collected and reviewed. | An assessment of GHG emissions for the construction and operational phases of the Project was undertaken. Potential impacts relating to increased precipitation, flooding, and increased temperatures were assessed. Mitigation measures were determined wherever necessary. |
| Air Quality | Instrumental air quality monitoring was undertaken at multiple locations within the Project area to determine baseline conditions. $NO_2$, $SO_2$, CO, Hydrocarbons and PM were monitored over a 24 hour period. Sensitive receptors were identified in the Project area and mapped. | An air dispersion model was prepared to determine the nature and extent of any air pollution from the operational phase of the Project. A review of construction equipment was undertaken to determine potential air quality impacts. Mitigation measures were determined wherever necessary. |
| Hydrology | Maps and locations of surface water courses were reviewed and discussions with the Engineering team undertaken. Instrumental monitoring of surface water quality and groundwater quality was undertaken at several locations to determine baseline conditions in the Project area. Parameters monitored included pH, electrical conductivity (EC), turbidity, BOD, COD, dissolved oxygen (DO), Temperature, Total suspended solids (TSS), Total | Where potential problems were identified, appropriate mitigation measures were developed to minimize the impacts. |

| Socio-environmental aspects | Methodology for collection of baseline data | Methodology for Impact Assessment and Mitigation Measures |
|---|---|---|
| | Coliform Bacteria, Oil and Grease, Total Phosphorus, Total Nitrogen, Total Ammonium, Petroleum Hydrocarbons, Total Residual Chlorine, Total Zinc, Magnesium, Dissolved Copper. | |
| Natural Hazards | The FS was reviewed to determine areas where flood events occur. In addition, consultations with the Engineering Team were undertaken to determine areas where natural hazards exist, such as landslides. | Where potential problems were identified, appropriate mitigation measures were developed to minimize the impacts. |
| **Biological Resources** | | |
| Flora | A flora survey was undertaken including the following tasks; 1) Desk-top review of existing regional data; 2) Systematic transect search. A survey of state forest fund areas was also undertaken and an inventory of species prepared along with a shape file of the state forest fund within the Project corridor. | As part of the flora survey an assessment report was completed providing; a) description of survey methodology; b) justification for the timing of the survey and any limitations of the survey; c) Baseline conditions (including; detailed map of the habitat types and locations of any IUCN and Georgian red list plants within the project area; List of habitat types and plants identified during desk top studies; List of habitat types and plants identified during site surveys); d) assessment of impacts (construction and operational phase); and e) mitigation measures. |
| Fauna | A fauna survey was prepared by a National Ecologist. The survey included a desk-top review of existing regional data and two site walkovers | As part of the fauna survey an assessment report was prepared providing; a) description of survey methodology; b) justification for the timing of the survey and any limitations of the survey; c) Baseline conditions (including; detailed map of the habitat types and locations of any IUCN red list fauna within the project area; List of habitat types and species identified during desk top studies; List of habitat types and species identified during site surveys); d) assessment of impacts (construction and operational phase); and e) mitigation measures. |
| Protected Areas and Important Bird Areas | Maps and data relating to Important Bird Areas (IBAs) and protected areas were collected and reviewed. | No protected areas or IBAs were identified within the immediate Project area. |
| **Socio-economic Resources** | | |
| Demographics | A review of existing data, including information provided by GEOSTAT as well as the information collected as part of the social surveys provided by the Social Team. | Where potential problems were identified, appropriate mitigation measures were developed to minimize the impacts. |
| Economic Conditions | A review of existing data, including information provided by GEOSTAT | Where potential problems were identified, appropriate mitigation |

| Socio-environmental aspects | Methodology for collection of baseline data | Methodology for Impact Assessment and Mitigation Measures |
|---|---|---|
| | as well as the information collected as part of the social surveys provided by the Social Team. | measures were developed to minimize the impacts. |
| Infrastructure | The existing infrastructure in the Project area was identified during site visits and in consultation with the Engineering Team. | Where potential problems were identified, appropriate mitigation measures were developed to minimize the impacts. |
| Land Use | A review of the land uses was undertaken based on existing maps of the project area, satellite images, aerial photos and site visits. | Where potential problems were identified, appropriate mitigation measures were developed to minimize the impacts. |
| Waste Management | A review of the existing waste management situation in the region was undertaken and local waste management facilities were identified. | Where potential problems were identified, appropriate mitigation measures were developed to minimize the impacts. |
| Education and Educational Facilities | Site visits identified the health and educational facilities within the Project area. This was confirmed by a web-based search on the Ministry of Health and Ministry of Education and Science. | Where potential problems were identified, appropriate mitigation measures were developed to minimize the impacts. |
| Cultural Resources | Existing data was reviewed and a site walkover was undertaken to determine what PCR was present within the Project area. | Where potential problems were identified, appropriate mitigation measures were developed to minimize the impacts. |
| Noise & Vibration | Baseline noise monitoring was undertaken according to EU directive 2002/94-CE. Parameters included $L_{Aeq}$, $L_{AMAX}$, $L_{AMIN}$, PPV. | Reviewed Project description concerning noise and vibration created by equipment used during construction. Prepared a noise model based on the baseline noise levels and traffic projections over the next 30 years. Where potential problems were identified, appropriate mitigation measures were developed to minimize the impacts. |

## A.7 Structure of the Report

155. The report is organized as follows:

- **Section A: Introduction –** The section in hand provides the introductory information.
- **Section B: Legal, Policy and Administrative Framework -** This section presents an overview of the policy/legislative framework as well as the environmental assessment guidelines of GoG that apply to the proposed project.
- **Section C: Analysis of Alternatives** – This portion of the report provides an analysis of alternatives, including the 'no project' option.
- **Section D: Description of the Project –** Section D describes the Category of the Project, the Project need and its environmental setting. A scope of works is also provided indicating the type of engineering works required.
- **Section E: Description of the Environment –** This section of the report discusses the regional and local environmental baseline conditions. This section is divided into subsections relating to physical environment, biological environment and socio-economic conditions.

- **Section F: Environmental Impacts and Mitigation Measures –** Section F outlines the potential environmental impacts and proposes mitigation measures to manage the impacts.
- **Section G: Environmental Management Plan –** This section provides the EMP for the design, construction and operational phases of the Project.
- **Section H: Public Consultations –** Section H provides a summary of all of the stakeholder consultation activities undertaken.
- **Section I: Conclusions and Recommendations –** The final section of the report provides the report conclusions and recommendations.

# B. Project Description

## B.1 Section Layout

156. This section of the EIA provides the Project description. More specifically it provides:

- Summary of the type and location of the Project, including detailed site location maps;
- Confirmation of the Project environmental category according to the ADB SPS (2009);
- A summary description of the need for the Project;
- The scope of work for the Project, including a description of the construction works required.

## B.2 Type and Location of project

157. The Project is a road construction project located in Imereti Region of central Georgia. The Project road comprises Section F4 (Shoropani – Argveta) of the Khevi-Ubisa-Shorapani-Argveta Road (E-60).

158. The alignment passes hilly-mountainous relief from KM 0.0 to KM 1.3, on the left side of the existing road both as exposed road and through two tunnels. The alignment runs in the gorge of the river Dzirula from KM 1.3 to KM 3.0, crosses the river Dzirula several times. The alignment runs on the left side of the existing road, crosses the river Borimela, enters the tunnel and joins the existing road in Shorapani from KM 3.0 to KM 4.3. The alignment follows the existing road from KM 4.3 to KM 5.6. Widening of the road takes place at the expense of cutting into the slope on the left, then the alignment turns to the right, crosses the river Kvirila and the railway twice, then the alignment turns northward of Zestaphoni through three tunnels. From KM 9.6 to the end of the route design road bypasses Zestaphoni, joins the interchange under construction at km KM 14.7 at the village Argveta located on Zestaphoni-Kutaisi motorway.

159. The length of Project road is:

- Right lane **(TA)**[1] - 14.778 km;
- Left lane **(AT)** - 14.726 km.

160. **Figure B-1** indicates the location of the Project within the context of Georgia and **Figure B-2** illustrates the location in a local context. **Figure B-3 to B-12** provide a set of twelve detailed maps of the site including locations of tunnels and bridges.

## B.3 Category of project

161. Based on the existing ADB Environmental Safeguards Policy (2009), this Project falls under ADB's project **Category A** and under Category A the JICA Guidelines for Environmental and Social Considerations (April, 2010). According to ADB this category is defined as "*A proposed project is classified as category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment is required."*

162. According to JICA *"Proposed projects are classified as Category A if they are likely to have significant adverse impacts on the environment and society. Projects with complicated or unprecedented impacts that are difficult to assess, or projects with a wide range of impacts or irreversible impacts, are also classified as Category A. These impacts may affect*

[1] TA meaning Tbilisi – Argveta direction, AT meaning Argveta – Tbilisi direction.

*an area broader than the sites or facilities subject to physical construction. Category A, in principle, includes projects in sensitive sectors, projects that have characteristics that are liable to cause adverse environmental impacts, and projects located in or near sensitive areas*."

## B.4 Environmental Setting

163. **Figure B-13** provides an overview of the F4 Section environmental setting.

**Figure B-1: Road Location Map**


**Figure B-2: Project Road**

**Figure B-3: Project Road (KM0 – 0.6)**


**Figure B-4: Project Road (KM0.4 – 2.1)**

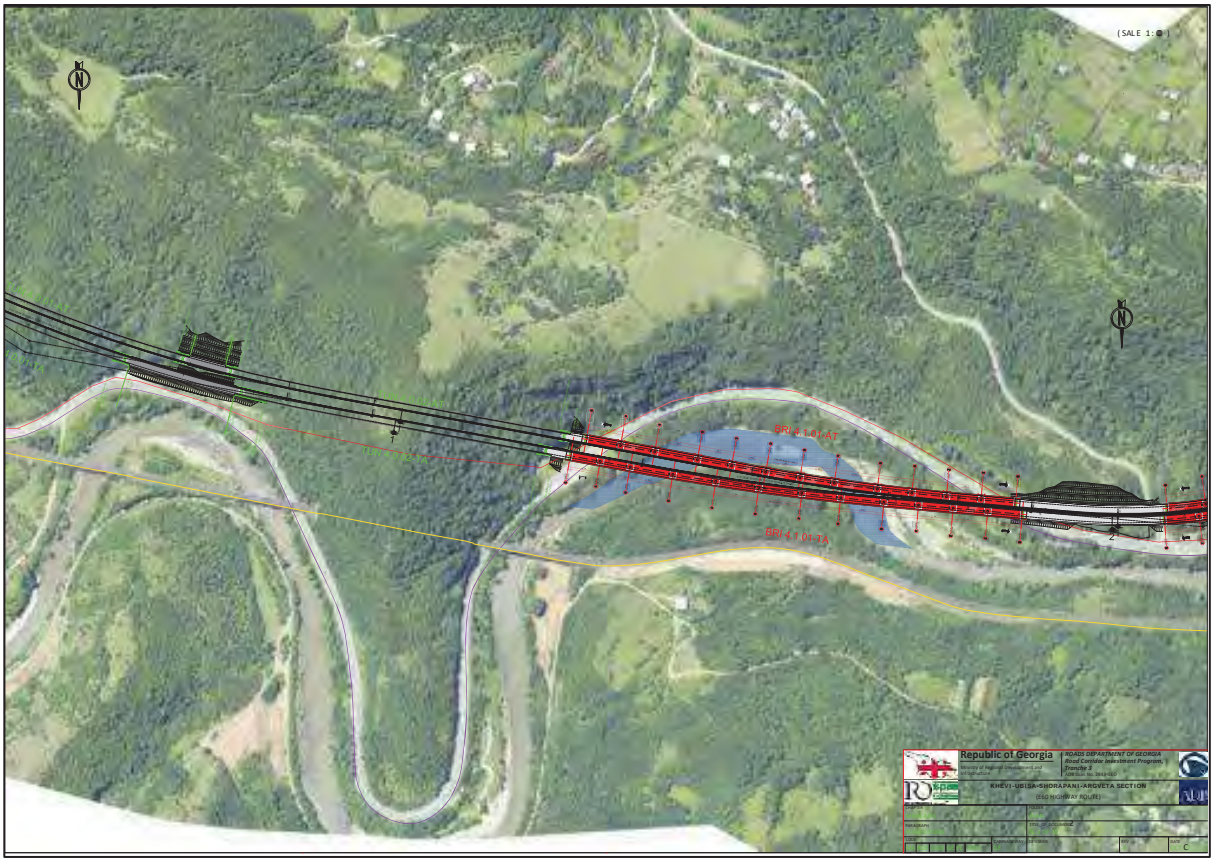


**Figure B-5: Project Road (KM2.1 – 3.7)**

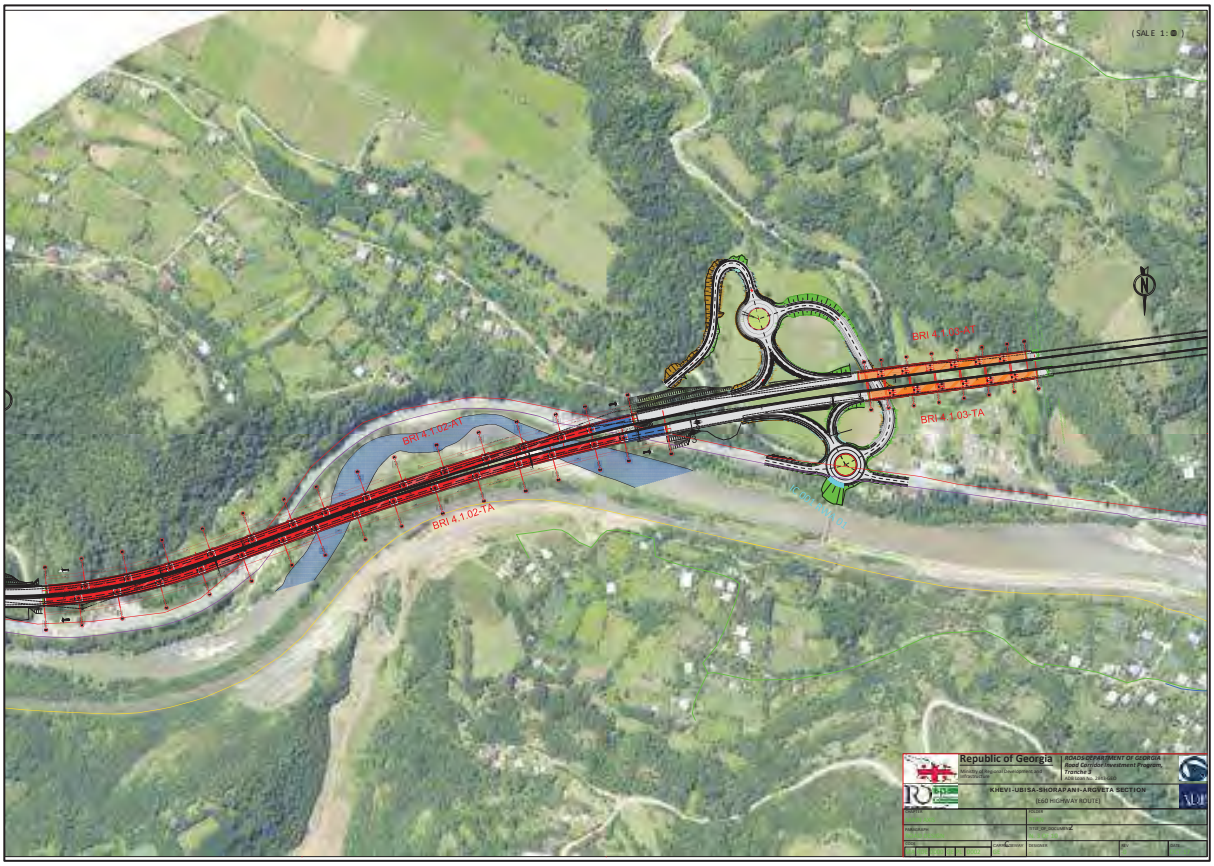



**Figure B-6: Project Road – KM3.7 – 5.5**

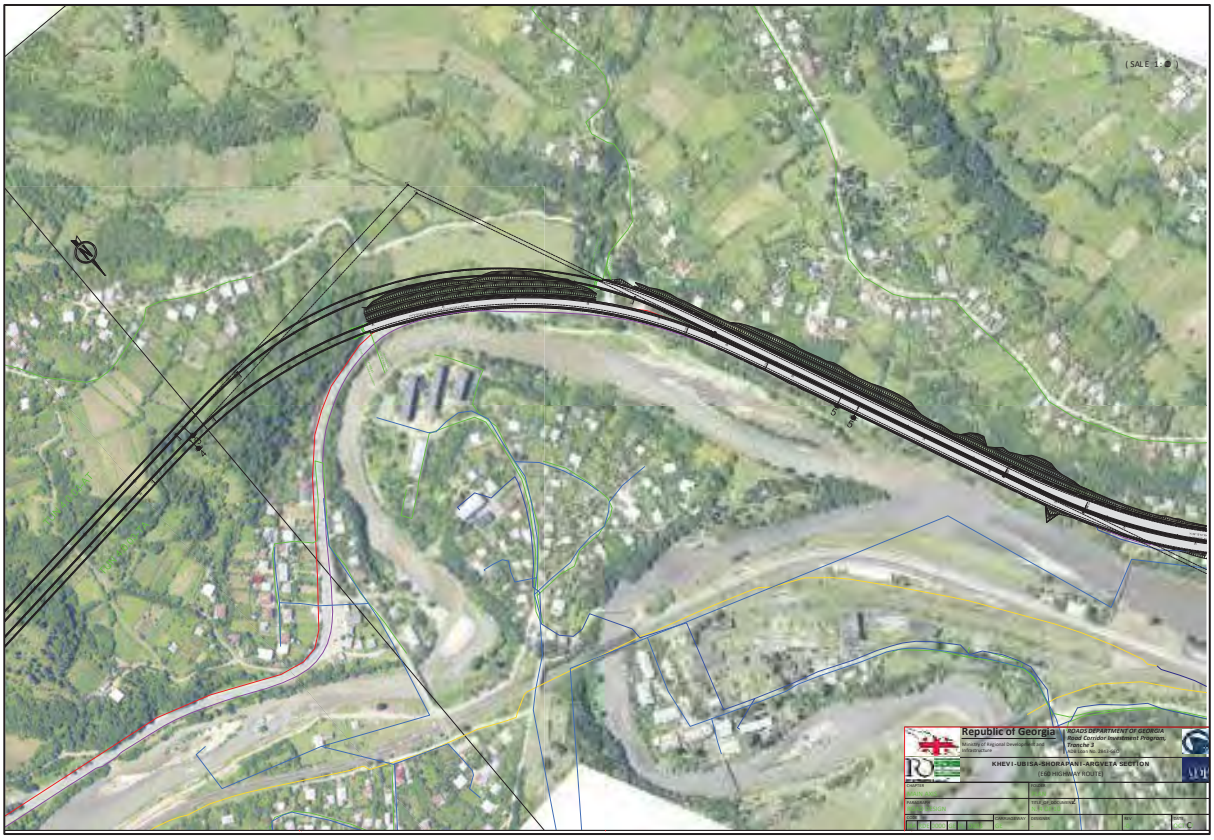


**Figure B-7: Project Road (KM5.5 – 7.0)**

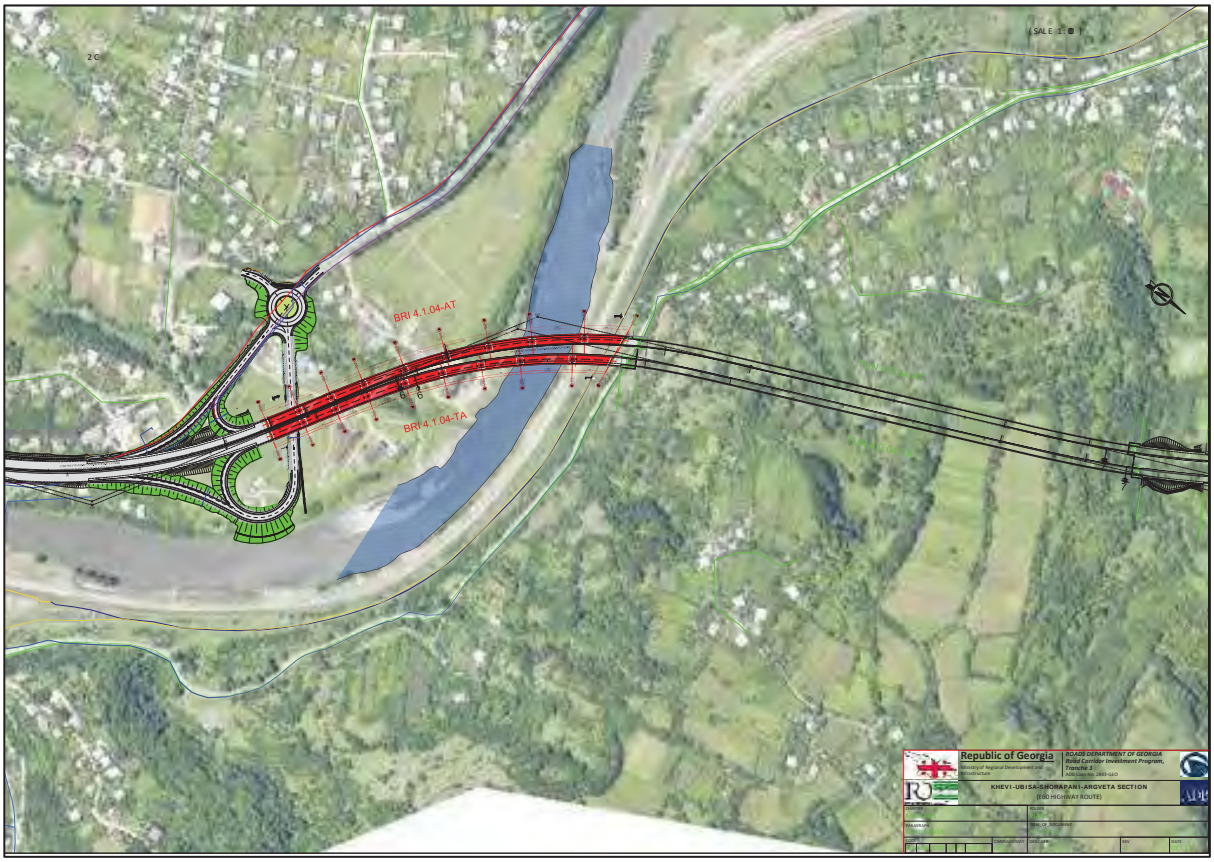



**Figure B-8: Project Road (KM7.0 – 8.7)**

**Figure B-9: Project Road (KM8.7 – 10.3)**

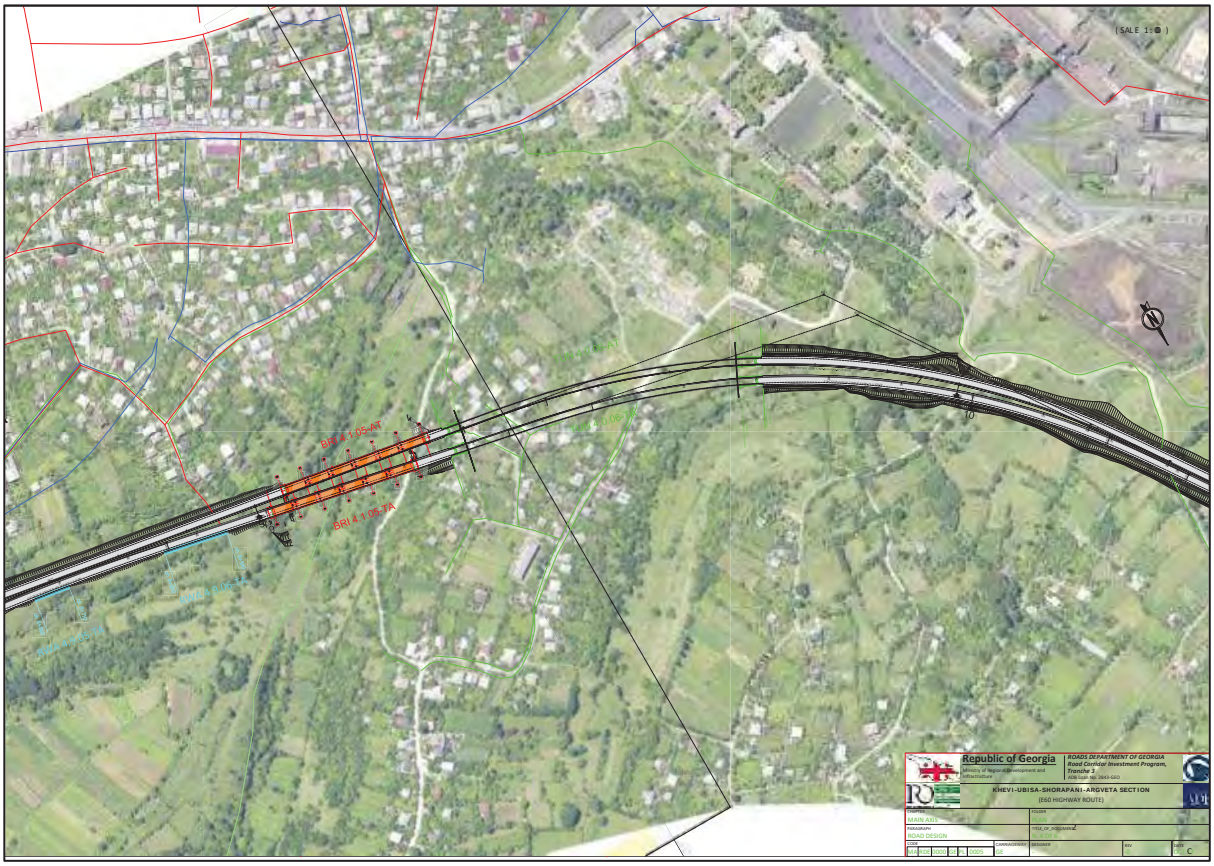



**Figure B-10: Project Road (KM10.0-11.6)**

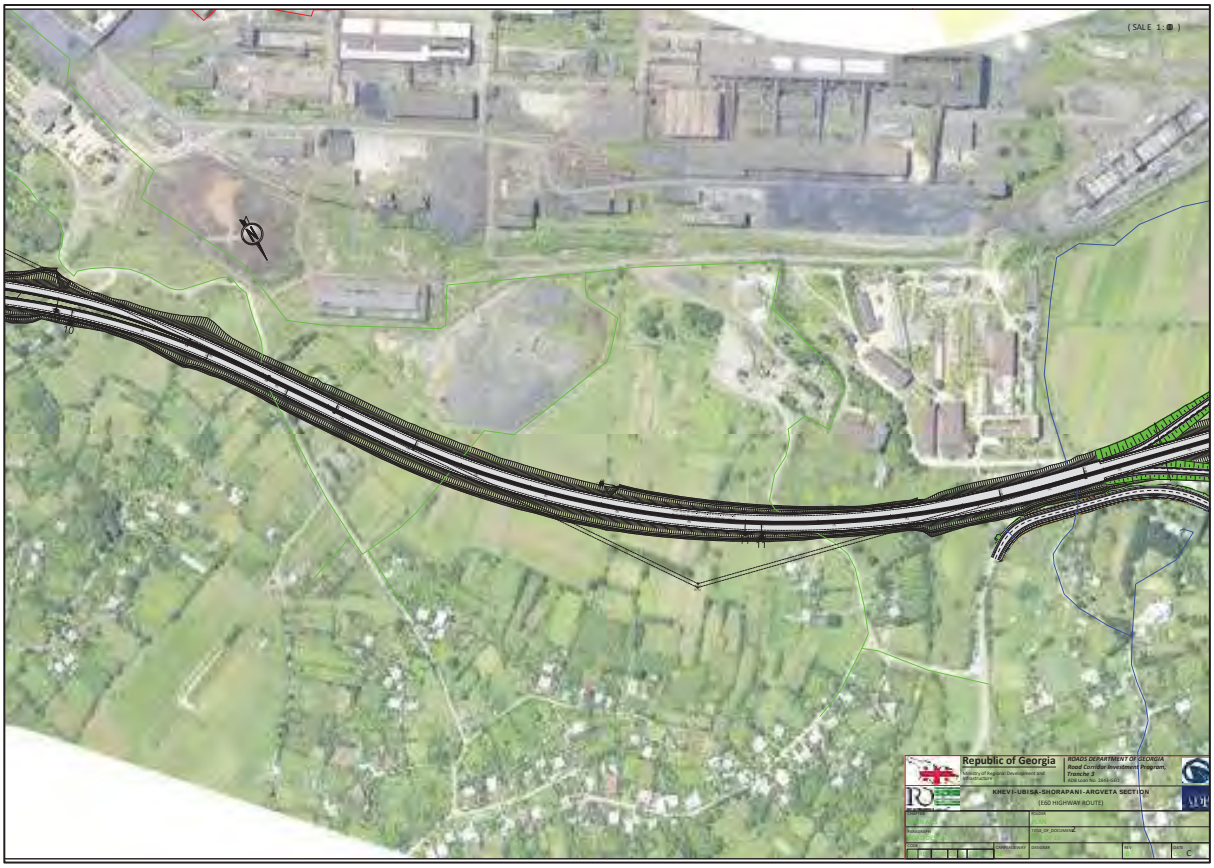


**Figure B-11: Project Road – KM11.5 – 13.0**

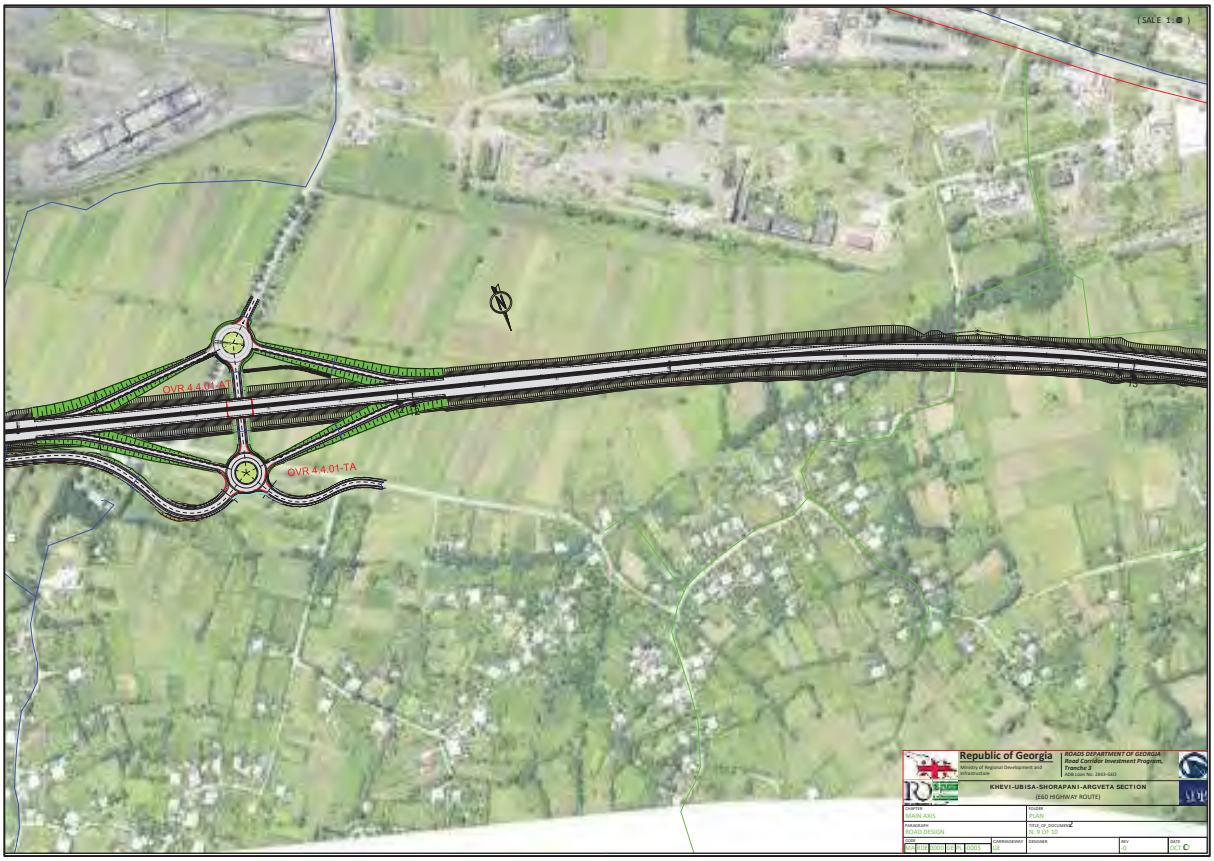



**Figure B-12: Project Road – KM13.0 – 14.7**

**Figure B-13: F4 Environmental Setting**


KM0 - The F4 section starts on the south bank of the Dzirula river, approximately 8km east of Zestafoni and opposite the settlement of Kveda Tseva. The south bank of the river is dominated by forest. However, the start of section F4 almost immediately disappears into a set of two tunnels thereby limiting impacts to vegetation. The road emerges from the tunnel to broadly follow the alignment of the existing road just to its south. The road will pass just behind the restaurant pictured opposite, one of very few properties in this portion of the road. The road then crosses back and forth across the Dzirula river before coming to a proposed interchange on the outskirts of Shorapani. The photo above is taken looking east.


KM4.3 - After the interchange the road enters a tunnel emerging on the south side of the Dzirula river opposite the 'center' of Shorapani. A number of residential properties and apartment blocks are located in this area as well as a school. The photo above is taken from a small pedestrian bridge crossing the Dzirula looking west. The new road will be constructed on the existing road, with further cut into the slopes on the left side of the road required.

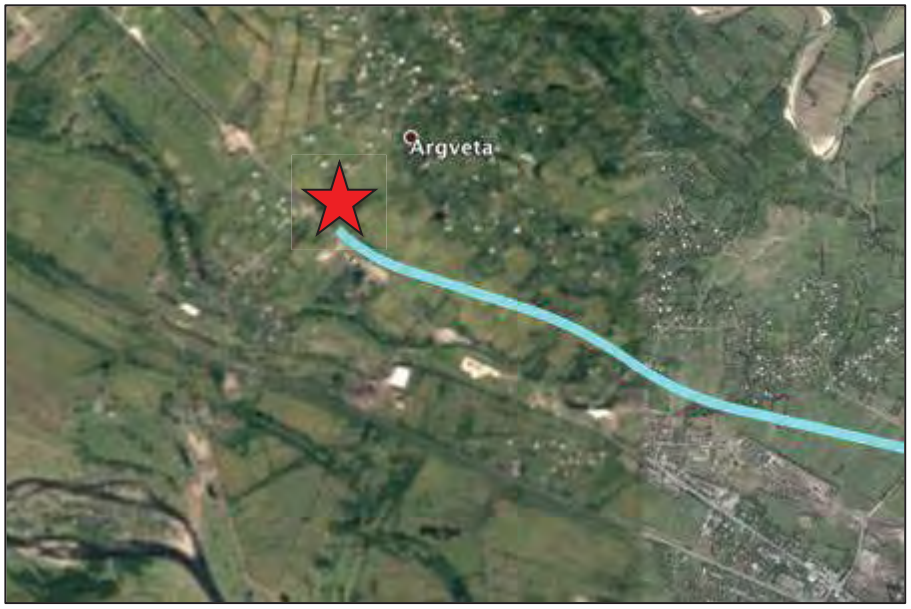

KM4.4 - The existing road follows the Dzirula river and the new road will follow almost the same alignment, or just to the south. Some small stalls selling items for tourists can be noted (see photo opposite). Few residential properties will be affected by construction works, although noise may be an issue during the construction and operational phases of the project here. The photo above is taken looking east towards the tunnel portal – TUN 4.0.03-TA/AT (tunnel shown in green on the plan).

KM6.0 - The road continues west towards Zestafoni. In this area a few residential buildings can be observed as well as some light industrial and commercial properties. At this point the Kvirila river joins with the Dzirula River. The alignment will then cross the Kvirula river and enter directly into a long tunnel (TUN 4.0.04-AT/TA) bypassing the north east of Zestafoni. The photo above is taken looking north east from across the Kvirila at the location where the new road will split from the existing pavement.

KM6.3 - The alignment will then cross the Kvirula river and enter directly into a long tunnel (TUN 4.0.04-AT/TA) bypassing the north east of Zestafoni. The photo above is taken looking south east across the river in the direction of the bridge, almost adjacent to the proposed tunnel portal.

KM9.3 - After existing the tunnel the road traverses a mix of woodland, agricultural land and pastureland avoiding impacts to residential properties. The road then passes through a small residential area to the north of Zestafoni. A bridge is planned in this location (BRI 4.1.05-TA/AT)

KM11.5 - The road continues west through agricultural land (mostly corn) on the north side of the GAA manganese processing plant. The road may encroach on the GAA property and as such soil samples have been taken in this area to assess if there is any soil contamination from the plant. The road crosses existing local roads and comes very close to a small medical clinic. Low and medium voltage transmission lines and residential gas pipelines are also located in this area. The photo above is taken looking south towards the GAA plant.




KM14.7 - The Project road ends at the junction with the new road (Argveta – Kutaisi) which is currently under construction. The topography of the road is flat in this portion which traverses agricultural land. The existing alignment is located approximately 50 meters to the south of the new road. The photo above is taken looking east from the end point of the road.

## B.5 Road Standards and Profiles

164. Geometric design standards have been selected based on traffic flow, road category and relief to ensure safe and unimpeded traffic flow. The road design is based on the Georgian National Standard SST 72: 2009 "Standard on Geometrical and Structural Requirements for the Public Motor Roads of Georgia" and TEM (Trans-European North-South Motorway) Standards. The main technical parameters adopted in the detailed design are as follows:

- Design speed - 100 km/h;
- Number of traffic lanes – 4;
- Width of traffic lane - 3.75 m;
- Width of each carriageway - 7.5 m;
- Width of paved shoulder (emergency lane) - 2.5 m;
- Width of verge – 1.0 m;
- Width of central reserve- 5.0 m;
- Width of paved shoulder at the central reserve - 1.0 m;
- Total width of each paved platform – 11.0 m
- Width of road bed - 27.0 m;
- Carriageway cross-fall on straight sections - 2.5%;
- Minimum radius of horizontal curve - 400 m;
- Maximum longitudinal gradient - 4%;
- Minimum convex curve - 15 000 m;
- Minimum concaved curve - 15 000 m.

165. A minimum radius of horizontal curve 400 m for the design speed 100 km/h is adopted based on Austrian standards and Russian standards (SNiP 2.05.02-85) for mountainous relief. The road axis has been designed separately for two independent right and left lanes. The axis is located on the outer edge of the paved section (1.0 m) of the central reserve: Tbilisi-Argveta direction **TA,** Argveta-Tbilisi direction **AT**.

### B.5.1 Cross Sections

166. In all the section of the motorway, the cross section is arranged in two carriageways with two traffic lanes each (2+2 lanes); the carriageways may be divided and independent according to the terrain characteristics. Traffic lanes in this proposal are always 3.75m, to guarantee enhanced and homogeneous safety level across the road.

**Cross Section on Embankment and Cuts** – The cross section includes:

- 2.50m wide paved external shoulder (hard shoulder) on the outmost of each carriageway this element may be widened on the internal carriageways, where sight analysis requires widening;
- 1.00m verge on the outmost of the external shoulders, where external safety barrier may be located according to needs;
- 5.00m wide central reserve (median), composed by:
    - 3.00m space for the safety barrier (typically reinforced concrete, dual) and related workspace.
    - 2x1.00m paved internal shoulders (or wider on the external carriageway only, where sight analysis requires widening).

167. The verge may also be 5-10cm above the pavement level, to protect embankment from erosion (should be interrupted every 25m to permit water flow, in dedicated channels with lining on embankments).

**Figure B-14: Cross Section on Embankment and Cuts**

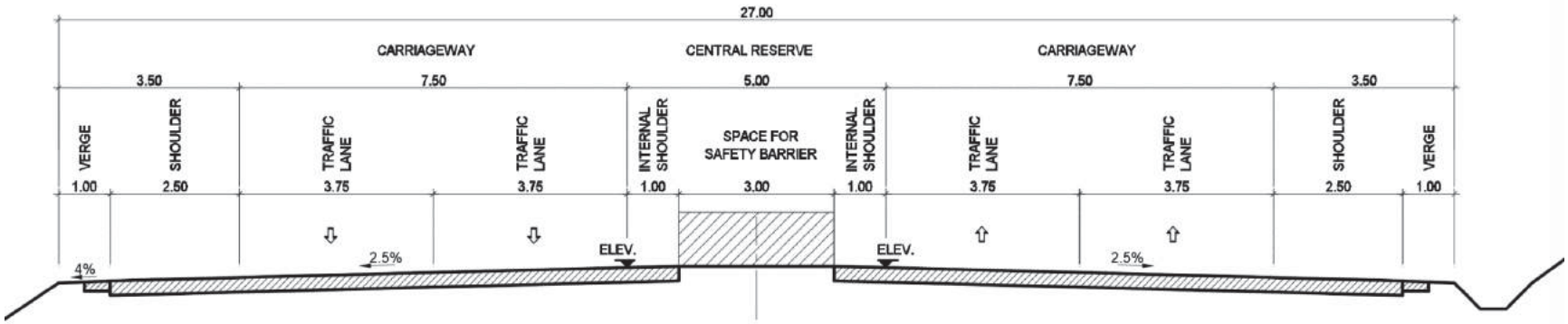



**Figure B-15: Cross Section on Bridges**

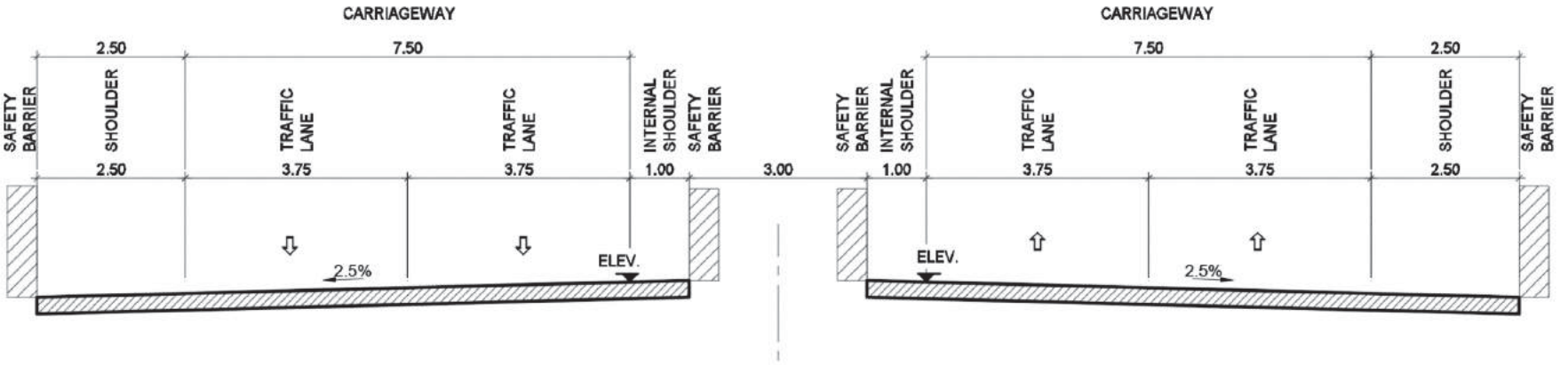
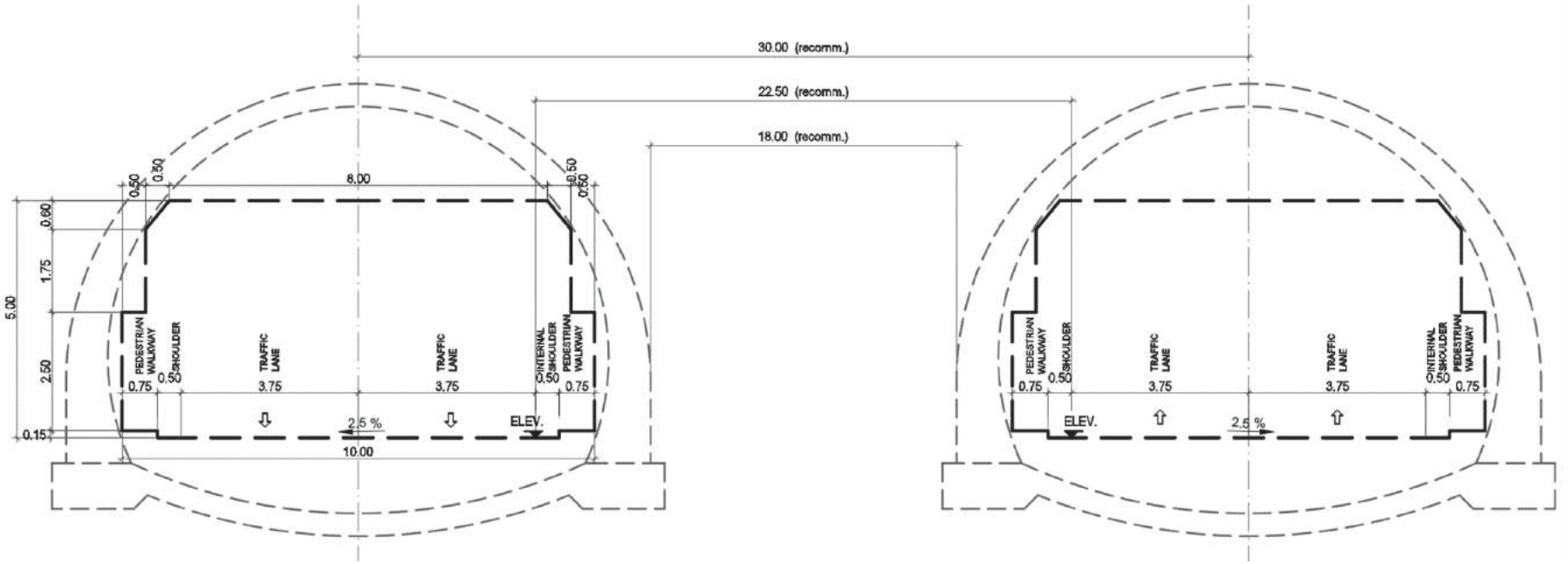


**Figure B-16: Cross Section in Tunnels**



**Cross Section on Bridges** - This is a functional cross section, so the structural part is not shown. The minimum width for the paved area is 11.00m (2x3.75+2.50+1.00). Safety barriers (internal and external) shall always be included, positioned outside of the shoulders (no element shall invade the shoulder space) and may be installed according to the manufacturer's specification. Side walkways shall be added, with a minimum clear width of 0.6m. Walkway may be also built with a cantilever metal structure, with external pedestrian parapet.

**Cross Section in Tunnels** - This is a functional cross section including the clear area (gabarit), so the structural part is not shown but shall be organized out of the dashed boundary line; the minimum vertical clearance is 5.00m, which is 1m more than the height of the standard trucks. All the structural parts and additional system (lighting, fans, cable ducts, etc.) shall be positioned outside the dashed boundary line. Minimum width for the paved area is 8.50m (2x3.75+2x0.50), pedestrian walkways are 0.75m wide, on both sides. There is no need of widening in the curves, since when the radius is minimum (400 m) the maximum speed allowed is 80 km/h.

## B.6 Bridges

168. Five long span bridges and one short span bridge will be constructed during the project works (throughout the report we will refer to five bridges, although from a technical perspective there are ten bridges as the AT lane and TA lane on each 'bridge' are not joined, but are standalone structures). **Table B-1** below provides summary details of the bridges and their locations.

**Table B-1: Bridges**

| Bridge # | Chainage Start (m) | Chainage finish (m) | Watercourse Type / Name | Bridge length (m) |
|---|---|---|---|---|
| **BRI 4.1.01-AT** | 1,256 | 1,846 | Dzirula River | 589 |
| **BRI 4.1.01-TA** | 1,250 | 1,890 | Dzirula River | 640 |
| **BRI 4.1.02-AT** | 2,039 | 2,980 | Dzirula River | 941 |
| **BRI 4.1.02-TA** | 2,050 | 2,930 | Dzirula River | 880 |
| **BRI 4.1.03-AT** | 3,230 | 3,485 | Borimela River | 255 |
| **BRI 4.1.03-TA** | 3,210 | 3,470 | Borimela River | 260 |
| **BRI 4.1.04-AT** | 5,862 | 6,317 | Kvirila River | 455 |
| **BRI 4.1.04-TA** | 5,853 | 6,273 | Kvirila River | 420 |
| **BRI 4.1.05-AT** | 9,044 | 9,240 | None | 196 |
| **BRI 4.1.05-TA** | 9,018 | 9,214 | None | 196 |
| **BRI 4.1.06-AT** | 7,061 | 7,101 | None | 40 |
| **BRI 4.1.06-TA** | 7,031 | 7,071 | none | 40 |
| **TOTAL** | | | | **4,912** |

169. The bridges are grouped into the following main typologies:
- Steel-concrete bridges - bridges 1,2,4: maximum span length up to 60 m for bridges 1 and 2 and up to 72 meters for bridges 4-AT and 4-TA.
- Precast concrete bridges – bridges 3 and 5: maximum span up to 34m

170. The following presents a short description of each bridge:
- Bridges 1-TA and 1-AT – Bridges are composed of spans with length 42, 48, 54 and 60 meters. Structural scheme is a continuous deck.

- Bridges 2-TA and 2-AT – Bridges are composed of spans with length 42, 48, 54 and 60 meters. Structural scheme is a continuous deck.
- Bridges 3-TA and 3-AT – Bridges are composed of spans with maximal length 34 meters.
- Bridges 4-TA and 4-AT – Bridges are composed of spans with lengths 48, 54, 60 and 72 meters.
- Bridges 5-TA and 5-AT – Bridges are composed of spans with maximal length 34 meters.

171. Both bridge types have their advantages and disadvantages as follows:

- Precast concrete - In this method a crane moves the precast concrete girder up to the top of substructure. The weakness of this method is the requirement of installation of temporary plant for prefabrication of precast girder and difficulty of span arrangement over 40 m in a span length, but the strength is short construction period due to using crane method and economic efficiency.
- Steel-concrete bridges - will be constructed using staging construction method using temporary steel bent to place the cast-in place concrete of superstructure. The weakness is relatively difficult in construction due to long period of construction to place cast-in-situ concrete of superstructure and requirement of temporary steel bent to support the formwork of concrete.

172. There are two types of pier geometry in elevation, as follows:

**Figure B-17: For steel-concrete bridges – type 1:**

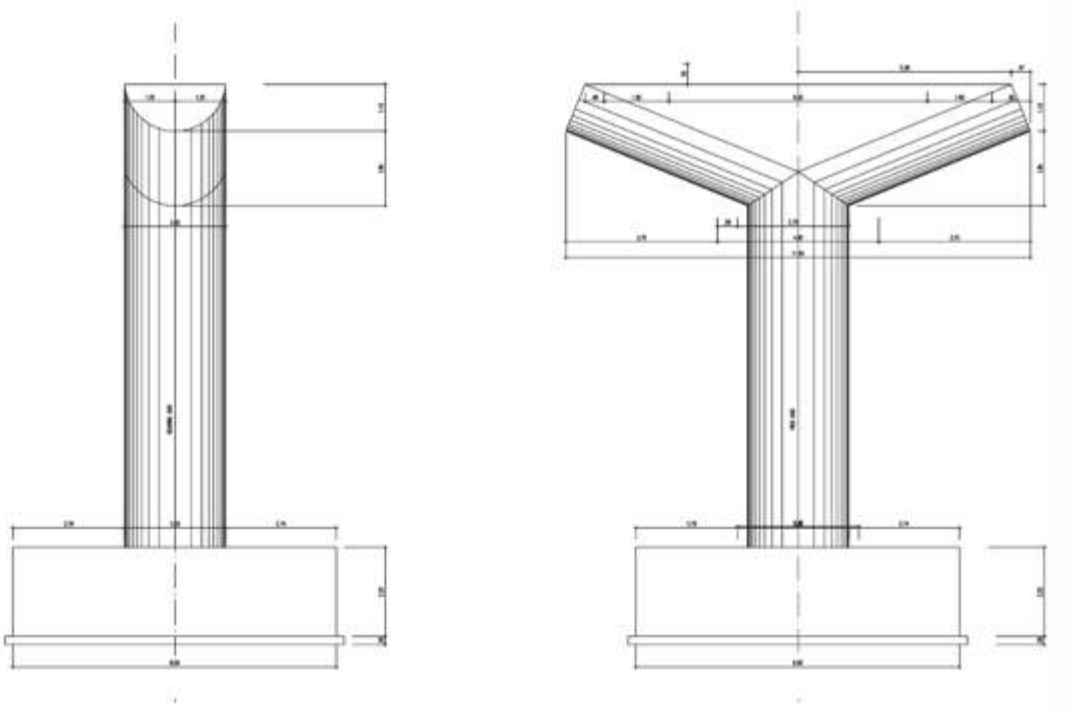
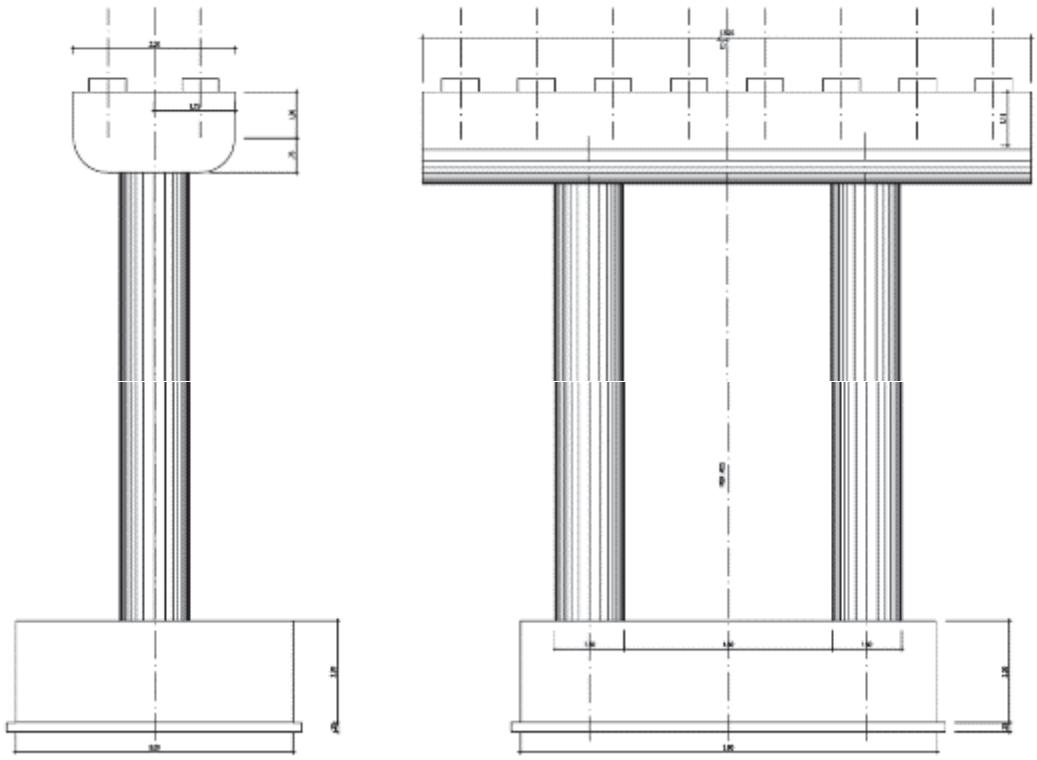
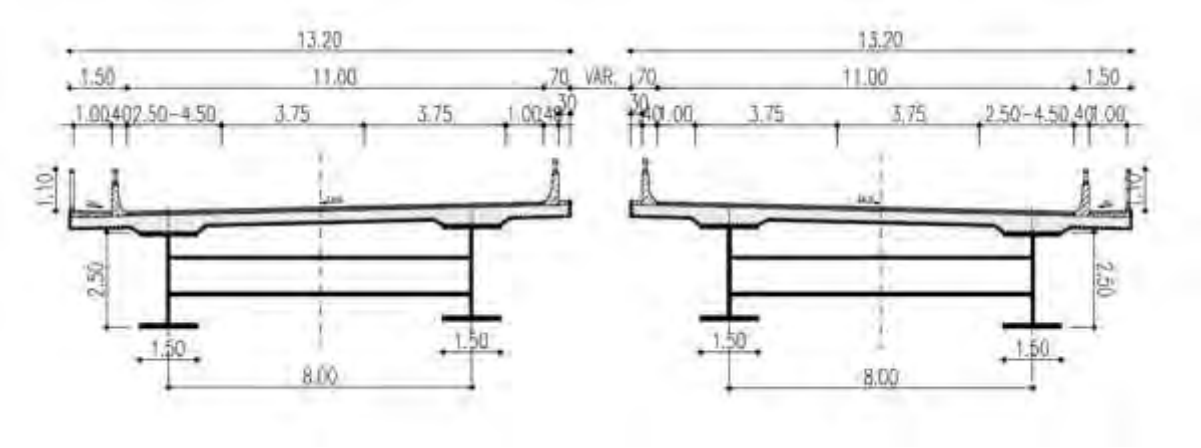


**Figure B-18: For pre-stressed precast PSC beams bridges – type 2**



173. The bridge decks will be two main beams connected by a trasversal beam and with the slab cast on a steel plate, more or less as is shown in **Figure B-19** below.

