Environmental Impact Assessment

Final – March 2018

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

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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 250m^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. <u>Induced Impacts</u> – 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. <u>Instrumental Monitoring</u> – 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

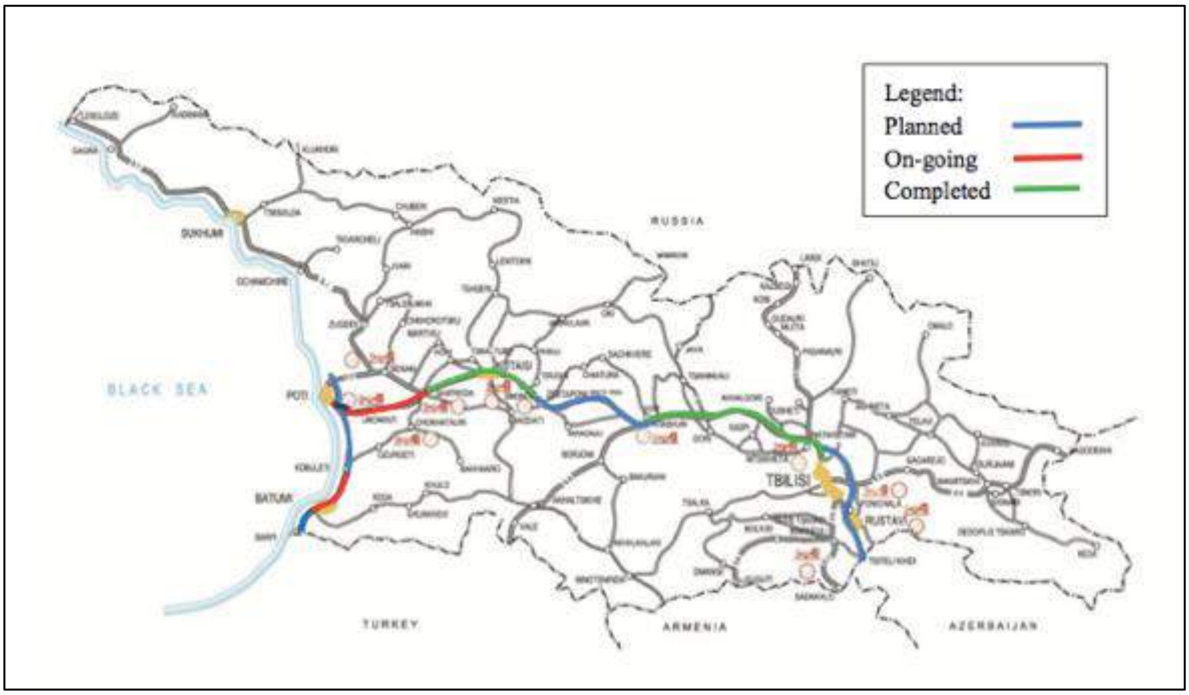
A.1 General

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. 50 m around construction camps and ancillary facilities, e.g. asphalt plants. 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). 500 meters from construction camps and ancillary facilities.	250 m from centerline of road. 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)