**Figure B-19: Bridge Cross Section**




174. For foundation of substructures, installation of piles will be done through boring using cast-in-place bored pile with reinforced concrete was adopted due to local field condition, environment effect, and supply of materials. This construction method has minor noise and vibration impacts compared to precast driving methods.

## B.7 Tunnels

175. In Section F4 six tunnels will be constructed with double tubes with length from 399 m to 1166 m. In this Section, the ground thickness over the tunnel are generally limited and crossed clusters rock shown poor mechanical characteristics.

**Table B-2: Tunnels in Section F4**

| Tunnel # | Length (m) | Chainage | | Maximum Overburden | Lithology |
|---|---|---|---|---|---|
| | | Start (m) | End (m) | | |
| TUN 4.0.01-AT | 560 | 165 | 725 | 59.85 | Medium sound rock |
| TUN 4.0.01-TA | 399 | 226 | 625 | 63.97 | |
| TUN 4.0.02-AT | 510 | 725 | 1,235 | 141.49 | Medium sound rock |
| TUN 4.0.02-TA | 445 | 725 | 1,220 | 149.23 | |
| TUN 4.0.03-AT | 1,165 | 3,472 | 4,637 | 83.51 | Medium sound rock |
| TUN 4.0.03-TA | 804 | 3,490 | 4,294 | 86.06 | |
| TUN 4.0.04-AT | 715 | 6,330 | 7,045 | 76.76 | From moderately weak to medium sound rock |
| TUN 4.0.04-TA | 723 | 6,300 | 7,023 | 74.83 | |
| TUN 4.0.05-AT | 1,193 | 7,137 | 8,330 | 59.74 | From moderately weak to medium sound rock |
| TUN 4.0.05-TA | 1,152 | 7,107 | 8,259 | 58.81 | |
| TUN 4.0.06-AT | 450 | 9,277 | 9,727 | - | From moderately weak to medium sound rock |
| TUN 4.0.06-TA | 444 | 9,265 | 9,709 | - | |

**Table B-3: Typical Tunnel Dimensions**

| **Parameter** | **Value** |
|---|---|
| Width of pavement | 7.50 m |
| Width of sidewalk | 0.75 m |
| Width of Shoulder | 0.50 m |
| Total width of tunnel | 10.00 m |

176. Ventilation - The primary ventilation for the tunnels having length >1000m (TUN 4005 TA/AT and TUN 4003 AT) will be of the longitudinal type. Ventilations is guaranteed by the use of axial Jet-Fans, having rotor's diameter 1.250mm, stainless steel box, with reversible flow, fire resistant for 2h at 400°C. Moreover, Jet-Fans cables and switching for fan's wiring have the same fire resistance characteristics.

177. Escape Routes - Escape routes are provided for tunnels which length is >1000m, which in case of fire will allow users to reach the other tube of the tunnel, and from there they will go to the nearest portal. Escape routes are accessible only through specific filter areas with fire doors REI 120 in order to avoid the propagation of the fire or smoke inside bypass and pressurized by ventilation systems.

178. Fire Protection - Tunnels having length >500m are equipped with the fire protection system. Pump stations and the related tanks are installed next to the substations ES3, ES4 and ES5. The electrical plant supply are realized according to standard EN 12845. Fire protection network will supply the 120l/min hydrants located inside the niches of the tunnel next to the SOS every 150m along the slow lane. Next to the portals will be posed 300l/min hydrants above the ground. SOS stations and inside the substations are equipped with fire extinguishers. Fire detection inside the tubes is realized with the heat sensitive cable or double conductor cable with insulation sensitive to temperature, protected by a special outer sheath. This system is added to the smoke detection inlet system, to the opacimeters and to the ccTV plant (obscuration function).

179. SOS Emergency Phone System - Tunnels longer than 300m SOS emergency phone at portals, inside the tunnels (every 150 m) and into pedestrian bypass allow service users to calls for roadside and emergency medical assistance.

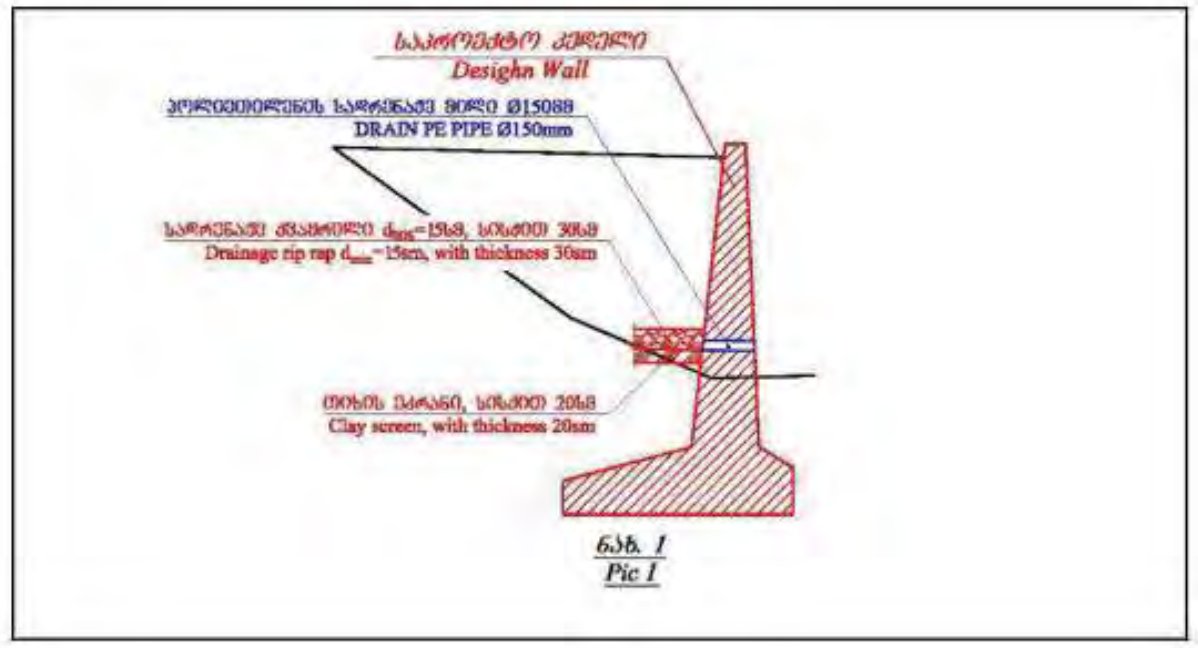
## B.8 Retaining Walls

180. To construct the roadbed in the project section concrete retaining walls and reinforced concrete support structures will be required on several sections due to the difficult relief conditions of the project section. Reinforced concrete retaining walls are required at the beginning of the project section from:

- KM 0.00 to KM 0.25
- KM 8.63 to KM 8.71
- KM 8.84 to KM 8.94

181. A reinforced concrete support structure wall is required at Shorapani, on the section of the road from KM 4.36 to KM 4.43.

**Figure B-20: Typical Retaining Wall**



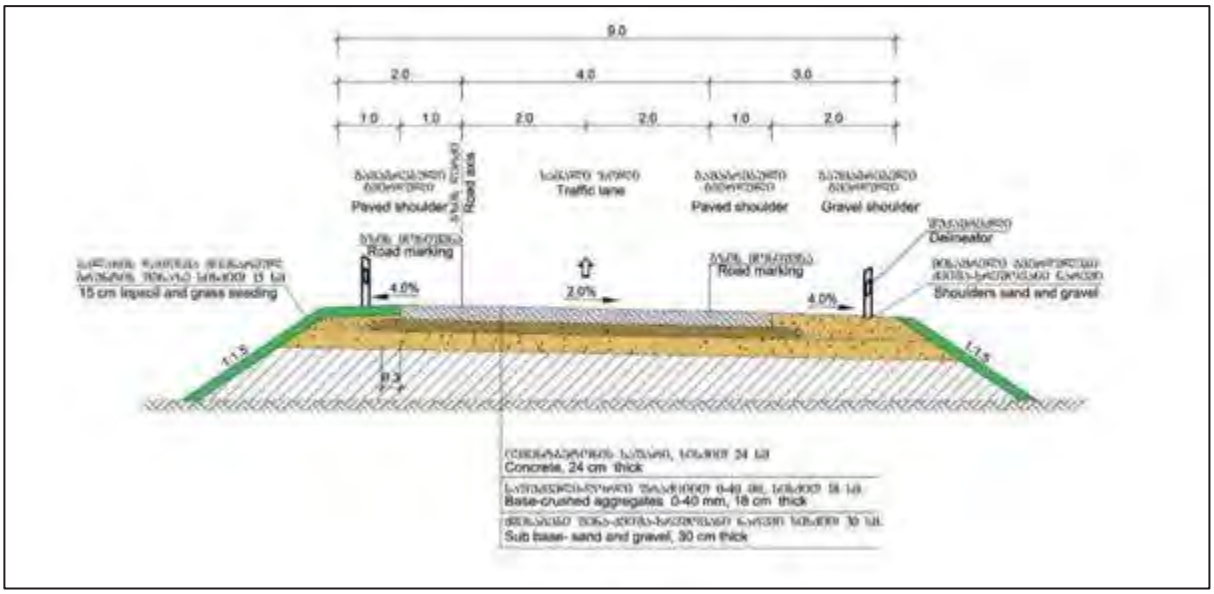

## B.9 Interchanges

182. There are four interchanges planned in F4 Section. **Figure B-3** to **B-12** provide plans of the Project road including all interchanges.

183. The pavement structure for interchanges includes:

- Pavement - cement-concrete, thickness 24 cm.
- Base course - crushed aggregates 0-40 mm, thickness 20 cm.
- Sub-base - sand and gravel mix, thickness 30 cm.

**Figure B-21: Road Pavement Structure for Interchanges**




## B.10 Culverts and Underpasses

184. Culverts, cattle passes and underpasses crossing the project motorway are designed in compliance with standard design practices for motorways using box type culverts. Culverts on the Project road ensure uninterrupted discharge of precipitations, water from ravines and water from drain channels. The Project road passes inhabited areas, arable lands, pastures and other rural territory. Thus box section underpasses shall be constructed to pass cattle, pedestrians and vehicles and ensure uninterrupted crossing of the Project road.

185. The following types of culverts will be constructed:

- Underpasses for rural roads, which are construction of cast in situ reinforced concrete structures of closed contours cross sections 6.0x4.5 m - 6 units for passing rural roads is envisaged in the design.
- Cattle passes, which ensure cattle cross the project road. Construction of cast in situ reinforced concrete structures of closed contours cross sections 4.0x2.5 m - 4 units is envisaged in the design.
- Culverts, for which cast in situ reinforced concrete culverts cross section 2.0x2.5 m - 17 units, 4.0x2.5m - 2 units is envisaged in the design to provide water discharge from ravines and canals.

186. **Table B-4** indicates the type and number of culverts.

**Table B-4: F4 Culvert Requirements**

| # | Chainage (m) |
|---|---|
| **CUL 4.5.01-AT** | 50 |
| **CUL 4.5.01-TA** | 50 |
| **CUL 4.5.04-AT** | 190 |

| # | Chainage (m) |
|---|---|
| **CUL 4.5.04-TA** | 190 |
| **CUL 4.5.06-TA** | 620 |
| **CUL 4.5.08-AT** | 755 |
| **CUL 4.5.08-TA** | 760 |
| **CUL 4.5.06-AT** | 615 |
| **CUL 4.5.10-TA** | 4,639 |
| **CUL 4.5.10-AT** | 4,661 |
| **CUL 4.5.12-TA** | 5,021 |
| **CUL 4.5.12-AT** | 5,049 |
| **CUL 4.5.14-TA** | 5,391 |
| **CUL 4.5.14-AT** | 5,408 |
| **CUL 4.5.16-TA** | 8,333 |
| **CUL 4.5.16-AT** | 8,344 |
| **CUL 4.5.18-TA** | 8,683 |
| **CUL 4.5.18-AT** | 8,694 |
| **CUL 4.5.20-TA** | 9,923 |
| **CUL 4.5.20-AT** | 9,954 |
| **CUL 4.5.22-TA** | 10,172 |
| **CUL 4.5.22-AT** | 10,197 |
| **CUL 4.5.24-TA** | 10,534 |
| **CUL 4.5.24-AT** | 10,558 |
| **CUL 4.5.26-TA** | 10,794 |
| **CUL 4.5.26-AT** | 10,817 |
| **CUL 4.5.28-TA** | 11,223 |
| **CUL 4.5.28-AT** | 11,245 |
| **CUL 4.5.30-TA** | 11,567 |
| **CUL 4.5.30-AT** | 11,579 |
| **CUL 4.5.32-TA** | 12,183 |
| **CUL 4.5.32-AT** | 12,204 |
| **CUL 4.5.34-TA** | 12,428 |
| **CUL 4.5.34-AT** | 12,449 |
| **CUL 4.5.36-TA** | 12,489 |
| **CUL 4.5.36-AT** | 12,510 |
| **CUL 4.5.38-TA** | 12,975 |
| **CUL 4.5.38-AT** | 12,997 |
| **CUL 4.5.40-TA** | 13,236 |
| **CUL 4.5.40-AT** | 13,259 |
| **CUL 4.5.42-TA** | 13,405 |
| **CUL 4.5.42-AT** | 13,427 |
| **CUL 4.5.44-TA** | 13,568 |
| **CUL 4.5.44-AT** | 13,591 |
| **CUL 4.5.46-TA** | 13,818 |
| **CUL 4.5.46-AT** | 13,842 |
| **CUL 4.5.48-TA** | 13,955 |
| **CUL 4.5.48-AT** | 13,979 |
| **CUL 4.5.50-TA** | 14,188 |
| **CUL 4.5.50-AT** | 14,213 |
| **CUL 4.5.52-TA** | 14,349 |
| **CUL 4.5.52-AT** | 14,274 |

187. Eight underpasses will be constructed using reinforced concrete culverts. **Table B-5** below indicates their locations.

**Table B-5: F4 Underpasses**

| # | Chainage (m) |
|---|---|
| **UND 4.3.01-AT** | 10,293 |
| **UND 4.3.01-TA** | 10,269 |
| **UND 4.3.02-AT** | 12,770 |
| **UND 4.3.02-TA** | 12,749 |
| **UND 4.3.03-AT** | 13,222 |
| **UND 4.3.03-TA** | 13,200 |
| **UND 4.3.04-AT** | 13,636 |
| **UND 4.3.04-TA** | 13,614 |

## B.11 Overpasses

188. One overpass will be constructed at km 11+854 with a length of 40 meters.

## B.12 Construction Process

189. During the construction phase the following activities will be undertaken:

- **Land Acquisition -** Under JICA Guidelines for Environmental and Social Considerations (April, 2010), the Employer must prepare the Land Acquisition and Resettlement Plan (the LARP) before dispatching the appraisal mission of JICA. Then, the Employer will implement the plan and acquire the land before the commencement of the construction works at any part of the site.
- **Site Specific Environmental Management Plan (SSEMP)** - Ensure that the Site Specific EMP is submitted to the Engineer for review at least 10 days before taking possession of any work site. No access to the site will be allowed until the SSEMP is reviewed by the Engineer and approved by the Project Management Consultant.
- **Site Clearing Works -** The Works include the following site clearing works within or adjacent to the RoW of the Project Road, in accordance with the Drawings or instructions of the Engineer:
  - Clearing and grubbing.
  - Removal and disposal of traffic signs, sign posts and their foundations.
  - Demolition, removal and disposal of existing bridges including foundations, abutments, piers, retaining walls, riverbank and waterway protection works.
  - Demolition, removal and disposal of existing culverts, inlet and outlet structures, headwalls, concrete drains, channel lining, and erosion protection works.
  - Removal of and any other natural or artificial objects within the RoW.
  - Removal and disposal of all vegetation and debris within the designated limits of the Right-of-Way.
- **Relocation of Existing Services -** The Works include the relocation of all services affecting the construction of the Project Road within the Right-of-Way. The services include the following
  - water mains
  - overhead electric supply lines
  - gas pipelines
  - underground telephone cables
  - sewer mains
- **Construction Activities**– The main construction phase aspects are described in detail below.

### B.12.1 Bridges

190. The construction of the new bridges includes but is not limited to the following parts of the structures and associated works:

- Foundations.
- Substructure including bridge bearings.
- Superstructure, including construction of expansion and deformation joints and footpaths.
- Deck pavement including hydro isolation, drainage, hand railing, and conduits for services.
- Approach slabs.
- Slope treatments in front and around the abutments.
- Construction and maintenance of traffic detours.
- Scour and erosion protection of the waterway areas and river bank protection upstream and downstream of the bridge crossing, and removal of old foundations and substructure from the waterways.
- All necessary and incidental items required for a complete bridge.
- All new and widened bridges will be designed for the life expectancy of 100 years.
- Oil and grease interceptor tanks.

### B.12.2 Tunnels

191. The actual development of the tunnel design follows the principles of ADECO RS method and is summarized in the following table.

**Table B-6: ADECO Tunnelling Method**

| Phase | ADECO RS |
|---|---|
| **Survey phase** | Analysis means first of all researching the medium to be tunneled from a geological and geomechanical point of view, especially by taking into consideration its resistance and deformability. |
| **Diagnosis phase** | And later forecasting by means of analytical and numeric instruments, what sort of stress-strain behavior will take place (Expected Deformation Response) when excavating (Categories A, B, C), in the hypothetical lack of stability operations. |
| **Therapy Phase** | The composition, in function of the foreseen behavior of the medium during excavation, of typical sections, defining the best type of stabilization operations for the expected operative context as well as phases, cadences, timing of implementation and any possible variability.<br>Control of the Expected Deformation Response may come about by:<br>• Defining the type of pre-confinement actions or confinement actions that are necessary to manage and control the Expected Deformation Response of the medium to excavation;<br>• Choosing the type of stabilization operations from those available with today's technology, on the base of pre- confinement and confinement actions that each one is capable of guaranteeing;<br>• Sizing and verification, by means of mathematical models, of the operations chosen to reach the medium's desired behavior under excavation with the necessary safety coefficient; and<br>• Forecast, again using mathematical models, of the medium's stress-strain behavior under excavation when so stabilized. |

### B.12.3 Culverts

192. Project works include the construction of culverts and underpasses, including inlet and outlet structures and associated works in accordance with the Specification. The scope of the cross drainage works includes:

- Complete replacement of existing culverts which are old, structurally deficient or undersized;
- Extension of existing culverts which are of adequate design and in good condition;
- Construction of new culverts at locations where no cross drainage structure existed before;
- Cleaning of existing culverts which are partially or completely silted;
- Miscellaneous repair of the existing culvert joints, headwalls, wing walls, and scour and erosion protection works; and
- Construction of new scour protection and channel lining works.

### B.12.4 Other Drainage Structures

193. Surface runoff from the carriageway and all other pavements, and any cut and embankment slopes must be discharged through longitudinal drains designed for adequate cross section, bed slopes, invert levels and the outfalls. The Works include construction of the drainage system components in urban and rural areas according to the types, dimensions, classes and material requirements for this work.

### B.12.5 Earthworks

194. The Works include the following types of earthworks necessary for the construction of the Project Road and all associated works:

- Removal of topsoil.
- Construction of embankments.
- Construction of subgrade.
- Excavation and removal of the existing pavement materials and the existing road embankment.
- Removal and replacement of unsuitable materials.
- Structural excavation.
- Excavation for the construction of side drainage and cross-drainage works.
- Excavation for the removal and relocation of the existing utilities.
- All backfilling necessary for the construction of bridges, retaining walls or other earth retaining structures, cross drainage structures and associated works, side drains and erosion protection work.
- Preparation of beddings and filters for all structural, cross drainage, side drains or pavement works.
- Excavation, filling or backfilling necessary for the execution of any other incidental works.

195. **Table B-7** indicates the approximate earthworks and pavement quantities for the Project Road.

**Table B-7: Estimated Earthworks for Section F4**

| Description | Unit | Quantity |
|---|---|---|
| Stripping of topsoil | $M^3$ | 132,420 |
| Road bed excavation and excavation in cut | $M^3$ | 1,250,000 |
| Embankment Construction for roads and associated works up to bridge pay lines | $M^3$ | 1,600,000 |
| Subgrade Preparation | $M^3$ | 320,00 |
| Preparation of the underlying granular pavement layer | $M^3$ | 100,000 |
| Dismantling of existing concrete structures | $M^3$ | 2,500 |

| Description | Unit | Quantity |
|---|---|---|
| Removal and transportation of existing bituminous pavement | $M^3$ | 30,500 |
| Structural excavation for culverts, headwalls & wingwalls and retaining walls | $M^3$ | 50,000 |
| Granular backfill to culverts, headwalls, wingwalls and bedding for culverts | $M^3$ | 35,000 |

### B.12.6 Pavement

196. Two different pavement structures will be used:
- Concrete pavement structure for the motorway and interchanges; and
- Asphalt pavement structure for all Slip Roads and all Minor Roads and bridges.

197. The following shall apply to the motorway, concrete pavement structure, construction category I:
- 28 cm Concrete;
- 30 cm Crushed Aggregate Course;
- 27 cm Granular Base Course;
- 85 cm Total Pavement Construction.

198. The following shall apply to slip roads and minor roads, asphalt pavement structure, construction category III:
- 4cm Asphalt Wearing Course;
- 4cm Asphalt Binding Course;
- 14 cm Asphalt Bearing Course;
- 58 cm Granular Base Course;
- 80 cm Total Pavement Construction.

199. For bridges, following the best practices all around the world and for durability reasons (total waterproofing and protection of the concrete slab), asphalt pavement is envisaged, precisely 11 cm of thickness.

200. Concrete pavements are already constructed on preceding sections of the highway. The pavement designs for the constructed sections were carried out in accordance to the German pavement design standard RStO 01.

201. The proposed pavement structure was designed according to "AASHTO, Guide for Design of Pavement Structures" and according to "RStO 01 the German Guideline for determination of Pavement Structures". Traffic load and other design parameters were evaluated for a 20 year design life cycle. At this stage of the project the pavement design and determination of the layer thicknesses aims at a constant pavement structure along the full length of the road which is suitable for the varying traffic loads.

### B.12.7 Removal of Asphalt

202. The Contractor shall remove the existing bituminous pavement layers and stockpile this material at locations that will be specified by the RD and instructed by the Engineer. The asphalt will be re-used, where practical, for access roads and temporary roads, after which it will be re-used for shoulder material.

### B.12.8 Construction Equipment

203. **Table B-8** provides indicative lists of the key equipment required in the construction phase (not including tunneling equipment).

**Table B-8: Key Equipment Section F4**

| No. | Equipment Type and Characteristics | Minimum Number required |
|---|---|---|
| 1 | Bulldozer (>245HP) | 4 |
| 2 | Excavator (>100HP) | 12 |
| 3 | Crushing and screening plant – mobile type at least 150 m3/h including rock material washing machinery | 2 |
| 4 | Concrete Paving Machinery width not less than 9.0 m for 2-layer concrete placing including film-forming machinery | 2 |
| 5 | Small Concrete Paving Machinery width not more than 5.0 m including film-forming machinery | 1 |
| 6 | Front Loader (>135HP) | 15 |
| 7 | Concrete batching plant (>150m3/hr) | 2 |
| 8 | Motor grader (>135HP) | 10 |
| 9 | Vibratory roller (> 13T) | 8 |
| 10 | Tipper truck (10T) | 30 |
| 11 | Tipper truck (16T) | 30 |
| 12 | Mobile concrete carriers (>25T) | 25 |
| 13 | Transit mixer (>6m3) | 6 |

## B.13 Source of Materials

### B.13.1 Borrow Material

204. Where practical cut will be balanced with fill. An assessment of the volumes of cut and fill are provided in **Section F.8.3** which discusses the management of spoil material. In addition, specific conditions are contained within this EIA for the correct siting and management of borrow pits.

### B.13.2 Concrete Batching and Asphalt

205. Bitumen and bituminous products are not produced locally in Georgia and is mainly imported from Iran, Azerbaijan and Romania. Bituminous products, which are necessary for the project (production and construction) must be imported and comply with European standards.

206. Cement is produced locally by companies such as Saqcementi and Kartuli Cementi in Kaspi (approximately 80 km east of the Project area), other sources of cement may also be found closer to the site.

207. The Contractor will be responsible for ensuring the concrete batching facilities and asphalt plant comply with the conditions outlined in **Section F.8.5**. The Contractor will source concrete and asphalt from existing batching plants or from his own dedicated plant.

**Section F.7.4** provides explicit conditions for operating batching plants and asphalt plants and the conditions for sourcing concrete and asphalt from existing plants.

### B.13.3 Technical and Potable water

208. Approximately 200 $m^3$ of technical water will be needed per day during the construction phase and around 15 $m^3$ of potable water per day. Most technical water will be sourced from the rivers adjacent to the construction sites. Potable water will be sourced from existing water supply pipelines, or will be provided to camps in bottles. The final locations of the extraction points (for both technical and potable water) will require the approval of the Engineer and the RD prior to the start of extraction to ensure that over extraction of water resources does not happen. Potable water will also need to be tested regularly throughout the construction period to ensure it meets the drinking water standards of GoG.

## B.14 Camps and Storage Areas

### B.14.1 Construction Camps

209. Camp sites will be selected keeping in view the availability of an adequate area for establishing campsites, including parking areas for machinery, stores and workshops, access to communication and local markets, and an appropriate distance from sensitive areas in the vicinity. The final locations of the camps will be selected by the Contractor after the approval from the RD and the Engineer.

210. The area requirement for construction camps will depend upon the workforce deployed and the type and quantity of machinery mobilized. For example, the camps may include rock crushing plant and concrete batching facilities. In view of the area required, it will not be possible to locate campsites within the RoW and the contractors will have to acquire land on lease from private landowners. The construction camp will also have facilities for site offices, workshop and storage yard, and other related facilities including fuel storage.

211. The Contractor will provide the following basic facilities in the construction camps:
- Safe and reliable water supply.
- Hygienic sanitary facilities and sewerage system.
- Treatment facilities for sewerage of toilet and domestic wastes
- Storm water drainage facilities.
- Sickbay and first aid facilities.

212. Detailed criteria for siting of construction camps and establishment of facilities are given in **Section F.7.4**.

### B.14.2 Storage Areas

213. Temporary storage areas will be required for certain activities, such as the storage of sand and gravels and construction equipment. These storage areas may range in size from anything between 50 $m^2$ to more than a hectare. The precise locations of these temporary facilities is not known at this stage, as such mitigation measures shall be prepared to ensure that these areas are sited in approved locations.

## B.15 Road Safety

214. The following elements are provided for traffic control and security on road:
- Road signs and indicators;

- Fences;
- Signal posts;
- Traffic markings;
- Lighting;
- Traffic lights;
- U-turns;
- Ground for short time stops for vehicles;
- Sidewalks;
- Bus stops.

215. The main road safety benefits the project will deliver are the following:

- Reduced risk of vehicles leaving their lane to avoid potholes and surface deformations;
- Improved sight distances;
- Better separation between pedestrians and vehicles; and
- Better night driving conditions due to wider carriageway and improved pavement centerline markings.

216. Some of these advantages could be partially offset by the higher speeds that may lead to accidents, which will be possible after the road improvements.

## B.16 Traffic Projections

217. Traffic forecasts for Dzirula and Argveta are presented below by **Figure B-22** and **Figure B-23.** The figures indicate that traffic volumes are set to more than double over the next 30 years between Dzirula and Argveta.

**Figure B-22: Forecasted Traffic, Dzirula, 2017 - 2037**

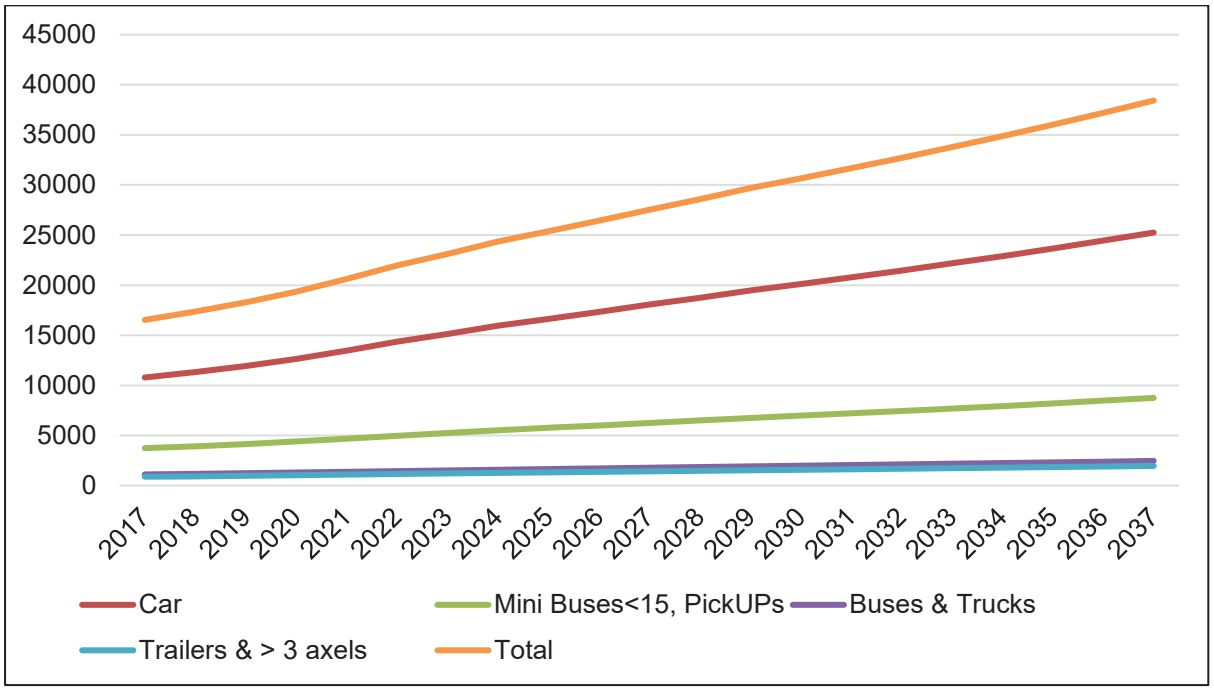
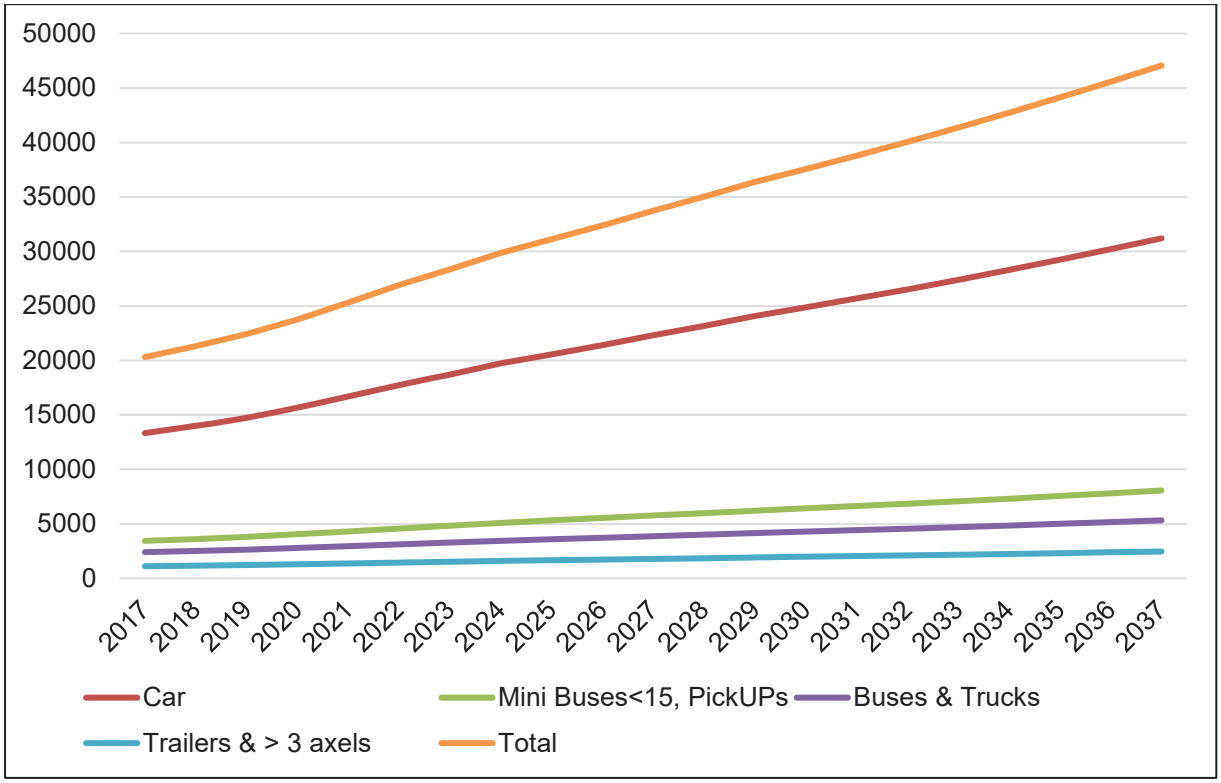


**Figure B-23: Forecasted Traffic, Argveta (approx. KM 14), 2017 - 2037**



# C. Alternatives

## C.1 General

218. One of the objectives of an EIA is to investigate alternatives to the Project. In relation to a proposed activity "alternatives" means different ways of meeting the general purposes and requirements of the proposed activity. The following section provides an assessment of alternative corridors, alignments, transport modes and technologies, as well as the 'no action' alternative.

## C.2 The No Action Alternative

219. The "No Action" Alternative in this instance is defined as a decision not to undertake the proposed construction of the Project Road. The "No Action" Alternative would result in the continued deterioration of the road, bridges and drainage structures along the RoW, thereby impeding the economic development of the Project Area and the Imereti region. All positive benefits would be foregone. The relatively minor, less than significant environmental impacts (such as noise and short-term air quality impacts due to maintenance activities) and inconveniences (such as traffic diversions) would be avoided in the short-run. In the long run, however, the steadily declining state of the roadway would severely hamper economic development in the area. In light of these considerations, the "No Action" Alternative is deemed to be neither prudent nor in the best interest of Georgia or those with an interest in, and attempting to assist restoration of, Georgia's well being.

## C.3 Alternative Road Corridors

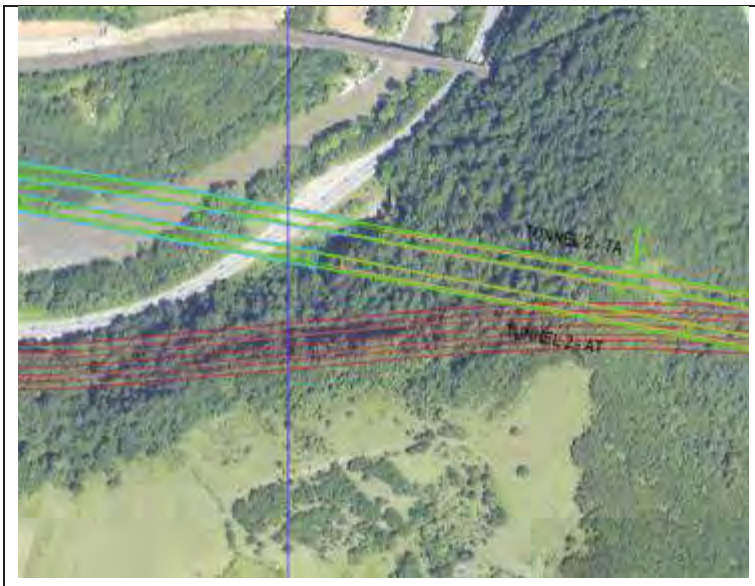
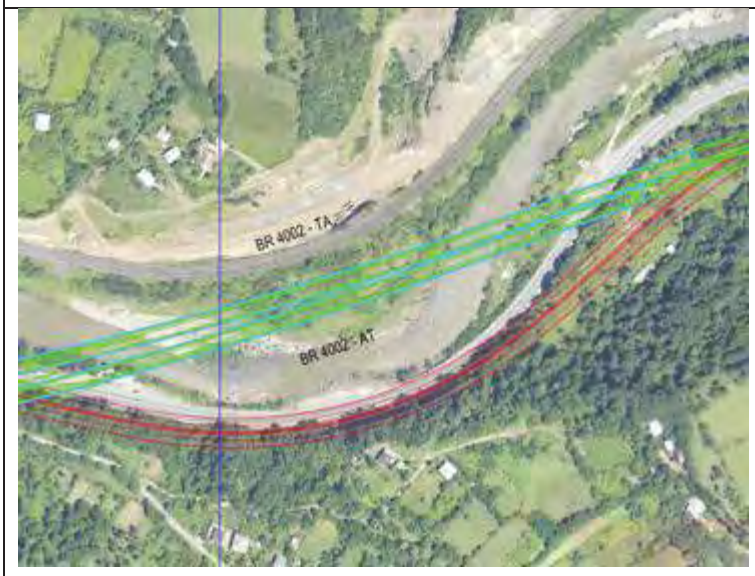
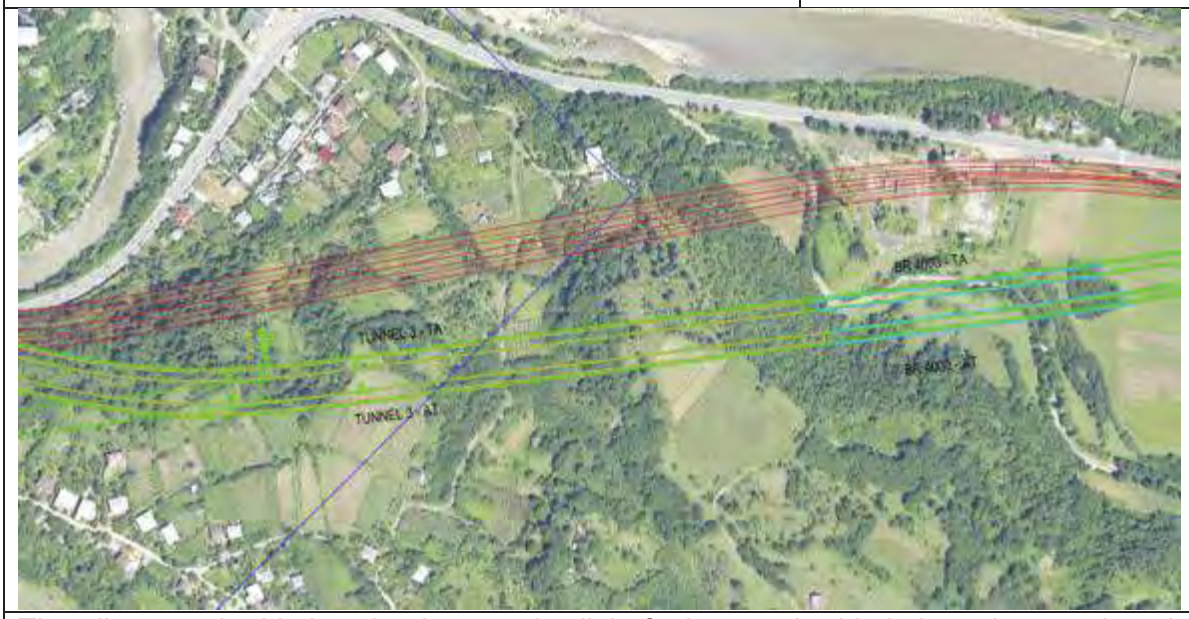
220. Given the complex topography of the region and Georgia in general, there are no other feasible alternative corridors that would be able to compete with the existing corridor in terms of travel times. In addition the Project forms part of the overarching program to upgrade the E-60 motorway which includes many sections that have recently been upgraded, or are in the process of upgrading (or detailed design), including the sections of road joining the start and end points of the Project road.

## C.4 Alternative Transport Modes

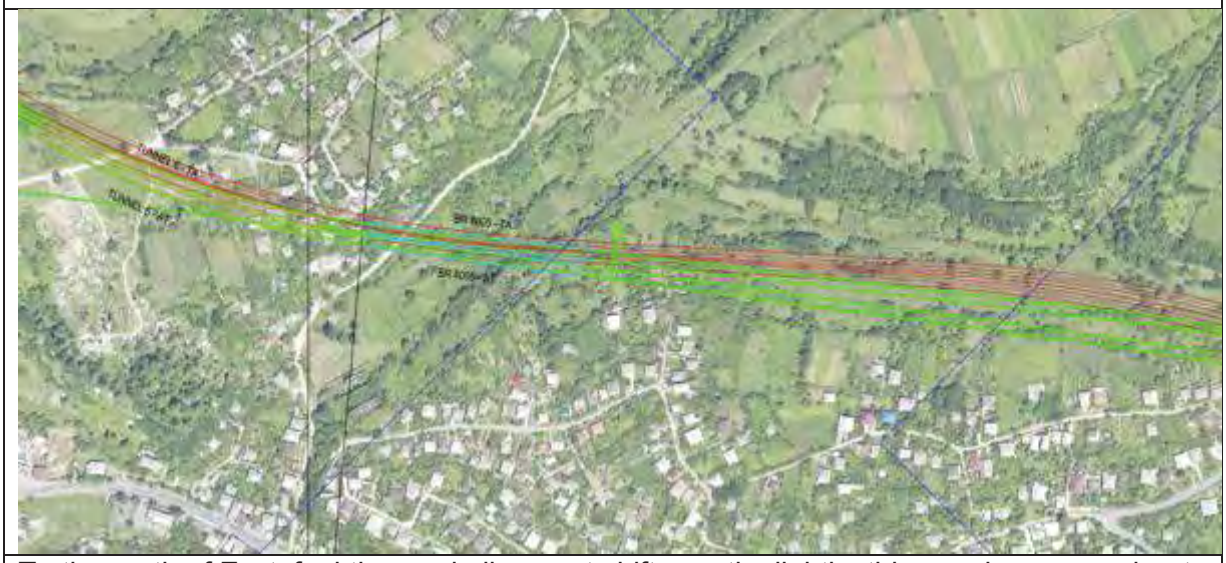
221. As noted above, the Project forms part of a program upgrading the E-60. The Khevi – Argveta section of the E-60 (including section F4) if one of the last remaining sections of the road requiring upgrading. Accordingly, the Project is focusing on the upgrading of the E-60 and will not consider any other transport mode as an alternative.

## C.5 Alternative Alignments

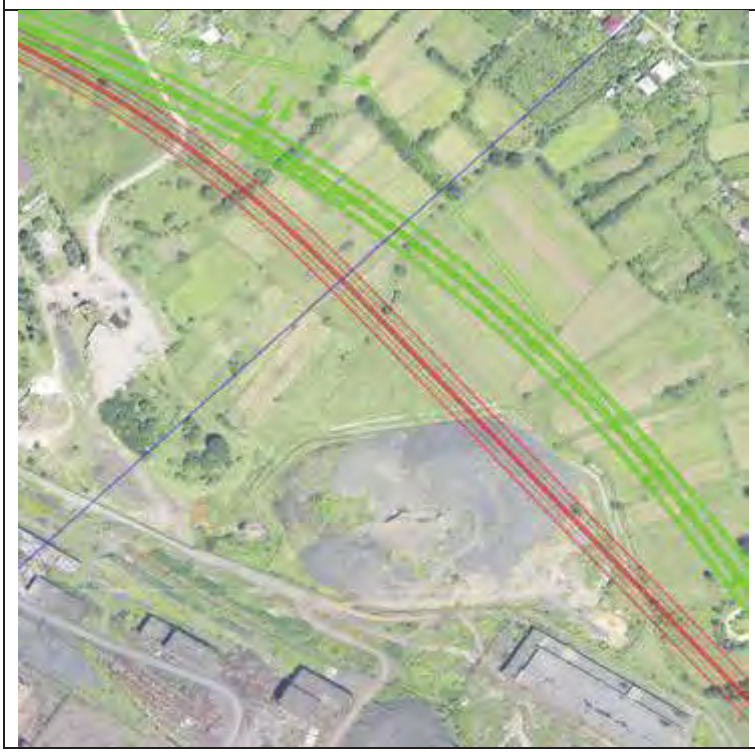
222. During the Projects Feasibility Phase a number of alignments were considered that broadly follow the existing E-60 corridor. The result of the Feasibility Report was a draft final corridor which the detailed design would use as a basis for the final road alignment (horizontal and vertical). During the detailed design phase a number of factors were taken into account to determine the final alignment, they included the consideration of potential resettlement issues and social aspects such as access and noise. The following figures indicate where alternatives have been adopted in the final alignment.

| | |
|---|---|
|  | At Tunnel 2 the tunnel will now exit to the north of the FS alignment (in red) and cross back and forth over the Dzirula river via Bridge 1. The aim of this change was to reduce the amount of cut material that would be required in the southern slope and limit impacts to the existing road. |
|  | Bridge 2 has been adopted based on the same principles as Bridge 1 above, reducing cut and also straightening the alignment thereby avoiding impacts to the existing road. |
|  | |
| The alignment in this location is moved a little further south, this is based on engineering | |

requiremnets rather than any specific environmental or social aspect.



To the north of Zestafoni the road alignment shifts south slightly, this may have a moderate impact upon residential properties in terms of noise, but not in resettlement. However, the small settlement in the upper left hand side of the photo will now under passed by a tunnel (Tunnel 6), thereby reducing resettlement impacts in this area.



The section to the north of the Alloy works has been moved slightly to the north to avoid passing through a large slagheap located within the works boundary. This slagheap probably contains high levels of pollutants and as such moving around this area reduces the need for disposal of hazardous waste.

## C.6 Alternative Pavement Types

223. Only one pavement type was considered for the motorway and interchanges; rigid concrete.[2] The rigid pavement structure is recommended for the following reasons:

[2] Asphalt pavement structure will however be used for all Slip Roads, bridges and all Minor Roads and bridges.

- Concrete pavements are already constructed on preceding sections of the E60 Highway. The pavement designs for the already constructed sections were carried out in accordance to the German pavement design standard RStO.
- The high traffic load over the design life with heavy truck traffic requires a high strength to prevent rutting. The concrete pavement has a flexural strength and is less dependent on variations in subgrade strength. Deformation in the subgrade is not transferred to the subsequent layers.
- Along the alignment extreme varying surface temperatures of the pavement are expected from hot summer temperature to freezing in winter. Also contraction and expansion of the concrete slabs have to be considered by expansion joints, the integrity of the concrete is not reduced. Asphalt pavements may become soft in summer leading to rutting and hard and brittle in winter.
- The concrete surface is not damaged by the unavoidable oil and grease leaking from passing vehicles. The life span of a concrete pavement is general higher compared to a flexible pavement and maintenance cost might be also lower as the initial construction costs could be higher.
- For the actual situation in Georgia with no local bitumen production which requires all bituminous products to be imported, the concrete production from local available sources (gravel and cement) seem to be in more than one respect advantageous.

# D. Environmental Laws, Standards and Regulations

## D.1 General

224. This section of the EIA provides a summary of:

- Environmental Legislation of Georgia;
- The Administrative Framework;
- Environmental Regulations and Standards of Georgia;
- National Technical Regulations Relevant to the Project;
- Environmental Permitting Procedure;
- Permit and Licenses Required for Off-site Works During Construction;
- International Conventions Relevant to the Project Ratified by Georgia;
- An overview of the ADB safeguard policies.

## D.2 General

225. Georgian legislation comprises the Constitution, environmental laws, international agreements, subordinate legislation, normative acts, presidential orders and governmental decrees, ministerial orders, instructions and regulations. Along with the national regulations, Georgia is signatory to a number of international conventions, including those related to environmental protection.

226. The Ministry of Environmental and Natural Resources Protection (MoENRP) of the Government of Georgia is responsible for regulating the activities that affect the natural environment.

## D.3 Environmental Legislation of Georgia

227. A list of Georgia's environmental legislation as it pertains to the proposed project is given in **Table D-1**.

**Table D-1: List of environmental laws and regulations relevant to the project**

| Year | Law / Regulation | Last revision | Code |
|---|---|---|---|
| 1994 | Law on soil protection | 16/07/2015 | 370.010.000.05.001.000.080 |
| 1995 | Constitution of Georgia | 03/05/2017 | 010.010.000.01.001.000.116 |
| 1996 | Law on subsoil | 26/12/2014 | 380.000.000.05.001.000.140 |
| 1996 | Law on environmental protection | 01/06.2017 | 360.000.000.05.001.000.184 |
| 1996 | On the system of protected areas | 17/02/2016 | 360.050.000.05.001.000.127 |
| 1997 | Law on wildlife | 01/06.2017 | 410.000.000.05.001.000.186 |
| 1997 | Law on water | 26/12/2014 | 400.000.000.05.001.000.253 |
| 1999 | Law on protection of atmospheric air | 01/06.2017 | 420.000.000.05.001.000.595 |
| 1999 | Forestry code of Georgia | 01/06.2017 | 390.000.000.05.001.000.599 |
| 1999 | Law on compensation of damage from hazardous substances | 06/06/2003 | 040.160.050.05.001.000.671 |
| 2000 | Law on regulation and engineering protection of the sea and river banks | 05/05/2011 | 400.010.010.05.001.000.830 |
| 2003 | Law on Red List and Red Book of Georgia | 01/06.2017 | 360.060.000.05.001.001.297 |
| 2005 | Law on licences and permits | 29/06/2017 | 300.310.000.05.001.001.914 |
| 2003 | Law of Georgia on conservation of soil and restoration-amelioration of soil fertility | 19/04/2013 | 370.010.000.05.001.001.274 |
| 2007 | Law on environmental impact permit | 01/06/2016 | 360.160.000.05.001.003.078 |

| | | | |
|---|---|---|---|
| 2007 | Law on ecological expertise | 01/06.2017 | 360.130.000.05.001.003.079 |
| 2014 | Waste code | 01/06.2017 | 360160000.05.001.017608 |
| 2017 | Environmental Assessment Code | 01/06.2017 | 360160000.05.001.018492 |

228. Brief summaries of the listed documents are given below:

229. **Constitution of Georgia** states the basic rights of people to live in a healthy environment and obligation to protect it. According to constitution everyone has the right to obtain complete, objective, and timely information about environmental conditions (Article 37 Part 3). It assures that the state shall protect environment and foster sustainable development (Article 37 Part 4). It establishes a legal framework that guarantees public access to information about the condition of the environment (Article 37 Part 5, Article 41 Part 1).

230. **Law on Environmental Impact Permit** determines the list of the activities and projects subject to the ecological examination as well as provides the legal basis for public participation in the process of issuing an environmental impact permit. The mentioned permit is obtained through Ecological Examination. Below we provide very brief description of EIA process as defined by the aforementioned laws. The law will be substituted with Environmental Assessment Code from January 1, 2018.

231. **Environmental Assessment Code (EAC).** The Code establishes a legal basis for regulating issues related to projects and strategic documents, which implementation may have significant impact on the environment, human life and health. It regulates the procedures related to environmental impact assessment, strategic environmental assessment, public participation in decision-making, trans boundary environmental impact assessment; defines rights and obligations of the developer, the planning authority, the public and the competent authorities in the course of decision-making envisaged by this Code; describes procedures of issuing Environmental Decision; exemption rules. The law includes two annexes. Annex I lists activities subject to EIA, Annex II - lists activities/projects that require screening procedure. Screening is responsibility of the Ministry. Under the EAC construction of international and interstate roads; construction and operation of tunnels and/or bridges on the international and interstate roads belongs to activities subject to EIA. According to the document, the main stages of environmental impact assessment include:

- Scoping procedure;
- Preparation of the EIA Report by the developer or the consultant;
- Ensuring public participation;
- Examination of the information presented in the EIA Report and any supplementary information provided by the developer to the Ministry as well as assessment of the information received through the public participation and consultation processes;
- Expertise procedure;
- Implementation of transboundary environmental impact assessment procedure (weather appropriate);
- Issuance of Environmental Decision or the decision on refusal to implement the project by the Minister.

232. **Law on Licenses and Permits** regulates legally organized activities posing certain threats to human life/health, and addresses specific state/public interests, including usage of resources, regulates activities requiring licenses/permits, determines types of licenses/permits required, and defines the procedures for issuing, revising and cancelling of licenses and permits. The law is generic law and refers to the law on Environment Impact Permit for details of environmental permitting procedures.

233. **Law on Ecological Expertise.** The expertise is conducted by the Ministry of Environment and Natural Resources Protection, for activities requiring environmental impact permits. The list of such activities is given in the Law of Georgia on Environmental Impact Permits. An environmental impact permit is issued only in the event of a positive conclusion by ecological expertise. Conclusion of ecological expertise is an integral part of an environmental impact or construction permit (in case activity requires construction permit). Its conditions are mandatory for permit holders.

234. **Law on Environmental Protection** regulates the legal relationship between the bodies of the state authority and the physical persons or legal entities (without distinction-legal form) in the field of environmental protection and in the use of nature on all Georgia's territory including its territorial waters, airspace, continental shelf and special economic zone. The law defines the principles and norms of legal relations, rights and obligations and responsibilities, awareness raising, education and scientific research in the field of environment, key players and principles of environmental management; describes economical mechanisms and levers; ecological insurance; basics of environmental audit; environmental requirements during privatization; justifies needs of environmental standards and limits (air, water, soil, noise, vibration, fields, radiation) and ecological requirements for production, transportation and storage of goods and food products; ecological requirements applicable to waste; states necessity of environmental impact assessment (with reference to the law on Environmental Impact Permit) and related issues (strategic environmental protection and transboundary environment assessment); defines general principles of environmental protection; considers different aspects on protection of ecosystems, protected areas, issues of global and regional management, protection of ozone layer, biodiversity, protection of Black Sea and international cooperation aspects. As stated in the law, in order to protect the climate against the global changes, the subject of the business activity is obliged to observe the limits to green-house gas emissions as well as to take measures for mitigating this emission. The emission of the green-house gases is regulated on the basis of integrated control of pollution of environment (Article 51). Besides, the subject of the business activity is obliged to reduce or stop production and use of such chemicals, which are likely to have effects on the ozone, layer of the earth and cause depletion of it (Article 52).

235. The status, of natural resources, study and usage of mineral resources is regulated by the **Law of Georgia on Subsoil**. The law describes rights and obligations of the users (Including re-cultivation after expiration of the license term), duration of the licenses (for energy resources – up to 45 years; for metal ores – up to 40 years; up to 30 years for construction materials and other non-ore mineral resources; ground water and gas (except for the natural gas) – up to 25 years); protection of natural resources and safety requirements; termination of license; state supervision and control over the use of mineral resources; general requirements during mining. With regards to the issues related to the licenses for use of the natural resources the law gives reference to the law on Licenses and Permits, Law on Oil and Gas and related regulations. The law states the need for protection of environment and OHS during operation (mining), including requirements for waste (including waste water) management. According to the law extraction and treatment of mineral resources from deposits both of natural and technogenic origin (soil disposal areas) are subject to state supervision and control.

236. The **Waste Management Code** (2015) provides the legal conditions for implementation of measures aiming at prevention of generation of waste and increased re-use, environmentally-sound treatment of waste (including recycling and extraction of secondary raw materials, energy recovery from waste, as well as safe disposal). The following summarizes the key points of the code.

**Article 7 - General waste management requirements**

- Waste, depending on its type, properties and composition, shall be collected, transported and treated in a manner not impeding its further recovery.
- Waste shall be collected, transported and treated in a manner which excludes, to the maximum extent possible, pollution of the environment and risks for human health.
- In case of waste pollution caused by waste transport activities, the waste transporter shall be responsible for taking clean up measures.
- The producer and holder of waste is obliged to treat their waste
- on their own or hand it over for collection, transport and treatment to persons entitled to carry out such operations in accordance with this Law and legislation of Georgia.
- Where waste has been submitted for recovery or disposal, the original producer's and/or holder's responsibility shall remain until recovery or disposal is completed.
- Persons who collect and transport waste shall hand it over for treatment to appropriate facilities, holding the relevant permit or registration.
- The burning of waste outside permitted incinerators shall be prohibited.

**Article 14 - Company waste management plan**

- Legal and natural persons that produce more than 200 tonnes of non-hazardous waste or 1000 tonnes of inert waste or any amount of hazardous waste annually, shall prepare a company waste management plan.

**Article 15 – Environmental Manager**

- The persons under Article 14 of this Law shall nominate a suitable person as a company environmental manager.

**Article 17 - General obligations for hazardous waste management**

- The production, collection and transportation of hazardous waste, as well as its storage and treatment, shall be carried out in conditions providing protection for the environment and human health. It shall be prohibited to
  a) discard hazardous waste outside waste collection containers;
  b) discharge it into the sewerage systems or underground or surface waters, including the sea;
  c) burn it outside waste incinerators permitted for that purpose;
  d) treat it outside waste treatment facilities permitted to treat such type of waste

**Article 18 - Special obligations for hazardous waste management**

- Waste producers that produce more than 2 tons of hazardous waste per year shall
  a) create and implement a suitable separation and collection system for such waste;
  b) designate an environmental manager, pursuant to Article 15 of this Law, responsible to make arrangements for the safe management of said waste;
  c) make arrangements for briefing and training for staff handling hazardous waste.
- Until the exact content of waste is unknown, the waste shall be regarded as hazardous.
- Hazardous waste for which no appropriate treatment techniques and/or technologies are available in accordance with the requirements of this Law within the territory of Georgia shall be exported for treatment. Until the export is carried out, the waste shall be safely stored at temporary storage facilities.
- The Ministry may exceptionally once allow for an extended storage period of up to one year if this is justified and does not harm human health or the environment.
- Hazardous waste may only be collected and transported by a natural or legal person after its registration pursuant to this Law.

**Article 29 - Obligations for keeping records and reporting on waste**

- Records on waste shall be kept and waste reports shall be submitted to the Ministry by

natural and legal persons:

a) dealing professionally with collection, transport and/or treatment of waste;

b) which produced more than more than 2 tones non-hazardous (excluding municipal waste) waste or any amount of hazardous waste per year.

237. **Law on Protection of Atmospheric Air.** The law regulates protection of atmospheric air from man-caused impact. Pollution of atmospheric air is emission of hazardous substances originating from activities which are able to have negative impact on human health and environment. Four types of pollution are considered (Part II, Chapter IV, Article II.2): Pollution of environment with hazardous matter, Radiation pollution of atmospheric air. Pollution with microorganisms and biologically active matter of microbial origin, Noise, vibration, electromagnetic fields and other physical impact. Maximum permitted limits for concentration of hazardous substances into the atmospheric air are defined for each contaminants and represent maximum concentration of hazardous pollutants, in averaged time span, recurring action of which has not have negative impact on human health and environment. Maximum permitted levels of emission of hazardous matters into the atmospheric air are defined with allowance of prospective of development of the enterprise, physical. geographical and climatic conditions, dispersion of emitted substances, background concentration of pollutants emitted from other neighboring enterprises, taking into account inter-location of existing or planned dwellings, sanatoria and recreation zones. In compliance with the law (Clause 28), in order to restrict pollution from the stationary sources3 of hazardous emissions the limits of emissions are to be set. The limit of pollution from the stationary source of emission is permitted quantity (mass) of emitted hazardous matters (Clause 29). Maximum annual emission level means the maximum permitted limit of discharge. This is annual permitted quantity of emission predetermined by technology in conditions of standard permitted capacity of discharge. Annual maximum capacity is defined for each hazardous substance and is calculated so that for each stationary source of emission cumulative emission from all registered sources of discharge does not exceed relevant maximum permitted value. Discharge of hazardous emissions from the stationary sources of emission without approved limits of discharge is forbidden. The standards of emissions (Clause 30) are to be worked out by the enterprise itself. According to the law (Clause 38) the enterprise is responsible for conducting self-monitoring which includes measurement of emission (evaluation), recording/registration and accounting. Emission which has not been recorded in self-monitoring record is considered illegal. As mentioned in the Clause 51 results of the monitoring and information on pollution of the air with hazardous substances is transparent and accessible for the public.

238. **Law on Water** regulates water use, defines rights and obligations of water users, sets out the types of licenses for the use of water, the rules and conditions of their issuance, considers conditions of suspension, withdrawal and deprivation of license, regulates water flows. The law states liability of all natural and legal persons to prevent pollution of catchment basins, water reservoirs, snow and ice covers, glaciers, permanent snow cover with industrial, household and other wastes and emissions which may cause deterioration of the underground water quality; prohibits piling of industrial and household wastes near the public water headwork's and in their sanitation zones, bans construction of facilities and implementation of any other activity which may cause water pollution; sets requirements for forest use within water protection zones. The state management of water protection and use is exercised through accounting, monitoring, licensing, control and supervision.

1. State monitoring of water is implemented by the Legal Entity under Public Law - the National Environmental Agency under the Ministry of Environment and Natural

[3] Stationary source of pollution of the atmospheric air is stationary device or construction with a special emission unit. Any stationary device or construction which, proceeded from its technological peculiarities, is not fitted with sputtering device is also considered as a stationary source of emission.

Resources Protection. By virtue of the law when locating/designing/constructing/commissioning of a new or reconstructed enterprise, or other facility, as well as in introducing of new technological process capable to affect the state of water, the rational water use is to be secured. At the same time, attention is to be paid to the measures ensuring due accounting of water abstracted from and returned to water bodies; protection of water from contamination, pollution-and depletion; avoidance of the unfavorable water impact; restriction of land flooding up to minimum necessary level, protection of land from silting, swamping or drying up; as well as environmental protection and landscape preservation.

2. Under the law required is purification, up to the fixed standard, of the waste water discharged in a water body. In order to protect the quality of water resources, the law requests creation of sanitary protection zone that consists of three belts, each having a special regime. The procedure fixing the water quality standards, the maximum permissible rates of emission of harmful substances (including microorganisms) into ambience, the water abstraction quotas and the temporary rates (limits) of emission of harmful substances (including microorganisms) into water is defined by the Law of Georgia on the Environmental Protection.

3. Georgian legislation may provide liability for other violations of law in the water protection and use sphere. Water users shall compensate for damages caused by violation of the law on Water in the amount and under procedure established by legislation of Georgia. Under the Article 17 (Protection of natural resources of the Black Sea) anadromous fish species (fish species seasonally migrating upstream of a river against the current) within the rivers of Georgia shall be protected by creation of conditions necessary for their reproduction, through conservation of the habitat, determination of procedures for regulating the fishing industry, determination of a total permissible amount of catching these species within the territorial waters, and within and outside special economic zones of Georgia, also through implementation of other measures defined by the legislation of Georgia. Article 20 (River water protection zone) defines protection zone of a river shall be its adjacent territory, where a special regime is established to protect water resources from pollution, littering, fouling, and depletion. This zone may include its dry bed, adjacent terraces, natural elevated and steep riversides, as well as gullies directly adjacent to riversides. 3. The width of a river water protection zone shall be measured in meters from the edge of a riverbed to both sides under the following procedure:
   - 10 meters - in the case of a river up to 25 kilometers long,
   - 20 meters - in the case of a river up to 50 kilometers long,
   - 30 meters - in the case of a river up to 75 kilometers long,
   - 50 meters - in the case of a river over 75 kilometers long.

4. Within this zone, prohibited is to: a) construct, expand or reconstruct functioning enterprises, except for cases directly determined by law; b) spray, by air atomisation, perennial plants, sown crops and forest lands with toxic chemicals; c) keep, collect or place toxic chemicals and mineral fertilizers, as well as any other wastes as defined in the legislation of Georgia. It is requested that hydraulic structures located within a water protection zone shall be normally equipped with appropriate technical facilities to completely exclude the possibility of river pollution and littering.

239. **Law on Wildlife.** The law regulates wildlife protection and use including hunting and fishing. The main goal of the law is to ensure protection and restoration of wildlife, its habitats, preservation and sustainability of species diversity and genetic resources, creation of conditions for sustainable development, taking into account the interests of present and future generation; legal ensuring of wildlife protection (including in-situ and ex-situ

conservation, translocation and reproduction of wildlife) and state-based provision of use of wildlife objects. In addition to this law, Georgian legislation on the wildlife is based on the Constitution of Georgia, Georgia's international agreements and treaties, laws on Environmental Protection and on the System of Protected Areas, law of Georgia on Wildlife and law of Georgia on the "Red List" and "Red Book". It is one of the main goals of the Environmental Protection Law to support the preservation of biodiversity of the country, the preservation of rare, endemic and endangered species, the protection of the marine environment, and the maintenance of the ecological balance (Art. 3.1 (d)). The Law contains regulations on both wild animals and plants which are threatened by extinction and those which are not. Two main legal acts regulating the issues of species protection in Georgia.

240. **Law on Red List and Red Book** which gives the legal definitions of Red List and Red Book (relevant recommendations and methodological issues) of endangered species of Georgia. The Red List structure was also legally defined, as well as the relevant procedures for including species in the Red List, procedures for revising, and updating of it. The Law also regulates issues related to planning and financial matters connected with the protection, taking of, rehabilitation and conservation of endangered species. The Red List of Georgia was approved by Order of President of Georgia No. 303 (2006), later - by the Resolution of the Georgian Government No. 190, dated 20-Feb-14. The law defines special cases when removal of individuals of the Georgian Red List species from their habitats is allowed. Decisions are made by the Government of Georgia.

241. **Forestry Code** regulates relations and state policy in the area of forestry management, use and protection. The code specifies all activities, which may be carried out in Forestry Fund. It allows only those activities, which are related to forest resource protection or use such as timber logging, collection of non-timber resources, use of area for agriculture or recreation, establishment of hunting farms, etc. State forestry fund may be used for a special purpose in urgent cases. Decisions are made by the Government of Georgia.

242. **Law on Soil Protection.** The law provides the policy requirements and principles of the protection and preservation of fertility soil resources against negative impacts. Soil protection is the state problem since correct and rational use of all types of soil, including barren soil, saline soils, swamped soil, alkali soil and aqueous soil are the main reserve of dynamic development of agriculture and of the national economy as a whole. The purpose of the present Law is to establish the rights and the duties of landholders, landowners and the state in the field of soil protect. The law defines soil protection measures and methods and prohibits certain activities, e.g. use of fertile soil for non-agricultural purposes; implementation of non-agricultural activity without topsoil removal and conservation; any activity, which results in deterioration of soil properties, etc. In addition to this law soil protection issues are regulated by order #2-277 (25.11.2005) of the Minister of Agriculture on approving Recommendations for Complex Measures for Soil Protection from the Erosion.

243. **Law of on Conservation of Soil and Restoration-Amelioration of Soil Fertility** is to ensure conservation and improvement of soil in the territory of Georgia, define the legal principles, measures, limitations and prohibitions to that end; soil conservation and fertility restoration improvement measures. It prohibits unregulated grazing, removal of windbreaks, application of non-registered fertilizers or other substances, soil contamination and any activity, which results in deterioration of soil properties and facilitates desertification, swamping, salinization, etc. Businesses that use soil or conduct activities upon soil that have the potential to negatively impact soil conservation are required to follow the Law and related normative documents and regulations, including Order #113 (27.05.2005) of the Minister of Environment and Natural Resources' Protection on affirming regulation on "Removal, Storage, Use and Re-cultivation of the Fertile Soil Layer" and 2) Resolution of the GoG #424

(31.12.2013) on affirming technical regulations on "Removal, Storage, Use and Re-cultivation of the Fertile Soil Layer". These documents consider issues of land resources protection and rational use and issues related to removal, storage, use and re-cultivation of the fertile soil layer during different activates. According to the regulation, restoration of degraded soil fertility must be implemented using re-cultivation (technical and biological) methods.

244. **Law on System of Protected Areas**. Forms a legal basis for planning, establishment and maintenance and assignment of categories of protected areas, described funding issues for each category. It specifies ownership forms of land and other natural resources in protected areas, allowed and prohibited activities.

245. **Law on Regulation and Engineering Protection of Seacoasts and Riverbanks of Georgia** provides general principles and requirements for protection of coastal areas and riverbanks from negative environmental impacts.

246. **Law on Compensation for Damage Caused By Hazardous Substances** Includes principles and procedures for compensating the negative impacts caused by discharge of hazardous substances into environment.

247. Laws and regulations related to social aspects and land ownership applicable to the project are presented in **Table D-2.**

**Table D-2: List of social and land ownership related laws relevant to the project**

| Year | Law / Regulation | Last revision | Code |
|---|---|---|---|
| 1996 | Law on agricultural land ownership | 16/06/2017 | 370.030.000.05.001.000.132 |
| 1997 | Civil code of Georgia | 22/06/2016 | 040.000.000.05.001.000.223 |
| 1997 | Law on compensation of land substitute costs and damages due to allocating agricultural land for non-agricultural purposes | 25/12/2014 | 370.020.000.05.001.000.244 |
| 1999 | Law on rules for expropriation of property for public needs | 06/09/2013 | 020.060.040.05.001.000.670 |
| 2007 | Law on cultural heritage | 25/09/2013 | 450.030.000.05.001.002.815 |
| 2007 | Law on public health | 21/06/2017 | 470.000.000.05.001.002.920 |
| 2010 | Law on state property | 03/06/2016 | 040.110.030.05.01.004.174 |
| 2010 | Labour Code | 12/06/2013 | 270000000.04.001.016012 |

248. Brief summaries of the listed documents are given below:

249. **Civil Code** regulates contractual relations, describes the rights and responsibilities of natural and legal persons, defines the penalties in the case of violations of the requirements set out in the document. The Civil Code differentiates between movable and immovable property and provides rules for acquiring title over property, as well as any proprietary or obligatory rights thereto. This piece of legislation must be taken into account when entering into contracts in Georgia.

250. **Labour Code** regulates employment relations, unless such relations are otherwise regulated by international treaties that have been implemented in Georgia. Employers are obliged to comply with requirements and clauses of the document for the purpose of ensuring that the rights of employees are protected.

251. **Law on Public Health** regulates legal relations for ensuring a safe environment for human health. It indicates quality norms of for air, soil and water pollution and restrictions

related to ionized radiation, noise and vibration. The limits must be complied with. Section 7 of the law is dedicated to safety of technological processes.

252. **Law on Compensation of Land Substitute Costs and Damages due to Allocating Agricultural Land for Non-agricultural Purposes** defines compensation amounts, required at the time of allocation, use or disposal of agricultural land parcel for non-agricultural purpose; the payment procedure and the procedure for changing the agricultural land category, including payment of losses to landowners or land users, as a result of restricting their rights or reducing the quality of their land.

253. **Law on agricultural land ownership.** Objective of the law is to ensure improvement of the structure of agricultural land based on rational use of resources, avoidance of splitting and unsustainable use of the land plots. The law defined the rules for acquisition and selling the land, participation of the state in agricultural land related relations. The law deals with land ownership issues, restrictions of land alienation in case of co-ownership, sets priority of the state in buying out the agricultural land plots.

254. **Law on rules for expropriation of property for public needs** outlines respective procedures and conditions for expropriation of private property as well as procedures for compensation payment for expropriated property or the transfer of other property with the same market value.

255. **Law on State Property** regulates relationships on state property management and transfer for use by others, defines special requirements and procedures for transfers. The Ministry of Economy and Sustainable Development is the state authority in charge of the property.

256. **Law on cultural heritage** sets out procedures for protection of cultural heritage and permitting arrangements for archaeological investigations.

## D.4 Administrative Framework

257. **Ministry of Environment and Natural Resources Protection (MoENRP)** - The Ministry of Environment and Natural Resources Protection is responsible for all environmental protection issues and natural resources. The responsibilities of the Ministry as the competent authority are: a) to intermit, limit, or stop any activity having or likely to have adverse impact on the environment, b)to issue a series of licenses and permits (including for environmental impact), c) to control the execution of mitigation measures by the developer, d)to receive free and unrestricted information from the developer about the utilization of natural resources, monitoring systems, waste management and explanations from authorities concerning the Project. Connected with projects of the actions presented to ecological examination, department of the mentioned ministry of ecological examination organizes discussion of an estimation of influence on environment and prepares the documentation (the project of the order of the minister) to let out the permission to influence to environment.

258. **Ministry of Economy and Sustainable Development (MoESD)** - MoESD is responsible for carrying out the review of technical documentation (including conclusion of independent experts) and issuing Permits on Construction for projects, as well as for supervision over constructing activities and for arranging Acceptance Commission after completion of construction. State supervision of construction and compliance monitoring is provided by the Main Architecture and Construction Inspection (MACI), which is operating under the Ministry of Economy and Sustainable Development of Georgia.

259. **The Roads Department (RD)** - The Roads Department of the Ministry of Regional

Development and Infrastructure (RD) is responsible for elaboration of policy and strategic plans related to developing motor roads, management of road and traffic related issues and construction, rehabilitation, reconstruction and maintenance of the roads of public use of international and national significance, utilizing funds from the state budget, lawns, grants and other financial sources. Thus, the RD is responsible for the procurement of design and EIA studies, as well as works on construction and rehabilitation of roads and is responsible for ensuring compliance with the Georgian legislation and environmental and social requirements of the relevant donor organizations. Control of implementation of the Environmental Management Plan (EMP) is direct responsibility of the Roads Department. Within the RD there is Environmental Division dealing with the environmental issues. This division is supposed to review the EIAs and EMPs related to the Roads Department projects and perform monitoring of compliance of the contractor's performance with the approved EMPs, EIAs, environmental standards and other environmental commitments of the contractor.

260. **The Ministry of Culture, Monument Protection and Sports** - responsible on supervision of the construction activities in order to protect archaeological heritage. In case if construction is to be carried out in a historic sites or zones of cultural heritage, consent of the Ministry of Culture, Monument Protection and Sport is also required for issuing construction permit.

261. **The "National Service for the Foodstuffs Safety, Veterinary and Plant Protection" of the Ministry of the Agriculture** - responsible for implementation of complex sanitary protection measures in case of identification burial sites during earthworks. Information about suspicious burial sites should be delivered to the "National Service for the Foodstuffs Safety, Veterinary and Plant Protection" of the Ministry of the Agriculture by the Construction Contactor (field environmental officer) and RD field officer.

## D.5 Environmental Regulations and Standards

262. Georgia has a large set of specific standards that refer to emission, effluent, and noise standards, as well as standard to handle and dispose specific wastes ranging from sewage to hazardous wastes. The following summarizes these laws and standards.

### D.5.1 Ambient Air Quality Standards

263. Maximum permissible concentrations (MPC) for **air** born pollutants are set by the hygienic standards on Maximum Permissible Concentrations of Air Born Pollutants for Settlements (HN 2.1.6. 002-01), see **Table D-3**. This project will also ensure compliance with IFC guideline values (not interim targets) as these values are, in some instances, more stringent than the national standards (see **Table D-4**).

**Table D-3: Georgian Standards for Ambient Air Quality**

| Parameter | Maximum Permissible Concentration (MAC) for Air Quality | |
|---|---|---|
| | Averaging Period Period | Limit (mg/m$^3$) |
| Nitrogen Dioxide ($NO_2$) | 30 minutes | 0.2 |
| | 24 Hours | 0.04 |
| Sulphur Dioxide ($SO_2$) | 30 minutes | 0.5 |
| | 24 Hours | 0.05 |
| Carbon Monoxide (CO) | 30 minutes | 5.0 |
| | 24 Hours | 3.0 |
| Total Suspended Particulates (TSP) / Dust | 24 Hours | 0.15 |
| | 30 minutes | 0.5 |

**Table D-4: IFC Ambient Air Quality Guidelines**

| Parameter | Averaging Period | Guideline Value (µg/m$^3$) |
|---|---|---|
| $SO_2$ | 24 hour | 20 |
| | 10 minute | 500 |
| $NO_2$ | 1 year | 40 |
| | 1 Hour | 200 |
| PM10 | 1 year | 20 |
| | 24 hour | 50 |
| PM2.5 | 1 year | 10 |
| | 24 hour | 25 |
| Ozone | 8-hour daily maximum | 100 |

### D.5.2. Surface Water Quality Standards

264. The values of Maximum Admissible Concentrations of the harmful substances in surface are provided in the Environmental Quality Norms approved by the Order #297N (16.08.2001) of the Ministry of Labour, Health and Social Protection (as amended by the Order No 38/n of the same Ministry of 24.02.2003). The admissible level of pollutants in surface water is given in **Table D-5**. All effluents shall comply with the Georgian National Standards. However certain parameters are not specified in the national standards for these IFC Guidelines are being used as shown in the Table.

**Table D-5: Applicable Standards for Surface Water Quality**

| Parameter | Units | Maximum Permissible concentration |
|---|---|---|
| pH | | 6.5-8.5 |
| Sodium, Na | mg/l | 200 |
| Chloride | mg/l | 350 |
| Cyanide (total) | mg/l | 0,17 |
| Boron | mg/l | 0.53 |
| Chemical oxygen demand, COD | mg/l | 30 |
| Biological oxygen demand, BOD | mg/l | 6 |
| Total petroleum hydrocarbons | mg/l | 0.3 |
| Arsenic, As | mg/l | 0.053 |
| Chromium, $Cr^{6+}$ | mg/l | 0.05 |
| Copper, Cu | mg/l | 1.03 |
| Mercury, Hg | mg/l | 0.00053 |
| Nickel, Ni | mg/l | 0.13 |
| Lead, Pb | mg/l | 0.03 |
| Selenium, Se | mg/l | 0.013 |
| Zinc, Zn | mg/l | 1.03 |
| Phenols (total) | mg/l | 0.001 |
| Benzene | mg/l | 0.5 |
| Toluene | mg/l | 0.5 |
| Ethylbenzene | mg/l | 0.01 |
| Benzo(a)pyrene | mg/l | 0.000005 |

265. Quality requirements depend on category of water body (ref. Technical regulations of protection of surface water from pollution, approved by decree #425 of the government of

Georgia, 31/12/2013). The categories are: a) household water use, b) domestic water use and c) fisheries. The latter, in its turn, splits in highest, first and second categories.

**Table D-6: Water quality requirements by water use category**

| | **Water use category** | | | |
|---|---|---|---|---|
| | **Household water use** | **Domestic water use** | **Fisheries** | |
| | | | **Highest and first** | **Second** |
| | Increase not higher that listed below is allowed | | | |
| Suspended solids | 0.25mg/l | 0.75 mg/l | 0.25mg/l | 0.75 mg/l |
| | For rivers with natural content of suspended solids 30mg/l, around 5% increase is allowed | | | |
| | If waste water contains suspended particles with deposition rate above 0.2mm/sec discharge in water reservoirs is not allowed. Discharge of effluents containing suspended particles with deposition rate above 0.4mm/sec is prohibited. | | | |
| Floating matter | Patches and films of oil, petroleum products, fats must not be detectable | | | |
| Colour | Must not be visible in water column | | Water must not have unusual colour | |
| | 20cm | 10cm | - | |
| Odour, taste | Water must not have odour and taste of higher than 1 unit intensity | | Water must not result in unusual odour and taste in fish | |
| | After chlorination of other treatment | Without treatment | - | |
| Temperature | After discharge of waste water, temperature in water reservoir must not exceed by more than 5% compared to the natural value | | For water bodies where cold water lowing fish is found (*Acipenseridae, Coregonidae*) maximum allowable temperatures in summer and winter are 20C and 5C respectively, for other water bodies 28C (in summer), 8C (in winter) | |
| pH | Must be in 6.5-8.5 interval | | | |
| Water mineralisation | <1000mg/l, Incl. chlorides – 350mg/l; sulphates - 500mg/l | To comply with requirement given in section related to taste (see above) | In accordance with taxation | |
| Dissolved oxygen | Must not be lower than | | | |
| | 4mg/l | 4mg/l | 6mg/l | 6mg/l |
| Biological oxygen demand | At 20C must not exceed | | | |
| | 3mg/l | 6mg/l | 3mg/l | 6mg/l |
| Chemical oxygen demand | Must not exceed | | | |
| | 15 mg/l | 30 mg/l | - | - |
| Chemical substances | Must not exceed maximum permissible limits | | | |
| Pathogens | Must be free for pathogens, including viable helmint eggs, tenia oncosperes and viable cysts of pathogen organisms | | | |
| Toxicity | - | - | At the point of discharge and control section of the river toxic impact must not be observed. | |

### D.5.3 Groundwater Quality Standards

266. Groundwater quality standards are not set under Georgian law. Drinking water quality standards are commonly used instead as assessment criteria for groundwater. Quality of drinking water is determined by the Technical Regulations for Drinking Water (approved by order №58 of the government of Georgia, (15.01.2014).

**Table D-7: Drinking water quality criteria**

| Parameter | Units | Value |
|---|---|---|
| Odour | Unit | 2 |
| Taste | Unit | 2 |
| Colour | Grad | 15 |
| Turbidity | Turbidity units (formazine) or mg/l (kaolin) | 3.5 or 2 |
| **Metals and Miscellaneous** | | |
| Boron, B | mg/kg | 0.5 |
| Arsenic, As | mg/kg | 0.01 |
| Cadmium, Cd | mg/kg | 0.003 |
| Copper, Cu | mg/kg | 2 |
| Mercury, Hg | mg/kg | 0.006 |
| Nickel, Ni | mg/kg | 0.07 |
| Lead, Pb | mg/kg | 0.01 |
| Selenium, Se | mg/kg | 0.01 |
| Zinc, Zn | mg/kg | 3 |
| Total Petroleum Hydrocarbons, TPH | mg/kg | 0.1 |
| Cyanide | mg/kg | 0.07 |
| Sulphate | mg/kg | 250 |
| Chloride | mg/kg | 250 |
| pH | pH value | 6-9 |
| Sodium, Na | mg/kg | 200 |
| **Microbiological characteristics** | | |
| Thermotolerant coliforms | Bacteria in 100cm$^3$ | not allowed |
| Tota; coliforms | Bacteria in 100cm$^3$ | not allowed |
| Mesophylic aerobes and facultative anaerobes | Colony forming units in 1cm$^3$ | < 50 |
| Colifagues | Negative colonies in 100m$^3$ | not allowed |
| Sulphitereducing clostridia | Spores in 20cm$^3$ | not allowed |
| Lamblias and cysts | Cysts in 50dm | not allowed |

### D.5.4 Noise Standards

267. Admissible noise standards of the IFC and Georgian national standards for residential areas are similar. The standards for noise are set according to the Decree # 297/N of Georgian Ministry of Health, Labor and Social Affairs about “Noise at workplaces, in houses and public buildings and at the places of nonsing buildings, SN 2.2.4/2.1.8. 000 – 00” issued on August 16, 2001. There are defined as the admissible norms of noise as the maximum of the admissible norms for several zones of the territories, see **Table D-8**.

268. For IFC noise impacts should not exceed the levels presented in **Table D-9** and **Table D-10** or result in a maximum increase in background levels of 3 dB at the nearest receptor location off site. This project will comply with both IFC Guidelines and Georgian Standards.

**Table D-8: Georgian Standards for Noise Levels**

| | Receptor | Time | Sound level, max, dBA |
|---|---|---|---|
| 1 | **Areas bordering** residential houses, schools, and other educational institution buildings | 7:00-23:00 | 55 |
| | | 23:00-7:00 | 45 |
| 2 | **Areas adjacent to** residential; houses, outpatient buildings, dispensaries, rest houses, elderly and disabled living facilities, preschool, school and other education facilities, library buildings facilities | 7:00-23:00 | 70 |
| | | 23:00-7:00 | 60 |
| 3 | **Areas adjacent to** sanatoria and hostels | 7:00-23:00 | 75 |
| | | 23:00-7:00 | 65 |

Note: +10dBA can be used for the areas in 2 metres from the fencing/enclosing structures of first row of buildings (outer building envelope) facing the main road for lines 2 and 3.

**Table D-9: IFC Noise Level Guidelines**

| Receptor | One hour $L_{aeq}$ (dBA) | |
|---|---|---|
| | Daytime 07.00-22.00 | Night-time 22.00 – 07.00 |
| Residential; institutional; educational | 55 | 45 |
| Industrial; commercial | 70 | 70 |

**Table D-10: IFC Work Environment Noise limits**

| Type of Work, workplace | IFC General EHS Guidelines |
|---|---|
| Heavy Industry (no demand for oral communication) | 85 Equivalent level Laeq,8h |
| Light industry (decreasing demand for oral communication) | 50-65 Equivalent level Laeq,8h |

### D.5.5 Vibration Standards

269. The Georgian Standards for vibration are designed for human comfort. These are shown in **Table D-11**. Note that no standards for building damage exist.

**Table D-11: Georgian General Admissible Vibration Values in Residential Houses, Hospitals and Rest Houses, Sanitary Norms 2001**

| Average Geometric Frequencies of Octave Zones (Hz) | Allowable Values X0,Y0, Z0 | | | |
|---|---|---|---|---|
| | Vibro-acceleration | | Vibro-speed | |
| | $m/sec^2$ | dB | $m/sec\ 10^{-4}$ | dB |
| 2 | 4.0 | 72 | 3.2 | 76 |
| 4 | 4.5 | 73 | 1.8 | 71 |
| 8 | 5.6 | 75 | 1.1 | 67 |
| 16 | 11.0 | 81 | 1.1 | 67 |

| **Average Geometric Frequencies of Octave Zones (Hz)** | **Allowable Values X0,Y0, Z0** | | | |
|---|---|---|---|---|
| | Vibro-acceleration | | Vibro-speed | |
| | $m/sec^2$ | dB | $m/sec\ 10^{-4}$ | dB |
| 31.5 | 22.0 | 87 | 1.1 | 67 |
| 63 | 45.0 | 93 | 1.1 | 67 |
| Corrected and equivalent corrected values and their levels | 4.0 | 72 | 1.1 | 67 |

Note: It is allowable to exceed vibration normative values during daytime by 5 dB during daytime In this table of inconstant vibrations, a correction for the allowable level values is 10dB, while the absolute values are multiplied by 0.32. The allowable levels of vibration for hospitals and rest houses have to be reduced by 3dB.

### D.5.6 Soil Quality

270. Soil quality is currently assessed by Methodological Guides on Assessment of Level of Chemical Pollution of Soil (MG 2.1.7.004-02). However, these limits will soon be replaced as Georgia harmonizes its regulations with the EU and moves away from the outdated standards prepared while part of the Soviet Union. The national standards for soil quality are given in **Table D-12** along with the proposed new standards developed by the Ministry of Environment and Natural Resources Protection of Georgia in close cooperation with the National Environment Agency (NEA), Ministry of Agriculture and Ministry of Labour, Health and Social Affairs and with support from the United Nations Development Programme (UNDP) and Global Environment Facility (GEF).

**Table D-12: Soil screening values**

| Compound | Units | Current Limit | Proposed Limit |
|---|---|---|---|
| Metals and Miscellaneous | | | |
| Arsenic, As | mg/kg | 2 | 30 |
| Cadmium, Cd | mg/kg | 2* | 0.5** – 1.0*** |
| Copper, Cu | mg/kg | 3-132* | 60**-100*** |
| Mercury, Hg | mg/kg | 2.1 | |
| Nickel, Ni | mg/kg | 4-80* | 60**- 80*** |
| Lead, Pb | mg/kg | 32-130* | 100** - 140*** |
| Zinc, Zn | mg/kg | 23-220* | 130** - 200*** |
| Total Petroleum Hydrocarbons | mg/kg | 1000 | - |
| Cyanide | mg/kg | 0,2 | - |
| Volatile Organic Compounds | | | |
| Benzene | mg/kg | 0.3 | 0.05 |
| Toluene | mg/kg | 0.3 | - |
| Total xylenes | mg/kg | 0.3 | 0.05 |
| Semi Volatile Compounds | | | |
| Benzo(a)pyrene | mg/kg | 0.02-0.2 | 0.1 |
| Isopropylbenzene | mg/kg | 0.5 | - |
| Pesticides | | | |
| Atrazine | mg/kg | 0.01-0.5 | - |
| Lindane | mg/kg | 0.1 | - |
| DDT (and its metabolite) | mg/kg | 0.1 | 0.075 |

* Note: Sodium and neutral (clay and clayey) pH >5.5 - No screening value available, ** Light Soils, ***Other Soils

## D.6 National Technical Regulations Relevant to the Project

271. Technical (national) regulations applicable to the road project in Georgia include:

- Law on Roads (310.090.000.05.001.000.089, last amended in 2013);
- Construction norms and regulations 2.05.03-84 - Design of bridges, viaducts, overpasses and pipes;
- Construction norms and regulations 2.05.02-85 - Motor roads (regulate traffic safety, environmental issues, set forth main technical and traffic operation norms, crossings and intersections, paving aspects, etc.)

272. According to these documents:

- International and national importance roads should be built bypassing the settlements. Access roads to the settlements should be provided. To allow modernisation, the distance between the residential area (settlement) and the edge of the carriageway must be not less than 200m, distance to agricultural land - 50m. If because of technical or economical purposes the road is to cross the settlement, minimum distance to the residential area must be 50m, in case noise barriers are provided – 25m. For local roads minimum distance to residential area must be 50m, distance from agricultural land – 25m.
- To protect residential area from noise and emission impact, 10m wide green barrier must be arranged;
- Along with technical and economic aspects environmental impacts must be taken into account during design and construction;
- Prior to arrangement of temporary infrastructure and preparation of road embankment, topsoil must be removed and stockpiled until subsequent use for re-cultivation after completion of construction and removal of all temporary facilities;
- Roads along the rivers, lakes and reservoirs must be built with consideration of protection zone boundaries for the surface water bodies.

## D.7 Environmental Permitting Procedures

273. The permit application/issuance procedure for the planned development, including Environmental and Social Impact Assessment coordination, timeframes for information disclosure and public review are set in the law of Georgia on Environmental Impact Permit and include the following steps (Procedure described below is valid until January 1, 2018):

**Table D-13: Environmental impact permit issuance procedure (valid until January 1, 2018)**

| Step | Action | Comment | Timeframe |
|---|---|---|---|
| 1 | Publication of information on the project in central and regional newspapers. | The advertisement has to include the project title, location, place and the date, time and venue of public disclosure meeting(s). It will also identify locations where the EIA can be reviewed and where comments may be submitted. | Day 0 |
| 2 | • Submission of the draft ESIA report to the Ministry of | Hard copy and electronic version of the report | within 3 days after announcement in the |

| Step | Action | Comment | Timeframe |
|---|---|---|---|
| | Environment and Natural Resources Protection (MoENRP) | delivered to MoENRP | newspapers |
| | • Feedback | Receiving public comments on the disclosed EIA | 45 days from announcement in the newspapers |
| | • Meetings with stakeholders including local community, NGOs, local authorities, etc. | All comments and questions must be documented and answers, minutes of the meeting(s) written up. | Between 50 and 60 days after publication of the advert |
| 3 | Development of final version of the ESIA and submission to the MoENRP (together with Non-technical Summary, Technical Summary, reports on emissions and allowable limits) for the state ecological examination. | Comments received from the stakeholders considered in the report. Minutes of meeting(s) enclosed to the document as attachment. . | After arranging a public review of the EIA report and development of final version of the EIA, the developers is authorised to submit, within one year, an application to the permit issuing administrative body for a permit |
| 4 | Consideration of the documents by MoENRP and issuance of conclusion | | 20 days after registration of an application for a permit and submission of the EIA package to the MoENRP. |

Note: According to the national regulations (Law on Licenses and Permits and in compliance with Resolution of the GoG on rules and conditions for issuance of construction permit (N57, 24 March 2009, with amendments) construction/ modernization of highways requires Construction Permit. According to the national legislation, administrative body issuing the permit (the Ministry of Economy and Sustainable Development) ensures involvement of the other Ministries including the Ministry of Environmental Protection in the permitting process. For the project subjected to the construction permit, the authorization (construction permit) incorporates elements of environmental impact permit.

274. After January 1, 2018, the procedure described below will be applicable (but not to this Project).

**Table D-14: Environmental impact permit issuance procedure (after January 1, 2018)**

| Step | Action | Comment | Timeframe |
|---|---|---|---|
| 1 | Written application to the Ministry submitted by developer. | The application submitted by the developer shall be accompanied with the following documents and/or data:<br>a. EIA report;<br>b. Projects on estimation of the limits for emission of harmful substances into the atmospheric air and for the injection of polluting substances into the surface waters together with the waste waters.<br>c. Notification about a confidential part of a submitted application, if applicable;<br>d. Copy of the document evidencing payment of the fee (500 GEL) in accordance with the existing legislation.<br>e. Electronic copy of above mentioned | Day 0 |

| Step | Action | Comment | Timeframe |
|---|---|---|---|
| | | documents. | |
| 2 | Ministry ensures publication of submitted application and attached documents on its official website as well as on the notice board of the relevant local authorities and/or representative bodies and upon request, provides paper copies of abovementioned documentation. | The Developer is entitled to request the Environmental Decision on several activities through a single application, if the activities are significantly interconnected. | within 3 days after submission of the application |
| 3 | Minister sets up the Expert Commission | | within 5 days after registration of the application |
| 4 | Expert commission prepares and submits the expertise conclusion on the EIA report to the Ministry | | within 40 days |
| 5 | Ministry takes decision on the finding of a deficiency in application | | within 15 days after registration of the application |
| 6 | Feedback from stakeholders | | within 40 days after the publication of the application |
| 7 | Publication of announcement on the public hearing | The announcement on public hearing shall include the information on:<br>a. The content and brief description of the issue to be discussed, format of the discussion;<br>b. The time, place and rules of the public hearing;<br>c. The web address where the respective application, the EIA report and any other information relevant to decision-making will be available as well as indication about the opportunity of accessing the paper copies of these documents during the public hearing. | no less than 20 days prior to organizing the public hearing |
| 8 | Public hearing | The Ministry is responsible for organizing and conducting the public hearing. It is chaired and protocoled by a representative of the Ministry.<br>The public hearing is organized in the closest appropriate administrative building to the site of the planned project or within its vicinity. If the project is planned to be implemented within the administrative borders of a self-governing community, the public hearing is organized in the closest appropriate administrative building to the site of the | no earlier than 25th day and no later than 30th day after the publication of the application |

| Step | Action | Comment | Timeframe |
|---|---|---|---|
| | | project or within its vicinity and if the project is planned to be implemented within the administrative borders of a self-governing city, the public hearing is organized in the appropriate administrative building determined by the Ministry, or within its vicinity. The public hearing is open to the public and any person has a right to participate in it. | |
| 9 | Prior to issuance of the Environmental Decision or the decision on the refusal to implement the project, the Ministry ensures involvement of the Ministry of Culture and Monument Protection of Georgia, within its competence, in the administrative procedures as other public authority, under the rule envisaged by Article 84 of General Administrative Code of Georgia. | | |
| 10 | The Minister issues individual administrative legal act on issuance of the Environmental Decision or the decision on the refusal to implement the project | | no less than 51 and no more than 55 days after registration of the application |
| 11 | Ministry ensures publication of the EIA report, the Expertise Conclusion, the Environmental Decision or the legal act on the refusal to implement the project and the results of public participation on its official website as well as on the notice board of the relevant local authorities and/or representative bodies and upon request, provides paper copies of abovementioned documentation | | within 5 days after issuing the Environmental Decision or the legal act on the refusal to implement the project |

## D.8 Licenses, Permits, and Approvals

275. The Project will also be required to obtain a number of permits and consents, of which the main permits and the implementing national legislation are described in **Table D-15**. The Law on Licences and Permits governs the issue of all permits and consents. Subject to satisfaction of application requirements, all the permits are issued within 30 days from application submission.

**Table D-15: Permits / Licences and Approvals Register**

| Permit Required Activity | Permit / License/ Approval Title | Issuing Authority | Implementing Law | Responsible Party for Obtaining License |
|---|---|---|---|---|
| **Pre-construction** | | | | |
| Construction activities | Construction Permit | Ministry of Economy and Sustainable Development | Law No.1775 on Licenses and Permits; Government | RD |

| | | | | |
|---|---|---|---|---|
| | | | Resolution N57 "On Terms and Conditions of issuance of Construction Permit" | |
| Construction activities | ESIA Approval | MoENRP | Law No.519 on Environmental Protection<br><br>Law No.5603 on Ecological Expertise<br><br>Law No 890-II Environmental Assessment Code<br><br>Order No.515 of Minister of Environmental Protection and Natural Resources on Rules of Conduction of Ecological Expertise | RD |
| Construction activities | Cultural Heritage Clearance | National Agency of Cultural Heritage | Law No 4708 "On Cultural Heritage" Law No.1775 on Licenses and Permits; Government Resolution N57 "On Terms and Conditions of issuance of Construction Permit" | RD |
| Construction activities | Visual geological-engineering conclusion | National Environmental Agency | Government Resolution N57 "On Terms and Conditions of issuance of Construction Permit"; Order N7 of the Minister of Environment Protection | RD |
| Asphalt Plant | ESIA Approval | MoENRP | Law No.519 on Environmental Protection<br><br>Law No.5603 on Ecological Expertise<br><br>Law No 890-II Environmental Assessment Code<br><br>Order No.515 of Minister of Environmental | RD |

| | | | | |
|---|---|---|---|---|
| | | | Protection and Natural Resources on Rules of Conduction of Ecological Expertise | |
| **Construction Phase** | | | | |
| Tree felling in state forest lands for ROW and permanent facilities | Forest use agreement | Ministry of Energy & Natural Resources | Law No.2124 on Forestry Code of Georgia; Resolution No.242 of Government of Georgia on Approval of Rules for Forest Use<br><br>Resolution No.132 of Government of Georgia on Approval of Regulations on Rules and Conditions of Issuance of Forest Usage License | Contractor |
| Tree felling in state forest lands for Temporary Facilities | Forest Use Agreement | Ministry of Energy & Natural Resources | Resolution No.242 of Government of Georgia on Approval of Rules for Forest Use; Order N10/61 of the Chairman of State Department of Forestry | Contractor |
| Construction material extraction from borrow pits | Mineral extraction licence | Ministry of Energy & Natural Resources | Decree of the Government of Georgia N136 of August 11, 2005; Law N 946 “On Fees for Use of Natural Resources” | Contractor |
| Underground water abstraction | Mineral extraction licence | Ministry of Energy & Natural Resources | Decree of the Government of Georgia N136 of August 11, 2005; Law N 946 “On Fees for Use of Natural Resources” | Contractor |
| Water abstraction from river, lake | Surface water abstraction approval | MoENRP | Order of the Minister of Environment Protection & Natural Resources N745; Order of the Minister of Environment Protection N 16 | Contractor |
| Exhaust from stationary sources | Air emission limit approval | MoENRP | Order of the Minister of Environment Protection & Natural | Contractor |

| | | | | |
|---|---|---|---|---|
| | | | Resources N745; Order N667 of the Minister of Environment Protection and Natural Resources; Law "On Ambient Air Protection" | |
| Treated sewerage, hydro-test water etc. discharge into river, lake | Approval of liquid discharge into surface water body | MoENRP | Order of the Minister of Environment Protection & Natural Resources N745; Order of the Minister of Environment Protection N 16 | Contractor |
| Construction or upgrade of access roads | Approval of construction or upgrade activities | Ministry of Infrastructure and local municipalities | Government Resolution N57 "On Terms and Conditions of issuance of Construction Permit" | Contractor |
| Transportation of oversized and overweight cargo | Transportation permit | Ministry of Internal Affairs | Joint Order N956/1-1/746 of the Minister of Internal Affairs and Minister of Economic Development; Law N 700 "On Road Transport"; Law "On Road Traffic" | Contractor |
| Spoil disposal | Spoil disposal approval | MoENRP | Law "On Subsoils", May 8, 2012 | Contractor |
| Import of explosives | Permit to import explosives | Ministry of Internal Affairs | Tax Code of Georgia; Decree of the Government of Georgia N420; Law N2911 "On Control of Technical Hazard"; Order N 1-1/2502 of the Minister of Economy and Sustainable Development | Contractor |
| Use of explosives | Permit to use explosives | Ministry of Energy | Tax Code of Georgia; Decree of the Government of Georgia N420; Law N2911 "On Control of Technical Hazard"; Order N 1-1/2502 of the Minister of Economy and | Contractor |

| | | | | |
|---|---|---|---|---|
| | | | Sustainable Development | |

## D.8.1 Construction Permit

276. The Law on Licences and Permits defines protocols for the issue, amendment and withdrawal of permits. For projects such as this, a construction permit is needed. The responsible authority (the Road Department) must obtain the following approvals before it will grant a construction permit:

- Geological conclusions to be issued by National Environmental Agency;
- Cultural heritage clearance to be issued by National Agency of Cultural Heritage;
- ESIA approval (ecological expertise) to be issued by MoENRP;
- Project design approval to be issued by MoESD; and
- Project's registered rights to land.

277. The conclusion of the ecological assessment (i.e. MoENRP expert examination of the EIA) is a part of the construction permit and its recommendations are compulsory for the developer.

### D.8.1.1 Material Extraction

278. In addition, Off-site works will include extraction of construction materials or purchase of material from already existing licensed quarries. (The latter option is preferable).

279. Licensing is of these areas is regulated by the law of Georgia on Licenses and Permits. The body responsible for licensing is the MoENRP. Terms and rules of a license for material extraction are specified in the license along with the exact location of a site, volume of permitted extraction and maturity of a license. Licenses are issued through auctioning. According to the law, the license is granted to the proponent presenting the best proposal that shall meet the criteria stipulated for resources and environmental protection, and recognized as the most economical acceptable. The validity of the license for abstraction of construction materials may be up to 30 years, while short term licenses may vary from 2 to 5 years. A license holder is obliged to ensure sustainable use of the resources with due regard of environmental and resource protection rules; guarantee safety of works with consideration of ambient air, water, soil, forest, protected areas, protection norms for historical and cultural monuments and buildings. A license holder is obliged to stop operation if any rare plant or object of aesthetic value is found. The fact must be immediately communicated to relevant governmental authorities.

280. Due diligence check will be made by the Engineer to ensure that any quarry is utilizing the land within the cadastral land listed on the quarry.

281. The license holder is responsible for restoration and reinstatement of the used plot. The license can be terminated in case of non-compliance with license conditions, including environmental requirements. Liquidation or conservation costs are covered by the resource user. In case of license termination the owner automatically loses right to the land plot.

282. If the contractor decides to use own borrow pit/quarry the following requirements must be met:

- Sufficient resource in the proposed quarry must be insured to make a site financially viable; including rehabilitation expenses;

- Topsoil must be removed and stockpiled until reintroduction. The topsoil should not be buried, driven on, excessively handled, contaminated or stockpiled so as to hinder final land-use;
- If required, erosion protection must be provided;
- To ensure safe operation the access tracks must be of adequate width: the track should be twice the width of the widest vehicle in the case of one-way traffic and three times the width of the widest vehicle in the case of two-way traffic;
- Gates and fences should be designed, regularly inspected and repaired to prevent unauthorised entry; signs at any insecure locations on a site indicating the risk must be provided;
- Operation and decommissioning of the quarry/borrow pit must be performed in compliance with the conditions of the quarrying license and with due regard to environmental standards;
- Upon completion of the licence term, the quarry/borrow pit area affected by the development should be re-cultivated: the topsoil reinstated, the status of the site restored to the state close to the initial state (for instance, the site may be planted with vegetation).

283. Should material be abstracted from the riverbed, the riverbed and the landform may not be adversely affected. Abstraction of gravel should not be carried out in high water period. The operation site must be protected by a gravel mound (up to 2m wide). In compliance with the national legislation (Law on Natural Resources) abstraction of inert material from a riverbed is prohibited in case the activity violates stability of any hydro technical structures (a dam, a retaining wall). Sourcing is not allowed from sections where solid drift is not sufficient for 'feeding' the banks. In such areas, inert material abstraction from the river terrace within 50 m strip from the riverbed and directly from the stream is strictly prohibited.

## D.9 State Forest Fund

284. According to The Resolution No.242 of Government of Georgia on Approval of Rules for Forest Use, Article $27_1$ State forest land (or State Forest Fund (SFF)) may be used for the purposes of construction of motorways, as well as for other activities which are deemed as special use of forest lands. Article 27 states that if the activity that is deemed as special use of forest land and is subject to Ecological Expertise then the Client (in this case the RD) is obliged to apply to remove all trees identified in the affected SFF area from the SFF register or "de-list" them before they can be cut. The decision to de-list trees and plants from the State Forest Fund of Georgia is issued by the National Forest Agency excepting the vegetation species protected by the Red List of Georgia. A decision to de-list trees and plants from the Red List of Georgia is made by MoENRP. The client must apply to the MoENRP in writing regarding the presence of the Red-Listed species in the project area.

## D.10 International Conventions and Agreements

285. Important international environmental treaties that have been signed by Georgia and may have relevance to the Project are listed in **Table D-16**. They concern: climate change, depletion of the ozone layer, biological diversity and trade in wild flora and fauna, desertification; waste and pollution; cultural heritage, and preservation of the ecology of the Black Sea.