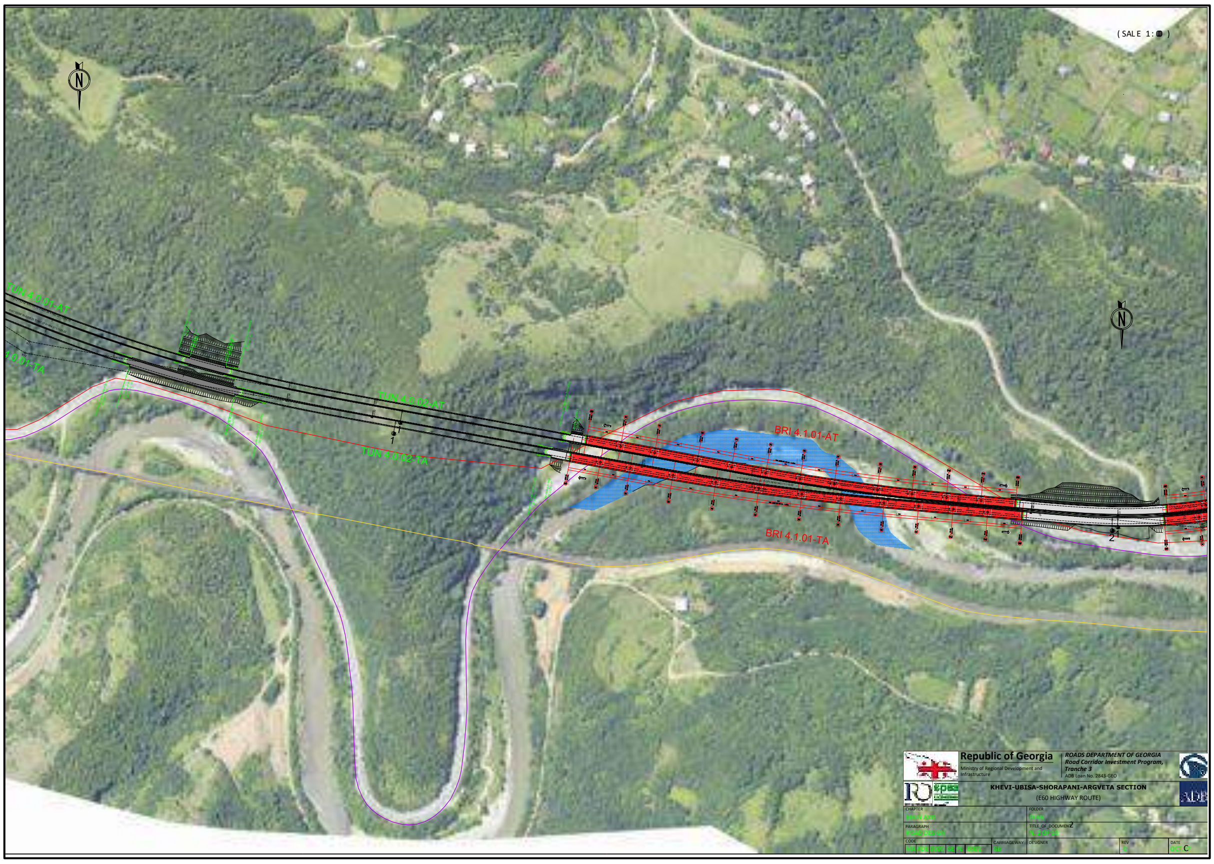


Figure B-5: Project Road (KM2.1 – 3.7)