**Table D-16: International Agreements and Treaties**

| Agreement Date | Agreement Name | Ratification | Entry into Force |
|---|---|---|---|
| 6/4/1999 | Agreement on cooperation in the area of preservation | | 6/4/1999 |

| Agreement Date | Agreement Name | Ratification | Entry into Force |
|---|---|---|---|
| | and use of genetic resources of cultured plants of member states of the CIS | | |
| 6/16/1995 | Agreement on The Conservation of African-Eurasian Migratory Waterbirds | | 8/1/2001 |
| 11/24/1996 | Agreement on The Conservation of Cetaceans of The Black Sea, Mediterranean Sea and Contiguous Atlantic Area | 5/31/2001 | |
| 12/4/1991 | Agreement on The Conservation of Populations of European Bats | 7/25/2002 | 8/24/2002 |
| 4/12/1996 | Agreement on The Control of Transboundary Shipments of Hazardous and other Wastes Between States Members of The Commonwealth of Independent States | 4/12/1996 | |
| 6/14/2002 | Black Sea Biodiversity and Landscape Conservation Protocol to the Convention on the Protection of the Black Sea Against Pollution | 9/22/2009 | 6/20/2011 |
| 1/29/2000 | Cartagena Protocol on Biosafety to the Convention on Biological Diversity | 2/2/2009 | 2/2/2009 |
| 3/22/1985 | Convention for The Protection of The Ozone Layer | 3/21/1996 | 6/19/1996 |
| 11/23/1972 | Convention for The Protection of The World Cultural And Natural Heritage | | 11/4/1992 |
| 6/25/1998 | Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters | 4/11/2000 | 10/30/2001 |
| 6/5/1992 | Convention on Biological Diversity | 6/2/1994 | 8/31/1994 |
| 3/3/1973 | Convention on International Trade in Endangered Species of Wild Fauna and Flora | 9/13/1996 | 12/12/1996 |
| 11/13/1979 | Convention on Long-Range Transboundary Air Pollution | 2/11/1999 | 5/12/1999 |
| 5/22/2001 | Convention on Persistent Organic Pollutants | 10/4/2006 | 1/2/2007 |
| 9/19/1979 | Convention on The Conservation of European Wildlife and Natural Habitats | 11/19/2009 | 3/1/2010 |
| 6/23/1979 | Convention on The Conservation of Migratory Species of Wild Animals | | 6/1/2000 |
| 3/22/1989 | Convention on The Control of Transboundary Movements of Hazardous Wastes and Their Disposal | 5/20/1999 | 8/18/1999 |
| 4/21/1992 | Convention on The Protection of The Black Sea Against Pollution | 9/1/1993 | 1/15/1994 |
| 2/2/1971 | Convention on Wetlands of International Importance Especially as Waterfowl Habitat | 2/7/1997 | 6/7/1997 |
| 6/17/1994 | Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa | 7/23/1999 | 10/21/1999 |
| 12/2/1961 | International Convention for The Protection of New Varieties of Plants | | 11/29/2008 |
| 11/17/1997 | International Plant Protection Convention (1997 Revised Text) | 3/8/2007 | 3/8/2007 |
| 9/16/1987 | Montreal Protocol on Substances that Deplete The Ozone Layer | 3/21/1996 | 6/21/1996 |
| 4/21/1992 | Protocol on Cooperation in Combating Pollution of The Black Sea Marine Environment By oil and other Harmful Substances in Emergency Situations | 9/1/1993 | 1/15/1994 |
| 4/21/1992 | Protocol on The Protection of The Black Sea Marine Environment Against Pollution by Dumping | 9/1/1993 | 1/5/1994 |
| 4/21/1992 | Protocol on The Protection of The Black Sea Marine Environment Against Pollution from Land-Based Sources | 9/1/1993 | 1/15/1994 |

| Agreement Date | Agreement Name | Ratification | Entry into Force |
|---|---|---|---|
| 4/17/2009 | Protocol on the Protection of the Marine Environment of the Black Sea from Land-Based Sources and Activities | 9/24/2009 | |
| 12/11/1997 | Protocol to The United Nations Framework Convention on Climate Change | 6/16/1999 | 2/16/2005 |
| 12/10/1982 | United Nations Convention on The Law of The Sea | 3/21/1996 | 4/21/1996 |
| 5/9/1992 | United Nations Framework Convention on Climate Change | 7/29/1994 | 10/27/1994 |

## D.11 Asian Development Bank Safeguard Policies 2009

286. The ADB has three safeguard policies that seek to avoid, minimize or mitigate adverse environmental impacts and social costs to third parties, or vulnerable groups as a result of development projects[4].

287. **Safeguard Requirements 1: Environment** – The objectives are to ensure the environmental soundness and sustainability of projects, and to support the integration of environmental considerations into the project decision-making process. Environmental safeguards are triggered if a project is likely to have potential environmental risks and impacts. Eleven 'Policy Principles' have been adopted as part of the SPS, including:

1. Use a screening process for each proposed project, as early as possible, to determine the appropriate extent and type of environmental assessment so that appropriate studies are undertaken commensurate with the significance of potential impacts and risks. (The Project was initially screened by the ADB and classified as a Category A project).

2. Conduct an environmental assessment for each proposed project to identify potential direct, indirect, cumulative, and induced impacts and risks to physical, biological, socioeconomic (including impacts on livelihood through environmental media, health and safety, vulnerable groups, and gender issues), and physical cultural resources in the context of the project's area of influence. Assess potential transboundary and global impacts, including climate change. Use strategic environmental assessment where appropriate. (The EIA herewith provides the environmental assessment for the Project, including an assessment of climate change. Transboundary impacts are not applicable).

3. Examine alternatives to the project's location, design, technology, and components and their potential environmental and social impacts and document the rationale for selecting the particular alternative proposed. Also consider the no project alternative. (Alternatives have been considered, including the 'no project' alternative in **Section C – Alternatives**).

4. Avoid, and where avoidance is not possible, minimize, mitigate, and/or offset adverse impacts and enhance positive impacts by means of environmental planning and management. Prepare an environmental management plan (EMP) that includes the proposed mitigation measures, environmental monitoring and reporting requirements, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates, and performance

[4] ADB. 2009. Safeguard Policy Statement, Manila

indicators. Key considerations for EMP preparation include mitigation of potential adverse impacts to the level of no significant harm to third parties, and the polluter pays principle. (An EMP has been prepared for the Project and is outlined in detail in **Section G – Environmental Management Plans and Institutional Requirements**).

5. Carry out meaningful consultation with affected people and facilitate their informed participation. Ensure women's participation in consultation. Involve stakeholders, including affected people and concerned nongovernment organizations, early in the project preparation process and ensure that their views and concerns are made known to and understood by decision makers and taken into account. Continue consultations with stakeholders throughout project implementation as necessary to address issues related to environmental assessment. Establish a grievance redress mechanism to receive and facilitate resolution of the affected people's concerns and grievances regarding the project's environmental performance. (Consultations were held to discuss environmental issues, the findings of the consultations (and a description of the Project grievance redress mechanism) are presented in **Section H – Public Consultation, Information Disclosure & Grievance Mechanism**).

6. Disclose a draft environmental assessment (including the EMP) in a timely manner, before project appraisal, in an accessible place and in a form and language(s) understandable to affected people and other stakeholders. Disclose the final environmental assessment, and its updates if any, to affected people and other stakeholders. (This EIA and its EMP will be disclosed on the JICA and RD web-sites).

7. Implement the EMP and monitor its effectiveness. Document monitoring results, including the development and implementation of corrective actions, and disclose monitoring reports. (The EIA and its EMP outline a plan to monitor the implementation of the EMP and the institutional responsibilities for monitoring and reporting throughout the Project lifecycle: **Section G – EMP Institutional Responsibilities**).

8. Do not implement project activities in areas of critical habitats, unless (i) there are no measurable adverse impacts on the critical habitat that could impair its ability to function, (ii) there is no reduction in the population of any recognized endangered or critically endangered species, and (iii) any lesser impacts are mitigated. If a project is located within a legally protected area, implement additional programs to promote and enhance the conservation aims of the protected area. In an area of natural habitats, there must be no significant conversion or degradation, unless (i) alternatives are not available, (ii) the overall benefits from the project substantially outweigh the environmental costs, and (iii) any conversion or degradation is appropriately mitigated. Use a precautionary approach to the use, development, and management of renewable natural resources. (No critical habitats have been identified that would be significantly impacted by the Project).

**9.** Apply pollution prevention and control technologies and practices consistent with international good practices as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety Guidelines. Adopt cleaner production processes and good energy efficiency practices. Avoid pollution, or, when avoidance is not possible, minimize or control the intensity or load of pollutant emissions and discharges, including direct and indirect greenhouse gases emissions, waste generation, and release of hazardous materials from their production, transportation, handling, and storage. Avoid the use of hazardous materials subject to international bans or phase-outs. Purchase, use, and manage

pesticides based on integrated pest management approaches and reduce reliance on synthetic chemical pesticides. (The EIA and its EMP outline specific mitigation and management measures to prevent and control pollution: **Section G – Environmental Management Plans and Institutional Requirements.** No pesticides will be used during the lifecycle of the Project).

10. Provide workers with safe and healthy working conditions and prevent accidents, injuries, and disease. Establish preventive and emergency preparedness and response measures to avoid, and where avoidance is not possible, to minimize, adverse impacts and risks to the health and safety of local communities. (The EIA and its EMP outline the requirement for specific health and safety plans and emergency response plans: **Section G – Environmental Management Plans and Institutional Requirements).**

11. Conserve physical cultural resources and avoid destroying or damaging them by using field-based surveys that employ qualified and experienced experts during environmental assessment. Provide for the use of "chance find" procedures that include a pre-approved management and conservation approach for materials that may be discovered during project implementation. (No physical and cultural resources have been identified that would be significantly impacted by the Project. Chance finds are discussed in **Section G – Physical and Cultural Resources**) and a sample chance finds procedure is provided in **Appendix E**.

**Safeguard Requirements 2: Involuntary Resettlement**.

288. The objectives are to avoid involuntary resettlement wherever possible; to minimize involuntary resettlement by exploring project and design alternatives; to enhance, or at least restore, the livelihoods of all displaced persons in real terms relative to pre-project levels; and to improve the standards of living of the displaced poor and other vulnerable groups. The safeguard requirements underscores the requirements for undertaking the social impact assessment and resettlement planning process, preparing social impact assessment reports and resettlement planning documents, exploring negotiated land acquisition, disclosing information and engaging in consultations, establishing a grievance mechanism, and resettlement monitoring and reporting.

289. The involuntary resettlement requirements apply to full or partial, permanent or temporary physical displacement (relocation, loss of residential land, or loss of shelter) and economic displacement (loss of land, assets, access to assets, income sources, or means of livelihoods) resulting from (i) involuntary acquisition of land, or (ii) involuntary restrictions on land use or on access to legally designated parks and protected areas. Resettlement is considered involuntary when displaced individuals or communities do not have the right to refuse land acquisition that results in displacement. A land acquisition and resettlement plan (LARP) has been prepared for the Project to ensure compliance with the safeguard on Involuntary Resettlement.

**Safeguard Requirements 3: Indigenous Peoples**.

290. The objective is to design and implement projects in a way that fosters full respect for Indigenous Peoples' identity, dignity, human rights, livelihood systems, and cultural uniqueness as defined by the Indigenous Peoples themselves so that they (i) receive culturally appropriate social and economic benefits, (ii) do not suffer adverse impacts as a result of projects, and (iii) can participate actively in projects that affect them.

291. The Project does not involve impacts to Indigenous Peoples and therefore no further actions relating to this safeguard are required.

## D.12 JICA Guidelines for Environmental and Social Considerations (April, 2010)

292. Standards and References – When undertaking a Project, JICA guidelines state that the following conditions must be applied with regards to environmental and social aspects:

- Host country's laws, standards, policies and plans - ESC in a JICA project must comply with the laws, standards, policies, and plans of the host country. If the standard set by the host country differs from the international standard, the project proponents are advised to adopt the standard that better serves the purpose of attaining a higher level of ESC.
- The World Bank's Safeguard Policies - ESC in a JICA project must be in line with the World Bank's Safeguard Policies including Operational Policy on Environmental Assessment (OP 4.01), Natural Habitats (OP 4.04), Involuntary Resettlement (OP 4.12), Indigenous Peoples (OP 4.10), and other relevant policies.
- Internationally accepted standards - International standards, treaties, and declarations should also be applied as appropriate.

293. Classification - Each project is classified by JICA in to one of the following Environmental Categories based on the magnitude of its potential impact on the environment or society. In other words, the category indicates the level of ESC required.

- Category A - The project is likely to have significantly adverse impacts on the environment or society. For example:
    - A project with a wide range of impacts, impacts that are irreversible,
    - complicated, or unprecedented, and impacts that are difficult to assess.
    - A project for a sector that requires special attention (e.g., a sector that involves large-scale infrastructure development), involves activity that requires careful consideration (e.g., large-scale involuntary resettlement), or takes place inside or adjacent to a sensitive area (e.g., protected natural habitat). Examples of sectors, activities, and areas that require special attention are listed in 'Appendix 3' of the ESC Guidelines.
- Category B - The project may have adverse impacts on the environment or society, but these impacts are less significant than those of Category A projects. These impacts are site-specific; few, if any, of them are irreversible; in most cases, they can be mitigated more readily than Category A projects. Responsibilities of the project proponents include the planning and monitoring of necessary ESC activities. ESC procedures such as Initial Environmental Examination and stakeholder participation may be required, depending on the scale and nature of the adverse impacts.
- Category C - The project is likely to have minimal or no adverse impact on the environment or society.
- Category FI - JICA provides funds to a Financial Intermediary, which in turn implements sub-projects that may have adverse impacts on the environment or society, but these impacts cannot be identified in detail prior to JICA's approval. If there is a sub-project that can be categorized as Category A, it needs to go through the same procedure as a Category A project including JICA's environmental review and information disclosure prior to its implementation.

294. EIA is mandatory for projects whose environmental category is A, and an EIA Report must be disclosed to the public through JICA's website for at least 120 days before the project proponents and JICA agree to implement the project. Requirements for the EIA Report of a Category A project are described in Appendix 2 of the ESC Guidelines.

# E. Description of the Environment

295. This section of the report discusses the existing environmental and social conditions within the Project area under the following headings:

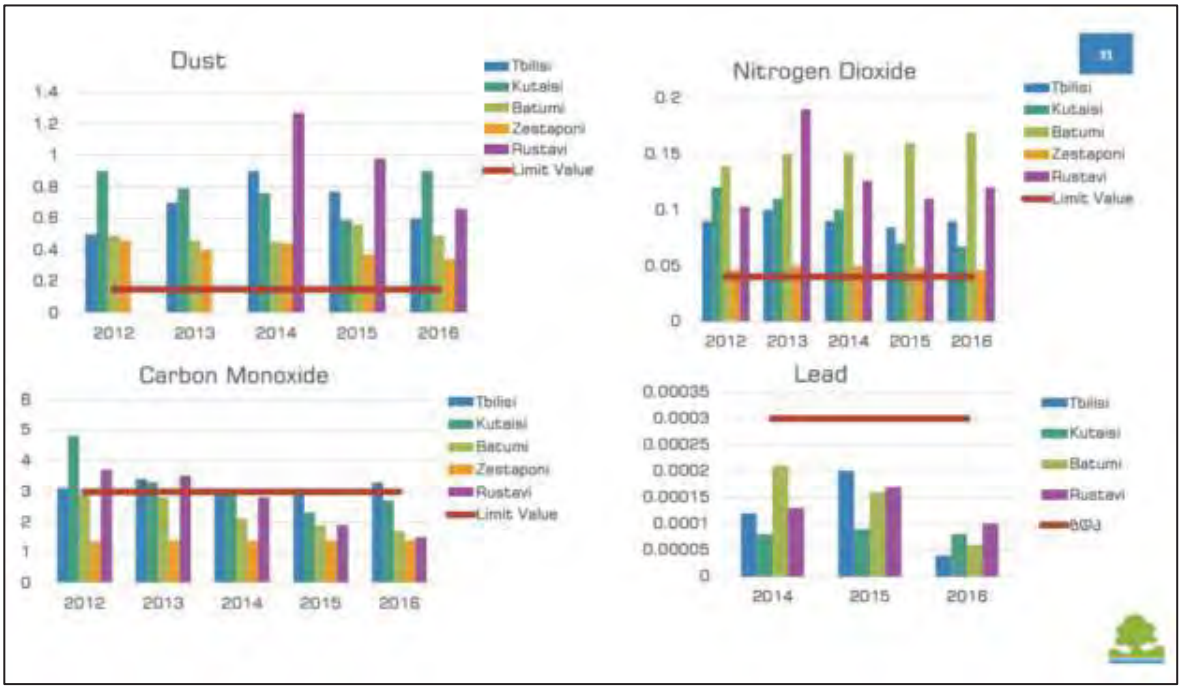
- Physical Resources (air quality, hydrology, topography, etc.);
- Ecological Resources (flora, fauna, protected areas);
- Economic Resources (infrastructure, land use, etc.);
- Social and Cultural Resources (health, education, noise, cultural resources, etc.)

## E.1 Physical Resources

### E.1.1 Air quality

296. The National Environmental Agency has recently published air quality statistics for five cities in Georgia. Of particular relevance to the Project is the data from Zestaphoni. **Figure E-1** indicates that in general Zestaphoni is the least polluted city of those monitored. However, ambient levels of dust and $NO_2$ currently exceed the national limits in Zestaphoni but levels of CO and Lead are well below the limits.

**Figure E-1: Ambient Air Quality Data**




#### E.1.1.1 Site Observations

297. Within the Project area the main sources of air emissions are from transport, including vehicles on the existing E-60, and large scale industrial facilities including the GAA manganese processing plant which is located almost adjacent to the southern boundary of the Project road between KM 11 and KM 12.

298. The main environmental issue concerning the GAA involves the lack of modern and efficient filters to reduce and control air emissions, in particular manganese dioxide emissions. **Figure E-2** illustrates high levels of emissions from GAA smoke stacks during a site visit in July, 2017. An emissions reduction program is being implemented by the plant in

order to meet the existing environmental regulations. However, according to the UN Environmental Performance Review ambient air quality monitoring in Zestafoni indicated that manganese concentration in air exceeded the MAC. Concentrations were 2.5 to 4-fold higher than the MAC, varying from 4.04 μg/m$^3$ $MnO_2$ at 500 m distance from the plant to 2.5 μg/m$^3$ $MnO_2$ at 300 m distance from the plant. Manganese concentrations in dust collected in residential houses or in the hospital at Zestafoni are characterized by higher levels compared with the Tbilisi control sample.

299. In addition, it is assumed that some rural households cook with wood burning stoves and they may also use wood for household heating. This can also generate emissions to air although they are not anticipated to be significant given the fact that the population within the Project corridor is quite limited.

**Figure E-2: Visible Air Emissions from GAA Plant, 2017 (taken from boundary of the Project road around KM 11.1)**

### E.1.1.2 Sensitive Receptors

300. The Project road passes close to a number of residential properties and sensitive receptors around Zestafoni and Shorapani. Those within 200 meters have been mapped and are included as part of the air quality assessment provided in **Section F** of this EIA.

### E.1.1.3 Baseline Ambient Air Quality

301. Air quality monitoring was carried out at nine different locations during August, 2017 to characterize the current air quality within the Study Area.

302. The pollutants selected for evaluation are based on the expected emissions from the Project activities and the level of risk to human health posed by these pollutants. They include:

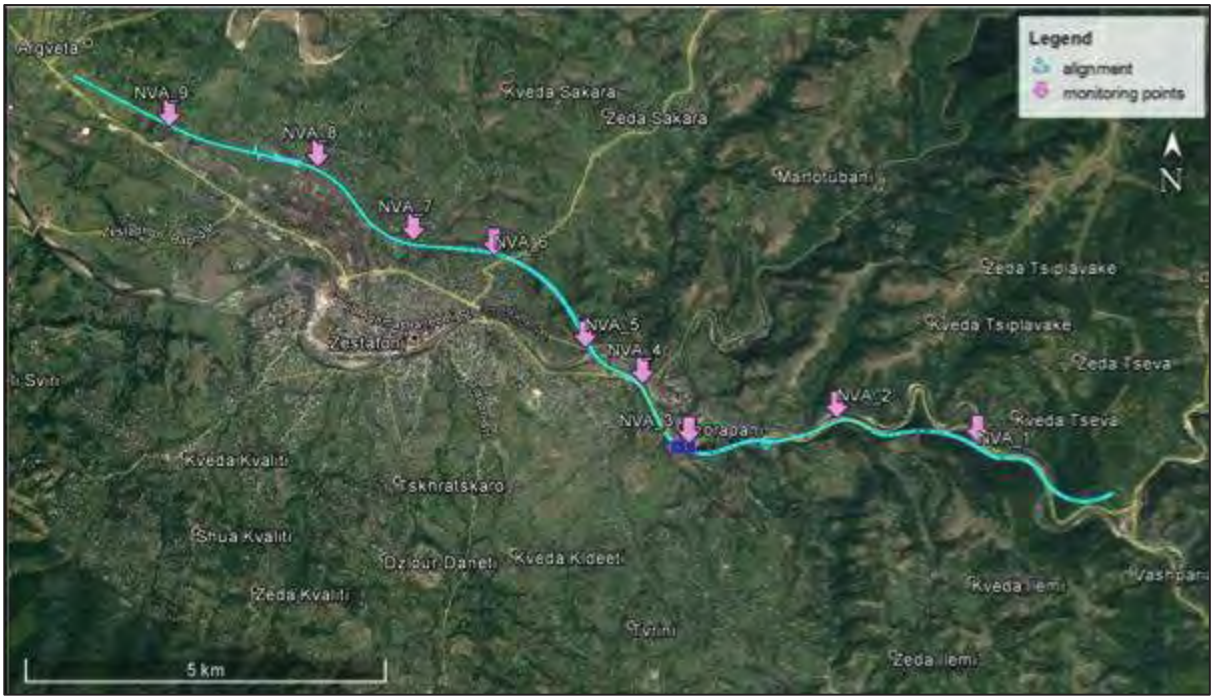
- Total Suspended Particulates (TSP), or Dust;
- Carbon Monoxide (CO);
- Nitrogen Dioxide ($NO_2$);
- Sulfur Dioxide ($SO_2$); and
- Particulate Matter ($PM_{10}$ and $PM_{2.5}$)

303. A description of sampling locations and the rationale of selection is given in **Table E-1**. The locations of the sampling points are indicated by **Figure E-3**. The ambient air quality data was compared against applicable IFC and Georgian Standards.

**Table E-1: Ambient Air Quality Monitoring Locations**

| Sample ID | Coordinates | Approximate Location | Rationale for Site Selection |
|---|---|---|---|
| AQ01 | 42 ° 05'31.75"N / 43° 07'47.68"E | KM0.0 | Start of F4, opposite a small cluster of residential properties. |
| AQ02 | 42 ° 05'42.77"N / 43° 06'23.19"E | KM2.2 | Adjacent to a roadside restaurant. Site of embankment cutting. |
| AQ03 | 42 ° 05'31.72"N / 43° 04'53.87"E | KM4.3 | Shorapani residential area, location of a school and exit of Tunnel 3. |
| AQ04 | 42 ° 05'58.49"N / 43° 04'26.10"E | KM5.5 | Adjacent to residential properties. |
| AQ05 | 42 ° 06'14.75"N / 43° 03'51.79"E | KM6.3 | At the portal to Tunnel 4. |
| N06 | 42 ° 06'56.22"N / 43° 02'57.23"E | KM8.3 | Close to the portal to Tunnel 5 adjacent to residential properties. |
| AQ07 | 42 ° 07'02.90"N / 43° 02'08.61"E | KM9.5 | Residential area at the portal to Tunnel 6 and at the end of Bridge 4. |
| AQ08 | 42 ° 07'36.01"N / 43° 01'11.19"E | KM11.0 | North of the GAA facility and south of a residential cluster. |
| AQ09 | 42 ° 07'54.20"N / 42° 59'41.87"E | KM13.4 | Adjacent to a small cluster of residential properties. |

**Figure E-3: Ambient Air Quality Monitoring Locations**




304. The results of the ambient air quality monitoring are provided in **Table E-2**. In all instances the parameters monitored were below national, and where applicable, IFC standards with the exception of sampling locations NVA-1 and NVA-2 adjacent to the existing road. The most noticeable factor was the higher levels of PM recorded at the first four monitoring stations which are adjacent to the existing road. This suggests that these levels $PM_{10}$ and $PM_{2.5}$ are attributable to vehicle movements on the existing road.

**Table E-2: Ambient Air Quality Monitoring Results**

| # | Time | Wind speed, m/s | Wind direction | CO, µg/m3 | $NO_2$, µg/m3 | $SO_2$, µg/m3 | $PM_{10}$, µg/m3 | $PM_{2.5}$, µg/m3 | TSP, µg/m3 | Comment |
|---|---|---|---|---|---|---|---|---|---|---|
| **NVA-1** | | | | | | | | | | |
| 1 | 12:30 -13:50 | 1.3 | W | <1000 | 376 | <500 | 28 | 26 | <100 | Edge of the E-60 highway |
| 2 | 19:30-19:50 | 1.4 | W | <1000 | <200 | <500 | 91 | 61 | 200 | |
| 3 | 01:30 -01:50 | 1.0 | W | <1000 | <200 | <500 | 18 | 15 | <100 | |
| 4 | 06:55–07:15 | 1.0 | W | <1000 | <200 | <500 | 10 | 9 | <100 | |
| **NVA-2** | | | | | | | | | | |
| 1 | 13:00-13:20 | 2.0 | SW | <1000 | 550 | <500 | 48 | 32 | 120 | 14.9m from the centerline of E-60 highway |
| 2 | 18:50-19:10 | 1.6 | SW | <1000 | 376 | <500 | 72 | 39 | 170 | |
| 3 | 01:00 -01:20 | 1.0 | SW | <1000 | <200 | <500 | 18 | 15 | <100 | |
| 4 | 06:50-07:10 | 1.0 | SW | <1000 | <200 | <500 | 10 | 9 | <100 | |
| **NVA-3** | | | | | | | | | | |
| 1 | 10:30 -10:50 | 2,0 | SW | <1000 | <200 | <500 | 12 | 9 | <100 | Next to internal road in Shorapani |
| 2 | 18:20-18:40 | 1.6 | SW | <1000 | <200 | <500 | 29 | 21 | <100 | |
| 3 | 00:30-00:50 | 1.2 | SW | <1000 | <200 | <500 | 10 | 7 | <100 | |
| 4 | 06:20 -06:40 | 1.0 | SW | <1000 | <200 | <500 | 5 | 4 | <100 | |
| **NVA-4** | | | | | | | | | | |
| 1 | 12:00-12:20 | 2.0 | W | <1000 | <200 | <500 | 36 | 24 | 110 | 15.2m from the centerline of E-60 highway |
| 2 | 17:50-18:10 | 1.2 | W | <1000 | <200 | <500 | 35 | 25 | 120 | |
| 3 | 24:00-24:20 | 1.1 | W | <1000 | <200 | <500 | 11 | 8 | <100 | |
| 4 | 05:50-06:10 | 1.0 | W | <1000 | <200 | <500 | <1.0 | <1.0 | <100 | |
| **NVA-5** | | | | | | | | | | |
| 1 | 10:00 -10:20 | 1.6 | NW | <1000 | <200 | <500 | 5 | 4 | <100 | Next to the local road |
| 2 | 17:20-17:40 | 1.2 | NW | <1000 | <200 | <500 | 25 | 16 | <100 | |
| 3 | 23:30-23:50 | 1.1 | NW | <1000 | <200 | <500 | <1.0 | <1.0 | <100 | |
| 4 | 05:20-06:40 | 1.0 | NW | <1000 | <200 | <500 | <1.0 | <1.0 | <100 | |
| **NVA-6** | | | | | | | | | | |
| 1 | 09:10-09:30 | 1.0 | SW | <1000 | <200 | <500 | <1.0 | <1.0 | <100 | 87.5m from the centerline of Gomi-Sachkhere-Chiatura-Zestaphoni road, in about 30m from the street - Zestaphoni |
| 2 | 16:40-17:00 | 1.0 | SW | <1000 | <200 | <500 | 16 | 11 | <100 | |
| 3 | 23:10-23:30 | 1.2 | SW | <1000 | <200 | <500 | <1.0 | <1.0 | <100 | |

| # | Time | Wind speed, m/s | Wind direction | CO, µg/m3 | $NO_2$, µg/m3 | $SO_2$, µg/m3 | $PM_{10}$, µg/m3 | $PM_{2.5}$, µg/m3 | TSP, µg/m3 | Comment |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 04:10-04:30 | 1.0 | SW | <1000 | <200 | <500 | <1.0 | <1.0 | <100 | |
| **NVA-7** | | | | | | | | | | |
| 1 | 08:30-08:50 | 1.5 | NW | <1000 | <200 | <500 | 9 | 6 | <100 | Next to existing internal road – Kvemo Sakara |
| 2 | 16:10-16:30 | 1.1 | NW | <1000 | <200 | <500 | 16 | 12 | <100 | |
| 3 | 22:50-23:10 | 1.0 | NW | <1000 | <200 | <500 | <1.0 | <1.0 | <100 | |
| 4 | 04:10-04:30 | 1.1 | NW | <1000 | <200 | <500 | <1.0 | <1.0 | <100 | |
| **NVA-8** | | | | | | | | | | |
| 1 | 07:30-07:50 | 2.2 | S | <1000 | <200 | <500 | 12 | 8 | <100 | Next to existing internal road – Kvemo Sakara |
| 2 | 15:30-15:50 | 1.1 | S | <1000 | <200 | <500 | 26 | 19 | <100 | |
| 3 | 22:30-22:50 | 1.1 | S | <1000 | <200 | <500 | <1.0 | <1.0 | <100 | |
| 4 | 03:30-03:50 | 1.3 | S | <1000 | <200 | <500 | <1.0 | <1.0 | <100 | |
| **NVA-9** | | | | | | | | | | |
| 1 | 07:00-07:20 | 2.0 | SW | <1000 | <200 | <500 | 17 | 15 | <100 | Next to existing internal road – Argveta |
| 2 | 15:00-15:20 | 1.1 | SW | <1000 | <200 | <500 | 21 | 10 | <100 | |
| 3 | 22:10-22:30 | 1.0 | SW | <1000 | <200 | <500 | 16 | 10 | <100 | |
| 4 | 03:00-03:20 | 1.2 | SW | <1000 | <200 | <500 | <1.0 | <1.0 | <100 | |
| | **MPC/guideline values/limits** | | **Aver.period** | **CO, µg/m3** | **$NO_2$, µg/m3** | **$SO_2$, µg/m3** | **PM10, µg/m3** | **PM 2.5, µg/m3** | **TSP, µg/m3** | **Comment** |
| **1** | National limit – max. permissible one time (volley) concentration (MPC), µg/m$^3$ | | 24 h | 3000 | 40 | 50 | n/a | n/a | 150 | One time (volley) maximum permissible concentration is the maximum concentration of hazardous substance determined in 20-30 minute interval based on one-time (volley) concentrations (ref. Technical Regulation – On approval of technical regulations for calculating threshold limit values of emission of harmful substances into the ambient air", approved by governmental decree #408, Document code: 300160070.10.003.017622). The measured values are in line with 30min aver.period values – see text in red. |
| | | | 30 min | 5000 | 200 | 500 | n/a | n/a | 500 | |
| **2** | IFC/WHO (updated 2016) – guideline value, µg/m3 | | 1 year | n/a | 40 | 50 | 20 | 10 | n/a | |
| | | | 8h | 10000 | n/a | n/a | n/a | n/a | n/a | |
| | | | 24 h | n/a | n/a | 20 | 50 | 25 | 120 | |
| | | | 1h | 30000 | 200 | n/a | n/a | n/a | n/a | |
| | | | 30 min | 60000 | n/a | n/a | n/a | n/a | n/a | |
| | | | 10 min | 100000 | n/a | 500 | n/a | n/a | n/a | |
| **3** | EU limit, µg/m3 | | 1 year | n/a | 40 | n/a | 40 | 25 | n/a | |
| | | | 8h | 10000 | n/a | n/a | n/a | n/a | n/a | |
| | | | 24 h | n/a | n/a | 125 | n/a | n/a | n/a | |
| | | | 1h | n/a | 200 | 350 | n/a | n/a | n/a | |

## E.1.2 Climate

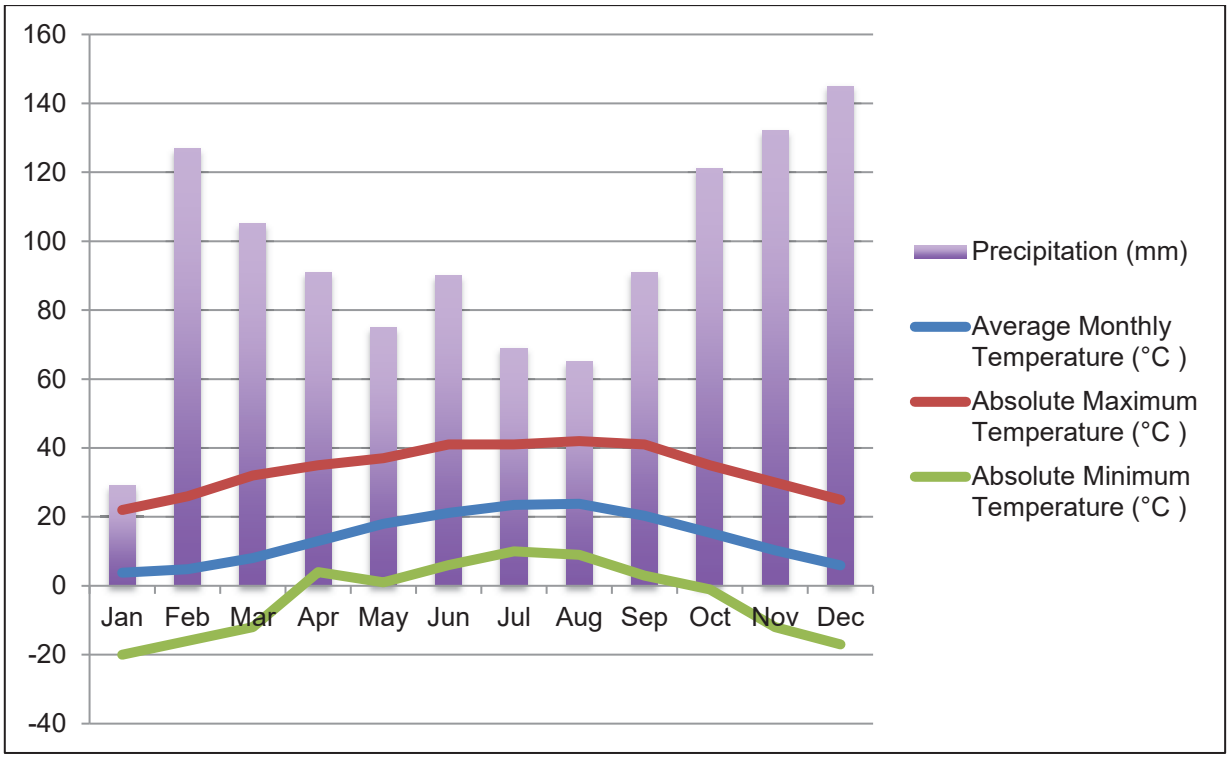
305. Due to the peculiar geographical position of Georgia between the Black and Caspian seas and the presence of powerful natural climatologic in the North of the Main Caucasus Range, and also owing to the large range of elevations above sea level, the climate of Georgia is varies quite widely for a small country. Climates of all types, ranging from subtropical, characteristic of the coastal zone of the Black sea, to the Arctic, prevailing in the most mountainous region of the Caucasus range can be found.

306. According to technical document GOST 16350-80 the Project road is located in district II9, which is characterized by a temperate warm climate with mild winters.

### E.1.2.1 Precipitation & Temperature

307. Annual precipitation in Zestafoni is around 1,200 mm. Rainfall is highest in the Winter, Autumn and Spring, although rainfall can still be observed during the hotter summer months (see **Figure E-4**).

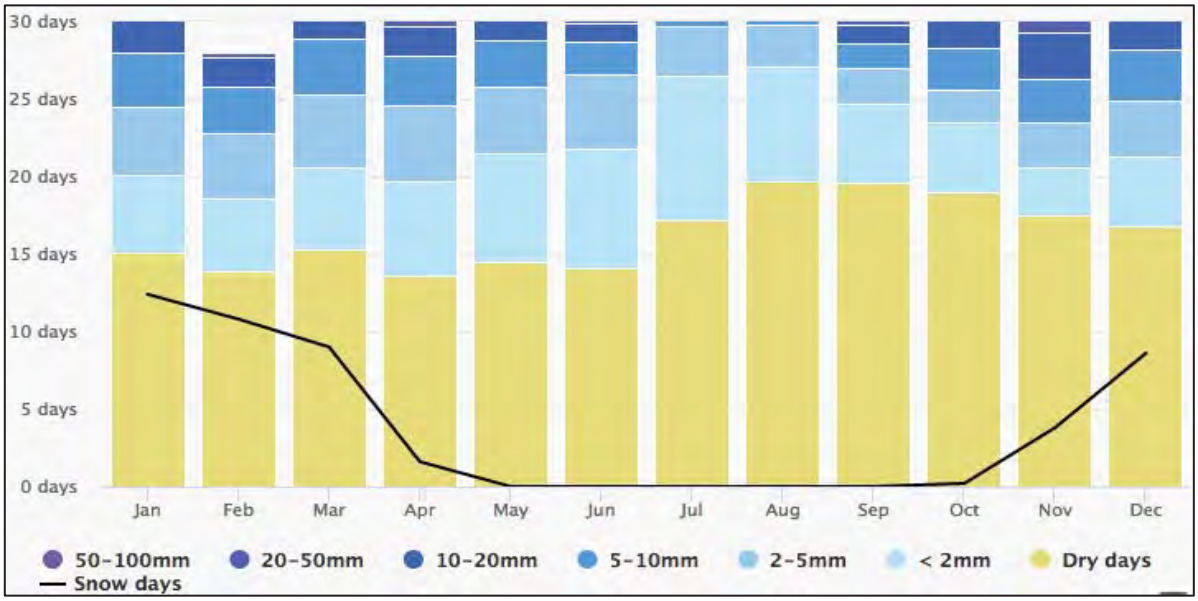
**Figure E-4: Temperature and Precipitation (mm), Zestafoni**




308. >0.2 mm/day are considered sufficient to effectively suppress wind-blown dust emissions[5] [6]. **Figure E-5** details the number of days showing >0.2 mm/day rainfall. On average each year, around ten such days occur between November and June and rarely in the months of July to August.

[5] IFC (2007). Environmental, Health and Safety Guidelines. General EHS Guidelines: Environmental. Air Emissions and Ambient Air. April 2007.
[6] Office of the Deputy Prime Minister (2005). *Planning Minerals Policy Statement 2: Controlling and Mitigating the Environmental Effects of Minerals Extraction in England. Annex1: Dust*.

**Figure E-5: Precipitation Levels (mm), Zestafoni**




309. Snow cover is not formed every year, as winter precipitation often falls as rain. The average duration of snow cover is an average of 6-20 days. Snowstorm in the mountains to the north of Zestafoni are possible from November to April. The average total duration of snowstorms per year is 8 hours. Average per year number of days with Blizzard is three, maximum – ten. Most often blizzards occur in the winter months, in which the average duration of snowstorms per day snowstorm is 2.7 hours

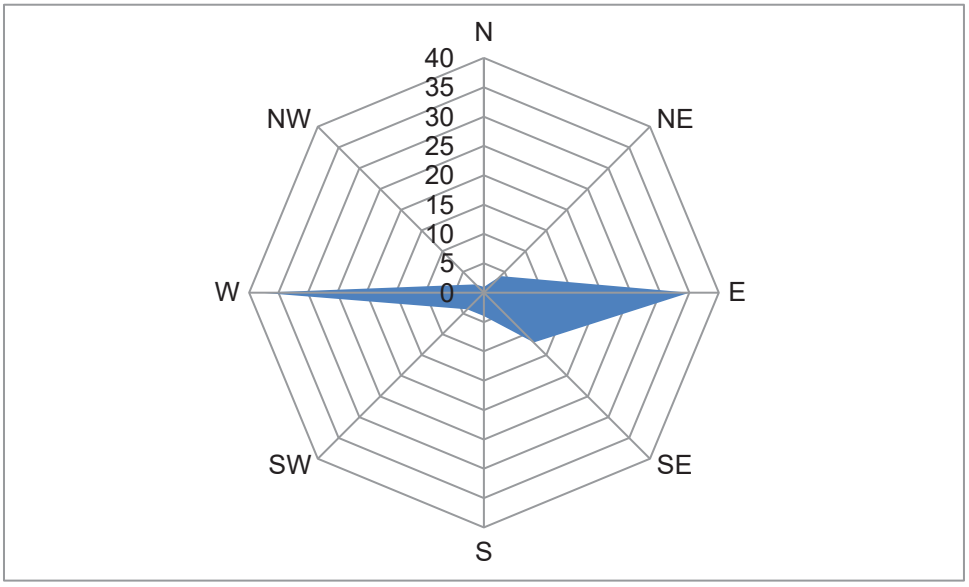
310. Thunderstorms occur in all months of the year. The maximum number of days with thunderstorms refers to June (6 days), and the average duration of thunderstorms in the afternoon with thunderstorm is 1.5 hours and the maximum continuous – 12.3 hours.

311. **Figure E-4** illustrates the monthly temperature for Zestafoni which ranges on average, from 5 °C in the winter months to around 25 °C in the summer. Absolute maximum and minimum temperatures show that it is possible for the temperatures to reach as low as 20 °C and more than 40 °C in the summer.

### E.1.2.2 Prevailing Winds

312. Wind strength, direction and frequency is shown in **Figure E-6**. The wind rose illustrates that the dominant wind direction is from the east. However, strong winds from the west are also experienced quite frequently.

**Figure E-6: Wind Rose, Zestafoni**




### E.1.2.3 Climate Change

313. General - Georgia is a mountainous country with diverse physical geography and climates, has a history of natural disasters, making the nation particularly susceptible to global environmental changes.

314. Climate trends observed since the 1960s include:

- Increased temperatures in the west by 0.3°C, and by 0.4°–0.5°C in the east (see **Figure E-7**).
- Increase in the number of hot days, particularly in the lowlands. Number of dangerously hot days in Tbilisi increased 14 days (1986–2010).
- Increased precipitation in the west (the mountain areas of Svaneti and Adjara. Both saw increases of 14%); decreased precipitation along the Likhi Ridge and to the east.
- Decrease in glacier mass by 30 %.
- Increased number of extreme events such as extreme precipitation, which cause
- landslides, mudflows and droughts; as well as more frequent floods in the west.


**Figure E-7: Change of Annual Air Temperature in Georgia (1936-2005)**

Source - Climate Change in the South Caucuses. Zoï Environment Network, 2011

315. Projected climate changes include:

- Increased average annual temperatures by 0.8°–1.4°C by 2050 and 2.2°–3.8°C toward 2100; greatest increase in northwest mountains.
- Precipitation data less certain, but general increase expected up to 2050, and potential decreases of up to 24 % by 2100 (However, other data provided seems to seems to indicate that there will be a general decrease in precipitation, see **Figure E-9**).

- Increase in the number of hot days (which may double in some mountain areas) and more frequent heat waves June – August.[7]
- Decrease in both days and nights with frost.
- Complete loss of Georgia's 637 glaciers projected by 2160 due to higher temperatures.

**Figure E-8: Forecasted changes of annual air temperature in the Georgia**

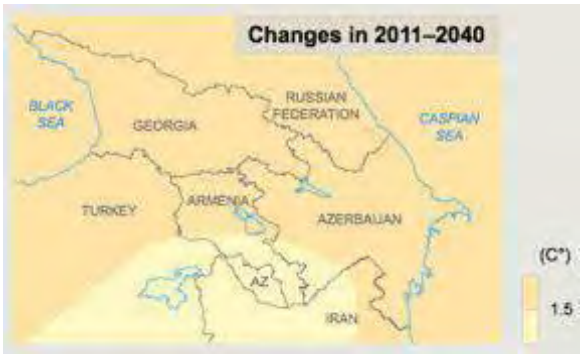
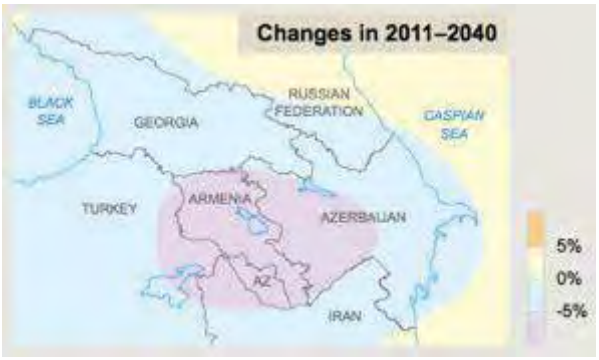



**Figure E-9: Forecasted changes of annual precipitation in Georgia**




Source - Climate Change in the South Caucuses. Zoï Environment Network, 2011

316. No site specific data has been found relating to climate change. However, given the general overview above it can be assumed that there will be an increase in average annual temperatures of between 1 and 1.5 °C over the next 30 years and that precipitation will decrease. The number of hot days may increase, and as such, consideration of suitable pavement types shall be given.

**Greenhouse Gases (GHGs)**

317. General - According to the World Resources Institute Climate Analysis Indicators Tool (WRI CAIT), Georgia's 2011 GHG profile was dominated by emissions from the energy sector, which accounted for 71% (7.5 $MtCO_2e$) of Georgia's total emissions. Land-use change and forestry (LUCF) was the second most significant sector. Of the 7.5 $MtCO_2e$ % of emissions from the energy sector approximately 2 of the 7.5 $MtCO_2e$ was attributable to the transport sector (resulting from purchases of large, inefficient, aging used cars, as well as economic growth and improved living conditions overall. From 2001-2009, the number of vehicles doubled, and the number of buses and minibuses tripled.[8] In 2013 emissions data complied by the World Resources Institute (WRI) indicated that Georgia produced around 14 $MtCO_2e$ or 0.0003% of global GHG emissions. 2 $MtCO_2e$ represents 0.00004% of global GHG emissions.

## E.1.3 Topography

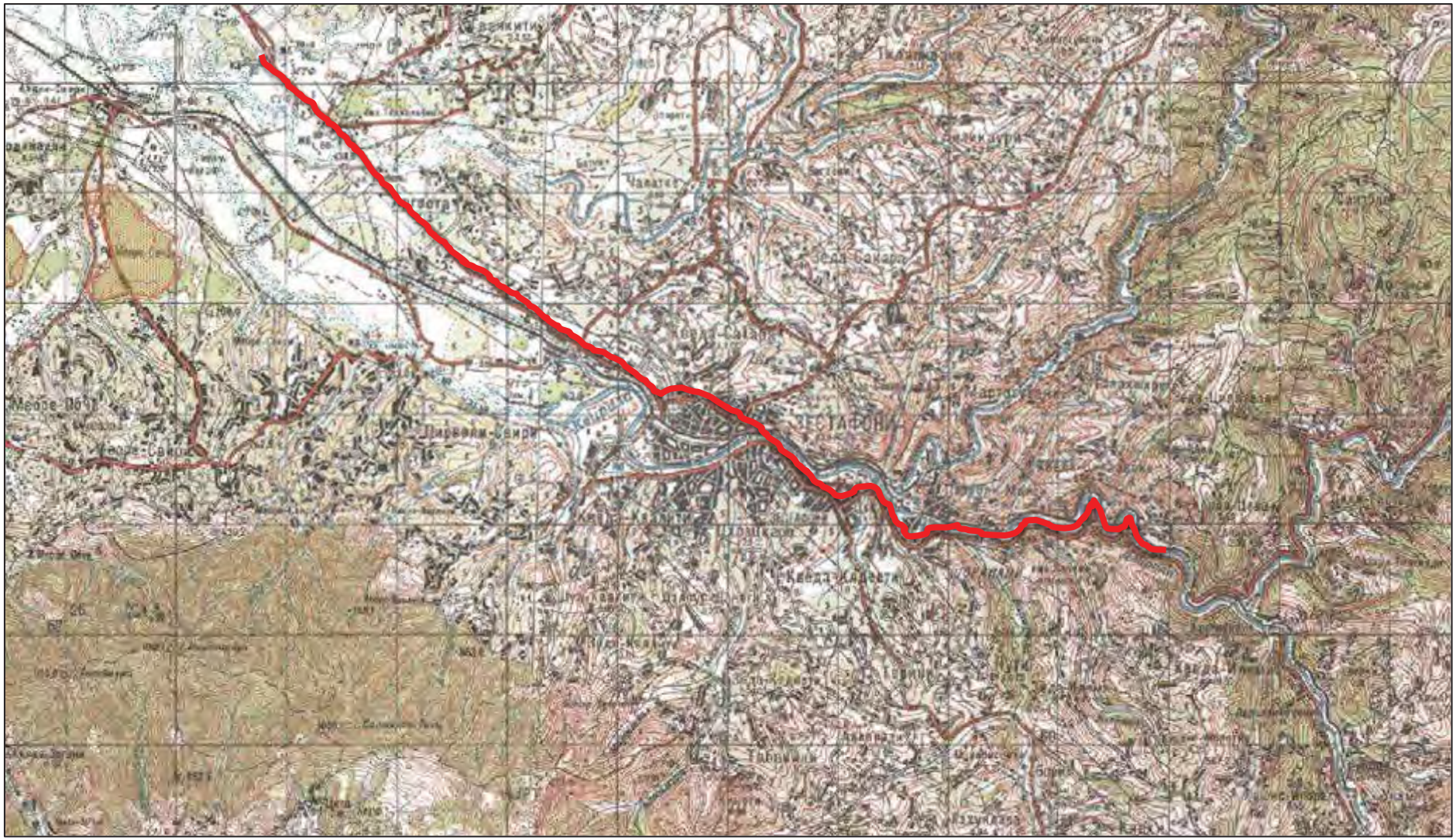
318. The Project area is located to the west of the Likhi Range which connects the Greater and Lesser Caucus Mountains. The Project corridor is set within a landscape of mountains, rolling hills and valley plain (see **Figure E-12** for a Topographical Map of the Project area). The existing road is located within the bottom of the river valley and as such elevation only varies between 200 and 170 meters above sea level. **Figures E-10** and **Figure E-11** illustrate the mountainous / rolling landscape in the first and middle portion of the road.

[7] Climate Risk Profile – Georgia. USAID, 2015
[8] Greenhouse Gas Emissions in Georgia. USAID, July, 2016

**Figure E-10: Topography of the Road Corridor (existing road can be observed to the left of the valley)**

**Figure E-11: Topography looking over Shorapani towards Zestafoni**

**Figure E-12: Topography of the Project Area with Existing Road**



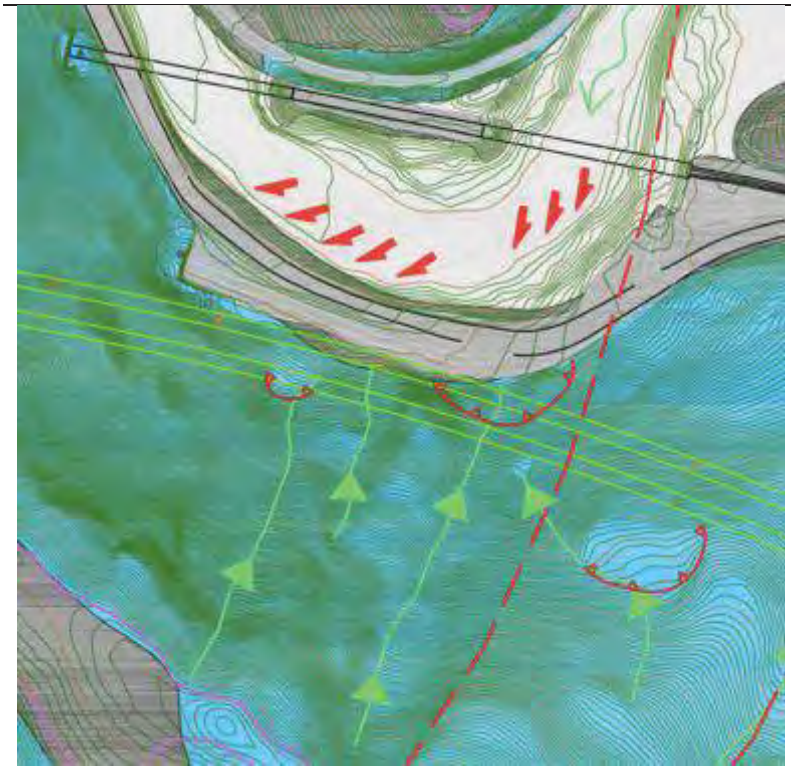
## E.1.4 Natural Hazards

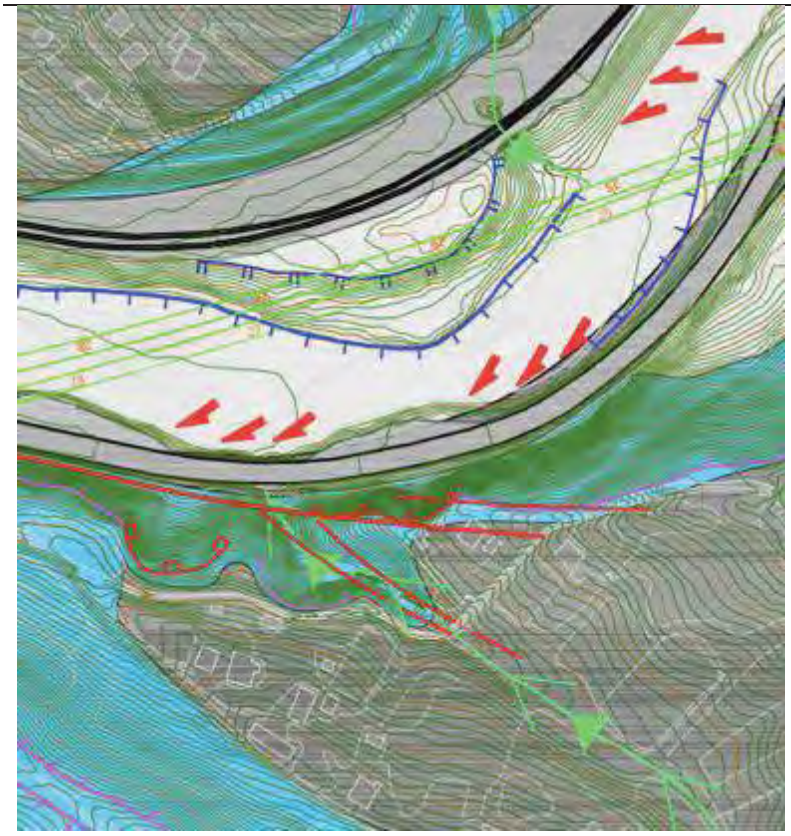
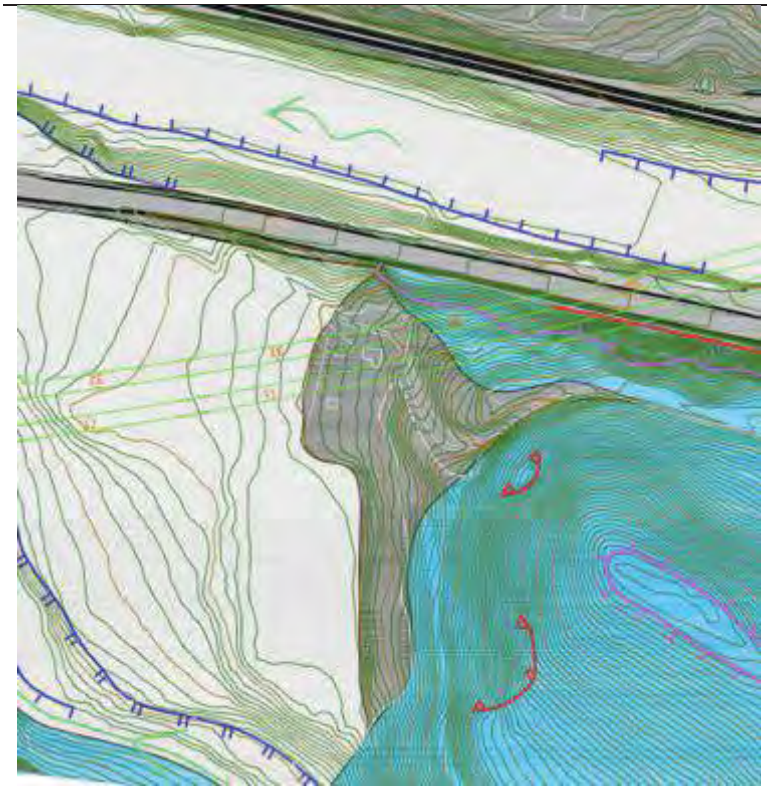
319. Regional Context - Georgia is one of the more complex mountainous regions living through the development of natural disasters, in which multi-spectral natural hazards are distinguished by their high recurrence rates and negative consequences for the population and infrastructure, as well as high rates of land resource losses and economic damage. Among the different types of natural disasters that periodically cause significant damage to the country's economy and often cause human casualties, the most relevant to the Project are landslides.