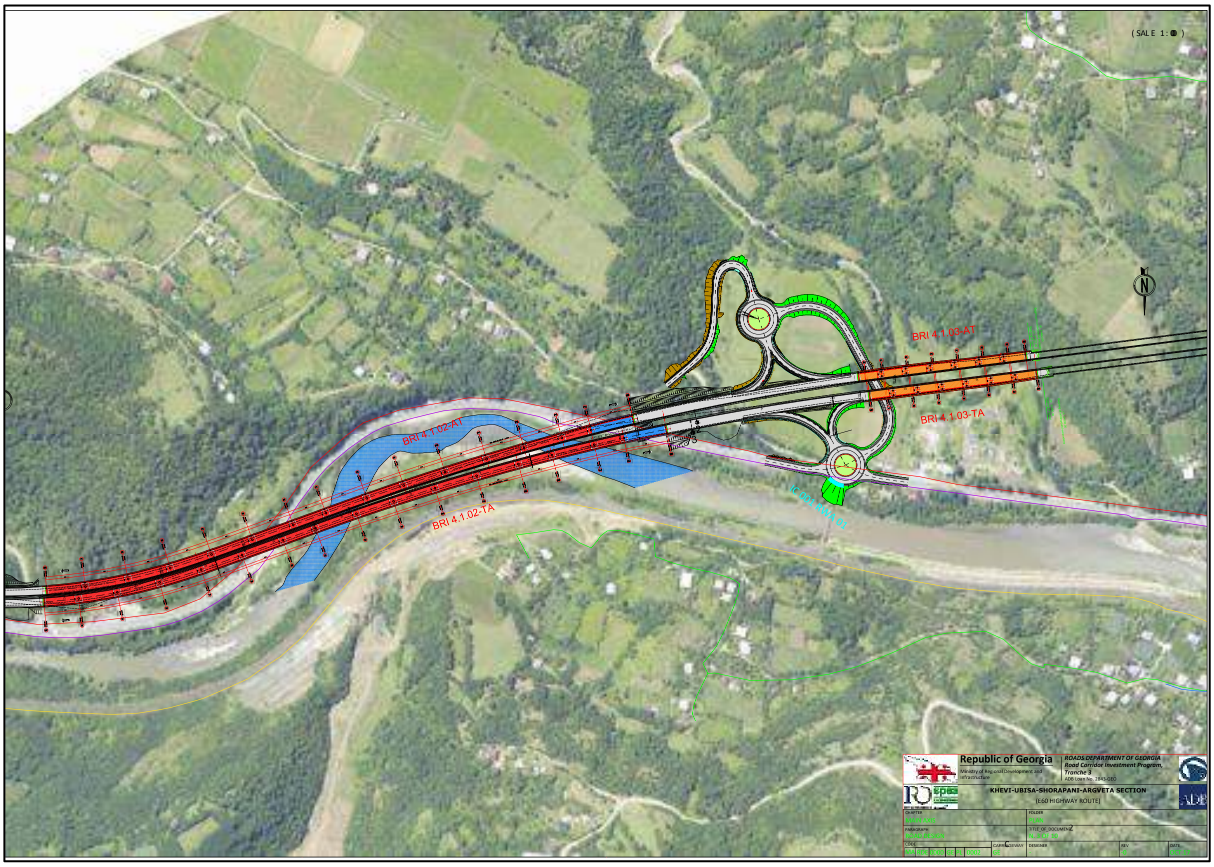


Figure B-6: Project Road – KM3.7 – 5.5

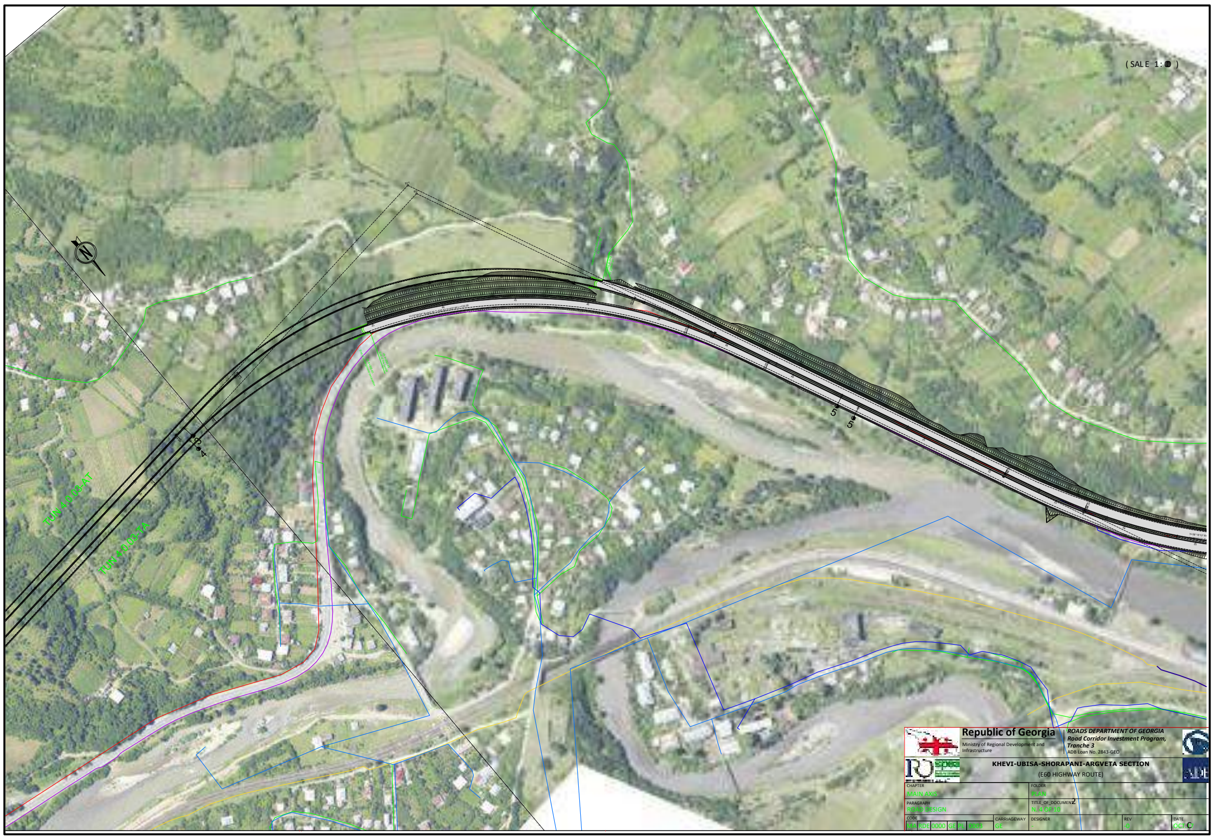


Figure B-7: Project Road (KM5.5 – 7.0)

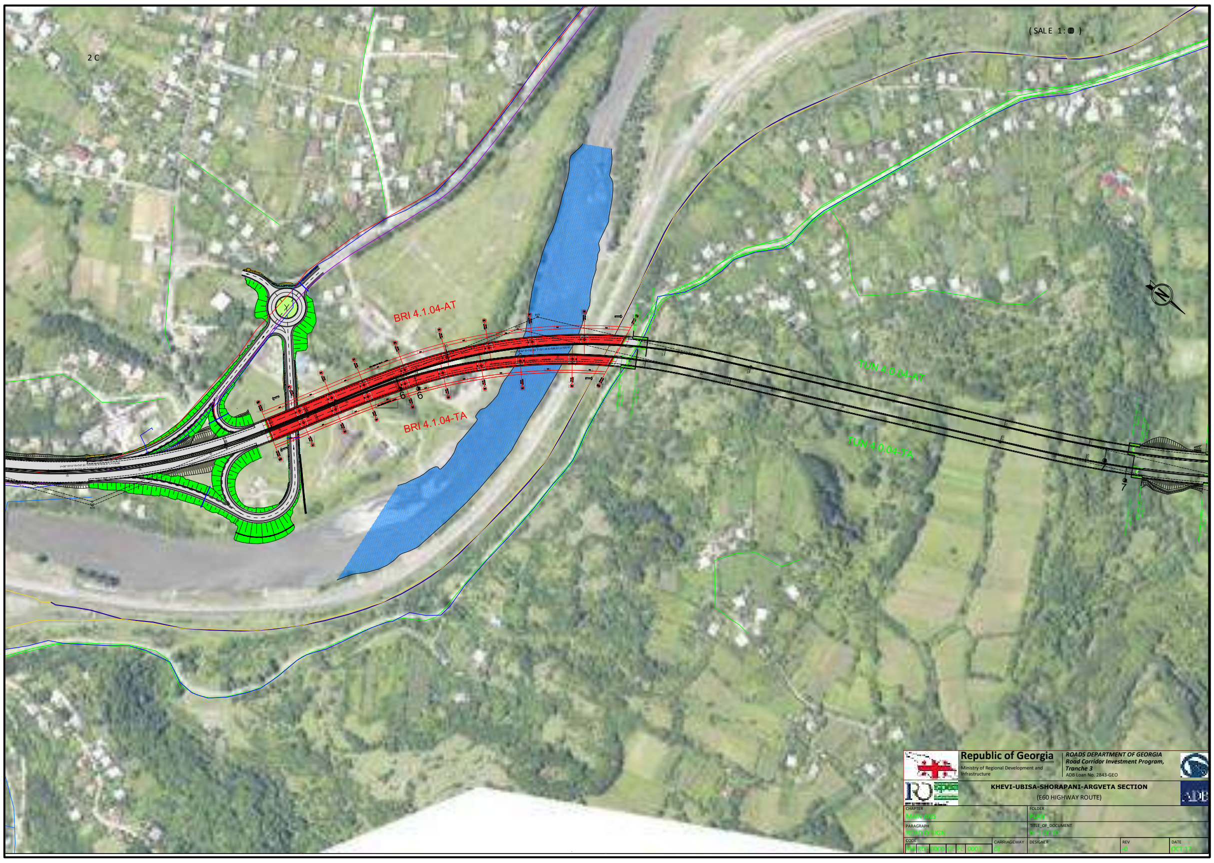


Figure B-8: Project Road (KM7.0 – 8.7)