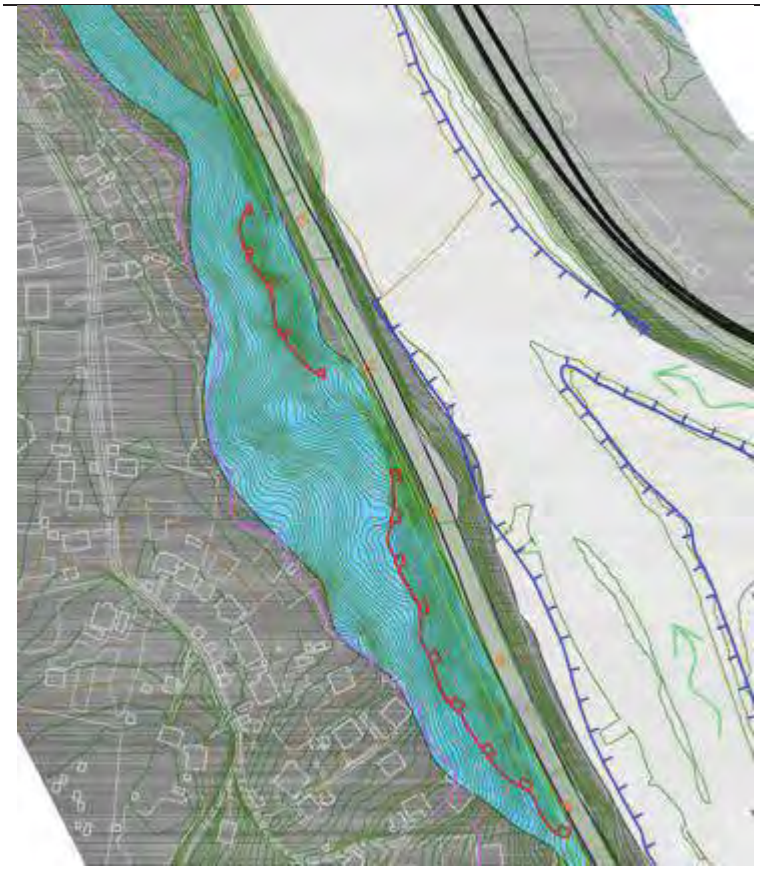
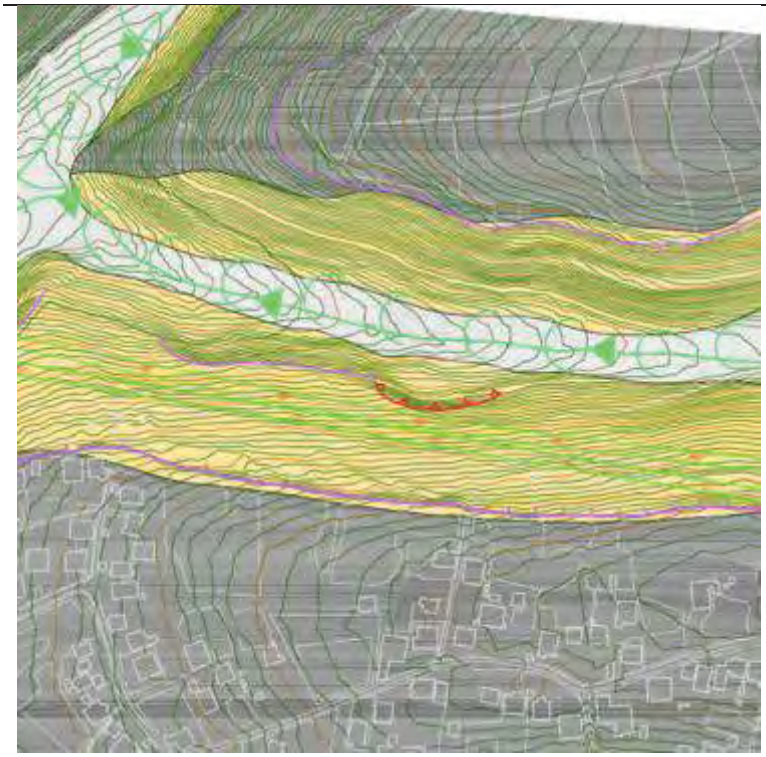
320. Almost all morphological-climatic zones in Georgia, starting with the sea coastline up to the high altitude mountain alpine-nival zone, have experienced damage to different extents. Over 50,000 landslides of different sizes and over 3,000 mudflow-transforming watercourses (rivers, canyons) have been identified in the country, as well as hundreds of kilometers of eroded riverbanks and coastline. Up to 70% of the territory and around 63% of the population are permanently at risk of natural disasters of different intensities.

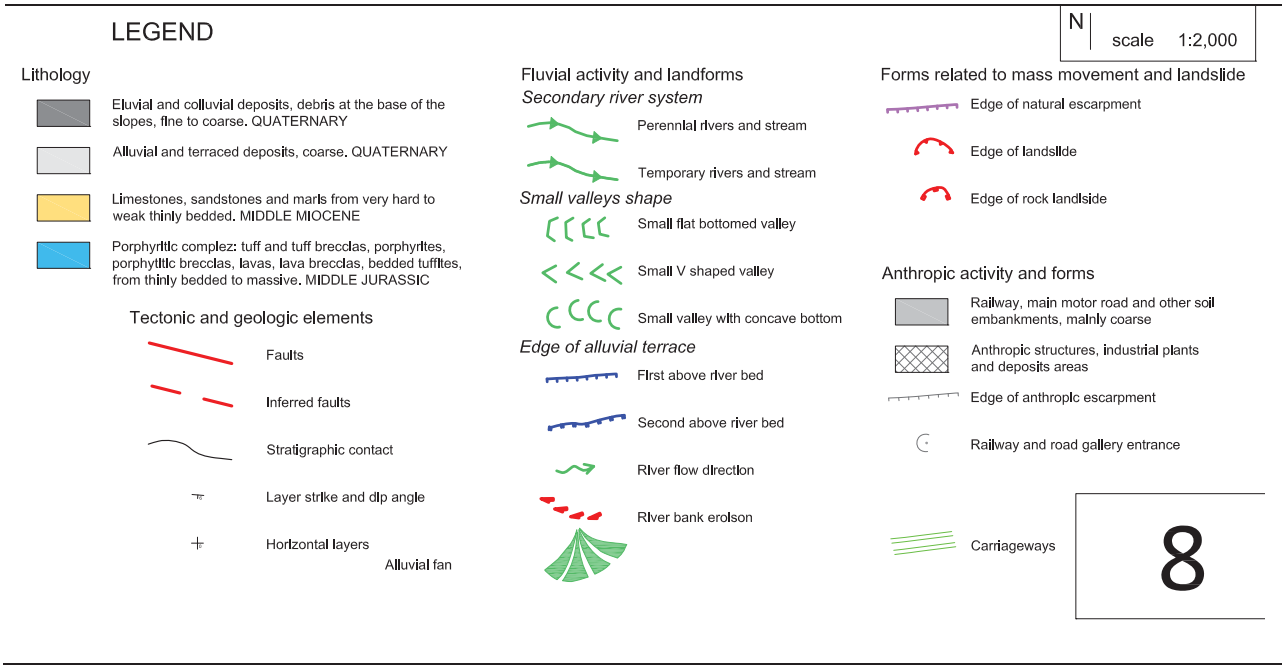
321. Landslides – Within the Project area a few areas prone to landslides have been identified. **Table E-3** provides the locations of the landslides.

**Table E-3: Landslide Locations Within the Project Area**

| | |
|---|---|
|  | KM 0.6 – Located above a tunnel. |

| | |
|---|---|
|  | KM 2.8 – This landslide area is located above the existing road which the new alignment bypasses to the north. |
|  | KM 3.1 – Located above a cut slope on a steep embankment. |

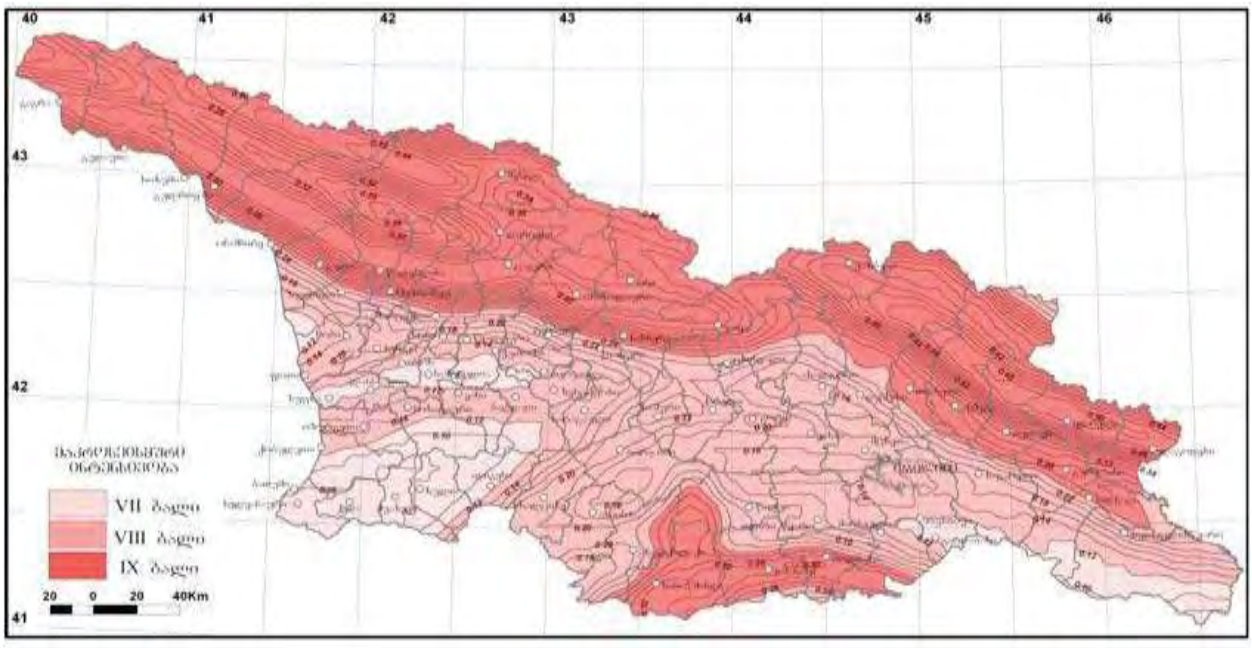
| | |
|---|---|
|  | Between KM 4.8 and 5.2 – located immediately above the new alignment. |
|  | KM 8.7 – located immediatel== to the north of the new alignment. |




322. Generally, the landslides do not affect the project alignment, except for the mass movements identified above around KM 0.6 affecting TUN 4.0.01-TA/AT and its eastern and western portals.

323. Seismicity - According to the Seismic Hazard Map of Building Norms and Rules effective in Georgia "Earthquake-resisting construction (SSM III, 21.10.2009 N 128, article 1477) PN 01.01-09)", the study area is located in the 8-point earthquake zone (MSK 64 scale) with the dimensionless coefficient of seismicity (A) equaling 0.16 (village Khevi) under the same document. **Figure E-13** illustrates the seismic conditions in Georgia.

**Figure E-13: Seismicity Map of Georgia (MSK Scale)**



## E.1.5 Hydrology

### E.1.5.1 Surface Water

324. Regional Context – In Georgia there are 26,060 rivers and stream with a total length of 60,000 km. They belong both to the Caspian and Black Sea basins. 25,075 (99.4%) of the rivers are small (less than 25km length), with total length of 54,768 km. More than 18,109 (70%) of the rivers belong to the Black Sea basin, and 7,951 (30%) belong to the Caspian Sea basin. **Figure E-14** below illustrates the division on the Caspian and Black Sea basins.


**Figure E-14: Rioni Sub-basin**

325. The Project road is located within the Black Sea basin in the Rioni sub-basin. The Rioni sub-basin dominates western Georgia and has a total catchment area of 13,400 km$^2$, which is approximately 20% of the whole Georgian territory.

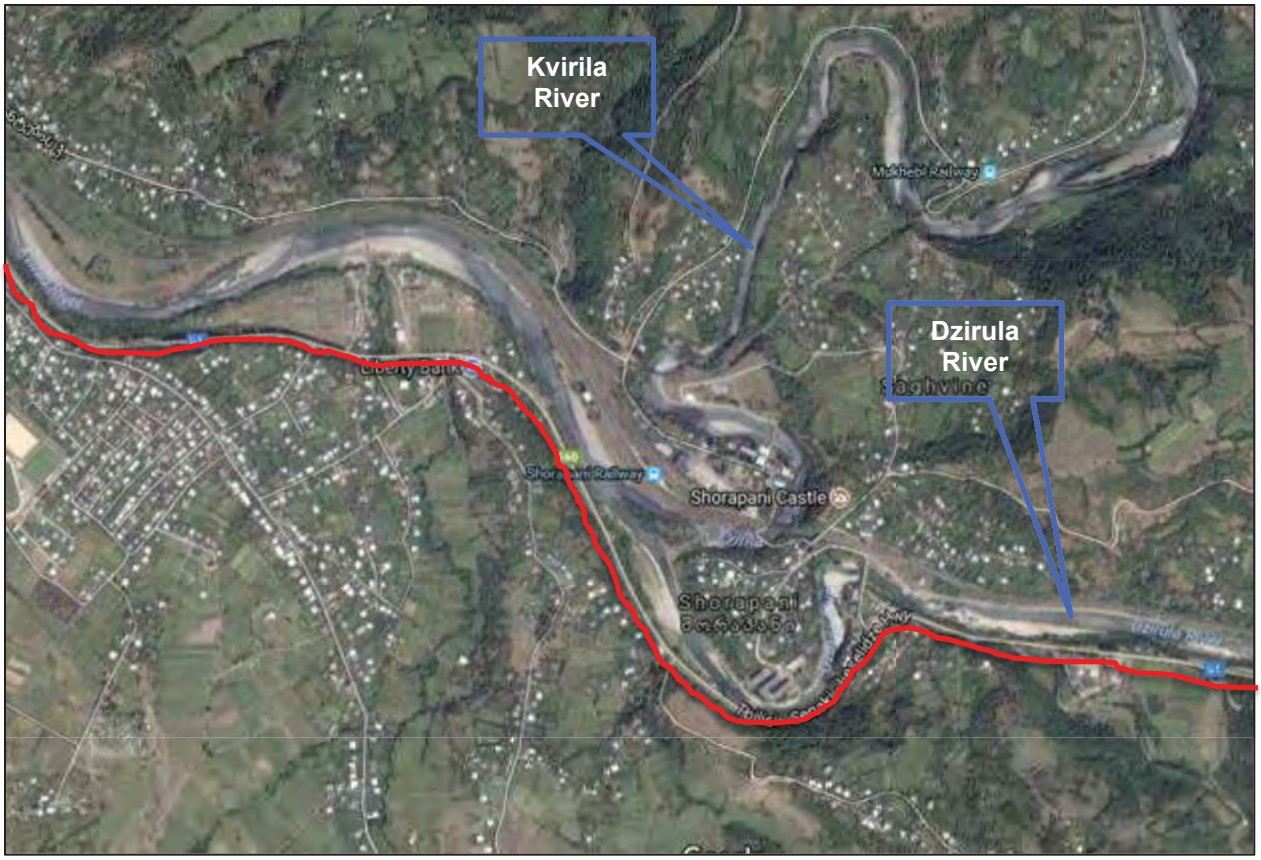
326. Local Context – Two main rivers can be found within the Project area, the Kvirila and the Dzirula. The confluence of the two rivers is in Shorapani adjacent to the Project road at Km 5.0, see **Figure E-15**.

327. **Kvirila** - The river Kvirila heads from Ertso basin on the southern slope of Racha Ridge. It flows out of Ertso Lake at 1,711 m altitude and into Vartsikhe water reservoir. Before the water reservoir was created, it flowed into the river Rioni from its left bank. The length of the river is 140 km, its total fall is 1628 m, its mean slope is 11,6‰, the area of the rivers basin is 3,598 km$^2$ and the mean height of the basin is 790m. The river comprises 2,906 tributaries of different ranges with the total length of 5,254 km.

328. The upper part of the basin is located on the southern slope of Racha ridge and western slope of the Likhi range, its middle course is located over Kartli-Imereti crystal massif, while the lower reaches flow across Kolkheti Plain. The upper part of the basin is characterized by deep gorges and gullies typical to the mountainous region. There are milder relief forms spread over the crystal massif, and the river flows out across Kolkheti Plain past Zestafoni.

329. The upper part of the Kvirila basin is structured with the Upper and Middle Jurassic limestones, marls, sandstones, porphyries and slates. The Upper and Middle Miocene clays, marls, sandstones and conglomerates dominate in the middle part. The Upper and Middle Jurassic rocks are spread in the environs of Zestafoni, and there are Cretaceous limestones, marls and sandstones spread over the same location and past it. The part of the middle course of the basin and surface of its lower course is mostly covered with the Quaternary deposits, which are partially presented by alluvial and fluvio-glacial deposits. Alluvial and alluvial-prolluvial deposits are also in bulk. The humus calcareous soils are spread over Racha ridge. A great part of the basin is occupied by brown forest soils, and zheltozem dominate on Kolkheti Plain. The percentage of forest land in the basin is over 50%.

**Figure E-15: Dzirula and Kvirila Rivers**




330. The river is fed with rain (45,0%), snow (31,8%) and underground (23,2%) waters. The water regime of the river is characterized by spring floods, autumn-and-winter freshets and summer unstable low- water periods. Floods mainly start at the beginning of March, reaching their maximum at the end of April or at the beginning of May and are over at the end of June. The course of floods is frequently disturbed by the freshets caused by rains. The freshets caused by rains are quite frequent even during the summer low-water periods. Particularly intense freshets are observed in autumn as a result of continuous rains. Such cases take place 4 or 5 times annually and last from 2 to 15 days. The level of the autumn freshets in the lower reaches of the river exceed that of spring floods, with their annual maximums more frequently fixed in autumn. In winter, the river has unstable levels due to rainfalls and warming. 24.3% of the annual flow flows in spring, 24.4% flows in summer, 22.1% flows in autumn and 29.2% of the annual flow flows in winter.

331. **Dzirula** - The river Dzirula heads at 1,252 m above sea level where several brooks merge on the western slopes of Likhi Range and flow into the river Kvirila from its left bank. The length of the river is 89 km, its total fall is 1,052 m and the area of its catch basin is 1,270 $km^2$.

332. The river comprises 1,386 tributaries with the total length of 1,677 km. The major tributaries are the Dumala (34 km), Chkherimela (39 km) and Khelmosula (16 km).

**Figure E-16: Dzirula River, KM 4.4, June 2017**

333. The river basin is located on Imereti Plateau and is bordered by Likhi Range from east and south-east and by the river Kvirila basin from north and north-west. The river basin is well developed in the lower zone due to the confluence with the river Chkherimela. The relief of the river basin within the limits of the Likhi Range is strongly dissected with deep gorges of the river tributaries. The geology of the river basin is represented by granites, gneisses, limestones and sandstones. The soil cover of the basin is represented by loamy soils, and the vegetation cover in almost all basin is presented as a dense hardwood forest.

334. The river gorge is winding and mostly V-shaped. The width of the gorge bed varies from 20-25 m to 300-350 m. The slopes of the river gorge merge with the slopes of the adjacent ridges. The river has terraces only in its middle and lower reaches. The width of the terraces varies from 50 to 400 m; their height is from 2-3 m to 7-8 m. The river floodplain is weakly developed.

335. The river bed is moderately winding and mostly non-branched. The bed in the upper reaches is stony giving the current a mountainous character. The width of the current varies from 10 to 30 m, its depth is 0,5-1,8 m, and its speed is within the limits of 0,8 and 1,5 m/sec.

336. The river is mostly fed with snow and rain waters. Its water regime is characterized by spring flood often accelerated by freshets caused by rains, non-stable low-water periods in summer and freshets in autumn and winter caused by rains and rapid air warming. The yearly distribution of the river flow is extremely uneven. On average, 48% of the annual flow flows in spring, 9-12% flows in summer and autumn and 30% flows in winter. Short icy events mostly as icy edges are fixed only at the river mouths.

337. Other small tributaries within the are include the Borimela River (which the Project road crosses at KM 3.5), and the Ajamura and Samanishvilisghele rivers, both of which located on the south bank of the Kvirila river more than 1.3 km from the Project road.

**Table E-4: Average monthly discharges of the Kvirila and Dzirula Rivers**

| River | Station | Catchment ($km^2$) | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dzirula | Tseva | 1190 | 21.6 | 33.5 | 54.0 | 58.2 | 29.8 | 19.4 | 13.5 | 9.59 | 8.93 | 16.0 | 20.1 | 25.9 |
| Kvirila | Zestafoni | 2490 | 45.3 | 70.6 | 10.4 | 12.6 | 83.0 | 55.7 | 35.3 | 26.5 | 23.6 | 39.2 | 45.6 | 53.7 |

**Table E-4: Peak Discharges of the Kvirila and Dzirula Rivers**

| River | Station | Catchment ($km^2$) | Reoccurrence □ Year | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 1000 | 100 | 50 | 20 | 10 | 5 |
| Dzirula | Tseva | 1190 | 965 | 670 | 575 | 455 | 380 | 315 |
| Kvirila | Zestafoni | 2490 | 2130 | 1430 | 1245 | 1000 | 850 | 695 |

338. Surface Water Quality – Water quality monitoring has been undertaken previously on the Kvirila river due to the presence of mining activities near the town of Chiatura which is approximately 28 kilometers north east of Zestafoni. One of the world's richest manganese (Mn) deposits and largest Mn mining areas lies in the foothills of the Caucasus Mountains, near the city of Chiatura. The monitoring revealed that the Kvirila River is contaminated with Mn and Fe. Total Mn levels were almost 15 times the MAC downstream of the discharge from the Central Keeping Facility (CKF, which is the main ore processing facility). Concentrations of total Mn were 2–12 times the MAC in Darkveti, Shuqruti, and Rgani streams, and total Fe values were 8–55 times the MAC in these tributaries. The primary sources of Mn and Fe in the Kvirila River are the untreated industrial wastewater discharged from the CKF, tailings and waste rock associated with the Mn ore disposed of on the Kvirila River floodplain, and the main tributaries (primarily Darkveti and Shuqruti streams). The monitoring report concluded that use of the Kvirila River before and after the CKF, for drinking, economic, cultural, and household purposes should be prohibited. Based on Mn concentrations, these areas are extremely highly polluted water, according to Georgian regulations.[9]

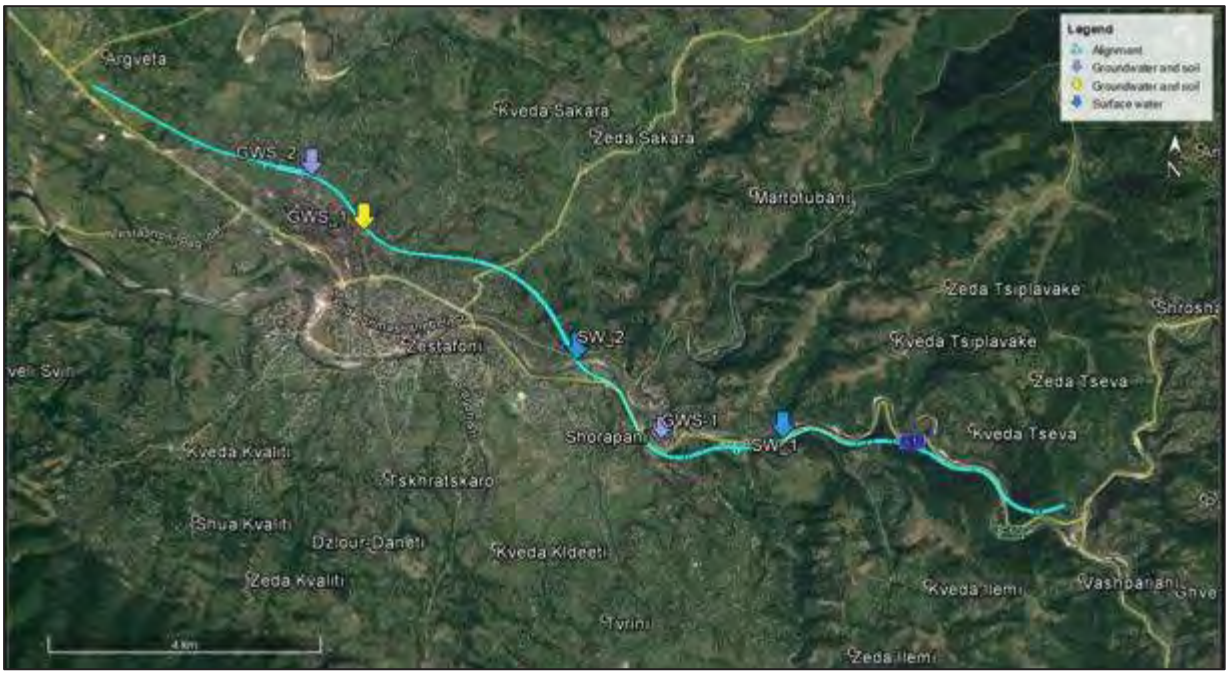
339. To further assess the status of water quality in the Project area, including the Kvirila and Dzirula rivers monitoring was undertaken in September, 2017. A total of two surface water samples were collected and analyzed to determine the baseline water quality levels. **Table E-5** describes the sample locations and rationale for their selection. The sampling locations are mapped in **Figure E-17**.

**Table E-5: Surface Water Quality Monitoring Locations**

| Sample ID | Coordinates | Rationale for Site Selection |
|---|---|---|
| SW01 | 42 ° 05'37.36"N / 43° 06'09.45"E | At location of Bridge BRI 4.1.01-AT/TA, Dzirula River |
| SW02 | 42 ° 06'12.29"N / 43° 03'57.67"E | At location of Bridge BRI 4.1.04-AT/TA, Kvirila River |

[9] Effects of Manganese Mining on Water Quality in the Caucasus Mountains, Republic of Georgia. Caruso, et al. Mine Water Environ. 2011

**Figure E-17: Surface Water Monitoring Locations**




340. The results of the water quality monitoring are presented in **Table E-6** below show that both the Dzirula and Kvirila rivers meet the national MACs for surface water quality at the sampling locations, although the levels of manganese in the Kvirila sample was above the recommended standards for drinking water. This reflects the findings of the study on manganese in the Kvirila river mentioned above.

**Table E-6: Surface Water Quality Monitoring Results**

| # | Parameter | Units | SW-1 (Dzirula) | SW-2 (Kvirila) | Method/standard | National, maximum allowable concentration |
|---|---|---|---|---|---|---|
| 1 | pH | - | 8.2 | 8.1 | ISO 10523-08 | 6.5-8.5 |
| 2 | Electrical conductivity (EC) | S/m | 0.027 | 0.0248 | ISO 7888-85 | n/a |
| 3 | Turbidity | FTU | 3.87 | 176 | ISO 7027-99 | n/a |
| 4 | $BOD_{5,}$ | $mg/lO_2$ | 2.7 | 1.7 | ISO 5815-03 | 6 |
| 5 | COD | $mg/lO_2$ | <15 | <15 | ISO 6060-89 | 30 |
| 6 | Dissolved oxygen (DO) | mg/l | 9 | 7.6 | ISO 5815-03 | ≥4 |
| 7 | Total suspended solids (TSS) | mg/l | 26 | 96 | ISO 11923-97 | increase by no more than 0.75 |
| 8 | Oil and grease | mg/l | <5.0 | <5.0 | EPA 413,1-97 | n/a |
| 9 | Total Phosphorus | mg/l | <0.1 | 0.1 | ISO 6878-04 | 2 |
| 10 | Total Nitrogen | mg/l | 0.25 | 0.3 | GOST 18826-73 | n/a |
| 11 | Total Ammonium | mg/l | <0.1 | <0.1 | GOST 4192-82 | 0.5 mg/l NH4 |
| 12 | TPH | mg/l | <0.04 | <0.04 | EPA 48,1-97 | 0.3 |
| 13 | Total residual chlorine | mg/l | <0.05 | <0.05 | GOST 18190-72 | n/a |

| # | Parameter | Units | SW-1 (Dzirula) | SW-2 (Kvirila) | Method/standard | National, maximum allowable concentration |
|---|---|---|---|---|---|---|
| 14 | Total Zinc | mg/l | <0.003 | <0.003 | ISO 8288-A-86 | 1 |
| 15 | Dissolved Copper | mg/l | <0.003 | <0.003 | ISO 8288-A-86 | 1 |
| 16 | Manganese | mg/l | <0.02 | 0.28 | EPA 3005 A-92 | 1 |
| 17 | Total Coliform Bacteria | 100ml | 680 | 800 | ISO 9308-1:2014 | ≤10 000 |

341. No fisheries are known to exist within the Project area, although recreational fishing was observed during surveys performed by the LCF.

### 1.5.2 Groundwater Water

342. Local Context – The water bearing strata is of contemporary alluvial deposits characterized by a free groundwater table declining along the general flow of the rivers. The shallow ground water level is 1.5m – 1.8m below ground and anticipated amplitude of groundwater level fluctuation is below 1m. At some locations near the riverbeds and groves, groundwater is very shallow depths (0.3m). Aquifers are mainly fed from rivers and precipitation.

343. As part of the Projects Geological study a number of boreholes were excavated within the Project area. Groundwater levels between generally ranged between 0.3 and 8.8 meters in depth. A number of groundwater wells and natural springs are present within the Project area and according to a recent World Bank study groundwater and springs are main sources of water supply for the Imereti population.[10]

344. Groundwater Quality - A total of two groundwater samples were collected from two wells to assess the baseline groundwater quality in the Project area. Sampling was originally intended close to Shorapani, but the monitoring team had difficulties accessing this location and as such sampled at two locations close to the GAA plant instead. **Table E-7** provides a summary of the results.

**Table E-7: Groundwater Quality Monitoring Locations**

| Sample ID | Coordinates | Rationale for Site Selection |
|---|---|---|
| GW1 | 42 ° 07'11.23"N / 43° 01'40.06"E | Behind GAA Site |
| GW2 | 42 ° 07'36.52"N / 43° 01'06.14"E | Behind GAA Site |

345. Results – The results of the groundwater monitoring indicate all parameters in sample location GWS-1 meet the national MACs and where applicable, WHO standards. GWS-2 however exhibited high hardness, total dissolved solids, calcium, manganese and sulfates.

**Table E-8: Groundwater Quality Monitoring Results**

| # | Parameter | Units | GWS-1 | GWS-2 | Method/standard | National limit, maximum allowable concentration | WHO, guidance values, mg/l |
|---|---|---|---|---|---|---|---|
| 1 | pH | - | 7.35 | 7 | ISO 10523-08 | 6.5-8.5 | n/a |
| 2 | Dissolved oxygen (DO) | mg/l | 7.1 | 5 | ISO 5815-03 | n/a | n/a |

[10] Second Regional Development Project, Imereti Regional Development Program, Imereti Tourism Development Strategy. Strategic Environmental, Cultural, Historical and Social Assessment. World Bank, 2014

| # | Parameter | Units | GWS-1 | GWS-2 | Method/standard | National limit, maximum allowable concentration | WHO, guidance values, mg/l |
|---|---|---|---|---|---|---|---|
| 3 | Electrical conductivity (EC) | S/m | 0.0478 | 0.178 | ISO 7888-85 | n/a | n/a |
| 4 | Alkalinity | mg-eq/l | <0.2 | <0.2 | Gost 23268.3-78 | n/a | n/a |
| 5 | Hardness | mg-eq/l | 5.38 | 22.5 | Gost 23268.5-78 | 7-10 | n/a |
| 6 | Total suspended solids (TSS) | mg/l | <2.0 | <2.0 | ISO 11923-97 | n/a | n/a |
| 7 | Total dissolved solids | mg/l | 466 | 1946.7 | Calculated | 1000-1500 | n/a |
| 8 | Arsenic, As | mg/l | <0.005 | <0.005 | Gost 4152-89 | <0.01 | 0.01 |
| 9 | Chlorides | mg/l | 17 | 41.1 | Gost 23268,17-78 | <250 | n/a |
| 10 | Iron, Fe | mg/l | <0.02 | <0.02 | EPA 3005 A-92 | <0.3 | n/a |
| 11 | Nitrates | mg/l | 8.91 | 8.86 | Gost 18823-73 | <50 | 50 |
| 12 | Sodium, Na | mg/l | 17.1 | 125.4 | ISO 9964-3-93 | <200 | n/a |
| 13 | Potassium, K | mg/l | 1.05 | 3.08 | ISO 9964-3-93 | n/a | n/a |
| 14 | Calcium, Ca | mg/l | 80 | 245 | Gost 23268,5-78 | <140 | n/a |
| 15 | Magnesium, Mg | mg/l | 16.8 | 124 | Gost 23268,5-78 | <85 | n/a |
| 16 | Lead, Pb | mg/l | <0.01 | <0.01 | ISO 8288-A-86 | <0.01 | 0.01 |
| 17 | Sulfates | mg/l | 36 | 960 | Gost 23268,3-78 | <250 | n/a |
| 18 | Manganese, Mn | mg/l | <0.02 | <0.02 | EPA 3005 A-92 | <0.4 | 0.4* |

## E.1.6 Geology & Soils

### E.1.6.1 Geology

346. In the Project area, along the highway alignment, three major geological units can be identified:

1. Effusive volcanic rocks covering the crystalline basement (not exposed in Lot F4), dated Middle Jurassic. They are represented by the porphyritic complex including the following geological formations:
    a. J2b2 (A) - Tuff and tuff breccias, from moderately hard to hard. Mainly massive.
    b. J2b2 (B) - Irregular succession of porphyrites, porphyritic breccias, lava breccias, bedded tuffites, tuff and tuff breccias; mainly hard. From thinly bedded to massive.
2. Sedimentary rocks covering the volcanic units, dated Middle Miocene and represented by the following geological formations:
    a. $N_1^2$ (m) - Marls.
    b. $N_1^2$ - Limestones and sandstones. From very hard to weak, thinly bedded.
3. Quaternary soils, covering both the volcanic and the sedimentary rocky units, represented by:
    a. eQ - Eluvial cover deposits on the upper plains. Coarse and/or fine.
    b. cdQ - Colluvial deposits in the valley floors and debris at the slope bases. Coarse and/or fine.
    c. aQ - Recent alluvial and terraced deposits. Coarse.
    d. aaQ - Current alluvial deposits. Coarse.

347. From a geo-lithological point of view, along the alignment, three main homogeneous sections can be identified, depending on similar lithological conditions (**Table E-9**, below):

a) From km 0+000 to 6+350 – outcropping formations are represented by volcanic rocks of the porphyritic complex, including both the mainly effusive rocks of the $J_2b_2$ (B) formation and the mainly pyroclastic rocks of the $J_2b_2$ (A) formation. The contact between this two geological units is generally a stratigraphic contact, being tuffs above lavas. In some cases, important faults cause tectonic contacts between them. In this section, tunnels are expected to be excavated in $J_2b_2$ (B) formation; bridges are expected to have their abutments and piers on quaternary deposits (aQ, aaQ and mQ with a variable thick) covering the $J_2b_2$ (B) formation; cuts are expected to be mainly in the porphyritic complex, sometime affecting the thin covering quaternary deposits.
b) From km 6+350 to ~ 10+200 – outcropping formations are mainly represented by carbonate sandstones of $N_1^2$ formation, overlaying with a stratigraphic limit the $J_2b_2$ (A) formation, exposed in the major valleys. Covering quaternary deposits are widespread in this area. Several faults are observed. In this section, tunnels are expected to be excavated in the porphyritic complex (both $J_2b_2$ (A) and (B) formations) and in the $N_1^2$ formation; one bridge crosses a colluvial deposit overlaying the $N_1^2$ formation; one cut is expected to be excavated in the $N_1^2$ formation.
c) From km ~ 10+200 to 14+726 – in this area, colluvial and alluvial deposits (cdQ and aQ) outnumbers the not-outcropping rocky formations.

**Table E-9: Lithology – Rikoti - Argveta**

| Bridges | from km | to km | length | lithology |
|---|---|---|---|---|
| **T-TA-1** | 260,00 | 590,00 | 330 | Irregular succession of porphyrites, porphyritic breccias, lava breccias, bedded tuffites, tuff and tuff breccias; mainly hard. From thinly bedded to massive |
| **T-TA-2** | 830,00 | 1200,00 | 370 | Irregular succession of porphyrites, porphyritic breccias, lava breccias, bedded tuffites, tuff and tuff breccias; mainly hard. From thinly bedded to massive |
| **T-TA-3** | 3510,00 | 4270,00 | 760 | Irregular succession of porphyrites, porphyritic breccias, lava breccias, bedded tuffites, tuff and tuff breccias; mainly hard. From thinly bedded to massive |
| **T-TA-4** | 6320,00 | 6622,00 | 302 | Tuff and tuff breccias, from moderately hard to hard. Mainly massive |
| | 6622,00 | 6759,00 | 137 | Irregular succession of porphyrites, porphyritic breccias, lava breccias, bedded tuffites, tuff and tuff breccias; mainly hard. From thinly bedded to massive |
| | 6759,00 | 7020,00 | 261 | Tuff and tuff breccias, from moderately hard to hard. Mainly massive |
| **T-TA-5** | 7130,00 | 7496,00 | 366 | Tuff and tuff breccias, from moderately hard to hard. Mainly massive |
| | 7496,00 | 8250,00 | 754 | Limestones and sandstones from very hard to weak, thinly bedded |
| **T-TA-6** | 9280,00 | 9640,00 | 360 | Limestones and sandstones from very hard to weak, thinly bedded |

| | | | | |
|---|---|---|---|---|
| **T-AT-1** | 200,00 | 610,00 | 410 | Irregular succession of porphyrites, porphyritic breccias, lava breccias, bedded tuffites, tuff and tuff breccias; mainly hard. From thinly bedded to massive |
| **T-AT-2** | 770,00 | 1220,00 | 450 | Irregular succession of porphyrites, porphyritic breccias, lava breccias, bedded tuffites, tuff and tuff breccias; mainly hard. From thinly bedded to massive |
| **T-AT-3** | 3490,00 | 4600,00 | 1110 | Irregular succession of porphyrites, porphyritic breccias, lava breccias, bedded tuffites, tuff and tuff breccias; mainly hard. From thinly bedded to massive |
| **T-AT-4** | 6345,00 | 6639,00 | 294 | Tuff and tuff breccias, from moderately hard to hard. Mainly massive |
| | 6639,00 | 6776,00 | 137 | Irregular succession of porphyrites, porphyritic breccias, lava breccias, bedded tuffites, tuff and tuff breccias; mainly hard. From thinly bedded to massive |
| | 6776,00 | 7030,00 | 254 | Tuff and tuff breccias, from moderately hard to hard. Mainly massive |
| **T-AT-5** | 7145,00 | 7504,00 | 359 | Tuff and tuff breccias, from moderately hard to hard. Mainly massive |
| | 7504,00 | 8300,00 | 796 | Limestones and sandstones from very hard to weak, thinly bedded |
| **T-AT-6** | 9290,00 | 9720,00 | 430 | Limestones and sandstones from very hard to weak, thinly bedded |

### E.1.6.2 Soils

348. The soils in the Project area are very productive and range of crops are grown in the region which is well known for is wine production. Soil temperatures from Zestafoni and topsoil thicknesses along the road alignment are shown in **Table E-10** and **Table E-11**.

**Table E-10: Soil Temperature**

| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Monthly Temperature (°C) | 2 | 3 | 8 | 15 | 21 | 26 | 29 | 28 | 22 | 15 | 9 | 4 |

**Table E-11: Topsoil Thickness in the Project Corridor**

| Chainage (km) | Topsoil Thickness (m) |
|---|---|
| 10+100 – 10+450 | 0.50 |
| 10+450 – 10+820 | 0.70 |
| 10+820 – 11+240 | 0.40 |
| 11+240 – 11+620 | 0.30 |
| 11+620 – 12+400 | 0.40 |
| 12+400 – 12+625 | 0.20 |
| 12+625 – 12+990 | 0,20 |
| 12+990 – 13+445 | 0.35 |
| 13+445 – 13+835 | 0.30 |
| 13+835 - 14+080 | 0.25 |
| 14+080 - 14+730 | 0.60 |

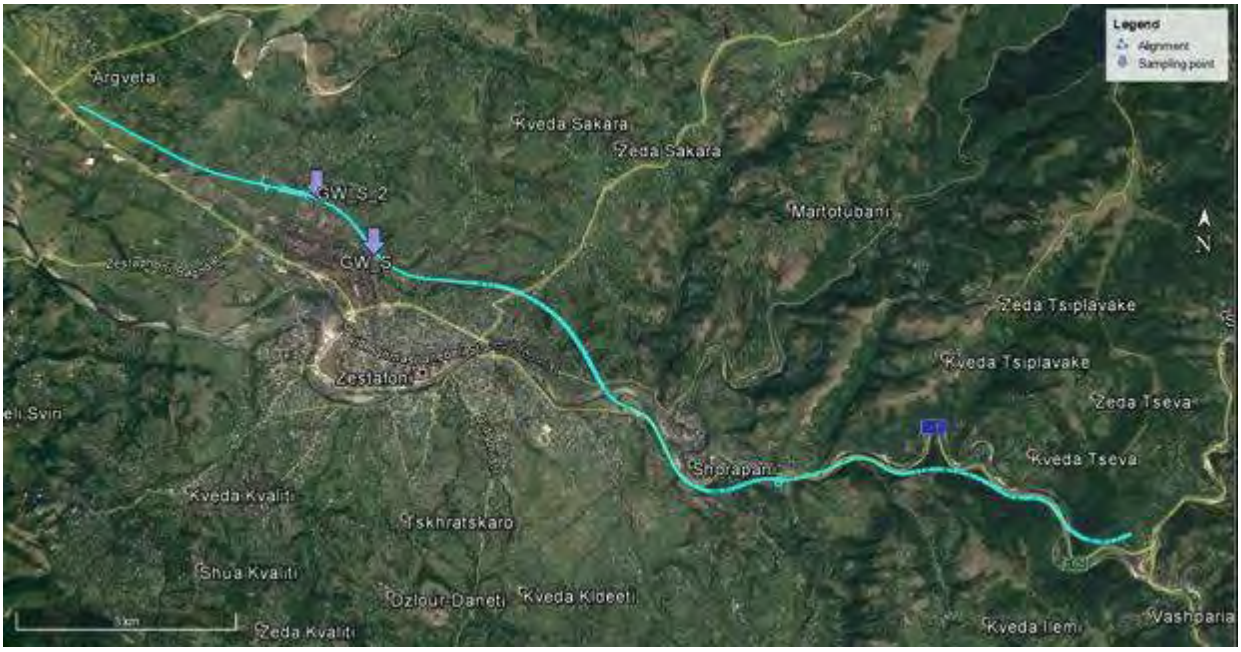
349. Hazardous wastes generated by the GAA, Chiatura manganese enrichment plant, and many small-size smelters operating in various settlements of Imereti have been identified as potential sources of soil pollution. [11]

350. To assess the status of soil quality in the Project area soil sampling and analysis was undertaken in September, 2017. A total of two soil samples were collected and analyzed to determine the existing soil quality. **Table E-12** describes the sample locations and rationale for their selection. The sampling locations are mapped in **Figure E-18**.

**Table E-12: Soil Monitoring Locations**

| Sample ID | Coordinates | Rationale for Site Selection |
|---|---|---|
| GW_S-1 | 42 ° 05'36.08"N / 43° 04'52.36"E | Behind the GAA Factory |
| GW_S-2 | 42 ° 07'36.52"N / 43° 01'06.14"E | Behind the GAA Factory |

**Figure E-18: Soil Monitoring Locations**




[11] Integrated Natural Resources Management in Watersheds of Georgia Program. USAID, 2011

**Table E-13: Soil Sampling Results**

| # | Parameter | Units | GWS-1 | GWS-2 | Method/standard | National limit, maximum allowable concentration | Proposed National Limit, MAC | Proposed National Preventive limits of risk elements in agricultural soil | Italian Standard For Residential Areas | UK Soil Guidelines for Residential Areas[12] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Copper, Cu (mobile) | mg/kg | 1.35 | 2.30 | GOST P50683-1994 | 3-132 | 60-100 | 60 | 120 | |
| 2 | Zinc, Zn (mobile) | mg/kg | <0.5 | 3.6 | GOST P50686-1994 | 23-220 | 130-200 | 120 | 150 | |
| 3 | Nickel, Ni (mobile) | mg/kg | 1.0 | 0.25 | GOST P50683-1994 | 4-80 | 60-80 | 50 | 120 | |
| 4 | Chromium, Cr (mobile) | mg/kg | <0.5 | <0.5 | GOST P50683-1994 | 6 | 100-200 | 90 | 150 | |
| 5 | Lead, Pb (total) | mg/kg | 41.5 | 47.0 | ISO 14869-.1-2001 | 32-130 | 100-140 | 60 | 100 | |
| 6 | Arsenic, As (total) | mg/kg | 14.4 | 16.2 | GOST 4152-89 | 2-10 | 30 | 20 | 20 | 32 |
| 7 | Cadmium, Cd(total) | mg/kg | <2.0 | <2.0 | ISO 14869-.1-2001 | 2 | 0.5 – 1.0 | 0.5 | 2 | |
| 8 | Polychlorinated biphenyl PCB | mg/kg | <7.0 | <7.0 | EPA 8082 A-2007 | 60 | 10 | - | 5 | |
| 9 | Asbestos | | nd | nd | NIOSH 9002 -1989 | 3-132 | - | - | 100 (next law) | |

[12]http://webarchive.nationalarchives.gov.uk/20140328153727/http://www.environment-agency.gov.uk/static/documents/Research/SCHO0409BPVY-e-e.pdf

**Table E–14: US EPA 16 PAHs Results**

| Parameter | Unit | GWS- 1 | GWS- 2 | Proposed Georgian Standard, MAC | Canadian SQG, residential | Dutch Target Value[13] | Dutch Intervention Values[14] | Italian Standard for Soils in Residential Areas | Italian Standard for Soils in Industrial / Commercial Areas |
|---|---|---|---|---|---|---|---|---|---|
| Naphthalene | ug/kgdm | 1.51 | 2.15 | 100 | 600 | | | | |
| Acenaphthylene | ug/kgdm | <0.5 | 1.98 | | | | | | |
| Acenaphthene | ug/kgdm | 1.11 | 4.42 | | | | | | |
| Fluorene | ug/kgdm | 1.20 | 3.29 | | | | | | |
| Phenanthrene | ug/kgdm | 11.30 | 28.08 | 100 | 100 | | | | |
| Anthracene | ug/kgdm | 2.16 | 5.81 | 10 | | | | | |
| Fluoranthene | ug/kgdm | 29.40 | 93.3 | 100 | | | | | |
| Pyrene | ug/kgdm | 20.50 | 72.2 | | 100 | | | 5,000 | 50,000 |
| Benzo(a)anthracene | ug/kgdm | 15.30 | 51.9 | 1,000 | 100 | | | 500 | 10,000 |
| Chrysene | ug/kgdm | 17.70 | 53.08 | 10 | | | | 5,000 | 50,000 |
| Benzo(b)fluoranthene | ug/kgdm | 35.80 | 382 | | 100 | | | 500 | 10,000 |
| Benzo(k)fluoranthene | ug/kgdm | 12.20 | 133 | | 100 | | | 500 | 10,000 |
| Benzo(a)pyrene | ug/kgdm | 26.20 | 270 | 100 | | | | 100 | 10,000 |
| Indeno(123cd)pyrene | ug/kgdm | 11.70 | 207 | | 100 | | | 100 | 5,000 |
| Benzo(ghi)perylene | ug/kgdm | 10.80 | 179 | | | | | 100 | 10,000 |
| Dibenzo(ah)anthracene | ug/kgdm | 2.44 | 41.6 | | 100 | | | 100 | 10,000 |
| Sum – 16 PAH | ug/kgdm | 200 | 1,530 | | | | | | |
| Sum – 16 PAH | mg/kgdm | 0.20 | 1.53 | | | | | | |
| Sum – 10 PAH | ug/kgdm | 138.27 | 1,023.32 | | | 1,000 | 4,000 | | |
| Sum - 10 PAH | mg/kgdm | 0.14 | 1 | 1 | | 1 | 40 | | |

* Parameters highlighted in green used for Dutch Sum 10 PAH Values.

[13] The target values indicate the level at which there is a sustainable soil quality. In terms of curative policy this means that the target values indicate the level that has to be achieved to fully recover the functional properties of the soil for humans and plant and animal life. Besides this the target values give an indication of the benchmark for environmental quality in the long term on the assumption of negligible risks to the ecosystem.

[14] The soil remediation intervention values indicate when the functional properties of the soil for humans, plant and animal life, is seriously impaired or threatened. They are representative of the level of contamination above which there is a serious case of soil contamination.

***** (PAH tests by ultrasonic extraction and GC/MS-SIM detection)

**Table E-15: Mercury report**

| Sample origination | Hg, mg/kgdm | Georgian regulations, mg/kg |
|---|---|---|
| GWS- 1 | 0.024 | 2.1 * (MPC with consideration of the background) |
| GWS- 2 | 0.089 | |

* Qualitative norms of the status of environment – Hygiene assessment of soil in residential areas, guidelines 2.1.7.003-02
******(Hg measured by Varian SpectrAA 220FS with Vapour Generation Accessory VGA-77 on the basis of SOP AEL 2003 (ISO17025 accredited) complied with EPA245.1 Standard Method.)

351. The results of the general soil sampling show that all parameters are within the current Georgian limits with the exception of Arsenic and Lead. However, as noted in **Section D.5.6**, these limits are considered outdated, stemming from old regulations developed during the Soviet times.

352. Assessing the results against EU limits (Italy and the UK), we can see that the results of all parameters sampled, including arsenic and lead, are well within the limits for residential areas, which are significantly lower than the ones for industrial areas, which should be the reference in this case. This, it should be said, is a direct effect of the precise choice, made by the Design Team, to move the alignment far from two piles of waste material sited on the northern boundary of the GAA, an area considered as hazardous. In addition, the results are also well within the recently proposed maximum allowable concentrations that have been developed by the MoENRP. Discussions with the UNEP indicate that these proposed limits will come into force some time in 2018. The UNEP stated that the purpose of the new limits is to harmonize them with the requirements of the Product Safety and Free Movement Code and Georgia's obligations undertaken under the Association Agreement with the European Union. Most importantly, all parameters are also below the proposed national Preventive limits of risk elements in agricultural soil, which is an important facor considering that much of the spoil material may be disposed of at the Kutaisi bypass which borders on an area of agricultural land.

353. Analysis of the PAHs shows that both samples meet the Dutch target levels meaning that the soil is considered a sustainable soil quality and will have negligible risk to the ecosystem. Levels of mercury were recoded below Georgian limits.

## E.1.7 Geomorphology

354. From a morphological point of view three geomorphological structures can be recognized in the Project area:

- Zemo Imereti Highland (Plateau);
- Kolkheti piedmont undulated zone; and
- Kolkheti Lowland (alluvial plain).

355. A detailed description of the alignment of the project road in terms of geomorphology is given below.

- KM 0.0 – 1.5. On this segment, the river Dzirula has a sharply meandering channel and the valley acquires a narrow canyon-like shape. The valley floor width varies from 40 m to 80 m. Compared with the right slope, the left one is steeper. Slope grades varies from 27° to 43°. The valley slopes are dissected with lateral inflows and small erosion gullies. The right slop is characterized by edges of both natural and anthropic escarpment, mainly related to the old and actual railway lines. Left slope is forested and not at all stable above the road profile: important natural escarpments are reported, and landslides have been detected between km 0+450, and km 0+750, affecting the western portal of TUN 4.0.01-TA and eastern portals of TUN 4.0.02 TA/AT.
- KM 1.5 – 2.3. On this segment the river Dzirula valley is narrow and V-shaped. The river runs in the narrow channel the width of which is 40 - 60 m. Above-flood-plain terraces are registered fragmentally. On both sides of the valley, slopes have equal grade and are

dissected with lateral erosion gullies. The slope grade varies from 16° to 37°. Also in this section, right slopes are characterized by anthropic escarpment, while the left forested steep slopes exhibit natural escarpments, but appear to be stable.

- KM 2.3 – 3.5. On this segment, from south-eastern direction, the river Dzirula is joined by the river Borimela which is its left tributary. It is deeply cut into the V-shaped canyon-like narrow valley. The river Dzirula valley slopes are steep and dissected with lateral erosion gullies. The slope grades vary from 150° to 41°. Above-flood-plain terraces are registered fragmentally. In the right side of the river, many anthropic landforms are observed (railroad line embankment, escarpment, slope stabilization), while in the left slopes are noticed natural escarpment and a series of small and shallow landslides affecting the actual motor road, but not affecting the future project road.
- KM 3.5 – 5.3. Within this segment, the river Dzirula is sharply meandering. The width of the valley floor varies from 40 m to 300 m; the flood-plain and above-flood-plain terraces are well- defined; the left slope of the river valley is relatively steep, with its grade changing from 25° to 45°and the grade of the right slope changing from 10° to 25°. The valley slope surfaces are dissected with lateral inflows and numerous small erosion gullies. On this segment, the river Dzirula joins the river Kvirila, its right main tributary. Steep natural escarpment with well-defined edge are widespread on the left side of the river; from km 4+800 to 5+300 the slope is unstable, since landslide scarps and deposits are observed.
- KM 5.3 – 6.3. This segment is located within the western end of the Zemo Imereti Highland, in the river Kvirila valley that in this section is wide. The valley slopes are steep and partly dissected with lateral erosion gullies. The valley floor is represented with the river channel, the flood-plain and above-flood-plain alluvial terraces. The height of the second terrace surface is 7 – 17 m above the river level. Within this segment, one shallow left tributary flows into the river Kvirila from the south. On both sides of the valley, angle of gradient of the slopes varies from 15° to 40°. The slopes are mainly forested and stable.

1. KM 6.30 – 10.1. In the Colchis Piedmont Undulated Zone, the middle part of the route will run from the northern periphery of the city Zestafoni to the north-western part of village Argveta. Within this zone, there are several streams and gullies, with a general NE-SW orientation, deeply cut into relief. Between the valleys' bottom and the slope crests, the difference between absolute elevations varies between 20 and 70 m. The slopes grade varies between 14° and 27°. The slopes of the above-said gullies are covered with vegetation and stable. The valleys are characterized by a concave or flat bottom.
2. KM 10.1 – 14.7. The last part of the Project road will run on the Colchis alluvial plain, which has absolute elevations of 145-150 m. The relief is slightly sloped (1° - 6°) south-westward. This section is characterized by the presence of 3 alluvial fans, wide from 350 m to 800 m. Natural stable escarpments are detected. In this area several anthropic landforms are present, including road embankment, edges of anthropic escarpment, deposit areas and the GAA industrial area of Zestafoni.

## E.2 Ecological Resources

356. The project corridor crosses forest areas, agricultural land plots, hilly forest slopes, residential areas and riparian ecosystems. 17.3 hectares (ha) of the municipality of Zestaphoni is covered by forest and shrubbery.

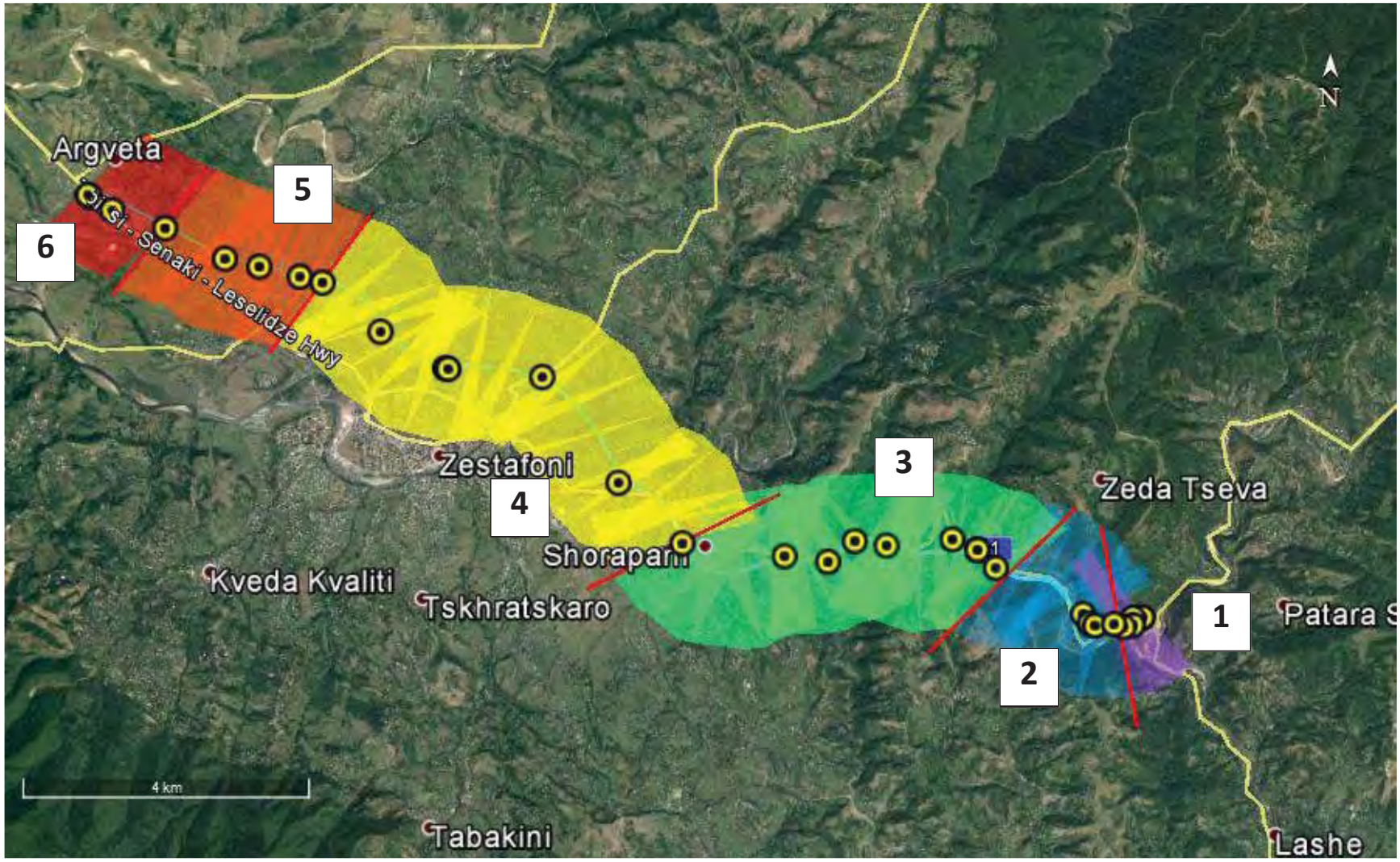
357. Due to human pressures natural vegetation has been taken over by agricultural crops and other human development. In these areas arable lands and pastures have developed. Some of the animal species typical for the area have moved to other areas in away from human activity. Over the time the fauna of the region has changed significantly. Animals currently found in the area of interest are mainly presented by those species that live in forested areas and/or can tolerate presence of humans. The natural forest massifs have significant value from biodiversity protection viewpoint, because of their importance as migration route for the local animal species.

358. Biodiversity Study – To fully understand the biodiversity in the Project area a biodiversity study was carried out by the LCF. The study was based on two aspects, firstly existing data was collected and analyzed in the form of a 'desk-top' study'. This was then followed up with field surveys carried out on August 8-9 and September 22-23, 2017. The aim of the study was to identify of animal species within the study area; to reveal significant habitats for inhabitant species; to determine possible impact on animal biodiversity on construction and operation phases and to develop impact mitigation measures.

### E.2.1 Flora

359. Habitat in the Project Area - The study area has been divided in 6 sections according to the habitats types based on collection of desk-top data and also field surveys undertaken in August 8-9 and September 22-23, 2017. **Figure E-19**, below illustrates the six sections and describes the flora observed during the site visit.

**Figure E-19: The study area with indication of the transects and boundaries of the habitats**



**Habitat Area 1**
(coordinates X=4660943.97, Y=347314.70; X=4660861.22, Y=346918.69)

**Conservation Status of the Habitat = HIGH**

Located near Kveda Tseva village, in the neighboring forest massif. Is situated on limestone hill of the southern slope of the valley. Natural vegetation is heavily altered and only units of original forest remains are observed in the form of young and middle-aged trees of Georgian oak (*Quercus iberica*), Common maple (*Acer campestre*), European ash (*Fraxinus excelsior*), young and mid-term Sweet chestnut (*Castanea sativa*) trees. In the underwood Common hazel (*Corylus avellana*) shrubs dominate. Plants typical for dry ecotopes mainly Oriental hornbeam (*Carpinus orientalis*) are registered. Other species are seldom met. In the understory Butcher's-broom (*Ruscus colchicus*) and mosses are present. In the areas where hornbeam growth is not dense Hawthorn (*Crataegus sp*.), Gaiter-tree (*Thelycrania australis*), *Pomegranate* (*Punica granatum*), Black locust (*Robinia Fseudoacacia*); Ailanthus (*Ailanthus altissima*), etc are registered.

In this section of alignment forest density accounts for (0.3-0.4); canopy density 21-30%; slope tilt 10-20-25$^0$. Two young trees Persian walnut trees (*Juglans regia*) – protected species under the Georgia Red List (VU category) have been registered. The trees are planted in the fenced in area. A number Georgian Red List species were identified during the State Forest Fund Inventory, some of which can be found in this habitat area.

The transects surveyed within the habitat:

| Y | X |
|---|---|
| 4667087 | 332826.9 |
| 4666866 | 333159.7 |
| 4666602 | 333887.2 |
| 4666163 | 335707.3 |
| 4666160 | 334710.6 |


**Habitat Area 2**
**(coordinates X=4660861.22, Y=346918.69; X=4661669.72, Y=345296.51)**

**Conservation Status of the Habitat = HIGH**

**T**he forested zone bordering to the first site – near Kveda Tseva village; the southern slope of the forest, which is bordered by railway line from the south-west; the specie composition of the vegetation is as follows: common hornbeam (*Carpinus caucasica*), Georgian oak (*Quercus iberica*), Norway maple (*Acer platanoides*), common maple (*Acer campestre*), sweet chestnut (*Castanea sativa* VU), European pear (*Pyrus caucasica*), Oriental hornbeam (*Carpinus orientalis*). On the south slope two samplings of European Yew trees (*Taxus baccata,* Red List of Georgia VU category) have been registered (GPS X 42.086772 Y 43.114246 and X 42.086170; Y 43.143955). In the understory the following shrubs and grasses have been found: February daphne (*Daphne mezereum*), Blackberry (*Rubus*), English ivy, (*Hedera helix*), Butcher's-broom (*Ruscus colchicus*), Solomon's seal, (*Poligonatum glaberrimum*), Bracken (*Pteridium tauricum*), common fern (*Dryopteris filix mas*).

The forest is young with inclusion of individual mid-term and mature (old-growth) trees. Density is low (0.3-0.4); canopy density percentage 30-40-%; slope tilt 21-30-35$^0$. Trees belong to C category (timber).

Moderately modified habitat; man-caused impact medium. Of protected species two young Chestnut trees (*Castanea sativa* – VU) and two European Yew trees (*Taxus baccata* – VU). A number Georgian Red List species were identified during the State Forest Fund Inventory, all of which can be found in this habitat area.

The transects surveyed within the habitat:

| Y | X |
|---|---|
| 4667061 | 332857.4 |
| 4666605 | 333889.0 |
| 4666045 | 335182.4 |

| **Habitat Area 3**<br>(coordinates X=4661669.72, Y=345296.51; X=4662103.27, Y=340960.28) |
|---|
| **Conservation Status of the Habitat = LOW** |
| **L**ocated on rocky massif of the north slope, near the central highway, where the forest is sparse (0.1-0.2) and belongs to the young forest grove group; the gradient of the slope is 25-350. Mixed vegetation types are distributed mainly of mezo-xerophilous type: Oriental hornbeam (*Carpinus orientalis*), Black locust (*Robinia Fseudoacacia*), Hawthorn (*Crataegus sp*.), Common plum (*Prunus divaricate*), Common maple (Acer campestre), Ailanthus (*Ailanthus altissima*), Common alder (*Alnus barbata*), Willow (*Salix*), Persimmons (*Diospyrus*), Fig tree (*Ficus carica*), Common hazel (*Corylus avellana*). In the upland meadows grasses are represented by: Wormwood (*Artemisia phyllostachys*), Astrodaucus orientalis, Foxtail (*Alopekurus*), (*Sambucus ebulus*), Milfoil (*Achilea setacea*), Creeping Savory (*Satureia spicigera*), Common chicory (*Cichorium intybus*), etc.<br><br>The quantity and density (0.3-0.4) increases farther in the forest. Slope tilt is 10-200. In the edges Deodar cedar (*Cedrus deodora*) is planted in rows. The trees are young and mid-term.<br><br>Moderately modified habitat. Impact – tree felling, grazing. Protected species not found. |

The transects surveyed within the habitat:

| Y | X |
|---|---|
| 4666086 | 335515.5 |
| 4665920 | 335577.8 |
| 4665935 | 335758.3 |
| 4665806 | 336053.2 |
| 4664591 | 337726.5 |
| 4664438 | 339069.7 |
| 4662958 | 340094.0 |

**Habitat Area 4**
(coordinates X=4662103.27, Y=340960.28; X=4665805.66, Y=336053.21)

**Conservation Status of the Habitat = LOW**

Shorapani village, left bank of the river, riparian floodplain meadow (0-5$^0$), where only ruderal grassland and shrubbery is distributed. Middle-aged cedar trees are grown in rows according to age composition between floodplain and highway. Shrubs are presented by Blackberry (*Rubus*), European dwarf elder (*Sambucus ebulus*), Greenbrier (*Smilax excelsa*), Hawthorn (*Crataegus sp.*), stc. Between the forest and existing road mid-term Deodora Cedar (*Cedrus deodora*) trees. Construction is not likely to affect these plantations.

The habitat is strongly modified. The area is uses as a pasture. Grasses are represented by Blackberry (*Rubus)*, Wormwood (*Artemisia phyllostachys*), Astrodaucus orientalis, Milfoil (*Achilea setacea*), Creeping Savory (*Satureia spicigera*), Common chicory (*Cichorium intybus*), Foxtail (*Alopekurus*), European dwarf elder (*Sambucus ebulus*), etc.

Similar habitats are found in riparian forest located close to the residential area/settlement.

The transects surveyed within the habitat:

| Y | X |
|---|---|
| 4664580 | 337729.4 |
| 4662103 | 340960.3 |
| 4661897 | 342373.0 |
| 4661807 | 342973.6 |

**Habitat Area 5**
(coordinates X=4665805.66, Y=336053.21; X=4666602.41, Y=333887.24)

**Conservation Status of the Habitat = LOW**

the road goes through overpass from the left bank of Dzirula river to the right river bank, crosses the road leading to Zeda Sakara via tunnel that ends near the ruins of former cognac factory, on the forested and abandoned plot (0-5-15$^0$), which borders with a hill from the south. Trees and bushes are represented by: Persimmon (*Diospyros*), Ailanthus (*Ailanthus altissima*), Persian walnut (*Juglans regia* VU**),** Black locust (*Robinia fseudoacacia*)*,* Honey locust (*Gleditschia triacanthos*), Oriental plane (*Platanus orientalis*)*,* Pomegranate *(Punica granatum*), Oriental hornbeam (*Carpinus orientalis*), Hawthorn (*Crataegus* sp.), Plum (*Prunus divaricata*), Fig tree (*Ficus carica*), Pokeweed (*Phytolacca americana*), European dwarf elder (*Sambucus ebulus*) and invasive species Canadian goldenrod (*Solidago canadensis*).

The transects surveyed within the habitat:

| Y | X |
|---|---|
| 4661924 | 345048.6 |
| 4662077 | 344703.7 |
| 4662013 | 343789.9 |
| 4660842 | 347179.8 |
| 4660943 | 347181.2 |
| 4660861 | 346918.7 |

**Habitat Area 6**
(coordinates X=4666602.41, Y=333887.24; X=4667086.80, Y=332826.86)

**Conservation Status of the Habitat = HIGH**

This is the marginal line of urban zone of Zestaphoni city, bordered by GAA from the south-west. The project corridor will cross the meadow (0-5$^0$) and the motorway, which connects the city to the suburbs. Along the road plantations of Poplar are registered. The corridor goes west towards Argveta, crosses homestead plots (vineyards, orchards), turns south – to a meadow. The meadow is bordered by mature and over mature Elm Zelkova (*Zelcova carpinifolia,* VU) groves with Persian walnut trees (*Juglans regia,* VU), mature Oriental hornbeam (*Carpinus orientalis*), Plum (*Prunus divaricata*), Black locust (*Robinia*

*fseudoacacia*). In the last section of the road near Argveta the interchange construction is in process.

In the limits of the section 6 of alignment corridor corn, grapes, fruits are cultivated. Part of the area is used as a pasture. Two protected species Persian walnut trees (*Juglans regia,* VU) and Elm Zelkova (*Zelcova carpinifolia,* VU) are found to be in the project impact zone. No areas of State Forest Fund are found in this area.

The transects surveyed within the habitat:

| Y | X |
|---|---|
| 4661670 | 345296.5 |
| 4661010 | 346491.5 |
| 4660879 | 346583.8 |
| 4660944 | 347314.7 |

360. State Forest Fund – The State Forest Fund (SFF) is a state-managed/controlled forest area under the management of the MoENRP but is not a protected area. Though it is not protected, for the purpose of controlling its use, the MoENRP requires all trees to be taken of the SFF registration or "de-listed" before they can be cut.

361. According to the ToR for this EIA:

*"Particular attention should be given to the presence of land plots registered as the State Forest Fund (SFF). If the right of the way of the selected alignment of the road section overlaps with the territory of the SFF, The consultant should prepare:*

1. *Cadastral measurement drawing for the relevant plot of the alignment (.shp files);*
2. *According to the effective law, conduct preliminary inventory of timber resources existing at the territory, which should be taken of the SFF registration, or 'de-listed';*
3. *In accordance with the Georgian legislation, provide relevant information on obtaining a cutting permit for species included in the Red List (if any);*
4. *Prepare Tree Compensation Plan according to the de-listing documentation"*

362. The Project area has been surveyed to determine the extent of the SFF that will be affected by the Project. Cadastral drawings are provided as part of **Appendix G**.

363. An inventory of the timber resources has also been prepared. A total of 1,428 trees more than 8cm in diameter were recorded for de-listing, including the following Georgian red-listed species:

- 77 Zelkova (greater than 8cm in diameter)
- 85 Chestnut (greater than 8cm in diameter)
- 38 Bladder Nut (greater than 8cm in diameter)
- 1 Yew Tree (greater than 8cm in diameter)
- 3 Circassian walnut (greater than 8cm in diameter)

364. In addition a further 5,804 trees less than 8cm in diameter were recorded for de-listing including the following Georgian re-listed species.

- 159 Zelkova (less than 8cm in diameter)
- 2 Chestnut (less than 8cm in diameter)
- 250 Bladder Nut (less than 8cm in diameter)

365. All of these species identified in the SFF inventory were located in Habitat Area 1 or 2. The full list of the trees to be de-listed is presented in **Appendix G** along with a map of the area.

366. Information relating to the compensation for tree cutting according to national legislation is outlined in **Section F-6.1**.

## E.2.2 Fauna

### E.2.2.1 Mammals

367. Information available from references (primary and secondary data sources) have been used as a basis for description of the area. According to available information there are two species (Caucasian squirrel and Eurasian otter) considered as vulnerable in Georgia (Georgian Red List) that may be found within the Project area. The Otter is also included in the IUCN red list as near threatened (NT) (see **Table E-16**).

368. During the site visit the list of species listed above was taken as guidance. The objective of the survey was to double check available information on the site. Particular attention was paid to detection of the species listed under protected category. Therefore, specific focus was on the study of the habitats suitable for these mammals.

**Otter (*Lutra lutra*)** is known to be found in Kvirila river, however the sources does not provide any information on community structure and number of species in the area of interest. The Otter is river associated species mainly met in slow flowing sections of the streams/rivers. It isn't uncommon for them to travel great distances on land or through the water. This can be up to 26 $km^3$. However, it is important to remember that otters home range differs from their territory. The actual territory that is distinctly their own is very small. Otters mark their habitat with droppings. So, they can be registered by smell (smell of fresh cut hay). Generally the otters are not afraid of people and can be met in the limits of residential areas. The aquatic habitats of otters are extremely vulnerable to man-made changes. Canalization of rivers, removal of bank

side vegetation, dam construction, draining of wetlands, aquaculture activities and associated man-made impacts on aquatic systems are all unfavorable to otter population. The bridge locations areas (**Figure E-19**) have been checked with particular care. No presence of otter has been registered.

**Figure E-19: Areas Checked for the Presence of Otters**

**Caucasian squirrel (*Sciurus anomalus*)** can be met in the deciduous forest. Their nests are usually found in the tree hollows, under rocks, inside heaps of stones, and in residential areas, such as graveyards and abandoned cattle sheds. They are diurnal, are not active in winter. The peak of activity is in summer Caucasian squirrels become most active during the early morning to morning and during the two hours before sunset in early summer. Like other tree squirrels, they are territorial. The animal marks territories with urine and feces. The marks are renewed several times every day. There is no information available regarding home range. Caucasian squirrels are herbivorous; they eat seeds and fruits and therefore, likely have an important influence on the forest ecosystem as seed dispersers. The main hazard for this specie is Siberian/red squirrel - invasive species. During the site visit the trees within the RoW of the new alignment (with exclusion of the areas where tunnels are planned) have been checked. Neither burrows, nor squirrels have been registered in the studied area. The review of the habitat along the alignment is not optimum for existence of the Caucasian squirrel. Therefore construction and subsequent presence (operation) of the highway will not change the population trend.

**Bats** (order Chiroptera) are considered as vulnerable group. They are rather limited in selection of nesting shelters. Favourable shelters are hollow trees, caves and abandoned buildings. All species of bats observed in Georgia are included in the Annex II of Bonn Convention and protected by the agreement of EUROBATS. Based on this agreement, Georgia is mandatory to protect all bats inhabiting within the project area and in its vicinities.

**Lesser horseshoe bat (*Rhinolophus hipposideros* Bechstein)** It forages close to ground within and along the edges of broadleaf deciduous woodland, which represents its primary foraging habitat, but also in riparian vegetation, Mediterranean and sub-mediterranean shrubland. Its prey consists mainly of midges, moths and craneflies. Foraging activities take place nearly exclusively within woodland areas, while open areas are avoided. Habitat loss and fragmentation may therefore reduce the amount of suitable habitats for the Lesser Horseshoe Bat and pose a threat to this species. Summer roosts (breeding colonies) are found in natural and artificial underground sites in the southern part of the range, and in attics and buildings in the northern part of it. In winter it hibernates in underground sites (including cellars, small caves and burrows). A sedentary species, winter and summer roosts are usually found within 5-10 km (longest distance recorded 153 km). Recommended conservation measures include protecting maternity roosting sites, hibernation caves and foraging habitats.

**Particoloured bat (*Vespertilio murinus*)** forages in open areas over various habitat types (forest, semi-desert, urban, steppe, agricultural land). It feeds on moths and beetles. Summer roosts tend to be situated in houses or other buildings; also rarely hollow trees, nest boxes, or rock crevices. Winter roost sites include rock fissures, often (as a substitute) crevices in tall buildings (including, or especially, in cities), occasionally tree holes or cellars. Winter roosts are usually in colder sites that are exposed to temperature changes. Migrations of up to 1,780 km have been recorded, although the species is sedentary in a large part of its range. This nocturnal species appears late in the evening, sleeping in narrow crevices during the day. It lives in small colonies and often single individuals are sighted. It hibernates throughout the winter. Young are born in June/July, generally two at a time, and are stuck onto the chest of the mother during flight.

**Common pipistrelle (*Pipistrellus pipistrellus* Schreber)** forages in a variety of habitats including open woodland and woodland edges, Mediterranean shrublands, semi-desert, farmland, rural gardens and urban areas. It feeds on small moths and flies. Summer roosts are mainly found in buildings and trees, and individuals frequently change roost site through the maternity period. Most winter roost sites are located in crevices in buildings, although cracks in cliffs and caves and possibly holes in trees may also be used. It is not especially migratory in most of its range, but movements of up to 1,123 km have been recorded. In at least parts of its range it seems to benefit from urbanization.

369. Indirect and short term impact is expected on the above-mentioned species. Indirect impact means damage of the section of the ecosystem, which is significant for animals for receiving energy in the form of the food; also replacement of migration corridors is meant under it, which will increase the background stress for fauna representatives, living in the neighboring habitats.

370. During the transect surveys within the studied corridor no mammals have been observed. Only traces of activity of the European pine marten have been registered.

### E.2.2.2 Reptiles

371. According to the literary sources, 8 species of reptiles are known to be present in the Project area, out of which 2 are lizards, 2 – turtles and 4 – snakes (see **Table E-17**). From reptiles worth to mention is endemic lizard met in the Mtkvari valley. The only Red-Listed species that is recorded on the nearby territory of the Project area is the Mediterranean turtle.

**Table E-17. Reptiles, known within the project area based on literary sources**

| № | Latin name | Common name | Georgian Red List | IUCN | Other protection | Section N |
|---|---|---|---|---|---|---|
| 1. | *Testudo graeca* Linnaeus | Mediterranean turtle | VU | VU | - | 1/4/ |
| 2 | *Emys orbicularis* | European Pond Turtle | LC | NT | - | 4 |
| 3. | *Natrix natrix* Linnaeus. | Ring snake | LC | LR/LC | Bern Convention | 4/5 |
| 4. | *Natrix tessellate* Laurenti. | Dice snake | LC | LC | Bern Convention | 4/5 |
| 5. | *Coronella austriaca* Laurenti. | Smooth snake | LC | LC | Bern Convention | 1/2/ |
| 6. | *Xerotyphlops vermicularis* Strauch. | Blind Snakes | DD | LC | - | 1/2/3/ |
| 7. | *Darevskia derjugini* | Artwin Lizard | LC | LC | Bern Convention | 1/2/3/ |
| 8. | *Darevskia rudis* | Spiny-Tailed Lizard | LC | LC | Bern Convention | 1/2/3/ |

| № | Latin name | Common name | Georgian Red List | IUCN | Other protection | Section N |
|---|---|---|---|---|---|---|
| 9. | *Anguis fragilis* | Caucasian Slow Worm | LC | LC | Bern Convention | 2/ |

VU = Vulnerable; NT = Near Threatened and LC = Least Concern, LR = Low risk, DD-Data Deficient

**Table E-16: Mammals, identified within the project area based on literary sources**

| № | Latin name | Common name | Red List of Georgia | IUCN | Other protection | Number of section |
|---|---|---|---|---|---|---|
| 1 | *Erinaceus concolor Martin.* | Southern whitebreasted Hedgehog | | LC | | 1/2/3/4/5/ |
| 2 | *Suncus etruscus Savi.* | Pygmy whitetoothed shrew | | LC | Appendix III of the Bern Convention. | 1/2/3/ |
| 3 | *Rhinolophus hipposideros Bechstein.* | Lesser horseshoe bat | | LC | Bonn Convention (Eurobats); Bern Convention; Annex II (and IV) of EU Habitats and Species; Some habitat protection through Natura 2000 | 1/2/3 |
| 4 | *Pipistrellus pipistrellus Schreber.* | Common pipistrelle | | LC | Bonn Convention (Eurobats); Bern Convention in parts of its range where these apply, and is included in Annex IV of the EU Habitats and Species Directive. | 1/2/3/ |
| 5 | *Eptesicus serotinus Schreber.* | Serotine | | LC | Bonn Convention (Eurobats); Bern Convention in parts of range where these apply. It is included in Annex IV of EU Habitats and Species Directive, and there is some habitat protection through Natura 2000. | 1/2/3 |
| 6 | *Vespertilio murinus Linnaeus.* | Particoloured bat | | LC | Bonn Convention (Eurobats); Bern Convention, in parts of its range where these apply. It is included in Annex IV of EU Habitats and Species Directive | 1/2/3//5/ |
| 7 | *Dryomys nitedula Pallas.* | Forest dormouse | | LC | Bern Convention (Appendix III); EU Habitats and Species Directive (Annex IV), in parts of its range where these apply. | 1/2/3/ |
| 8 | *Arvicola terrestris Linnaeus.* | Eurasian water vole | | LC | | 4 |
| 9 | *Microtus arvalis Pallas.* | Common vole | | LC | | 1/2/3/4/5/ |
| .10 | *Terricola nasarovi Shidlovsky.* | Nazarov pine vole | | LC | | 1/2/3/ |
| 11 | *Sylvaemus uralensis Pallas.* | Pygmy wood mouse | | | | 1/2/3/ |
| 1 | *Mus musculus* | House mouse | | LC | | 1/3/4/5/ |

| № | Latin name | Common name | Red List of Georgia | IUCN | Other protection | Number of section |
|---|---|---|---|---|---|---|
| 2 | *Linnaeus.* | | | | | |
| 13 | *Sciurus anomalus Gmelin.* | Caucasian squirrel | VU | LC | EU Habitats Directive (92/43) IV 21/05/92; Bern Convention II 01/03/02, in parts of its range where these apply. Occurs in protected areas. Population monitoring is recommended, particularly in parts of the range where declines have been noted. | 1/2/3 |
| 14 | *Lutra lutra Linnaeus.* | Eurasian otter, Common otter | VU | NT | Appendix I of CITES, Appendix II of the Bern Convention, Annexes II and IV of the EU Habitats and Species Directives. | 4 |
| 15 | *Mustela nivalis Linnaeus.* | Least weasel | | LC | Appendix III of the Bern Convention. | 1/2/3/4/5 |
| 16 | *Felis silvestris Shreber.* | Wild cat | | LC | CITES Appendix II (http://www.cites.org/eng/app/appendices.php); is fully protected across most of its range in Europe and Asia, but only some of its African range; is listed on the EU Habitats and Species Directive (Annex IV) as a "European protected species of animal"; listed in Appendix II of the Bern Convention. It is classed as threatened at the national level in many European range states (IUCN 2007). | 1/2/3/ |
| 17 | *Canis aureus Linnaeus.* | Golden jackal | | LC | | 1/2/3/4 |
| 18 | *Vulpes vulpes Linnaeus.* | Red fox | | LC | | 1/2/3/4 |
| 19 | *Canis lupus* | Wolf | | LC | Bern, CITES Appendix II | 1/2/3/ |
| 20 | *Sus scrofa Linnaeus.* | Eurasian wild boar | | LC | | 1/2/3/ |
| 21 | *Martes martes* | European pine marten | | LC | Appendix III of the Bern Convention and Annex V of the European Union Habitats Directive, and it occurs in a number of protected areas across its range. | 1/2/3/ |

VU = Vulnerable; LC = Least Concern; NT = Near Threatened

372. Due to the fact that it was extremely hot during the surveys, activity of reptiles was low as they were avoiding overheating. During the site survey only the Artwin lizard has been registered (see **Figure E-20**).

**Figure E-20: Darevska derhugini (coordinates 346891.28; 4660857.92)**

**Figure E-21: Pelophylax ridibundus (coordinates 340072.18; 4662963.5)**

### E.2.2.3 Amphibians

373. According to the literary sources, the main amphibian species present in the area include:

**Table E-18. Amphibians, known within the project area based on literary sources**

| № | Latin name | Common name | Georgian Red List | IUCN | Other protection | Section N |
|---|---|---|---|---|---|---|
| 1. | *Hyla arborea* Linnaeus | European Tree Frog | LC | LC | Bern Convention | 4/5/ |
| 2. | *Pelophylax ridibundus* Pallas. | Lake frog | LC | LC | Bern Convention | 4/5 |
| 3. | *Rana macrocnemis camerani* Boulenger. | Longlegged Wood Frog | LC | LC | Bern Convention | 3/4/ |

LC = Least Concern

374. During the site survey the listed species have one individual Lake frog has been registered near Shorapani crossing (see **Figure E-21** above).

### E.2.2.4 Insects

375. The insects know to be present in the project area are listed below (**Table E-19**).

**Table E-19.** Insects known within the project area based on literary sources

| № | Latin Name | Common name | Georgian Red List | IUCN | Section N |
|---|---|---|---|---|---|
| 1. | *Mylabris quadripunctata* | Four-spotted blister beetle | NE | NE | 1/2/3/5/6/ |
| 2. | *Dorcus parallelipipedus* | Lesser stag beetle | NE | NE | 1/2/3/ |

| № | Latin Name | Common name | Georgian Red List | IUCN | Section N |
|---|---|---|---|---|---|
| 3. | *Libellula depressa* | Broad-bodied chaser | NE | NE | 2/ |
| 4. | *Morimus verecundus* | Longhorn beetle | NE | NE | 2/3 |
| 5. | *Pieris napi* | Green-veined white butterfly | NE | NE | 1/2/3/5 |
| 6. | *Pieris rapae* | European cabbage butterfly | NE | NE | 1/2/3/4/5 |
| 7. | *Plebeius argus* | Silver-studded blue butterfly | NE | NE | 1/2/3/4/5/ |
| 8. | *Nimphalis antiopa* | Mourning-cloak butterfly | NE | NE | 1/2/3/4/5/6/ |
| 9. | *Lampyris noctiluca* | Glow-worm | NE | NE | 1/2/3/4/5/ |
| 10. | *Geotrupes spiniger* | Dumbledor beetle | NE | NE | 1/2/3/5/ |
| 11. | *Purpuricenus budensis* | Red long-horned Beetle | NE | NE | 1/2/3/4/ |
| 12. | *Polyommatus amandus* | Amanda's blue butterfly | NE | NE | 5/6 |
| 13. | *Polyommatus corydonius* | False chalkhill blue butterfly | NE | NE | 1/2/3/4/5/6/ |
| 14. | *Polyommatus thersites* | Chapman's blue butterfly | NE | NE | 1/2/3/4/5/6/ |
| 15. | *Cercopis intermedia* | Froghopper | NE | NE | 1/2/3/4/5/6/ |
| 16. | *Vanessa atalanta* | Red admiral butterfly | NE | NE | 1/2/3/4/5/6/ |
| 17. | *Vanessa cardui* | Painted lady butterfly | NE | NE | 3/4/5/6/ |
| 18. | *Ischnura elegans* | Blue-tailed damselfly | NE | NE | 3/4/ |
| 19. | *Panorpa connexa* | Scorpionfly | NE | NE | 4/5/ |
| 20. | *Apis melifera* | European honey bee | NE | NE | 4/5 |
| 21. | *Bombus lapidarius* | Red-tailed bumblebee, | NE | NE | 4/5/ |
| 22. | *Aphis urticata* | Dark green nettle aphid | NE | NE | 1/2/3/ |
| 23. | *Pieris brassicae* | Cabbage butterfly | NE | NE | 1/3/5/6 |
| 24. | *Pyrrhocoris apterus* | Firebug | NE | NE | 1/2/3/4/5/6/ |
| 25. | *Lymantria dispar* | Gypsy moth | NE | NE | 1/2/3/ |
| 26. | *Gryllus campestris* | Field cricket | NE | NE | 4/5/ |
| 27. | *Decticus verrucivorus* | Wart-biter | NE | NE | 4/5/6/ |
| 28. | *Tettigonia viridissima* | Great green bush-cricket | NE | NE | 5/6/ |

NE = not evaluated

376. Within the project area Red cricket, blue railed damselfly have been met. No butterflies were registered.

**Figure E-22: Gryllus campestris (coordinates 337730.19; 4664604.82)**

**Figure E-23: Ischura elegans (coordinates 339946.92; 4662915.10)**

377. The spiders know to be present in the project area are listed below (**Table E-20**).

**Table E-20. Insects, known within the project area based on literary sources**

| № | Latin name | Common name | Georgian Red List | IUICN | Section No. |
|---|---|---|---|---|---|
| 1. | *Misumena vatia* | Goldenrod crab spider | NE | NE | 1/2/3/ |
| 2. | *Pisaura mirabilis* | Nursery web spider | NE | NE | 1/2/3/ |
| 3. | *Alopecosa schmidti* | Wolf spiders | NE | NE | 1/2/3/ |
| 4. | *Micrommata virescens* | Green huntsman spider | NE | NE | 1/2/3/4/5 |
| 5. | *Agelena labyrynthica* | Eurasian grass spiders | NE | NE | 1/2/3/ |
| 6. | *Asianellus festivus* | Jumping spiders | NE | NE | 1/2/3/ |
| 7. | *Araniella dispcliata* | Orb-weaver spider | NE | NE | 1/2/3/ |
| 8. | *Dysdera crocata* | Sowbug hunter | NE | NE | 1/2/3/ |
| 9. | *Phialeus chrysops* | Jumping spiders | NE | NE | 3/4/5/ |
| 10. | *Argiope lobata* | Silver-faced | NE | NE | 1/2/3/ |
| 11. | *Menemerus semilimbatus* | Jumping spiders | NE | NE | 1/2/3/4/ |
| 12. | *Pardosa hortensis* | Wolf spiders | NE | NE | 1/2/3/4/ |
| 13. | *Larinioides cornutus* | Furrow orb spider | NE | NE | 1/2/3/4/5 |

NE = not evaluated

378. During the walkover several spider species have been registered as noted by **Figure E-24** to **Figure E-25**.

**Figure E-24: Pisaura mirabilis (coordinates 347288.84; 4660981.14)**

**Figure E-25: Pardosa hortensis (coordinates 344707.22; 4662074.4)**

**Figure E-26: Asinelllus festivus (coordinates 345050/30; 4661910.7**

379. The round worms, bristle worms and beetles know to be present in the project area are listed below (**Table E-21** and **Table E-22**).

**Table E-21. Round Worms (Nematodes), known within the project area based on literary sources.**

| № | Scientific Name | English Name | Georgian Name | National Red List | International Red List |
|---|---|---|---|---|---|
| 1. | *Tripylina arenicola* | - | - | NE | NE |
| 2. | *Plectus annulatus* | - | - | NE | NE |
| 3. | *Anaplectus granulosus* | - | - | NE | NE |
| 4. | *Mesodorylaimus bastiani* | - | - | NE | NE |
| 5. | *Eudorylaimus acutus* | - | - | NE | NE |
| 7. | *Pungentus silvestris* | - | - | NE | NE |
| 8. | *Enchodelus microdorus* | - | - | NE | NE |
| 9. | *Bursilla monhystera* | - | - | NE | NE |

NE = not evaluated

**Table E-22. Bristle Worms (Polychaetes), known within the project area based on literary sources**

| № | Scientific Name | English Name | Georgian Name | National Red List | International Red List |
|---|---|---|---|---|---|
| 1. | *Aelosoma hemprichi* | - | - | NE | NE |
| 2. | *Stylaria lacustris* | - | - | NE | NE |
| 3. | *Aulophorus furcatus* | - | - | NE | NE |
| 4. | *Specaria josinae* | - | - | NE | NE |
| 5. | *Ophidonais serpentine* | - | - | NE | NE |
| 6. | *Potamotrix bedoti* | - | - | NE | NE |
| 9. | *Lumbricus terrestris* | - | - | NE | NE |
| 10. | *Dendrodriloides grandis* | - | - | NE | NE |
| 11. | *Eiseniella tetraedra* | - | - | NE | NE |
| 13. | *Helodrilus cartlicus* | - | - | NE | NE |

**Table E-23. Oribatida, known within the project area based on literary sources**

| № | Scientific Name | English Name | Georgian Name | National Red List | International Red List |
|---|---|---|---|---|---|
| 1. | *Epilohmannia cylindrica* | - | - | NE | NE |
| 2. | *Rhysotritia ardua* | - | - | NE | NE |
| 5. | *Tectocepheus velatus* | - | - | NE | NE |
| 6. | *Oppiella fallax* | - | - | NE | NE |
| 7. | *Quadroppia quadricarinata* | - | - | NE | NE |
| 8. | *Suctobelbella falcate* | - | - | NE | NE |
| 9. | *Achipteria nitens* | - | - | NE | NE |
| 10. | *Sphaerozetes piriformis* | - | - | NE | NE |
| 12. | *Chamobates cuspidatus* | - | - | NE | NE |

### E.2.3 Avi Fauna

380. The majority of birds found on the study area are presented by forest, shrubbery and other species, birds related to rocky places and waterfowls. The list of bird species potentially available in the project area (based on the desk top analysis of available data) is given in **Table E-24** below. None of these species are protected.

The territory is not significant habitat for birds and does not include priority habitats for avian species (see **Figure E-27).**

**Figure E-27: Significant Bird Habitat in Georgia**

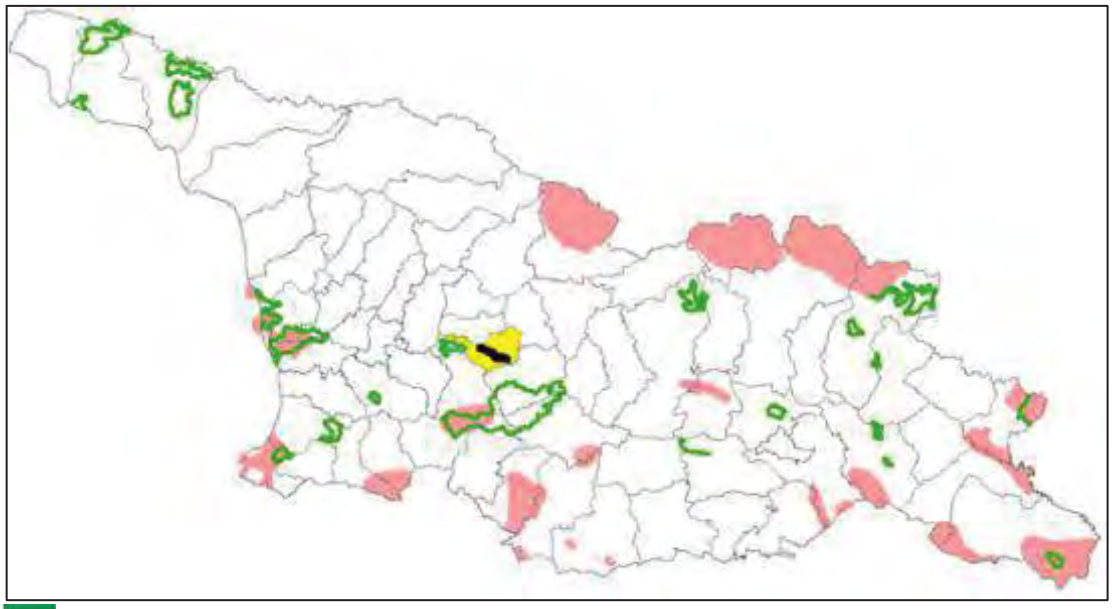



**Table E-24: Birds within the study area, known according to literary sources**

| # | Latin name | Common name | Georgian Red List | Season | IUCN | Other protection | Section |
|---|---|---|---|---|---|---|---|
| 1. | *Motacilla alba* | White Wagtail | - | YR-R, M | LC | Bern Convention | 1/2/3/4/5/6 |
| 2. | *Apus apus* | Common Swift | - | BB, M | LC | Bern Convention | 1/2/3/4/5/6 |
| 3. | *Merops apiaster* | European Bee-eater | - | BB, M | LC | | 1/2/3/4/5/6 |
| 4. | *Corvus cornix* | Hooded Crow | - | YR-R | LC | | 1/2/3/4/5/6 |
| 5. | *Garrulus glandarius* | Eurasian Jay | - | YR-R | LC | | 1/2/3/4/5/6 |
| 6. | *Turdus merula* | Eurasian Blackbird | - | YR-R | LC | Bern Convention | 1/2/3/4/5/6 |
| 7. | *Delichon urbicum* | House-Martin | - | BB, M | LC | Bern Convention | 1/2/3/4/5/6 |
| 8. | *Sturnus vulgaris* | Common Starling | - | YR-R, M | LC | | 1/2/3/4/5/6 |
| 10. | *Columba livia* | Rock Dove | - | YR-R | LC | | 1/2/3/4/5/6 |
| 11. | *Columba oenas* | Stock Dove | - | YR-R | LC | | 1/2/3/4/5/6 |
| 12. | *Columba palumbus* | Wood-Pigeon | - | YR-R | LC | | 1/2/3/4/5/6 |
| 13. | *Hirundo rustica* | Barn Swallow | - | BB, M | LC | Bern Convention | 1/2/3/4/5/6 |
| 15. | *Oriolus oriolus* | Golden Oriole | - | BB, M | LC | Bern Convention | 1/2/3/4/5/6 |

| # | Latin name | Common name | Georgian Red List | Season | IUCN | Other protection | Section |
|---|---|---|---|---|---|---|---|
| 16. | *Turdus viscivorus* | Mistle Thrush | - | YR-R, M | LC | Bern Convention | 1/2/3/4/5/6 |
| 17. | *Erithacus rubecula* | European Robin | - | YR-R | LC | Bern Convention | 1/2/3/4/5/6 |
| 18. | *Fringilla coelebs* | Chaffinch | - | YR-R, M | LC | Bern Convention | 1/2/3/4/5/6 |
| 19. | *Cuculus canorus* | Common Cuckoo | - | BB, M | LC | Bern Convention | 1/2/3/4/5/6 |
| 20. | *Phoenicurus phoenicurus* | Common Redstart | - | BB, M | LC | Bern Convention | 1/2/3/4/5/6 |
| 21. | *Passer domesticus* | House Sparrow | - | YR-R | LC | | 1/2/3/4/5/6 |
| 22. | *Carduelis carduelis* | European Goldfinch | - | YR-R, M | LC | Bern Convention | 1/2/3/4/5/6 |
| 23. | *Carduelis chloris* | Greenfinch | - | YR-R, M | LC | Bern Convention | 1/2/3/4/5/6 |
| 25. | *Parus major* | Great Tit | - | YR-R | LC | Bern Convention | 1/2/3/4/5/6 |
| 26. | *Lanius collurio* | Red-backed Shrike | - | BB, M | LC | Bern Convention | 1/2/3/4/5/6 |
| 38. | *Turdus philomelos* | Song Thrush | - | YR-R, M | LC | Bern Convention | 1/2/3/4/5/6 |
| 30. | *Aegithalos caudatus* | Long-tailed Tit | - | YR-R, M | LC | Bern Convention | 1/2/3/4/5/6 |
| 36. | *Falco tinnunculus* | Common Kestrel | - | YR-R, M | LC | Bonn Convention, Bern Convention | 1/2/3/4/5/6 |
| 37. | *Buteo buteo* | Common Buzzard | - | YR-R, M | LC | Bonn Convention, Bern Convention | 1/2/3/4/5/6 |
| 38. | *Phalacrocorax carbo* | Great Cormorant | - | YR-R, M | LC | | 4 |
| 39. | *Ardea cinerea* | Grey Heron | - | YR-R | LC | Bonn Convention, Bern Convention | 4 |
| 41. | *Egretta garzetta* | Little Egret | - | YR-R | LC | | 4 |
| 42. | *Nycticorax nycticorax* | Night-Heron | - | BB, M | LC | Bonn Convention, Bern Convention | 4 |
| 44. | *Tadorna ferruginea* | Ruddy Shelduck | - | YR-R | LC | | 4 |
| 45. | *Anas platyrhynchos* | Mallard | - | YR-R, M | LC | Bonn Convention, Bern Convention | 4 |
| 46. | *Milvus migrans* | Black Kite | - | YR-R, M | LC | Bonn Convention, Bern Convention | 1/2/3/4/5/6 |
| 47. | *Accipiter nisus* | Sparrowhawk | - | YR-R, M | LC | Bonn Convention, Bern | 1/2/3/4/5/6 |

| # | Latin name | Common name | Georgian Red List | Season | IUCN | Other protection | Section |
|---|---|---|---|---|---|---|---|
| | | | | | | Convention | |
| 48. | *Accipiter gentilis* | Goshawk | - | YR-R, M | LC | Bonn Convention, Bern Convention | 1/2/3/4/5/6 |
| 51. | *Charadrius dubius* | Little Ringed Plover | - | YR-R, M | LC | Bonn Convention, Bern Convention | 4 |
| 52. | *Larus ridibundus* | Black-headed Gull | - | YR-R, M | LC | | 4 |
| 55. | *Upupa epops* | Common Hoopoe | - | BB, M | LC | Bern Convention | 1/2/3/4/5/6 |
| 57. | *Corvus frugilegus* | Rook | - | YR-R, M | LC | | 1/2/3/4/5/6 |
| 60. | *Luscinia megarhynchos* | Luscinia megarhynchos | - | BB, M | LC | | 1/2/3/4/5/6 |
| 61. | *Phylloscopus collybita* | Common Chiffchaff | - | BB, M | LC | | 2/ |

YR-R = nests and reproduces in the area, can be found all year round; YR-V = visitor to these areas. It does not reproduce but is here throughout the year. BB = visits the area only for reproduction
M = Migratory; it can get to the area during migration (in autumn and spring)
LC = Least Concern.

**Table E-25: Birds, observed within the project area during the survey**

| # | Latin name | Common name | Georgian Red List | Season | IUCN | Other protection | Section |
|---|---|---|---|---|---|---|---|
| 1. | *Motacilla alba* | White Wagtail | - | YR-R, M | LC | Bern Convention | 1/2/3 |
| 2. | *Apus apus* | Common Swift | - | BB, M | LC | Bern Convention | 1/3/4/5 |
| 3. | *Merops apiaster* | European Bee-eater | - | BB, M | LC | - | 2/3/ |
| 4. | *Charadrius dubius* | Little Ringed Plover | - | YR-R, M | LC | Bonn Convention, Bern Convention | 4 |
| 5. | *Larus ridibundus* | Black-headed Gull | - | YR-R, M | LC | Bern Convention | 4 |
| 6. | *Corvus cornix* | Hooded Crow | - | YR-R | LC | - | 3/4/5/6 |
| 7. | *Garrulus glandarius* | Eurasian Jay | - | YR-R | LC | - | 2/3/4/5 |
| 8. | *Turdus merula* | Eurasian Blackbird | - | YR-R | LC | Bern Convention | 1/2/3/4 |
| 9. | *Delichon urbicum* | House-Martin | - | BB, M | LC | Bern Convention | 2/3/4/ |
| 11. | *Upupa epops* | Common Hoopoe | - | BB, M | LC | Bern Convention | 2/3/4/5 |
| 14. | *Luscinia megarhynchos* | Luscinia megarhynchos | - | BB, M | LC | - | 1/2/3/ |
| 15. | *Turdus viscivorus* | Mistle Thrush | - | YR-R, M | LC | Bern Convention | 1/2/3 |
| 16. | *Erithacus rubecula* | European Robin | - | YR-R | LC | Bern Convention | 2/ |
| 17. | *Fringilla coelebs* | Chaffinch | - | YR-R, M | LC | Bern Convention | 1/3/ |

| # | Latin name | Common name | Georgian Red List | Season | IUCN | Other protection | Section |
|---|---|---|---|---|---|---|---|
| 19. | *Phoenicurus phoenicurus* | Common Redstart | - | BB, M | LC | Bern Convention | 1/2/3 |
| 20. | *Passer domesticus* | House Sparrow | - | YR-R | LC | - | 1/3/5/6/ |
| 21. | *Carduelis carduelis* | European Goldfinch | - | YR-R, M | LC | Bern Convention | 1/2/3/ |
| 24. | *Parus major* | Great Tit | - | YR-R | LC | Bern Convention | 2/3/5 |
| 25. | *Lanius collurio* | Red-backed Shrike | - | BB, M | LC | Bern Convention | 2/3 |
| 26. | *Phylloscopus collybita* | Common Chiffchaff | - | BB, M | LC | | 2/ |
| 27. | *Turdus philomelos* | Song Thrush | - | YR-R, M | LC | Bern Convention | 2/3 |

YR-R = nests and reproduces in the area, can be found all year round.; YR-V = visitor to these areas. It does not reproduce but is here throughout the year. BB = visits the area only for reproduction;
M = Migratory; it can get to the area during migration (in autumn and spring)
LC = Least Concern.

### E.2.4 Fish

381. General - A fish study has been undertaken on the sites where construction of bridges/river crossings is planned. The objective of the survey was to:

- Study and assess the baseline environmental condition within the project section;
- Survey of hidrobionts, fin particular, ichthyofauna living in the project area;
- Development of mitigation measures, taking into account the impact factors.

382. The study was prepared based on existing literature sources and the results of field study conducted from 18.07.2017 to 28.07.2017. In the field research information was used from the local population and amateur fishermen.

383. Methodology - The ichtyofauna study included desk top study, visual audits, field surveys, anamnesis (interview of the local population and amateur fishermen) and laboratory processing of the obtained material. The research methodology is fully coincided with the methods used in international practice.