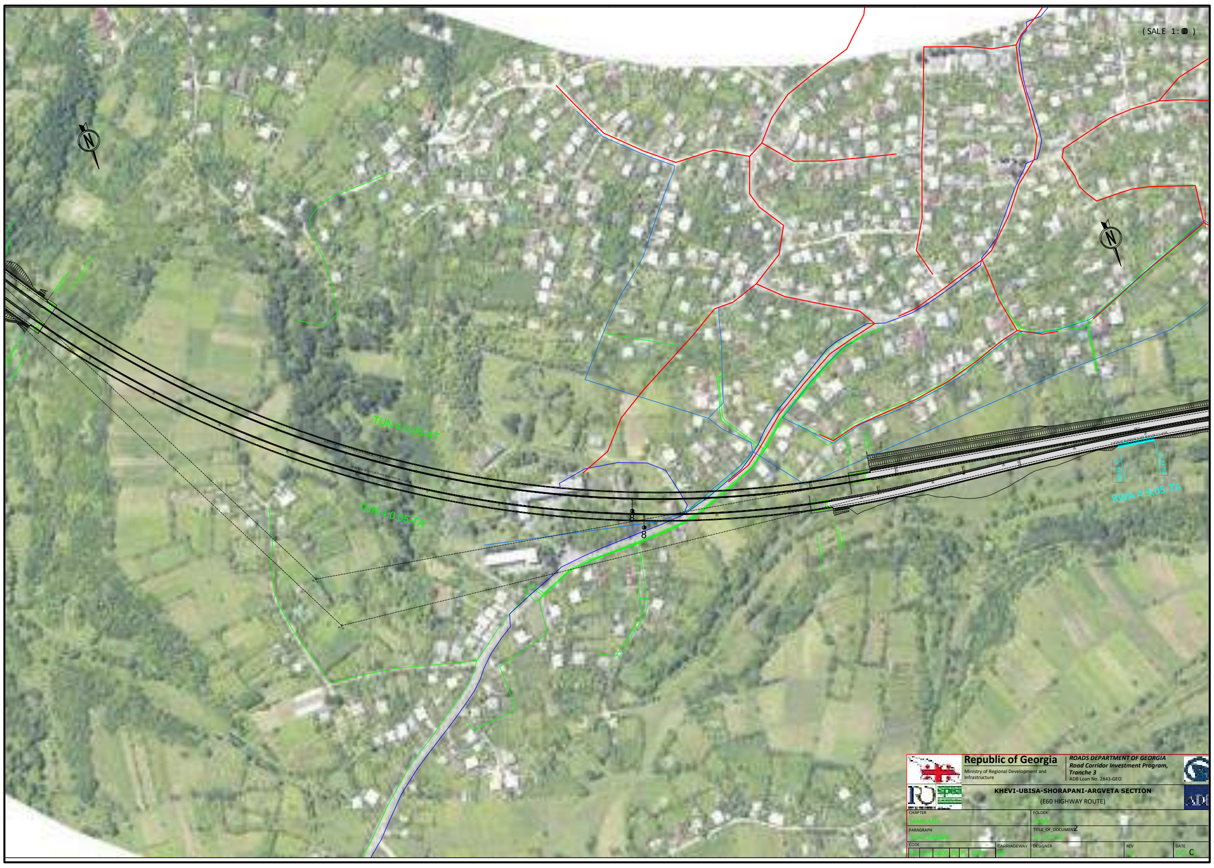


Figure B-9: Project Road (KM8.7 – 10.3)

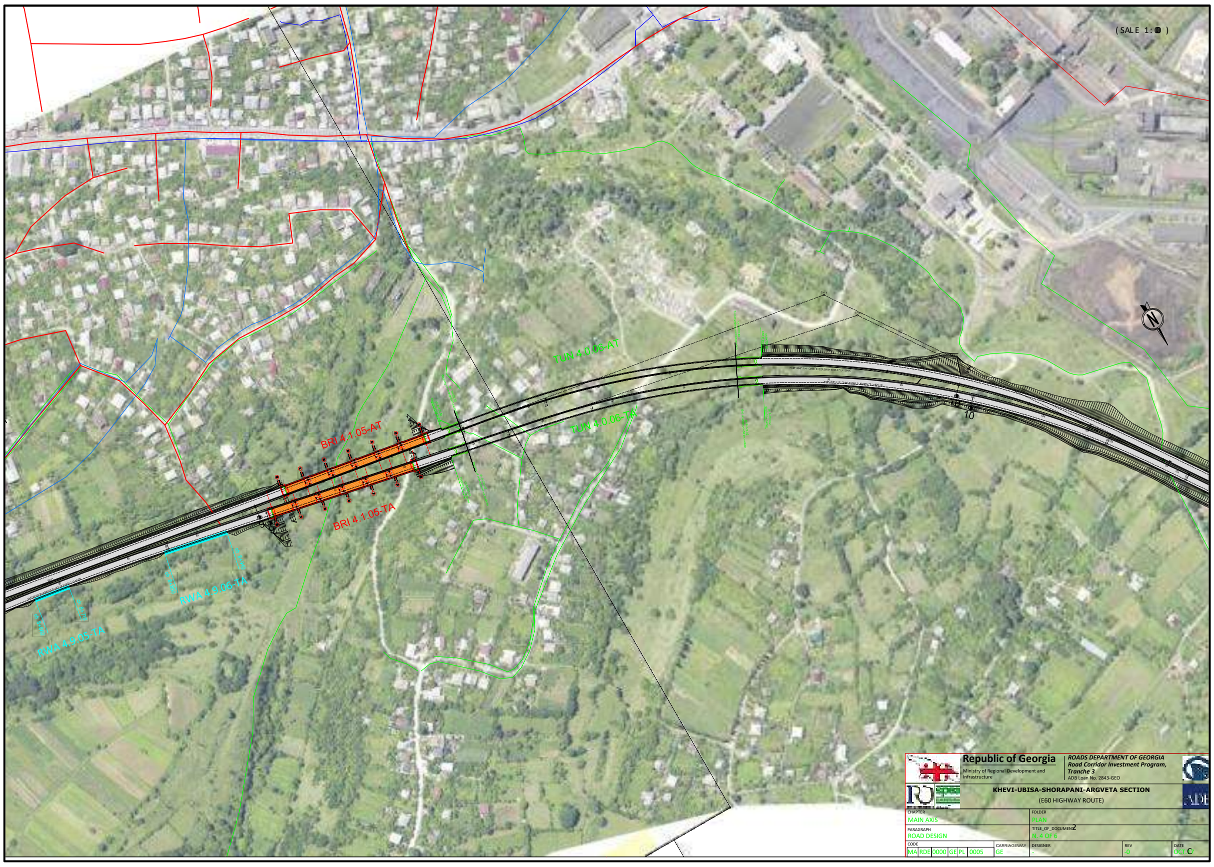


Figure B-10: Project Road (KM10.0-11.6)