384. Fish stock status has been be judged upon based on the following data:

- general mass of fish caught in the recent years;
- quantitative ratio of age groups;
- age of reaching the first and overall puberty of the population;
- direct influence of fish growth rate versus maturity;

385. Desktop Study - Work plan, survey route, locations for control catches and hydrochemical-hydrobiological sampling have been selected. A questionnaire for the local population and amateur fishermen was prepared.

386. Visual Audit - The visual audit to identify habitats for ichthyofauna species (geomorphology of the river bed in question, general hydrological characteristics, habitat hipsometria, relief, the river bottom hipsometria, visual - landscape background) has been carried out. Based on these data species theoretically present in the study area have been identified.

387. Field study - The field study method included:

- biological analysis of fish (length; weight; gender, maturity stage; collection, fattening coefficient, meristic and plastic characteristics, the digestive tract content);
- collection, labeling and preservation of scales for subsequent lab analysis;
- study of food base - hydroflora and hydrofauna; identification of macroinvertebrates and insects used for feeding;
- study of the status of living environment of both fish and invertebrates;
- determination of suspended solids; dissolved oxygen (using filed tester Oxi 330i); water and air temperature; pH measurements - on-site;
- sampling of water for lab analysis;
- assessment of species composition of zoobenthos and protozoa - periphyton species composition and biomass.

388. For control catches cast nets (weight 7.0 kg, mesh size 14 mm) were used. The catches were performed in control points selected along 50 m and 100 m sections. Sports-amateur fishing tools were used during the study. (No special permit or license was required). Research parameters include research of all biotic and abiotic factors related to the ecological niche.

389. During the survey catch and release principle was kept to. Every fish in the catch was registered in a special field log.

390. Interviews - The interview of local population and amateur fishermen was carried out to highlight the full picture of the Kvirila River and the Dzirula River ichthyofauna species composition. For this purpose, amateur fishermen with at least 5-10 years of fishing experience have been selected. The questionnaire was drawn up so to reduce the risk of false information (overestimation/bragging). Information confirmed by three or more respondents was assumed as reliable. During the entire study period, 5 fishermen were interviewed. (For results see **Table E-28**).

391. Laboratory Research - Study of age, growth and growth rate were identified through laboratory analysis of fish scales collected during the field survey.

392. **Tables E-26** and **Table E-27** indicate the fish species found in both rivers.

**Table E-26: List of fish species available in the rivers in the project area**

| Type | Kvirila River | Dzirula River |
|---|---|---|
| Brown trout (Salmo trutta morfa fario Linnaes, 1758) | + | - |
| Colchic barbel (Barbus tauricus rionica Kamensky, 1899) | + | + |
| Chub (Leuciscus leuciscus Linnaeus, 1758) | + | + |
| Colchic chondrostoma (Chondrostoma colchicum Derjugin, 1899 | + | + |
| Colchic khramulya (Capoeta sieboldi Steindachner, 1864) | + | + |
| monkey goby (Neogobius fluviatilis, Pallas 1814) | + | + |
| Spined loach (Cobitis taenia Linnaeus, 1758) | + | + |
| Common bleak (Alburnus alburnus, Linnaeus, 1758) | + | + |

**Table E-27: Species found as the result of fishing in the project area**

| Common name | Latin name |
|---|---|
| Colchic khramulya | Capoeta sieboldi Steindachner, 1864 |
| Common dace | Leuciscus leuciscus Linnaeus, 1758 |

393. Five fishermen were interviewed within the framework of the baseline survey: Amiran Gegetashvili; Beso Kalandadze; Misha Macharashvili; Tengo Kapanadze; Giorgi Tsertsvadze. **Table E-28** provides a list of the questions asked and the answers received during the interview.

**Table E-28: Results of the interview of local population.**

| N | Question | Interview results |
|---|---|---|
| 1 | What species of fish are spread in Kvirila and the Dzirula Rivers? | Mainly: trout (only in the head of Kvirila), barbel, chub, chondrostoma, khramulya, goby, cobitis, albunus. |
| 2 | Which fishing equipment do the local fishermen prefer? | The places are good for the throw nets and for fishing-rods, thus, it is hard to say which is of higher priority. |
| 3 | How many fishes can a skilled fisherman catch in 6 hours? | It depends on the situation, sometimes you may not catch at all, or sometimes you can easily catch 10-20 fish. |
| 4 | What local fishermen use as a squid when fishing with a fishing rod? | Mostly, earthworms as well as worms found under the stones. |
| 5 | Is fishing for personal consumption or for sale? | Just for personal consumption. |
| 6 | How often are the facts of poaching and how are they fighting against them? | Poachers appear either at night or very early so that no one can notice them. There are sanctions for poaching, thus, people try not to poach. |
| 7 | Which restrictive measures do the poachers use? | They use mainly electrofishing devices. |
| 8 | Do you remember the case of catching a mature fish (with a hard roe) and was there a brown trout among them? | Seldom. The trout spawn can be seen in the head of the rivers, and the rest fish lay their eggs in spring and summer. |
| 9 | Can you describe the obtaioned hard roe? | In autumn-winter period the trout roe is quite large, tasty, of orange colour, or sometimes red. Some mentioned that khramulya roe is toxic, therefore they do not eat it. The roe of the other fish is used. |
| 10 | Have you ever seen alevins with a yolk sac or a yellow shining spawn? | The trout alevins can be seen before the spring floods, but in the head of rivers. In the project area alevins of the other fish spawning in spring and summer period can be seen near the banks. |
| 11 | How popular is the project section for fishermen? | Fairly popular. One can see 2-3 fishermen on the edge of the river. In the section after Dzirula - Kvirila confluence, turbidity of water is high.Fish avoid the turbd water, therefore fishin in that area is pointless. The main fishing sites are in the Dzirula before the Dzirula-Kvirila confluence. |
| 12 | Whan does fish spawn in the project area? | Fish spawns in spring and summer. |

394. The following species have been found in the catch during the study in the Dzirula River:

| | |
|---|---|
| Colchic khramulya (Capoeta sieboldi Steindachner, 1864) - 2 units. |  |
| Chub (Leuciscus leuciscus Linnaeus, 1758)- 1 unit. |  |

395. On the bottom of the Dzirula River, in the project area, colonies of invertebrate species (food base for fish) have been registered. Hydroflora, represented by perythiton, the main food base for khramulya was found. Hydroflora and hydrofauna of the Kvirila River is sparce. This is conditioned by high concentration of suspended solids. In this section fish was not registered.

## E.2.5 Protected Areas

396. The nearest protected area to the Project road is the Ajameti Managed Reserve, which is located approximately 5 kilometers south west of the end point of the road (km14.7), see **Figure E-28**.[15]

397. In April of 1928, 20 ha of Kutaisi forested area was declared a nature reserve and in 1935 Ajameti Botanical Reserve was established at the ground level of the Ajameti forest massif. Ajameti was formed as a strict nature reserve in 1946 to preserve rare and relict Imeretian Oak and Elm Zelkova trees. The famous oaks of Ajameti are ancient natural treasures, with some of the trees being over 250 years old.

[15] Managed nature reserves were created in 1997, according to the Law on Animals, on the basis of forest and hunting farms.

**Figure E-28: Location of the Ajameti Managed Reserve (reserve comprises several portions)**

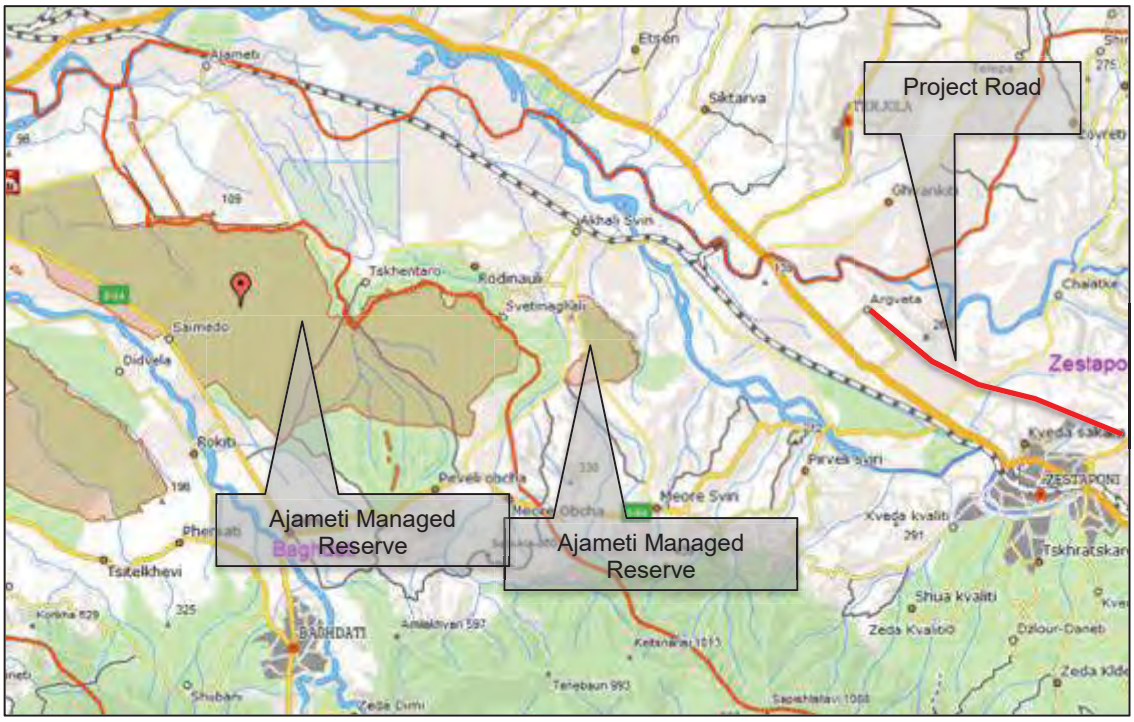



**Figure E-29: Ajameti Managed Reserve**

398. The only other protected area in the region is the Borjomi Nature Reserve which is located more than 20 kilometers south of the start point of the Project road, see **Figure E-30**.

**Figure E-30: Protected Areas Within the Vicinity of the Project Road**


399. The nearest Important Bird Area (IBA) to the Project road is the Adjara-Imereti Ridge more than twenty kilometers south of the Project road which overlaps with the Borjomi Nature Reserve. The IBA comprises populations of the following IBA trigger species:

- Caucasian Grouse Lyrurus mlokosiewiczi (IUCN Category – NT)
- Corncrake Crex crex (IUCN Category – LC)
- Great Snipe Gallinago media (IUCN Category – NT)
- Eastern Imperial Eagle Aquila heliaca (IUCN Category – VU)

## E.3 Economic Development

### E.3.1 Industries & Agriculture

400. Viticulture is the main economic activity in the municipality of Zestaphoni providing 80% of agricultural output. Its development is supported by favorable soil-climatic conditions. Vineyards occupy 5,000 hectares within the municipality. There are two active wine producing factories in the municipality.

401. The Rioni River Basin is abundant with mineral resources. The upper courses of the basin are rich in non-ferrous metal and non-metal mineral deposits, specifically manganese which can be found in large deposits in mines close to Chiatura some 20km north east of Zestaphoni. The manganese ore deposits near Chiatura, first discovered in 1849, have been exploited since 1879. The ores include pyrolusite and psilomelane (oxide ores) and rhodochroisite (carbonate ore). The country's largest producer, Chiaturmarganets, mines manganese ores from open cast and underground operations in Chiatura, which are supplied to the nearby GAA plant in Zestaphoni.

402. Founded in 1933 by Georgian scientist Giorgi Nikoladze, Georgian Manganese's Zestafoni Ferroalloy Plant has grown to become Georgia's largest silicomanganese processing plant and was recently purchased by an American company renaming the plant Georgian American Alloys. GAA produced over 187,000 metric tons of silicomanganese in 2012, however the mining and production of the manganese is not without its environmental problems, including impacts to air quality and impacts to the water quality of the Kvirila river, both issues are discussed above. The Project road passes almost adjacent to the north of the plant for around 2 kilometers between KM 9.7 and KM 11.8. As noted above soil samples and groundwater samples have been taken in this area to determine if contaminated the land exists within the vicinity of the GAA factory.

**Figure E-31: Location of GAA – Approximately Km 9.5 – Km 10.7**


**Figure E-32: Location of GAA – Approximately Km 10.7 – Km 12.5**


403. Other important industrial facilities plants in the Project area include "Saqkabeli" in Zestaphoni and "Elektroelementi" in Shorapani.

404. Agricultural land plots cover 7,027 ha of the municipality or 46% of the whole territory. 5,159 ha out of the above-mentioned area are arable lands. As for

greenhouse areas, it totals approximately 6 ha. Detailed information on Imereti region and Zestaphoni Municipality is given in **Table E-29**. Other than grapes, melon and maize are predominant crops grown in the region and have been noted within the Project corridor, specifically from KM 7.0 onwards.

**Table E-29: Agricultural Areas (Hectares)**

| | Imereti | Zestaphoni |
|---|---|---|
| Total Agricultural | 65,737 | 7,027 |
| Arable | 51,033 | 5,159 |
| Pasture | 5,410 | 363 |
| Greenhouse | 462 | 6 |

Source: www.geostat.ge

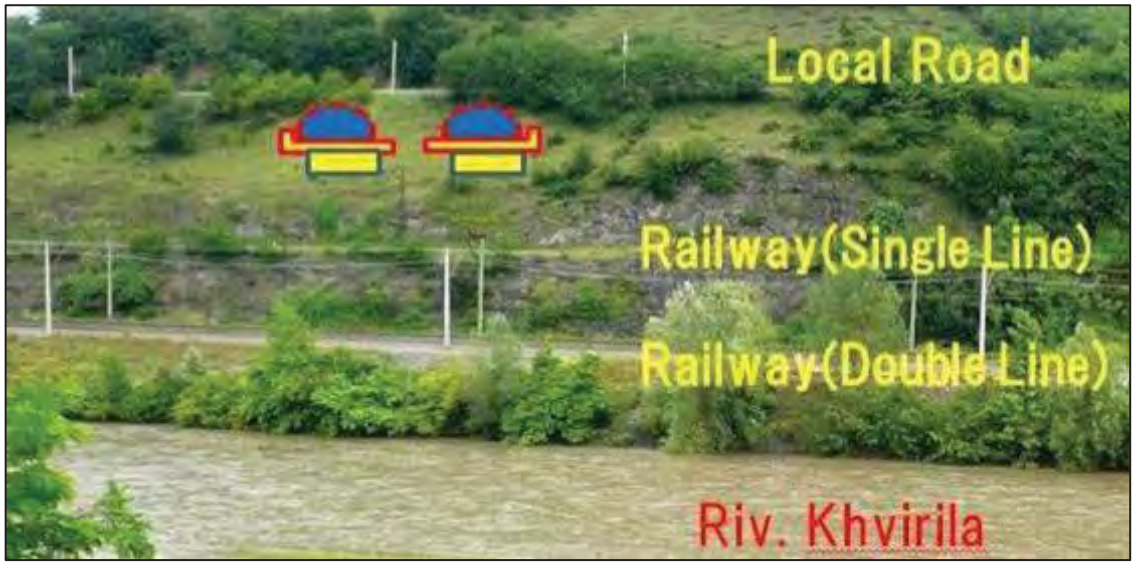
## E.3.2 Infrastructure and Transportation facilities

### E.3.2.1 Road, Rail and Air

405. Roads – The road network in the Project area is dominated by the existing E-60 which links Tbilisi with Batumi. The key issue with the existing road within the Project corridor is the route through Zestafoni which often becomes choked with traffic. The existing road does not bypass the town, rather it creeps through the town in a rather strange fashion, including a specific pinch point around the GAA factory. In the summer this point becomes extremely congested and long traffic delays can be experienced as people make their way too and from Tbilisi and Batumi for summer vacations. Numerous local roads feed onto the E-60 in Zestafoni, and these roads vary in condition from good to very poor.

406. Rail – The main line from Tbilisi to Batumi runs broadly parallel with the Project road until it reaches Zestafoni. In fact, in the first section of the road, between KM 0.0 and KM 6.0 the railway line and the road are only separated by a couple of hundred meters, with the road running south of the railway line. At one location, the new road alignment passes within 20 meters of the railway line (KM 2.5) and eventually passes over the railway line at KM 6.3 (see **Figure E-33**) as the road heads north west to start its bypass around Zestafoni.

**Figure E-33: Location of Road Crossing Railway Line**



407. Georgian Railways own and operate the rail services in Georgia. There are two live lines on this route, one on a higher elevation and one on a lower elevation. The line on the higher elevation operates 4 trips per day, the lower line accommodates approximately 40 journeys per day.

#### E.3.2.2 Utilities

408. Networked water supply and sewage systems only exist within the main towns and cities of Georgia, including Zestaphoni. Power is provided to villages in the region and is supplied by the company "EnergoProGeorgia". Villages mainly use groundwater resources for potable and home use.

#### E.3.2.3 Housing Stock

409. The housing stock in the Project area comprises mainly one or two storey houses that are distributed mainly along the local roads that weave their way around the valley slopes. The only multiple storey residential buildings observed within the Project area are located in Shoropani at KM 4.3 (within 100 meters), see **Figure E-34**, and KM 7.9 (road passes beneath these buildings in a tunnel).

**Figure E-34: Buildings at KM 4.3**

### E.3.3 Tourism and Recreation

410. Zestaphoni is not considered an important or significant area for tourism and recreation. A recent study of foreign visitors to Imereti region indicated that less than 2% of the visitors visited Zestafoni for recreation or vacation. [16]

411. According to RD environmental division, there are no exceptional landscapes requiring special attention along the project corridor.

## E.4 Social and Cultural Resources

### E.4.1 Socio-economic conditions

#### E.4.1.1 Administrative Issues

412. The Project road is located within the Region of Imereti. Imereti occupies a territory of approximately 6,552km$^2$ (9.4% of Georgia's area). Imereti consists of twelve administrative districts: Kutaisi (the Capital of the region), Tkibuli, Tskaltubo, Chiatura, Baghdati, Vani, Zestaponi, Terjola, Samtredia, Sachkhere, Kharagauli, Khoni. There are 542 settlements in the region of which: 10 cities (Kutaisi, Tkibuli, Tskaltubo, Chiatura, Baghdati, Vani, Zestaponi, Terjola, Samtredia, Sachkhere, and Khoni); 3 towns (Shorapani, Kulashi and Kharagauli); and 529 villages.

[16] Second Regional Development Project, Imereti Regional Development Program, Imereti Tourism Development Strategy. Strategic Environmental, Cultural, Historical and Social Assessment. World Bank, 2014

413. The Project road is located within Zestaphoni Municipality which covers a total area of 423 km$^2$ and includes the towns of Zestaphoni and Shorapani as well as numerous small villages as illustrated by **Figure E-35**. Of its total areas 7,027 ha is occupied by agricultural land plots and 16,500 ha area – by forest.

**Figure E-35: Towns and Villages of Zestaphoni Municipality**


414. The following settlements have been identified within the Project area.

- Kveda Tseva (KM 0)
- Shorapani (KM 4.0 – 6.0)
- Zestaphoni (KM 6.0 – 11.0)
- Kveda Sakara (KM 11.0 – 12.0)
- Argveta (KM 13.0 – 15.0)

### E.4.1.2 Demographics

415. According to the most recent census data (2014), Imereti has a population of 533,906 which is a significant decrease from the 2002 census when the population was recorded as 699,666. The population of Zestafoni was 58,401 in 2014 of which the majority was classified as rural population (see **Table E-29** below).

**Table E-29: Population of Imereti and its Municipalities**

| | Total Population | Urban | Rural |
|---|---|---|---|
| **Imereti** | **533,906** | **258,510** | **275,396** |
| Kutaisi, City of | 147,635 | 147,635 | - |
| Baghdati Municipality | 21,582 | 3,707 | 17,875 |
| Vani Municipality | 24,512 | 3,744 | 20,768 |
| **Zestafoni Municipality** | **58,401** | **20,917** | **37,124** |
| Terjola Municipality | 35,563 | 4,644 | 30,919 |
| Samtredia Municipality | 48,562 | 27,020 | 21,542 |
| Sachkhere Municipality | 37,775 | 6,140 | 31,635 |
| Tkibuli Municipality | 20,839 | 9,770 | 11,069 |
| Tskaltubo Municipality | 56,883 | 11,281 | 45,602 |

| | Total Population | Urban | Rural |
|---|---|---|---|
| Chiatura Municipality | 39,884 | 12,803 | 27,081 |
| Kharagauli Municipality | 19,473 | 1,965 | 17,508 |
| Khoni Municipality | 23,570 | 8,987 | 14,583 |

416. According to statistics provided by Geostat, there are 12,700 pensioners, 8,200 socially unprotected people and 780 Internally Displaced People (IDPs) registered as living in Zestaphoni.

417. 99.4% of the population of Imereti are Georgians, the remaining 0.6% is made up of Abkhazians (0.1%), Russians (0.3%), Armenians (0.1%) and Osetians (0.1%). [17] There are no ethnic minorities or indigenous people in the project area.

## E.4.2 Community Health & Education

### E.4.2.1 Health

418. Several medical facilities have been identified in the Project area, see **Table E-30** below.

**Table E-30: Medical Facilities in the Project Area (within 1 km)**

| # | Name | Location | Distance from the new alignment (m) |
|---|---|---|---|
| 1 | Shorapin Medical Faculty | Kveda Ilemi | 450 |
| 2 | Ilmis Medical Faculty | Shorapani | 1,000 |
| 3 | Tskhratskaro Medical Faculty | Zestafoni | 210 |
| 4 | Geo Hospital's Zestafoni Outpatient Center | Zestafoni | 340 |
| 5 | Lower Sector Medical Outpatient | Zestafoni | 10 |

**Figure E-36: Lower Sector Medical Outpatient**

[17] www.geoxtati.ge. 2014

### E.4.2.2 Safety

419. According to data provided by the RD, during the period 2012 – 2016 there were 2,713 collisions, 471 persons killed and 4,913 persons injured spread over the E-60 corridor, from km 18 to km 302 (284 km in total, from Tbilisi to Khobi) with some notable cluster locations. In other words, it means 1 collision every 16 hours, 1 person killed every 4 days and 1 person injured every 9 hours. Focusing the analysis on the Khevi – Argveta section, 351 collisions, 78 persons killed and 648 persons injured. Finally, along the F4 section 130 collisions occurred, with 30 persons killed and 218 persons injured. These data are summarized in the **Table E-31**, whereas **Tables E-32** shows the collisions rates in terms of "crashes per km". Finally the **Table E-33** shows the details of the F4 section.

**Table E-31: Collisions and Casualties in the Period 2012 – 2016**

| E-60 Road Section | km | Collisions | Injured | Killed |
|---|---|---|---|---|
| Tbilisi – Khobi | 284 | 2,713 | 4,913 | 471 |
| Khevi – Argveta | 50 | 351 | 648 | 78 |
| F4 | 16 | 130 | 218 | 30 |

**Table E-32: Collisions and Casualties Rates in the Period 2012 – 2016 (per km)**

| E-60 Road Section | km | Collisions | Injured | Killed |
|---|---|---|---|---|
| Tbilisi – Khobi | 284 | 9.55 | 17.30 | 1.66 |
| Khevi – Argveta | 50 | 7.02 | 12.96 | 1.56 |
| F4 | 16 | 8.13 | 13.63 | 1.88 |

**Table E-33: Collisions and Casualties in Section F4**

| Year | Collisions | Injured | Killed |
|---|---|---|---|
| 2012 | 25 | 43 | 11 |
| 2013 | 26 | 40 | 6 |
| 2014 | 19 | 38 | 2 |
| 2015 | 29 | 49 | 5 |
| 2016 | 31 | 48 | 6 |

420. As regards the collisions in the section F4, there was a low peak in 2014, but in the last two years the trend is negative. In 2016, 31 collisions occurred in this stretch, that is the highest value observed in the observed period.

421. The figures below summarize collisions by type and cause. The most part of collisions (56%) occurs between 2 or more motor vehicles; 7% of them result in the overturning of a vehicle. 24% of collisions involve pedestrians, thus showing that the protection of vulnerable road users is a major issue in this section. Another relevant category of collisions are those with obstacles (18%). As regards the causes of the crashes, according to data, the main one is defined as "wrong maneuver" (55%). It is interesting to underline that 30% of collisions are caused by dangerous overtaking and 7% by tailgating. These causes are strictly related to the type of cross-section (2 lanes) and the geometry (curvy alignment with few straight sections for safe overtaking).

**Figure E-37: Collisions by type (section F4, period 2012 – 2016)**

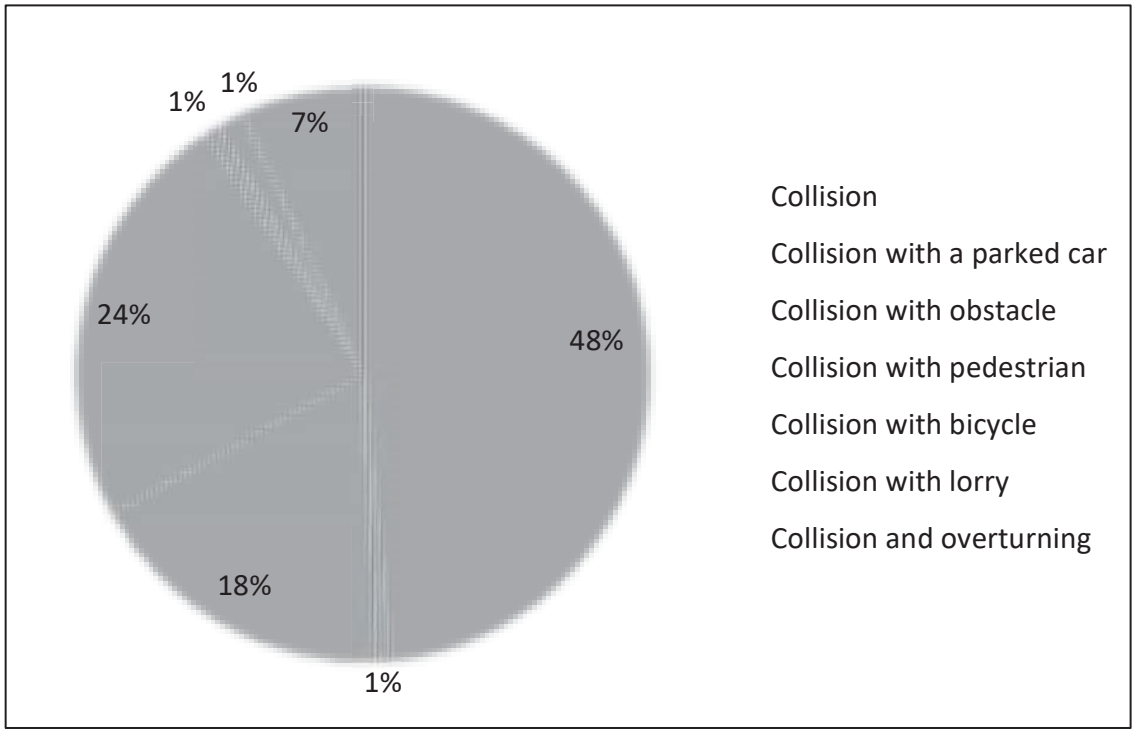
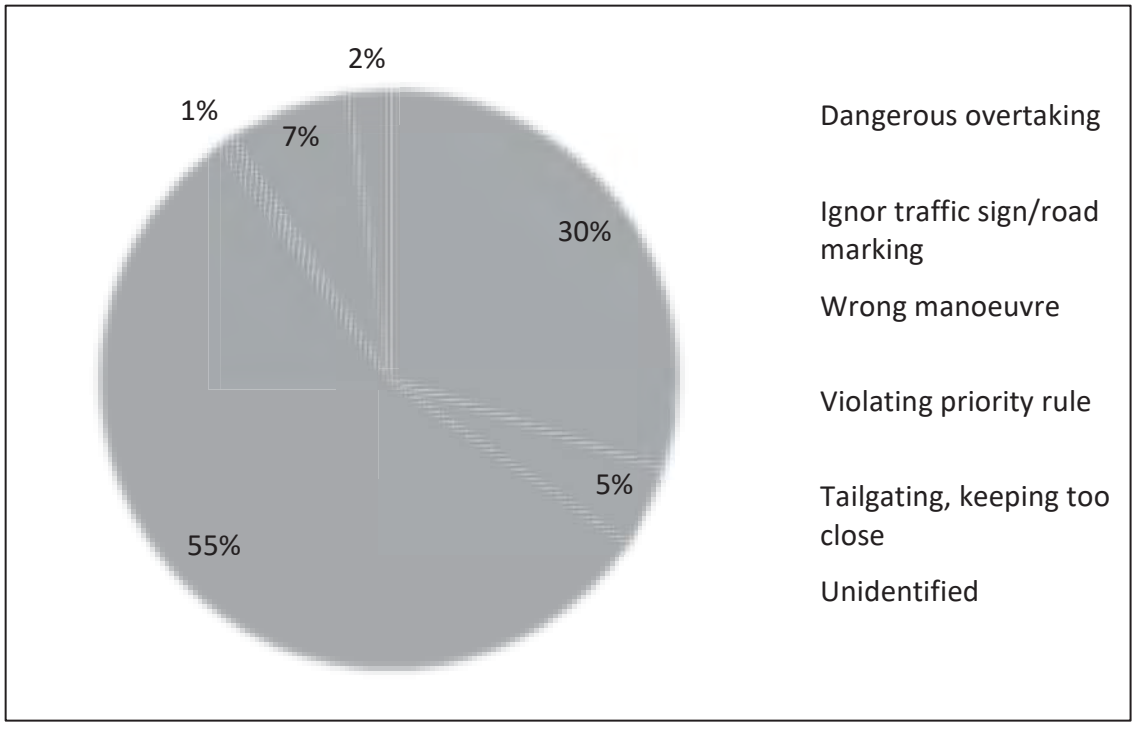



**Figure E-38: Collisions by cause (section F4, period 2012 – 2016)**




### E.4.2.3 Education and Educational Facilities

422. There are 33 public schools in Zestaphoni municipality, with 8,700 pupils. The nearest schools to the Project road are listed in **Table E-34** below.

**Table E-35: Schools in the Project Area (within 1 km)**

| # | Name | Location | No. of Pupils | Distance from the new alignment (m) |
|---|---|---|---|---|
| 1 | Shorapani School | Shorapani | 350 | 245 |
| 2 | Public School of Shorpani | Shorapani | 250 | 430 |
| 3 | LEPL Zestaponi N1 School | Zestafoni | 811 | 564 |
| 4 | LEPL Zestaponi N6 School | Zestafoni | 432 | 650 |
| 5 | Public school of Keda Sakare | Keda Sakare | 214 | 1,000 |

### E.4.3 Economy and Employment

423. According to the social survey undertaken for this Project, it is found that the average wage of the population in the target villages is 650 GEL. The majority (70%) interviewed in the social survey stated that the main source of income is wage, 20% of the surveyed families said that main source is pension/allowance, only 5 % said that it is self-employment.

424. According to the survey results on employment status, 34% of surveyed people are employed, almost 22% is unemployed, 11% are housewives, 17% students or pupils and 15% pensioners.

### E.4.4 Waste Management

425. Waste management, in compliance with international standards, has been playing an increasingly important role for Georgia after the country signed the Association Agreement with the European Union (EU). Currently solid waste disposal at the landfill is the only form of waste management in Georgia. The situation in regards to domestic and industrial wastewater management is complicated, as in most cases industrial and non-industrial wastewaters are discharged into surface waters without prior treatment.

426. Inert waste, including construction waste, is partially disposed at non-hazardous waste landfills and is used for filling/leveling activities in the construction of infrastructure facilities. There are no management systems for specific waste, including separated collection systems. However, recycling of specific waste, such as tires, batteries, packaging waste, etc., or disposal (such as asbestos waste) does occur in fragmented and uncoordinated way.

427. Presently, 56 landfills are recorded in Georgia. Only four of them, one private and three state-owned landfills, comply with international standards and have an Environmental Impact Assessment (EIA) permit. These are:

- Tbilisi Norio landfill;
- Rustavi landfill;
- Borjomi landfill;
- Privately owned BP landfill.

428. According to the active legislation (Waste Management Code), construction and management of non-hazardous (municipal) landfills (excluding Tbilisi and Adjara Autonomous Republic landfills) is the responsibility of the Waste Management Company of Georgia owned by the Ministry of Regional Development and

Infrastructure. The company conducts active measures to improve the conditions of the old/current landfills and construct new regional landfills. As of 2016, the Solid Waste Management Company manages the existing landfills. Twenty of them were closed and 30 of them were improved. The company continues work to construct new regional non-hazardous waste landfills. Tbilservice Group (municipal company established in 2007) manages Tbilisi's landfills.

429. Despite the above, the waste management problem remains very acute. There are still many illegal dumpsites in Georgia. Almost every rural settlement has one or more small dumpsites. They are often located on river banks or near the populated areas, thus posing a threat to human health and the environment.

430. One of the main causes of the above problem is related to the existing waste management system, especially in the rural areas. Specifically, no waste collection and removal services are provided in some of the rural areas, especially in remote villages located far from the municipal centers. Many villages are not equipped with waste containers, which forces local residents to dump their waste in the areas of their choosing. Around 18% of waste generated in the country is dumped into ravines, river banks and other illegal, spontaneously formed, dumpsites near residential areas.

431. Previously there was a landfill site in Zestafoni adjacent to Kvaliti village. The area of the site was 2.2 hectares and received 15,000 $m^3$/year of waste. However, the Solid Waste Management Company of Georgia closed the Zestaphoni municipal land fill in 2016 due to the fact that it was overloaded. As such there appears to be no landfill in Zestaphoni anymore.

### E.4.5 Physical and Cultural Resources

432. Regional Context - Imereti is an important historical and cultural region of Western Georgia. There are more than 450 historical, archaeological, architectural and natural monuments in the region, which give a full picture of ancient settlements, its cultural development and history. The region is home to 78 Churches, 13 Castles, 39 Archaeological Monuments and 27 Museums.

433. Findings of archaeological excavations show that the first human being in Imereti lived during the lower Palaeolithic period. Numerous flint and obsidian items, including cutting instruments and knives have been discovered in caves and settlements. During the VIII century Kutaisi became the capital of west Georgia and the capital of all Georgia in the X-XII centuries. It was during this period that Imereti had its renaissance. Unique masterpieces of Georgian architecture were created at this time – Bagrati Cathedral and Gelati Monastery Complex (UNESCO heritage site). During the XV century, after the fall of the Georgian feudal monarchy, Imereti became a separate feudal kingdom.

434. Project Corridor – Within the Project corridor the following physical cultural resources have been identified:

- Shorapani Fortress - Shorapani fortress is a monument of ancient times and of the Middle Ages. In historical sources, the fortress is mentioned by Strabo (I-BC - I AD), according to whom Shorapani fortress was so enormous that it contained the entire city population. According to Leonti Mroveli (IX century), the original fortress was built by the King Parnavaz I of Kartli in the III century BC. In the VI century, during the battle between Persia and Byzantium, the fortress passed from hand to

hand, but it did not lose its strategic importance. The fortress was occupied by the Ottomans in 1730, and was recaptured by the King Solomon I of Imereti in 1770. Since 1983, excavations began here; the nearby territory was completely cleared and the eastern, western and northern parts of the wall became visible. Under the structures, earlier buildings of previous times were discovered. Structures of antiquity covered with flat and curved tiles and Colchis Amphorae were found. Archaeological artifacts from Shorapani fortress and adjacent area are preserved in Janashia National Museum funds. Today, arched support column of the ancient fortress are found. From the fortress to the river Kvirila passes a 60 meter tunnel of the VI century. The tunnel was restored in the late feudal era.

**Figure E-40: Shorapani Fortress**

- Other Archaeological Sites – Argveta is also another area of archaeological importance. Artifacts from this area are preserved in the State museum. Archaeological finds were unearthed in 1980 during construction of a house in Argveta. These artifacts (iron axes, iron dagger, arrow heads) are now preserved in Givi Jaoshvili Zestafoni Ethnographic Museum. According to the register these artifacts belong to early ancient period. The area seems to be an interesting area from archaeological point of view. However the area is remote from the new alignment. Archaeological materials were also found in the Zestafoni area during construction of the GAA facility and are kept in Zestafoni Ethnographic Museum. These items include pottery from early ancient to late ancient time. In the same area bronze dagger was found.

**Figure E-41:** Stonework in Zestafoni

Visual surveys of the alignment near the west portal of the passage under the Zestaphoni-Chiatura road detected some stonework which may have some archeological importance. In addition, a mound located 200m north to the

plant may be the site of ancient settlement, while in the flatland, between the hill and the plant and old burial may be present. Finds from the area preserved in Zestafoni museum allow to assume this possibility. Maps indicating the locations of these potential archeological sites are indicated in **Figure E-44**.

- Churches – Only one church has been identified within the vicinity of the Project road, St Ninos, which is located approximately 300 meters south of the exit to tunnel 6, close to the boundary of the GAA facility. Numerous other churches are dotted around Zestafoni, and Shorapani, but none of them are close enough to be impacted by the Project. Maps indicating the locations of the churches are indicated in **Figure E-44**.

- Cemeteries – Only one cemetery has been identified within 250 meters of the Project road. The cemetery is located approximately 50 meters south of tunnel TUN 4.0.06-AT/TA, see **Figure E-42**.

**Figure E-42: Cemetery close to Tunnel TUN 4.0.06-AT/TA.**

- Other Sites of Potential Cultural Value – A small natural spring is located around km 10, close to the northern boundary of the GAA facility (see **Figure E-43**). Several visitors to this area were noted during site visits.

**Figure E-43: Natural Spring Adjacent to the GAA Facility (KM 10.1)**

**Figure E-44. Churches, cemeteries and places of worship in the region**

(yellow circle- church, red circle – Shorapani fortress, greed hexagons – cemeteries, orange hexagons – cemeteries with churches)


1.St Nino church, approximate distance 260m; 2 – St Nickolas church, approximate distance 650m, 3 – cemetery, approximate distance 630m; 4 – Shorapani fortress , approximate distance 590m

## E.4.6 Noise & Vibration

### E.4.6.1 General

435. Noise and vibration within the Project corridor can be discussed in two parts, firstly the parts of the corridor that broadly follow the existing alignment, and secondly the part of the corridor that bypass to the north of Zestafoni, more than 500 meters from the existing road.

436. Noise levels within the first part are predominantly a result of vehicle traffic on the existing road. Very little commercial, residential or industrial activities can be observed in these areas that would give rise to significant noise levels. In the second part of the corridor the alignment traverses a predominantly rural / residential landscape with the exception being the portion of the alignment that passes just to the north of the GAA facility. Noise and vibration monitoring has been undertake in both parts of the road for this EIA to determine baseline noise levels which will be used as part of the noise and vibration model presented later in this report.

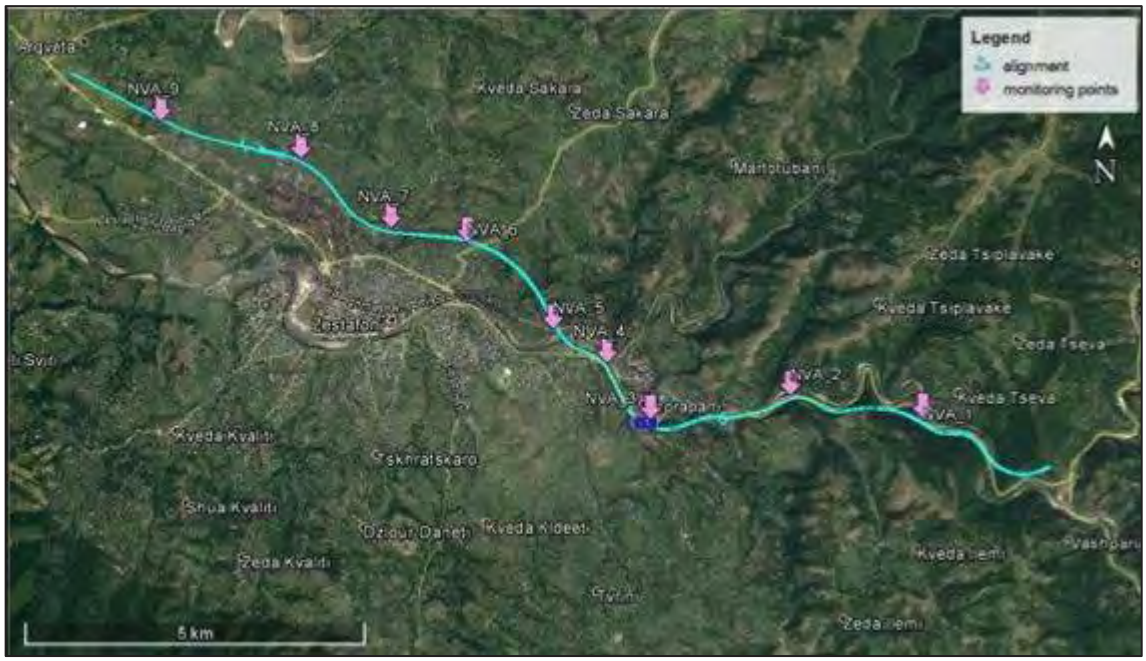
### E.4.6.2 Existing Noise & Vibration Levels

437. Baseline noise and vibration monitoring was undertaken in September, 2017 at a nine locations. **Table E-36** describes the sample locations and rationale for their selection. The sampling locations are mapped in **Figure E-37**.

**Table E-36: Noise and Vibration Monitoring Locations**

| Sample ID | Coordinates | Approximate Location | Rationale for Site Selection |
|---|---|---|---|
| N01 | 42 ° 05’31.75”N / 43° 07’47.68”E | KM0.0 | Start of F4, opposite a small cluster of residential properties. |
| N02 | 42 ° 05’42.77”N / 43° 06’23.19”E | KM2.2 | Adjacent to a roadside restaurant. Site of embankment cutting. |
| N03 | 42 ° 05’31.72”N / 43° 04’53.87”E | KM4.3 | Shorapani residential area, location of a school and exit of Tunnel 3. |
| N04 | 42 ° 05’58.49”N / 43° 04’26.10”E | KM5.5 | Adjacent to residential properties. |
| N05 | 42 ° 06’14.75”N / 43° 03’51.79”E | KM6.3 | At the portal to Tunnel 4. |
| N06 | 42 ° 06’56.22”N / 43° 02’57.23”E | KM8.3 | Close to the portal to Tunnel 5 adjacent to residential properties. |
| N07 | 42 ° 07’02.90”N / 43° 02’08.61”E | KM9.5 | Residential area at the portal to Tunnel 6 and at the end of Bridge 4. |
| N08 | 42 ° 07’36.01”N / 43° 01’11.19”E | KM11.0 | North of the GAA facility and south of a residential cluster. |
| N09 | 42 ° 07’54.20”N / 42° 59’41.87”E | KM13.4 | Adjacent to a small cluster of residential properties. |

**Figure E-44: Noise and Vibration Monitoring Locations**




438. Vibration Results – **Table E-37** provides the baseline vibration monitoring results. Vibration values in the control points are currently too low to cause any structural or cosmetic damage and/or cause nuisance of the residents. According to the national standard the values are ranked as weak and non-perceptible.

**Table E-37: Baseline Vibration Monitoring Results**

| | Displacement, mm; peak values | | | Velocity, mm/s; true RMS | | | Transversal vibration value in dBV | Comment |
|---|---|---|---|---|---|---|---|---|
| | Longitudinal X | Transversal Y | Vertical Z | Longitudinal X | Transversal Y | Vertical Z | | |
| NVA-1 | **0.001** | **0.051** | 0.000 | 0.000 | **0.440** | 0.000 | 78 | Edge of the E-60 highway |
| NVA-2 | **0.005** | **0.002** | 0.000 | 0.000 | **0.010** | 0.000 | 40 | 14.9m from the centerline of E-60 highway |
| NVA-3 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | Next to internal road in Shorapani |
| NVA-4 | **0.033** | **0.010** | **0.001** | 0.000 | 0.000 | 0.000 | | 15.2m from the centerline of E-60 highway |
| NVA-5 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | Next to the local road |
| NVA-6 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | 87.5m from the centerline of Gomi-Sachkhere-Chiatura-Zestaphoni road, in about 30m from the street - Zestaphoni |
| NVA-7 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | Next to existing internal road – Kvemo Sakara |
| NVA-8 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | Next to existing internal road – Kvemo Sakara |
| NVA-9 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | Next to existing internal road – Argveta |

Note:

Vibration velocity level (Lv) in dB has been defined as follows:
Lv = 20 x log10(V/Vref)
Where:

Lv = velocity level in decibels, mm/s (dBV)
V = RMS velocity amplitude, mm/s
Vref = reference velocity amplitude, mm/s (Vref=0.00005 mm/s. Reference – Order #297/ნ of the Minister of Labour, Health and Social Affairs on Approval of Standards of Quality of the State of Environment, Document ID 470.230.000.11.119.004.920)

Lv = 20 x log10(0.44/0.00005)=20x3.9=78dB (NVA-1)
Lv = 20 x log10 (0.01/0.00005)=20x2=40dB (NVA-2)

439. Noise monitoring results – **Table E-38** provides the baseline noise monitoring results. The monitoring results show that noise levels close to the existing road are elevated above IFC daytime and nighttime standards. However, as the Project corridor enters the rural bypass around the north of Zestafoni noise levels get lower and are within IFC guideline limits for daytime and nighttime noise.

## Table E-38: Baseline Noise Monitoring Results

| # | Time | Wind speed, m/s | Wind direction | $L_{eq}$, dBA | $L_{min}$,, dBA | $L_{max}$, dBA | $L_{eq}$, dBA | $L_{DN}$, dBA | $L_{DEN}$, dBA | L10, dBA | L50, dBA | L90, dBA | National limit (residential), Leq,dBA | IFC/WHO limit (residential), LAeq, dBA | EU limit, Leq, dBA | Comment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **NVA-1** | | | | | | | | | | | | | | | | |
| 1 | 12:30 -13:50 | 1.3 | W | 65.0 | 52.3 | 80.0 | 72.2 | 72.3 | 77.1 | 50.13 | 60.3 | 74.1 | 55 (Day)<br>45 (Night) | 55 (Day)<br>45 (Night) | 60 (Day)<br>55 (Evening)<br>45 (Night) | Edge of the E-60 highway |
| 2 | 19:30-19:50 | 1.4 | W | 78.0 | 55.0 | 85.0 | | | | | | | | | | |
| 3 | 01:30 -01:50 | 1.0 | W | 47.8 | 45.0 | 65.0 | | | | | | | | | | |
| 4 | 06:55–07:15 | 1.0 | W | 55.5 | 50.0 | 68.0 | | | | | | | | | | |
| **NVA-2** | | | | | | | | | | | | | | | | |
| 1 | 13:00-13:20 | 2.0 | SW | 68.3 | 54.0 | 75.0 | 62.4 | 62.6 | 62.8 | 46.1 | 50.3 | 63.4 | 55 (Day)<br>45 (Night) | 55 (Day)<br>45 (Night) | 60 (Day)<br>55 (Evening)<br>45 (Night) | 14.9m from the centerline of E-60 highway |
| 2 | 18:50-19:10 | 1.6 | SW | 52.0 | 49.0 | 80.0 | | | | | | | | | | |
| 3 | 01:00 -01:20 | 1.0 | SW | 45.0 | 42.0 | 65.0 | | | | | | | | | | |
| 4 | 06:50-07:10 | 1.0 | SW | 48.5 | 44.0 | 68.4 | | | | | | | | | | |
| **NVA-3** | | | | | | | | | | | | | | | | |
| 1 | 10:30 -10:50 | 2,0 | SW | 49.0 | 46.0 | 56.0 | 54.2 | 58.4 | 60.5 | 48.3 | 50.0 | 56.6 | 55 (Day)<br>45 (Night) | 55 (Day)<br>45 (Night) | 60 (Day)<br>55 (Evening)<br>45 (Night) | Next to internal road in Shorapani |
| 2 | 18:20-18:40 | 1.6 | SW | 59.0 | 54.0 | 78.0 | | | | | | | | | | |
| 3 | 00:30-00:50 | 1.2 | SW | 48.0 | 46.0 | 56.0 | | | | | | | | | | |
| 4 | 06:20 -06:40 | 1,0 | SW | 51.0 | 50.0 | 55.0 | | | | | | | | | | |
| **NVA-4** | | | | | | | | | | | | | | | | |
| 1 | 12:00-12:20 | 2.0 | W | 76.0 | 70.0 | 85.0 | 73 | 73.1 | 73.1 | 46.62 | 63.3 | 76.0 | 55 (Day)<br>45 (Night) | 55 (Day)<br>45 (Night) | 60 (Day)<br>55 (Evening)<br>45 (Night) | 15.2m from the centerline of E-60 highway |
| 2 | 17:50-18:10 | 1.2 | W | 76.0 | 53.0 | 83.0 | | | | | | | | | | |
| 3 | 24:00-24:20 | 1,1 | W | 50.5 | 48.0 | 60.0 | | | | | | | | | | |
| 4 | 05:50-06:10 | 1,0 | W | 45.0 | 43.0 | 55.0 | | | | | | | | | | |
| **NVA-5** | | | | | | | | | | | | | | | | |
| 1 | 10:00 -10:20 | 1.6 | NW | 57.0 | 54.0 | 61.0 | 72.0 | 72.0 | 72.0 | 43.4 | 50.7 | 71.7 | 55 (Day)<br>45 (Night) | 55 (Day)<br>45 (Night) | 60 (Day)<br>55 (Evening)<br>45 (Night) | Next to the local road |
| 2 | 17:20-17:40 | 1.2 | NW | 78.0 | 55.0 | 82.0 | | | | | | | | | | |
| 3 | 23:30-23:50 | 1.1 | NW | 44.4 | 40.0 | 50.0 | | | | | | | | | | |
| 4 | 05:20-06:40 | 1,0 | NW | 43.0 | 41.0 | 55.0 | | | | | | | | | | |
| **NVA-6** | | | | | | | | | | | | | | | | |
| 1 | 09:10-09:30 | 1.0 | SW | 32.3 | 31.7 | 40.7 | 33.2 | 40.0 | 40.0 | 31.9 | 32.2 | 34.2 | 55 (Day)<br>45 (Night) | 55 (Day)<br>45 (Night) | 60 (Day)<br>55 (Evening)<br>45 (Night) | 87.5m from the centerline of Gomi-Sachkhere-Chiatura-Zestaphoni road, in about 30m from the street - Zestaphoni |
| 2 | 16:40-17:00 | 1,0 | SW | 35.0 | 33.0 | 40.0 | | | | | | | | | | |
| 3 | 23:10-23:30 | 1.2 | SW | 32.0 | 30.6 | 38.3 | | | | | | | | | | |
| 4 | 04:10-04:30 | 1.0 | SW | 31.9 | 31.0 | 47.7 | | | | | | | | | | |
| **NVA-7** | | | | | | | | | | | | | | | | |
| 1 | 08:30-08:50 | 1.5 | NW | 33.0 | 29.0 | 38.0 | 41.3 | 47.3 | 47.3 | 32.7 | 39.3 | 50.1 | 55 (Day)<br>45 (Night) | 55 (Day)<br>45 (Night) | 60 (Day)<br>55 (Evening)<br>45 (Night) | Next to existing internal road – Kvemo Sakara |
| 2 | 16:10-16:30 | 1.1 | NW | 45.4 | 42.0 | 50.0 | | | | | | | | | | |
| 3 | 22:50-23:10 | 1.0 | NW | 42.0 | 39.5 | 46.0 | | | | | | | | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 04:10-04:30 | 1.1 | NW | 32.5 | 30.0 | 35.3 | | | | | | | | | | |
| **NVA-8** | | | | | | | | | | | | | | | | |
| 1 | 07:30-07:50 | 2.2 | S | 42.0 | 38.0 | 44.0 | 43.8 | 48.0 | 48.0 | 35.0 | 42.0 | 46.2 | 55 (Day)<br>45 (Night) | 55 (Day)<br>45 (Night) | 60 (Day)<br>55 (Evening)<br>45 (Night) | Next to existing internal road – Kvemo Sakara |
| 2 | 15:30-15:50 | 1.1 | S | 48.0 | 45.0 | 55.1 | | | | | | | | | | |
| 3 | 22:30-22:50 | 1.1 | S | 42.0 | 40.0 | 44.2 | | | | | | | | | | |
| 4 | 03:30-03:50 | 1.3 | S | 32.0 | 30.0 | 35.0 | | | | | | | | | | |
| **NVA-9** | | | | | | | | | | | | | | | | |
| 1 | 07:00-07:20 | 2.0 | SW | 39.0 | 35.0 | 48.0 | 44.9 | 49.7 | 49.7 | 35.5 | 41.5 | 47. 8 | 55 (Day)<br>45 (Night) | 55 (Day)<br>45 (Night) | 60 (Day)<br>55 (Evening)<br>45 (Night) | Next to existing internal road – Argveta |
| 2 | 15:00-15:20 | 1.1 | SW | 49.4 | 45.0 | 55.0 | | | | | | | | | | |
| 3 | 22:10-22:30 | 1.0 | SW | 44.0 | 42.0 | 52.0 | | | | | | | | | | |
| 4 | 03:00-03:20 | 1.2 | SW | 34.0 | 31.0 | 38.0 | | | | | | | | | | |

Note:
Daytime values are marked in red
Orange highlight indicated the sites where registered noise was found to be in allowable limits
L90, L50, L10 – statistical level = level exceeded 90%, 50% 10% of time respectively
$L_{eq}$ - equivalent sound level
$L_{DEN}$ – equivalent sound level/average equivalent level over 24 hr period. 5dBA is added for the interval from 19:00 to 23:00; 10dBA added for the time interval from 23:00 to 07:00
$L_{DN}$- average equivalent sound level over a 24 hour period, with a penalty added for noise during the nighttime hours of 22:00 to 07:00

# F. Environmental Impacts and Mitigation Measures

## F.1 Introduction

440. During the initial stage of the EIA process, several potential environmental and social impacts of the project were identified. The baseline surveys were conducted keeping in consideration the potential impacts. In this chapter, the potential environmental and social impacts are evaluated. The impacts have been identified based on consideration of the information presented in previous chapters. To avoid unnecessary repetition of supporting information, cross referencing to previous sections is given where necessary. Following the impact assessment, the mitigation measures related to each impact category is presented.