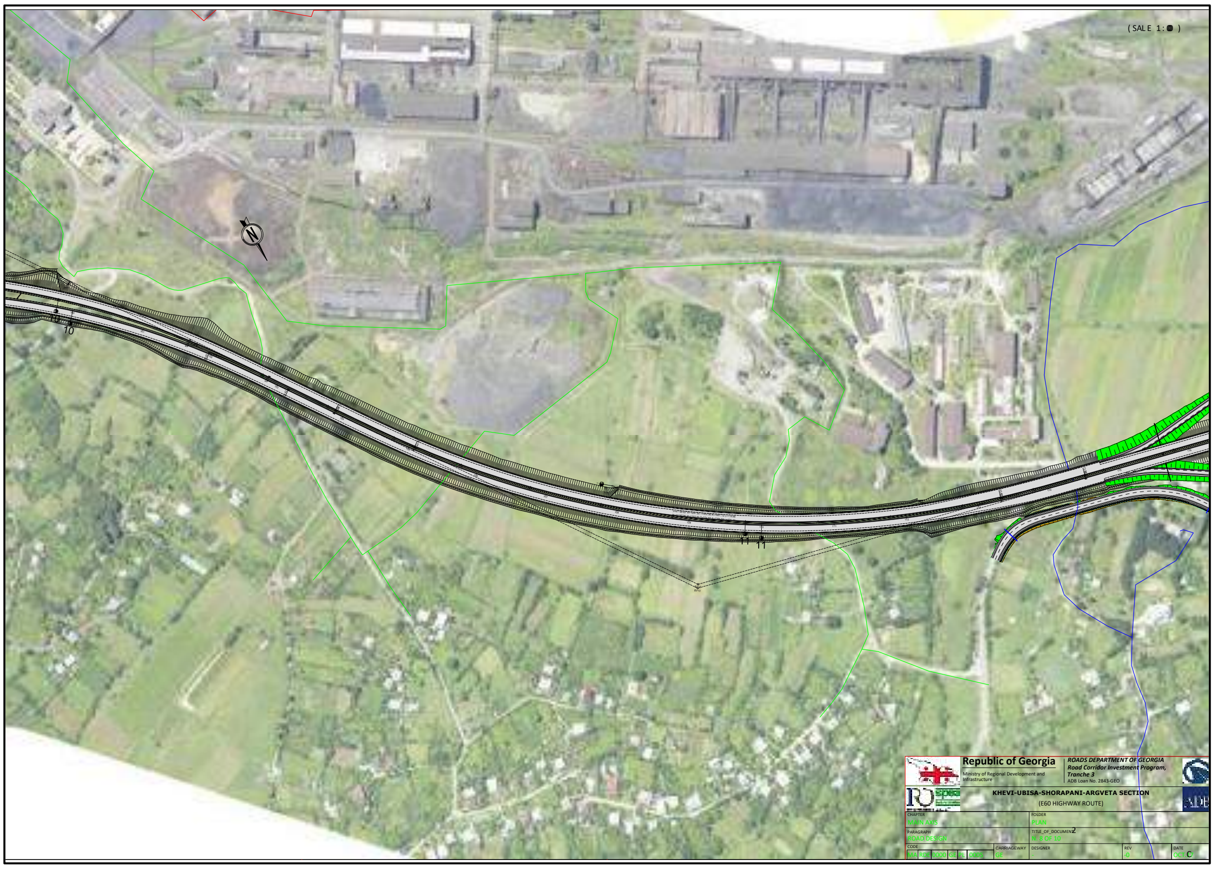


Figure B-11: Project Road – KM11.5 – 13.0

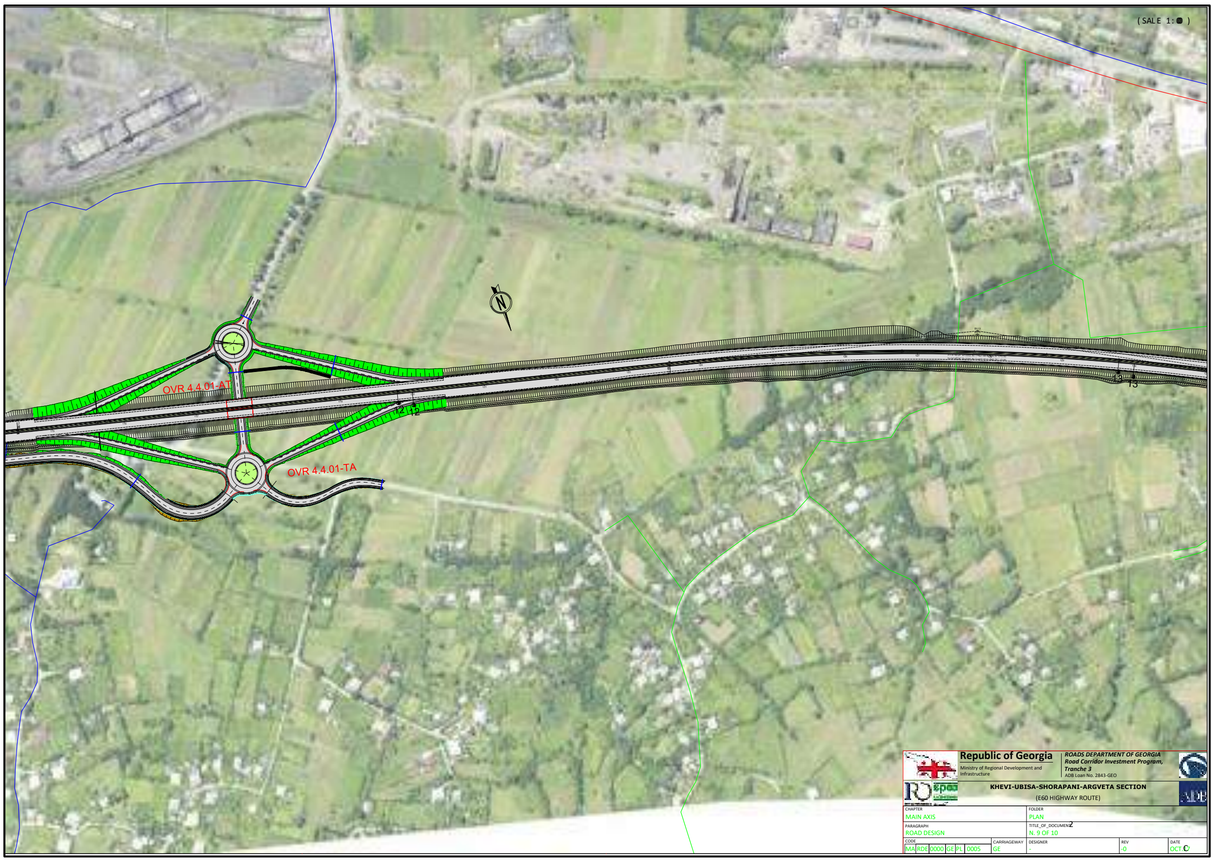


Figure B-12: Project Road – KM13.0 – 14.7

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.

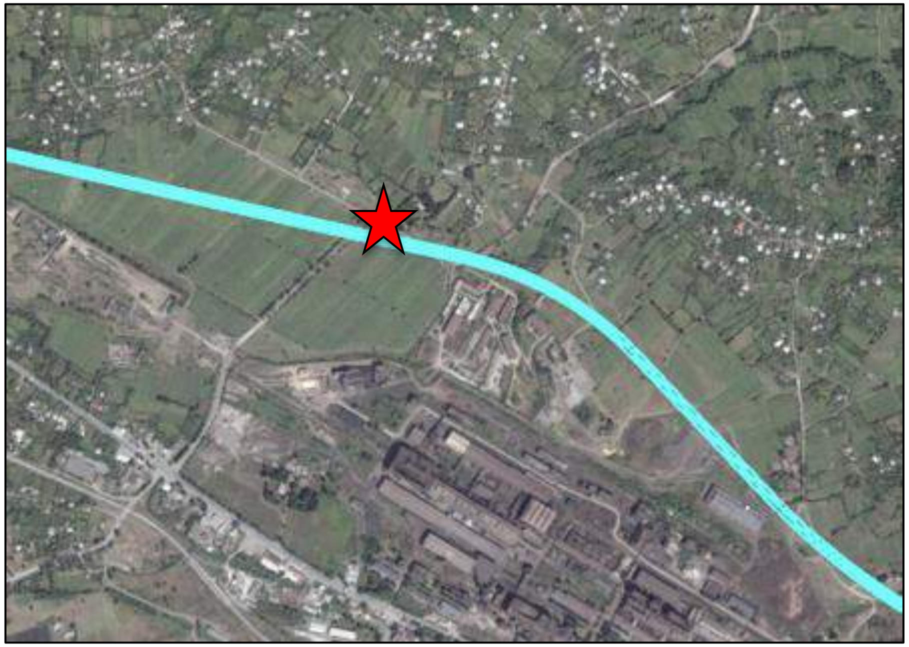
KM4.3 - After the interchange the road enters a tunnel emerging on the south side of the Dzirula river opposite the 'center' of Shorapani. A number of residential properties and apartment blocks are located in this area as well as a school. The photo above is taken from a small pedestrian bridge crossing 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).