## F.2 Impact Assessment Methodology

441. The general methodology used for impact assessment is described in this section. It describes the process of impact identification and definition, significance rating, the mitigation, management and good practice measures.

### F.2.1 Identification of Significant Environmental Aspects

442. The description of each impact will have the following features:

- Definition of the impact using an impact statement identifying the Project activity or activities that causes the impact, the pathway or the environmental parameter that is changed by the activity, and the potential receptors of the impact (aspect-pathway-receptor).
- Description of the sensitivity and importance value of the receiving environment or receptors.
- Extent of change associated with the impact.
- Rating of the significance of the impact.
- Description of appropriate mitigation and management measures and potential effectiveness of the proposed measures.
- Characterization of the level of uncertainty in the impact assessment.
- The significance of an impact is determined based on the product of the consequence of the impact and the probability of its occurrence. The consequence of an impact, in turn, is a function primarily of three impact characteristics:
    - magnitude
    - spatial scale
    - timeframe

443. Magnitude is determined from quantitative or qualitative evaluation of a number of criteria including:

- Sensitivity of existing or reasonably foreseeable future receptors.
- Importance value of existing or reasonably foreseeable future receptors, described using the following:
    - inclusion in government policy.
    - level of public concern.
    - number of receptors affected.
    - intrinsic or perceived value placed on the receiving environment by stakeholders.

  - economic value to stakeholders
- Severity or degree of change to the receptor due to impact, measured qualitatively or quantitatively, and through comparison with relevant thresholds:
  - legal thresholds—established by law or regulation
  - functional thresholds if exceeded, the impacts will disrupt the functioning of an ecosystem sufficiently to destroy resources important to the nation or biosphere irreversibly and/or irretrievably
  - normative thresholds – established by social norms, usually at the local or regional level and often tied to social or economic concerns
  - preference thresholds—preferences for individuals, groups or organizations only, as distinct from society at large
  - reputational thresholds—the level of risk a company is willing to take when approaching or exceeding the above thresholds

444. Spatial scale is another impact characteristic affecting impact consequence. The spatial scale of impacts can range from localized (confined to the proposed Project Site) to extensive (national or international extent). They also may vary depending on the component being considered.

445. The impact timeframe is the third principal impact characteristic defining impact consequence and relates to either its duration or its frequency (when the impact is intermittent). Impact duration can range from relatively short (less than four years) to long (beyond the life of the Project). Frequency ranges from high (more than 10 times a year) to low (less than once a year). These timeframes will need to be established for each Project based on its specific characteristics and those of the surrounding environment.

446. Once the impact consequence is described on the basis of the above impact characteristics, the probability of impact occurrence is factored in to derive the overall impact significance. The probability relates to the likelihood of the impact occurring, not the probability that the source of the impact occurs. For example, a continuous Project activity may have an unlikely probability of impact if there are no receptors within the area influenced by that activity.

447. The reversibility of each impact at the end of construction and operation are important, as these impacts may need on-going management after operation. The reversibility of each impact at the end of construction and operation will be noted and described alongside the three primary characteristics of magnitude, spatial scale and duration.

448. The characteristics are outlined in **Table F-1**.

**Table F-1: Characteristics Used to Describe Impact**

| Characteristic | Sub-components | Terms Used to Describe the Impact |
|---|---|---|
| Type | | Positive (a benefit), negative (a cost) or neutral |
| Nature | | Biophysical, social, cultural, health or economic<br><br>Direct, indirect or cumulative or induced |

| | | |
|---|---|---|
| Phase of the Project | | Construction, operation, decommissioning or post closure |
| Magnitude | Sensitivity of Receptor | High, medium or low capacity to accommodate change<br><br>High, medium or low conservation importance<br><br>Vulnerable or threatened Rare, common, unique, endemic |
| | Importance or value of receptor | High, medium or low concern to some or all stakeholders<br><br>High, medium or low value to some or all stakeholders (for example, for cultural beliefs)<br><br>Locally, nationally or internationally important<br><br>Protected by legislation or policy |
| | Severity or degree of change to the receptor | Gravity or seriousness of the change to the environment<br><br>Intensity, influence, power or strength of the change<br><br>Never, occasionally or always exceeds relevant thresholds |
| Spatial Scale | Area affected by impact - boundaries at local and regional extents will be different for biophysical and social impacts | Area or Volume covered Distribution Local, regional, transboundary or global |
| Timeframe | Length of time over which an environmental impact occurs or frequency of impact when intermittent | Short term or long term Intermittent (what frequency) or continuous Temporary or permanent<br><br>Immediate effect (impact experienced immediately after causative project aspect) or delayed effect (effect of the impact is delayed for a period following the causative project aspect) |
| Probability - likelihood or chance an impact will occur | | Definite (impact will occur with high likelihood of probability)<br><br>Possible (impact may occur but could be influenced by either natural or project related |

| | |
|---|---|
| | factors)<br><br>Unlikely (impact unlikely unless specific natural or Project related circumstances occur) |
| Reversibility/Sustainability | Potential for recovery of the endpoint from a negative impact<br><br>Reversible or irreversible Sustainability for positive impacts |
| Confidence in impact evaluation (degree of certainty in the significance ascribed to the impact) | Scientific uncertainty – limited understanding of ecosystem (or community) and processes governing change<br><br>Data uncertainty – restrictions introduced by incomplete or incomparable information, or by insufficient measurement techniques<br><br>Policy uncertainty – unclear or disputed objectives, standards or guidelines |

## F.2.2 Impact Significance Rating

449. The impact significance rating process serves two purposes: firstly, it helps to highlight the critical impacts requiring consideration in the approval process; secondly, it serves to show the primary impact characteristics, as defined above, used to evaluate impact significance. The impact significance rating system is presented in **Table F-2** and described as follows:

- **Part A**: Define impact consequence using the three primary impact characteristics of magnitude, spatial scale and duration.
- **Part B**: Use the matrix to determine a rating for impact consequence based on the definitions identified in Part A; and
- **Part C**: Use the matrix to determine the impact significance rating, which is a function of the impact consequence rating (from Part B) and the probability of occurrence.

450. Using the matrix, the significance of each described impact is rated.

**Table F-2: Method for Rating Significance**

| **PART A: DEFINING CONSEQUENCE IN TERMS OF MAGNITUDE, DURATION AND SPATIAL SCALE** | | | |
|---|---|---|---|
| Definition | | Criteria | |
| MAGNITUDE | | Negative | Positive |
| | Major | • Large number of receptors affected<br>• Receptors highly sensitive and/or are of conservation importance<br>• Substantial deterioration, nuisance or harm to receptors expected<br>• Relevant thresholds often exceeded<br>• Significant public concern expressed during stakeholder consultation<br>• Receiving environment has an inherent value to stakeholders | • Large number of receptors affected<br>• Receptors highly amenable to positive change<br>• Receptors likely to experience a big improvement in their situation<br>• Relevant positive thresholds often exceeded |
| | Moderate | • Some receptors affected<br>• Receptors slightly sensitive and/or of moderate conservation importance<br>• Measurable deterioration, nuisance or harm to receptors<br>• Relevant thresholds occasionally exceeded<br>• Limited public concern expressed during stakeholder consultation<br>• Limited value attached to the environment | • Some receptors affected<br>• Receptors likely to experience some improvement in their situation<br>• Relevant positive thresholds occasionally exceeded |
| | Minor | • No or limited receptors within the zone of impact<br>• Receptors not sensitive to change<br>• Minor deterioration, nuisance or harm to receptors<br>• Change not measurable or relevant thresholds never exceeded<br>• Stakeholders have not expressed concerns regarding the receiving environment | • No or limited receptors affected<br>• Receptors not sensitive to change<br>• Minor or no improvement in current situation<br>• Change not measurable<br>• Relevant positive thresholds never exceeded No stakeholder comment expected |

| | | | |
|---|---|---|---|
| TIMEFRAME | | Duration of Continuous Aspects | Frequency of Intermittent Aspects |
| | Short term / low frequency | • Less than 4 years from onset of impact | • Occurs less than once a year |
| | Medium term / medium frequency | • More than 4 years from onset of impact up to end of life of project (approximately 30 years) | • Occurs less than 10 times a year but more than once a year |
| | Long term / high frequency | • Impact is experienced during and beyond the life of the project (greater than 30 years) | • Occurs more than 10 times a year |
| SPATIAL SCALE | | Biophysical | Socio-economic |
| | Small | • Within the defined 'area of influence' | • Within the defined 'area of influence' |
| | Intermediate | • Within the district in which is the facilities are located | • Within the municipality in which the activity occurs |
| | Extensive | • Beyond the district in which the facilities are located | • Beyond the municipality in which the activity occurs |

**PART B: DETERMINING CONSEQUENCE RATING**

| MAGNITUDE | TIMEFRAME | SPATIAL SCALE | | |
|---|---|---|---|---|
| | | Small | Intermediate | Extensive |
| Minor | Short term / low frequency | Low | Low | Medium |
| | Medium term / medium frequency | Low | Low | Medium |
| | Long term / high frequency | Medium | Medium | Medium |
| | | | | |
| Moderate | Short term / low frequency | Low | Medium | Medium |
| | Medium term / medium frequency | Medium | Medium | High |
| | Long term / high frequency | Medium | High | High |
| | | | | |
| Major | Short term / low frequency | Medium | Medium | High |
| | Medium term / medium frequency | Medium | Medium | High |
| | Long term / high frequency | High | High | High |

**PART C: DETERMINING SIGNIFICANCE RATING**

| | | CONSEQUENCE | | |
|---|---|---|---|---|
| | | Low | Medium | High |
| PROBABILITY (of exposure to impacts) | Definite | Low | Medium | High |
| | Possible | Low | Medium | High |
| | Unlikely | Low | Low | Medium |

## F.3 Mitigation, Management and Good Practice Measures

451. Wherever the Project is likely to result in unacceptable impact on the environment, mitigation measures are proposed (over and above the inherent design measures included in the Project description). In addition, good practice measures may be proposed however these are unlikely to change the impact significance. In the case of positive impacts, management measures are suggested to optimize the benefits to be gained. Where mitigation measures are required the impact will be rated again to show the residual impact after implementation of management controls.

452. The following mitigation hierarchy will be utilized in selecting practical mitigation measures for unacceptable impacts as follows (in order of preference):

- Avoid the impact wherever possible by removing the cause(s).
- Reduce the impact as far as possible by limiting the cause(s).
- Ameliorate the impact by protecting the receptor from the cause(s) of the impact.
- Providing compensatory measures to offset the impact, particularly where an impact is of high significance and none of the above are appropriate.

## F.4 Screening of Impacts

453. Based on the impact assessment methodology discussed above, **Table F-3** presents the possible impacts of the proposed Project. Each impact is discussed further in this chapter.

## Table F-3: Impact Screening

| Aspect | Phase | Impact | Receptors | No. of Receptors Affected | Sensitivity of Receptors | Level of Public Concern | Risk of Exceeding Legal Threshold | Magnitude | Timeframe | Spatial Scale | Consequence | Probability | Significance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Air Quality | C | Emissions from stationary sources | Nearby communities | L | L | L | M | Minor | Short | Small | Medium | Definite | M |
| | C | Exhaust Emissions from construction vehicles and generators | Nearby communities | M | L | L | L | Minor | Short | Inter. | Low | Definite | L |
| | C | Dust from the movement of vehicles, stockpiles, etc. | Nearby communities / Agric. crops | M | M | M | M | Moderate | Short | Inter. | Medium | Definite | M |
| | O | Vehicle Emissions from traffic using the road. | Nearby communities | M | L | M | M | Moderate | Medium | Inter. | Medium | Definite | M |
| Climate Change | C | GHG Emissions from road construction. | Global | H | L | L | L | Minor | Short | Ext. | Low | Definite | L |
| | O | GHG Emissions from vehicle emissions. | Global | H | L | L | L | Minor | High | Ext. | Low | Definite | L |
| Soils | C | Loss / degradation of topsoil through land clearing, borrow pits, etc. | Overall EQ | M | M | M | M | Moderat w | Short | Inter. | Low | Possible | L |
| | | | | | | | | | | | | | |
| | C | Soil erosion on unstable slopes caused by poor construction works. | Overall EQ | M | L | M | L | Minor | Short | Small | Low | Possible | L |
| | O | Soil erosion caused by | Overall EQ | L | L | M | L | Minor | Medium | Small | Low | Possible | L |

| Aspect | Phase | Impact | Receptors | No. of Receptors Affected | Sensitivity of Receptors | Level of Public Concern | Risk of Exceeding Legal Threshold | Magnitude | Timeframe | Spatial Scale | Consequence | Probability | Significance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | poorly designed erosion protection measures, drainage, etc. | | | | | | | | | | | |
| | C | Soil contamination via spills and leaks of hazardous liquids from construction camps. | Overall EQ | M | M | L | M | Moderate | Short | Small | Low | Possible | L |
| | PC | Existing contaminated land behind GAA. | Overall EQ | L | M | L | M | Moderate | Medium | Small | Medium | Definite | M |
| Hydrology | C | Flooding caused by blocking existing drainage structures. | Nearby communities | M | M | M | L | Moderate | Short | Small | Low | Possible | L |
| | O | Flooding caused by poorly designed drainage structures. | Nearby communities | L | M | M | L | Moderate | Medium | Small | Low | Possible | L |
| | C | Water contamination from construction camps, etc. | Overall EQ | M | M | L | M | Moderate | Short | Small | Low | Possible | L |
| | C | Excessive water extraction affecting local water supplies. | Water users / Aquatic Life | L | M | L | M | Moderate | Short | Inter. | Medium | Possible | M |
| | O | Ground water supply degraded by new tunnels. | Water users | L | H | L | M | Moderate | Long | Inter. | Medium | Possible | M |
| Natural Hazards | C | Landslides caused by poor construction works on slopes. | Overall EQ | L | L | M | L | Minor | Short | Small | Medium | Unlikely | L |

| Aspect | Phase | Impact | Receptors | No. of Receptors Affected | Sensitivity of Receptors | Level of Public Concern | Risk of Exceeding Legal Threshold | Magnitude | Timeframe | Spatial Scale | Consequence | Probability | Significance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | O | Landslides caused by poor design of slope protection works. | Overall EQ | L | L | M | L | Minor | Long | Small | Medium | Unlikely | L |
| Flora & Fauna | C | Degradation of habitat caused during site clearing. | Overall EQ | L | M | L | M | Moderate | Medium | Small | Low | Possible | L |
| | C | Tree cutting. | Overall EQ | M | M | L | M | Moderate | Medium | Small | Low | Definite | L |
| | O | Blocking migration routes of animals. | Overall EQ | L | L | L | L | Minor | Long | Small | Low | Unlikely | L |
| Protected Areas | C | Degrading the habitat of protected areas through haul routes. | Overall EQ | L | H | L | L | Minor | Short | Inter. | Low | Unlikely | L |
| Infrastructure and Transport | C | Damage to access roads caused by construction vehicles. | Road users | M | L | M | L | Minor | Short | Inter. | Low | Possible | L |
| | C | Traffic delays due to road works. | Nearby communities | M | M | M | L | Moderate | Short | Small | Medium | Definite | M |
| | C | Limited accessibility to properties as road works block access. | Nearby communities | M | M | L | M | Moderate | Short | Small | Medium | Possible | M |
| | C | Damage to utilities which may not have been identified. | Nearby communities | M | M | L | L | Moderate | Short | Small | Low | Possible | L |
| | C | Temporary disruption to utilities while they are removed to make way for construction works. | Nearby communities | M | M | L | L | Moderate | Short | Small | Low | Definite | L |

| Aspect | Phase | Impact | Receptors | No. of Receptors Affected | Sensitivity of Receptors | Level of Public Concern | Risk of Exceeding Legal Threshold | Magnitude | Timeframe | Spatial Scale | Consequence | Probability | Significance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land Use | C | Loss of land and property due to the new road. | Land / Property owners | M | H | H | M | Major | Long | Small | High | Definite | H |
| | C | Disruption to businesses caused by reduced access to the business. | Nearby communities | M | H | H | M | Major | Short | Small | Medium | Possible | M |
| | O | Reduced income for businesses no longer located by the road. | Nearby communities | M | H | H | M | Major | Medium | Small | High | Definite | H |
| | O | Induced changes. | Nearby communities | M | L | L | L | Minor | Long | Inter. | Low | Possible | L |
| Waste | C | Pollution from hazardous waste from construction camps, etc. | Overall EQ | M | M | L | M | Moderate | Short | Small | Low | Possible | L |
| | C | Pollution from inert waste from construction camps, etc. | Overall EQ | M | L | L | L | Minor | Short | Small | Low | Possible | L |
| | C | Tunnel and embankment spoil dumped in unauthorized locations. | Overall EQ | M | M | H | M | Major | Medium | Inter. | Medium | Possible | M |
| OHS | C | Accidents and injuries to workers during the construction phase. | Contractors staff | M | M | L | M | Moderate | Short | Small | High | Definite | H |
| | C | Lack of workers rights. | Contractors staff | M | L | L | M | Minor | Short | Small | Low | Possible | L |
| | C | STD's contracted and | Contractors | L | H | L | L | Minor | Long | Inter. | Medium | Possible | M |

| Aspect | Phase | Impact | Receptors | No. of Receptors Affected | Sensitivity of Receptors | Level of Public Concern | Risk of Exceeding Legal Threshold | Magnitude | Timeframe | Spatial Scale | Consequence | Probability | Significance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | spread by workers. | staff / Nearby communities | | | | | | | | | | |
| Emergencys | C | Fires, explosions, etc, at site. | Contractors staff / Nearby communities | M | M | L | M | Moderate | Short | Small | Medium | Possible | M |
| PCR | C | Damage to PCR caused during construction. | PCR site and its users | L | M | L | M | Moderate | Long | Small | Medium | Possible | M |
| | O | Effects to PCR in terms of elevated noise, dust, etc. | PCR site and its users | L | L | L | M | Minor | Long | Small | Low | Unlikely | L |
| Noise | C | Elevated noise levels from construction equipment. | Contractors staff / Nearby communities | H | H | L | M | Moderate | Short | Small | Medium | Definite | M |
| | O | Elevated noise levels from vehicles using the road. | Nearby communities | H | H | M | H | Major | Long | Small | High | Definite | H |
| Vibration | C | Damage to properties caused during blasting and piling. | Nearby communities | M | H | M | H | Major | Short | Small | High | Possible | H |
| | O | Damage to properties from vehicle movement vibration. | Nearby communities | L | H | M | L | Minor | Long | Small | Low | Unlikely | L |

# F.5 Physical Resources

## F.5.1 Air quality

### Potential Air Quality Impacts

454. The potential impacts of the Project to air quality are described as follows:

Design and Pre-construction Phase

455. The road rehabilitation works are generally intermittent and not permanent in a specific site, the works move along the Project road as work progresses and as such air quality impacts will be short term in specific locations. However, fugitive emissions will be emitted on a longer-term basis from stationary sources such as quarries, borrow pits and asphalt plants. These sites can however be selected prior to construction and be placed in an area where it can cause the least impact on human and ecologic receptors.

Construction Phase

456. During construction, air quality is likely to be degraded by a range of operational activities including:

- Exhaust emissions from the operation of construction machinery (e.g. Nitrogen Oxides ($NO_X$), Sulfur Oxides ($SO_X$) and Carbon Monoxide (CO));
- Open burning of waste materials; and
- Dust generated from quarries, borrow pits, haul roads, unpaved roads, exposed soils and material stock-piles.

457. Dust is the major air quality problem from construction sites. Dust is a problem for a variety of reasons, as outlined below:

- Inconvenience to local people. For example, people may have to re-wash laundry that has been put outdoors to dry, and wash windows, curtains and vehicles. Dust can contaminate meat hanging up in open-air butchers and other food that is exposed to it in homes, shops and open-air restaurants, giving food a gritty texture.
- Health and safety problems. Dust may affect health by irritating eyes and worsening the health of people with asthma. Dust can reduce visibility for drivers on roads. It can also be blown for long distances by the wind.
- Crop damage. Even low concentrations of dust can affect plant and fruit growth as far away as one kilometer from a construction site. Plant growth is particularly susceptible to dusts that are highly alkaline, for example limestone and cement dust. Dust deposited during light rainfall can cause the soil surface to form a crust increasing run-off.
- Impact on ecology. Dust blowing onto watercourses may damage ecology by increasing sedimentation, reducing sunlight and suffocating fish. It may also affect plant growth and change the species of plants growing in an area. Dust may also damage trees and other vegetation planted as part of the construction contract.
- Damage to plant and equipment. Within the construction site, dust can cause mechanical or electrical problems in sensitive equipment such as computers. It can also increase abrasion of moving parts in equipment and clogging of air filters.

Operational Phase

458. The main source of air pollution during the operational phase will be vehicles moving on the highway. The main pollutants are: CO; $NO_X$; hydrocarbons (HC); $SO_2$; carbon dioxide ($CO_2$); and particulate matter (PM). These compounds can damage health and/or the environment. The concentration of pollutants generated by vehicles depends on factors such as the number, type and speed of vehicles. The effect of air pollution on local people depends on the distance between them and the road, wind direction, topography and other factors. The main direct effects are in the area closest to the road as the rapid dispersion and dilution of exhaust gases quickly reduces their concentrations to levels at which risks are minimal.

459. The impacts associated with air quality in the operational phase of the Project have been assessed using an air dispersion model. The findings of which are presented below.

**Mitigation Actions**

Pre-construction Phase

460. Locations for borrow pits, rock crushing facilities, concrete batching yards and asphalt plants will require approval from the Engineer, MoENRP and the RD during the Pre-construction phase. Efforts will be made to ensure that these facilities are as near to the Project road as practical to avoid unnecessary journeys and potential dust issues from vehicle movements during construction works on unpaved roads in urban areas. Haul routes will be prepared and submitted to the Engineer as part of his Traffic Management Plan (TMP).

461. To prevent impacts arising from asphalt plants, construction camps, batching plants and rock crushing plants, they will be prohibited within 500 meters of any urban area or sensitive receptor (school, hospital, etc). The locations of these facilities will be indicated within the Contractors SSEMP. Baseline air quality monitoring will also be undertaken by the Contractor during the pre-construction phase as described below under the recommended monitoring.

462. To adequately manage air quality impacts the Contractor will be responsible for the preparation of an Air Quality Plan, submitted to the Engineer as part of the SSEMP. The plan will detail the actions to be taken to minimize dust generation (e.g. spraying un-surfaced roads with water (including the types of equipment, sources of water, locations for watering and schedule), covering stock-piles, etc) and will identify the type, age and standard of equipment to be used and will also provide details of the air quality monitoring program for baseline and routine monitoring. The Plan will also include contingencies for the accidental release of toxic air pollutants.

Construction Phase

463. The Contractor will be responsible, through compliance with this EMP and his SSEMP, for the following;

- Exhaust emissions - No furnaces, boilers or other similar plant or equipment using any fuel that may produce air pollutants will be installed without prior written consent of the Engineer. Construction equipment will be maintained to a good standard and fitted with pollution control devices regularly monitored by the Contractor and Engineer.
- Open burning of waste materials - No burning of debris or other materials will occur on the Site without permission of the Engineer.

- Dust generated from haul roads, unpaved roads, material stock piles, etc:
- The Contractor will ensure and that material stockpiles will be located in sheltered areas and be covered with tarpaulins or other such suitable covering to prevent material becoming airborne.
- All trucks used for transporting materials to and from the site will be covered with canvas tarpaulins, or other acceptable type cover (which will be properly secured) to prevent debris and/or materials from falling from or being blown off the vehicle(s).
- Hard surfaces will be required in construction areas with regular movements of vehicles.
- Effective use of water sprays will be implemented (e.g., Carry out watering for dust control at least 3 times a day: in the morning, at noon, and in the afternoon during dry weather with temperatures of over 25°C, or in windy weather. Avoid overwatering as this may make the surrounding muddy). All water used for controlling dust will be free of odor and pollution.
- Earthwork operation to be suspended when the wind speed exceeds 20 km/h in areas within 500 m of any community.

464. In addition, any new borrow pits, concrete batching plant, rock crushing facility and asphalt mixing plant will be the subject of separate environmental application under the responsibility of the Contractor. The Engineer will ensure that no such facility becomes operational without the required permits.

465. The Contractor is also responsible for the preparation of a Health and Safety Plan. The Plan, required as part of the SSEMP, will include contingencies for the accidental release of toxic air pollutants.

466. Emissions from on-road and off-road vehicles should comply with national or regional programs. In the absence of these, the following should be considered:

- Regardless of the size or type of vehicle, owners / operators should implement the manufacturer recommended engine maintenance programmes.
- Drivers should be instructed on the benefits of driving practices that reduced both the risk of accidents and fuel consumption, including measured acceleration and driving within safe speed limits.
- Implement a regular vehicle maintenance and repair program.

Operational Phase

467. General - An Air Dispersion Model has been prepared for the Project. The following provides the results of the model along with maps illustrating the results.

468. Time frame of the model - The modelling has been developed for each of the below scenarios:

- Scenario year 2019
- Scenario year 2034.

469. The number of vehicles has been divided in 24 hours according to the provided traffic flow; the results of the modelling will be represented into values of concentration/time (hourly levels) for the considered pollutants in correspondence of the selected receptors.

470. Spatial domain and receptors - The model takes into consideration an area by far larger than the road strips and has been enlarged according to the morphology, the distribution of settlements and potential receptors for a total of about

20 square kilometres. The domain is a rectangle having dimensions of 6 km x 3.5 km; calculations have been carried out on the basis of progressive advancements for the road. Six main receptors have been inserted in group of three at the north and south of the road. They have been used for the considerations in terms of respect or excess of allowable limits.

471. Results - The results of the modelling are organized as follows:
- Scenario 2019 (probable start of road service).
- Scenario 2034.

472. The values of the concentration of pollutants are calculated in correspondence of the six selected receptors. The average yearly values and the values considered of reference by the present day legislation are put into evidence together to verify the threshold of acceptability. It must be put into evidence that the values only refers to the traffic in the new road, and do not consider any other external source.

**Table F-4: Average yearly contribution of the road traffic to the background (concentration / µg/m$^3$)**

| Receptors | PM10 | PM2.5 | $NO_2$ | $NO_X$ | CO | $SO_2$ | C6H6 |
|---|---|---|---|---|---|---|---|
| **Receptor** 1 North | 0.315 | 0.236 | 7.393 | 14.706 | 2.314 | 0.005 | 0.01 |
| **Receptor** 2 North | 0.156 | 0.113 | 3.171 | 6.553 | 1.072 | 0.002 | 0.005 |
| **Receptor** 3 North | 0.088 | 0.062 | 1.730 | 3.491 | 0.563 | 0.001 | 0.002 |
| **Receptor** 1 South | 0.617 | 0.469 | 9.215 | 23.806 | 4.666 | 0.01 | 0.021 |
| **Receptor** 2 South | 0.236 | 0.174 | 3.173 | 8.419 | 1.688 | 0.004 | 0.007 |
| **Receptor** 3 South | 0.164 | 0.119 | 2.094 | 5.584 | 1.128 | 0.002 | 0.005 |

473. The above values represent the contribution of the traffic to the background values in the year 2019 when the road is expected to enter in full service. With reference to the $PM_{10}$ it can be assumed with high confidence a background value of 17 µg/m$^3$ in is in accordance with the field measurements carried in September 2017.

474. Scenario for the interval years 2019 to 2034 - The following estimations have been calculated according to **Table F-4**, which reports the estimated increments/year of the average monthly concentration for the expected traffic increments. When background values are available they are considered into the calculations.

475. The average resulting values are presented in the below **Table F-5** and **Table F-6** which shows the increments, the background and the final expect values.

**Table. F-5 - $PM_{10}$ (µg/$m^3$) Comparison of expected values at 2019, background and limits**

| Receptor | Δ estimated yearly increment (aver.) $PM_{10}$ | Background level | Total | Limits (year) |
|---|---|---|---|---|
| **Receptor** 1 North | 0,315 | 17 | 17.315 | 40.0 |
| **Receptor** 2 North | 0,156 | 17 | 17.156 | 40.0 |
| **Receptor 3** North | 0,088 | 17 | 17.088 | 40.0 |
| **Receptor** 1 South | 0,617 | 17 | 17.617 | 40.0 |
| **Receptor** 2 South | 0,236 | 17 | 17.236 | 40.0 |
| **Receptor** 3 South | 0,164 | 17 | 17.164 | 40.0 |

476. The data analysis confirms that the emission of $PM_{10}$ generated by the traffic, at 2019, is very limited and even taking into account the background levels will not exceed the allowable limits. It must be taken into account that the largest part of the traffic generating the background will be diverted into the new road, for that the above scenario has to be considered very conservative.

**Table F-6 - $NO_2$ (µg/$m^3$) Comparison of expected values at 2019, background and limits**

| Receptor | yearly estimated Δ (average increment) $NO_2$ | Background level | Total | Limits (in one year) |
|---|---|---|---|---|
| **Receptor** 1 North | 7.393 | - | 7.393 | 40 |
| **Receptor** 2 North | 3.171 | - | 3.171 | 40 |
| **Receptor 3** North | 1.730 | - | 1.730 | 40 |
| **Receptor** 1 South | 9.215 | - | 9.215 | 40 |
| **Receptor** 2 South | 3.173 | - | 3.173 | 40 |
| **Receptor** 3 South | 2.094 | - | 2.094 | 40 |

477. The impact of the $NO_2$ emissions can only be perceived in the proximity of the road; there are no background data available.

478. The application of increment of emissions determined by the expected increase of traffic, permitted to develop the following tables (**Table F-7**, **F-8**, **F-9** and **F-10**) where the yearly increment of pollution for the considered pollutants is put into evidence. This data is also mapped in **Figure F-1** to **Figure F-12**.

**Table F-7: General scenario at 2034 for $PM_{10}$, $NO_X$ and $NO_2$**

| Receptors | $PM_{10}$ | $PM_{2.5}$ | $NO_2$ | $NO_X$ | CO | $SO_2$ | C6H6 |
|---|---|---|---|---|---|---|---|
| **Receptor** 1 North | 0.442 | 0.332 | 7.850 | 17.745 | 3.267 | 0.007 | 0.014 |
| **Receptor** 2 North | 0.220 | 0.160 | 3.417 | 8.019 | 1.528 | 0.003 | 0.007 |
| **Receptor** 3 North | 0.125 | 0.088 | 1.879 | 4.276 | 0.813 | 0.002 | 0.004 |
| **Receptor** 1 South | 0.872 | 0.663 | 10.299 | 29.579 | 6.612 | 0.015 | 0.029 |
| **Receptor** 2 South | 0.337 | 0.250 | 3.631 | 10.609 | 2.424 | 0.005 | 0.011 |
| **Receptor** 3 South | 0.235 | 0.171 | 2.429 | 7.103 | 1.635 | 0.004 | 0.007 |

**Table F-8: Yearly scenario 2019 to 2034 for $PM_{10}$ (including background at 2019)**

| year | **Receptor** 1 North | **Receptor** 2 North | **Receptor** 3 North | **Receptor** 1 South | **Receptor** 2 South | **Receptor** 3 South |
|---|---|---|---|---|---|---|
| 2019 | 17.32 | 17.16 | 17.09 | 17.62 | 17.24 | 17.16 |
| 2034 | 17.44 | 17.22 | 17.12 | 17.87 | 17.34 | 17.24 |

**Table F-9: Yearly scenario 2019 to 2034 for $NO_2$ (No background)**

| year | **Receptor** 1 North | **Receptor** 2 North | **Receptor** 3 North | **Receptor** 1 South | **Receptor** 2 South | **Receptor** 3 South |
|---|---|---|---|---|---|---|
| 2019 | 7.39 | 3.17 | 1.73 | 9.21 | 3.17 | 2.09 |
| 2034 | 7.85 | 3.42 | 1.88 | 10.30 | 3.63 | 2.43 |

**Table F-10: Yearly scenario 2019 to 2034 for CO (No background)**

| year | **Receptor** 1 North | **Receptor** 2 North | **Receptor** 3 North | **Receptor** 1 South | **Receptor** 2 South | **Receptor** 3 South |
|---|---|---|---|---|---|---|
| 2019 | 2.31 | 1.07 | 0.56 | 4.67 | 1.69 | 1.13 |
| 2034 | 3.27 | 1.53 | 0.81 | 6.61 | 2.42 | 1.63 |

479. The analysis of the impact on operational phase air quality determined by the traffic on the new road suggests that there are no negative impacts on the environment. In addition to the fact that the maximum allowable limits are not surpassed, it must be taken into account that the road provides benefits in term of vehicular emission due to the smoother drive and optimized alignment.

480. The emissions of vehicles on a highway are lower than vehicles driving a urban type road as the existing one where the frequent bends, inclination and traffic congestions do not allow a fluid drive. If a similar traffic flow should transit via the existing road, the emissions would be almost 20% higher.

**Figure F-1: PM10, 2019 (Km 0 – Km 8)**

**Figure F-2: PM10, 2034 (Km 0 – Km 8)**

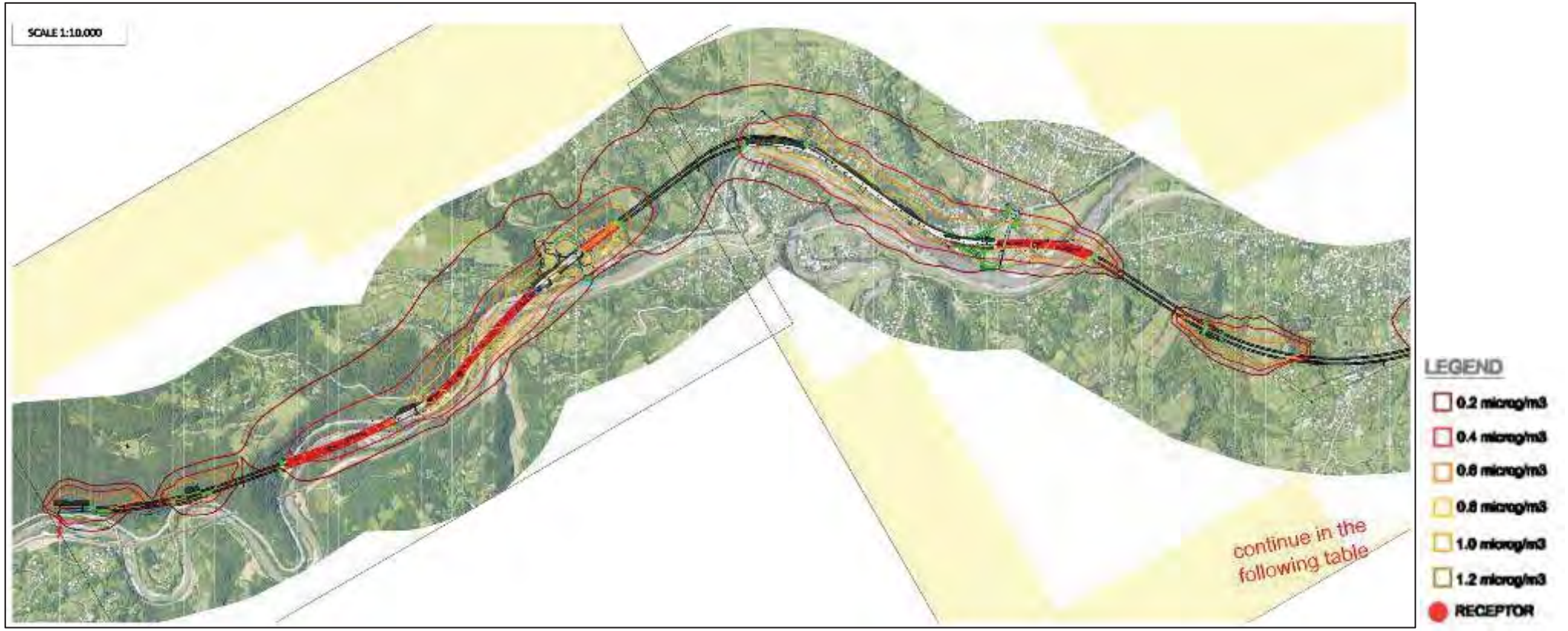


**Figure F-3: PM10, 2019 (Km 8 – Km 14.7)**

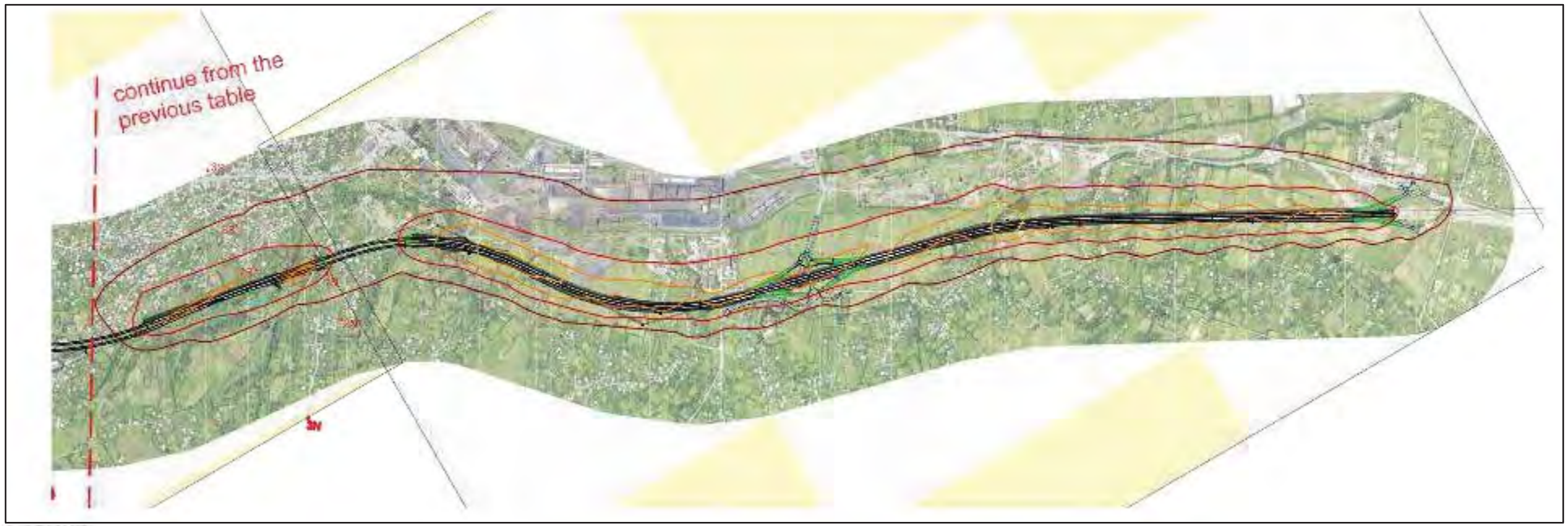


**Figure F-4: PM10, 2034 (Km 8 – Km 14.7)**

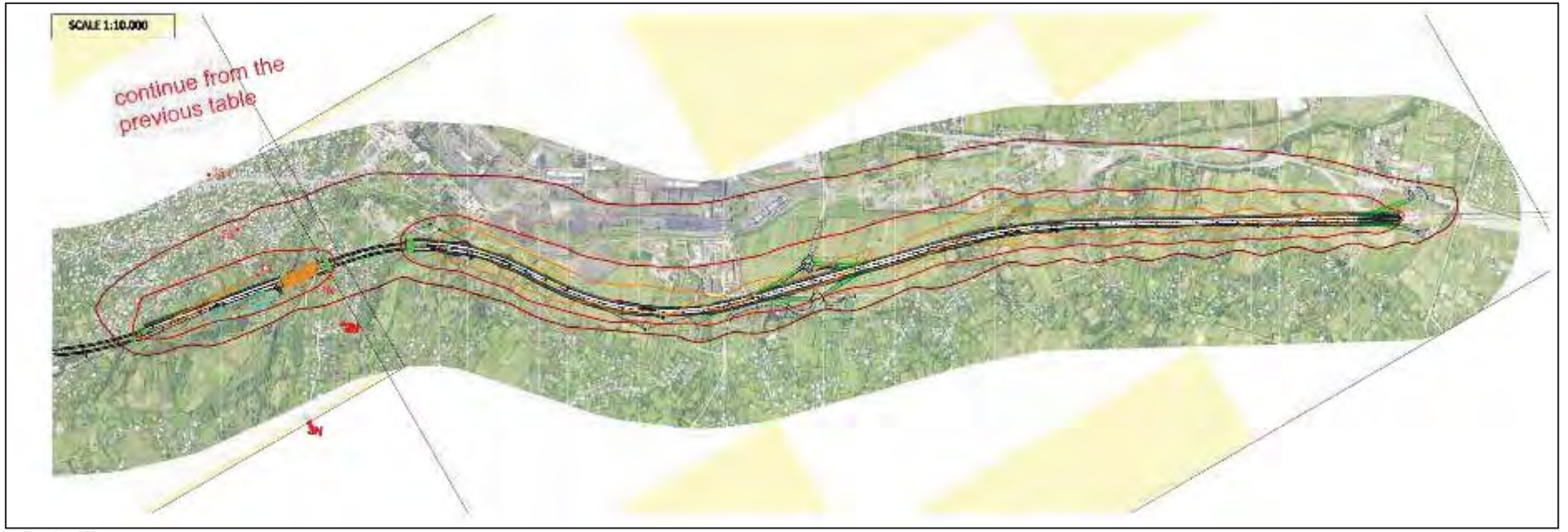


**Figure F-5: NO2, 2019 (Km 0 – Km 8)**

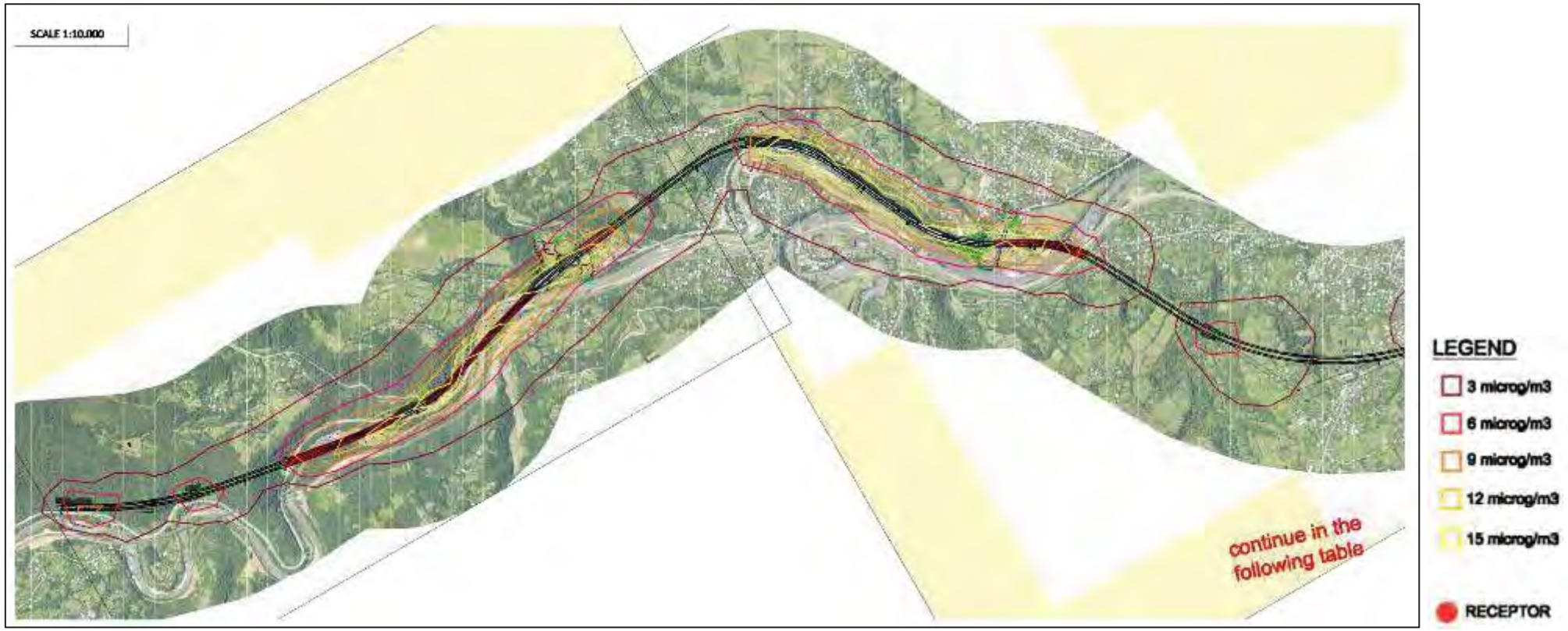


**Figure F-6: NO2, 2034 (Km 0 – Km 8)**

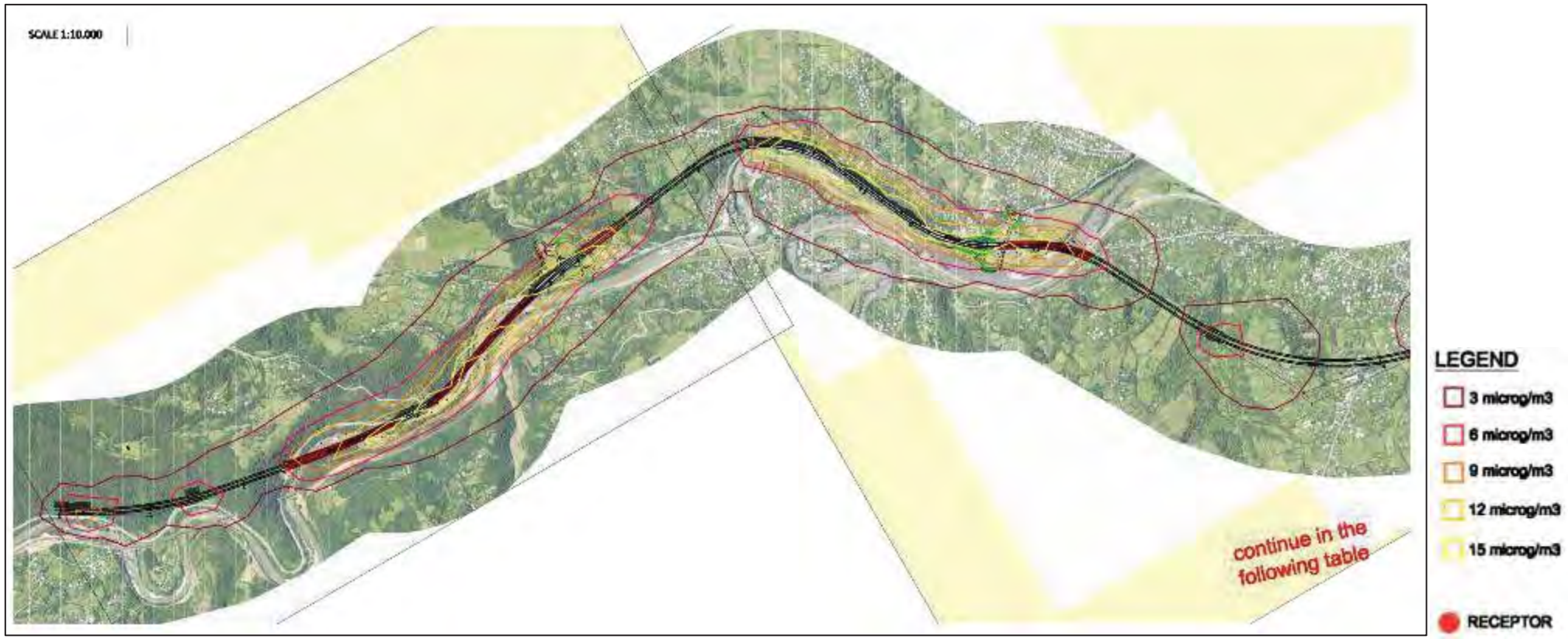


**Figure F-7: NO2, 2019 (Km 8 – Km 14.7)**

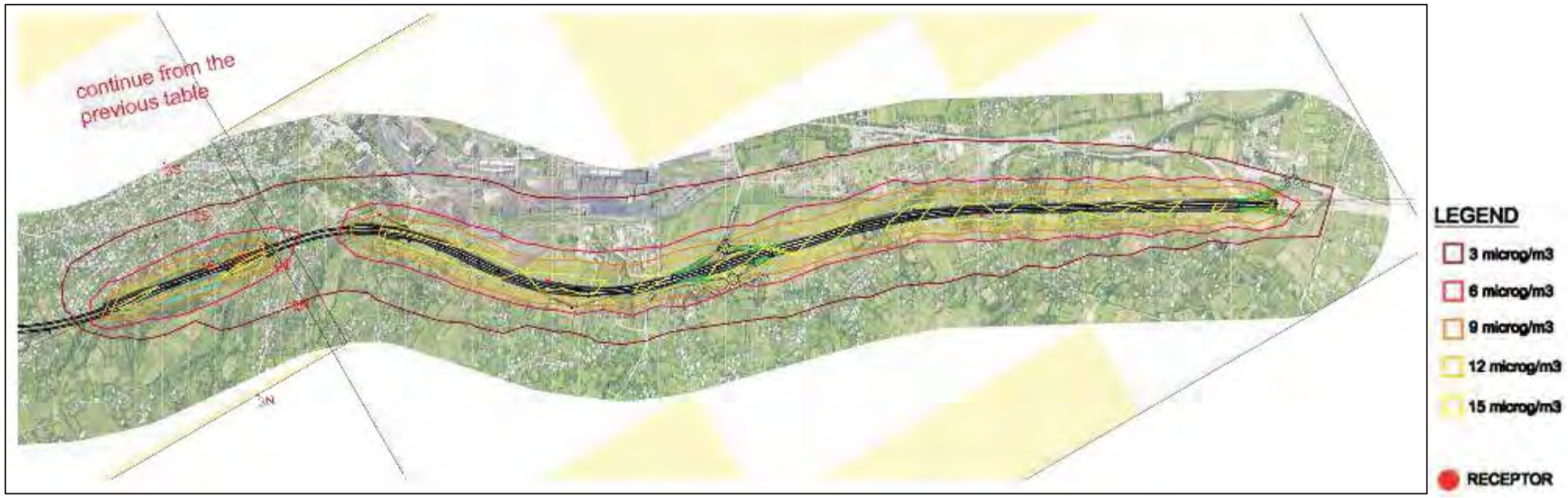


**Figure F-8: NO2, 2034 (Km 8 – Km 14.7)**

**Figure F-9: CO, 2019 (Km 0 – Km 8)**

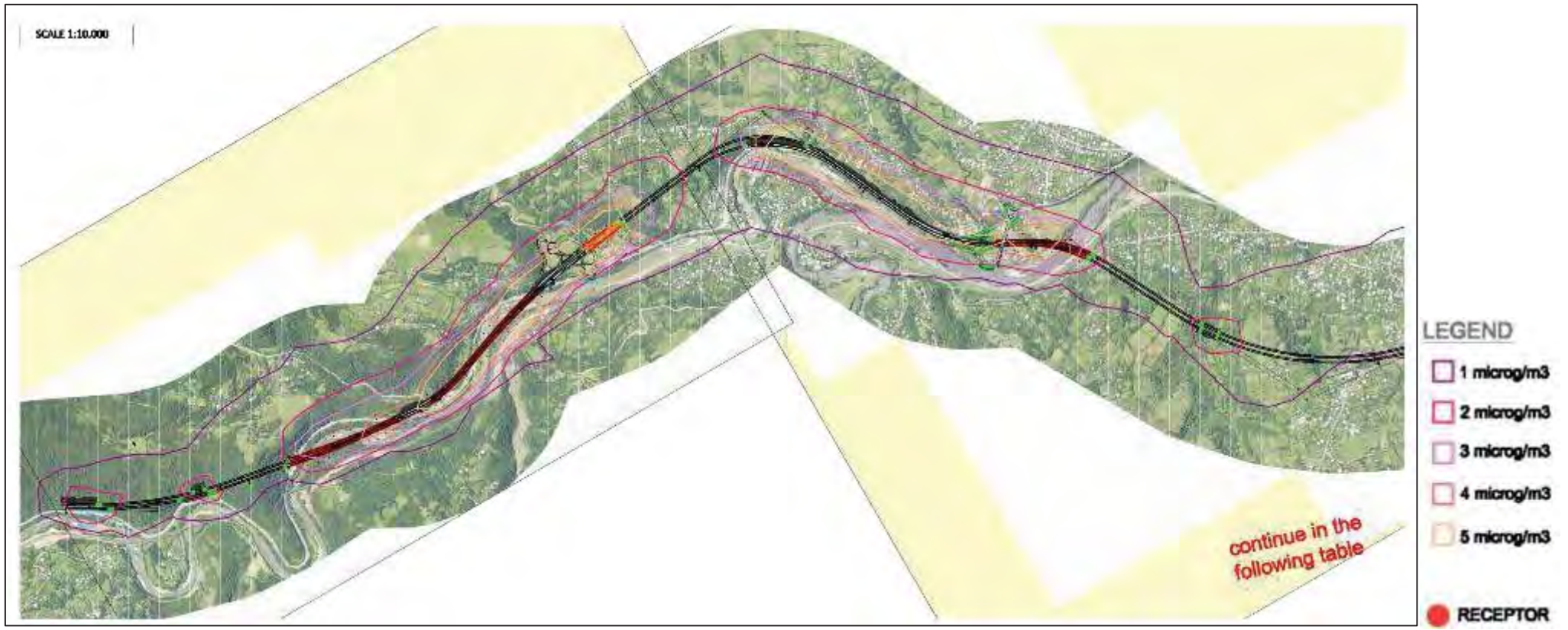


**Figure F-10: CO, 2034 (Km 0 – Km 8)**

**Figure F-11: CO, 2019 (Km 8 – Km 14.7)**

**Figure F-12: CO, 2034 (Km 8 – Km 14.7)**