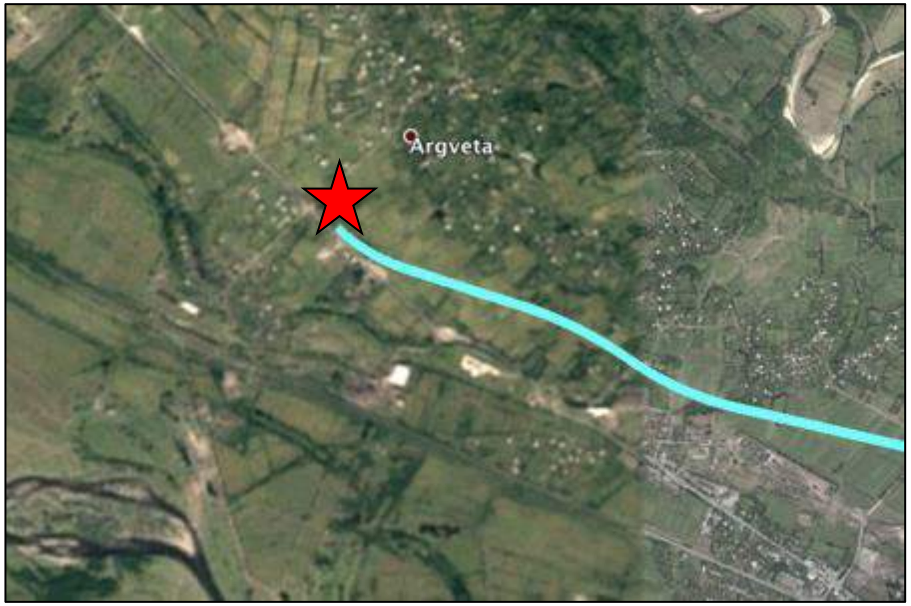
KM6.0 - The road continues west towards Zestafoni. In this area a few residential buildings can be observed as well as some light industrial and commercial properties. At this point the Kvirila river joins with the Dzirula River. The alignment will then cross the Kvirula river and enter directly into 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

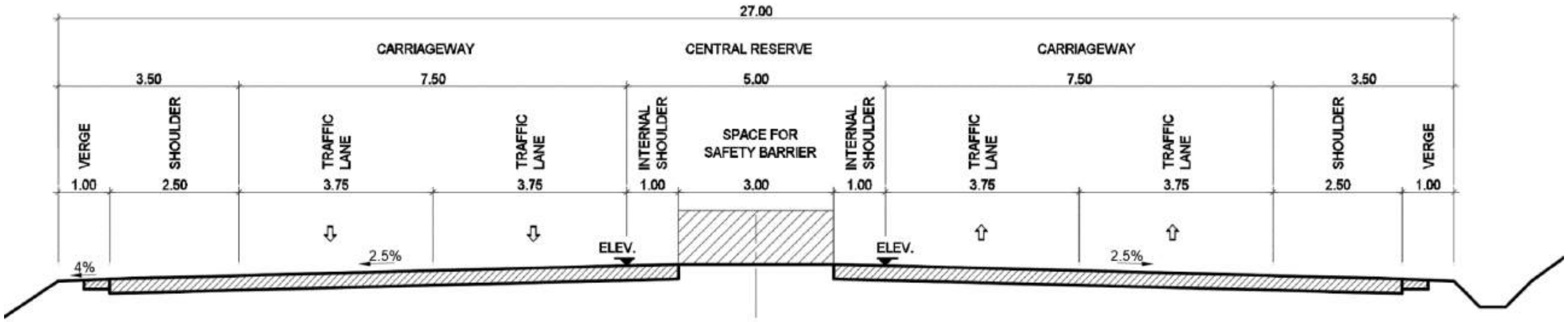


Figure B-15: Cross Section on Bridges

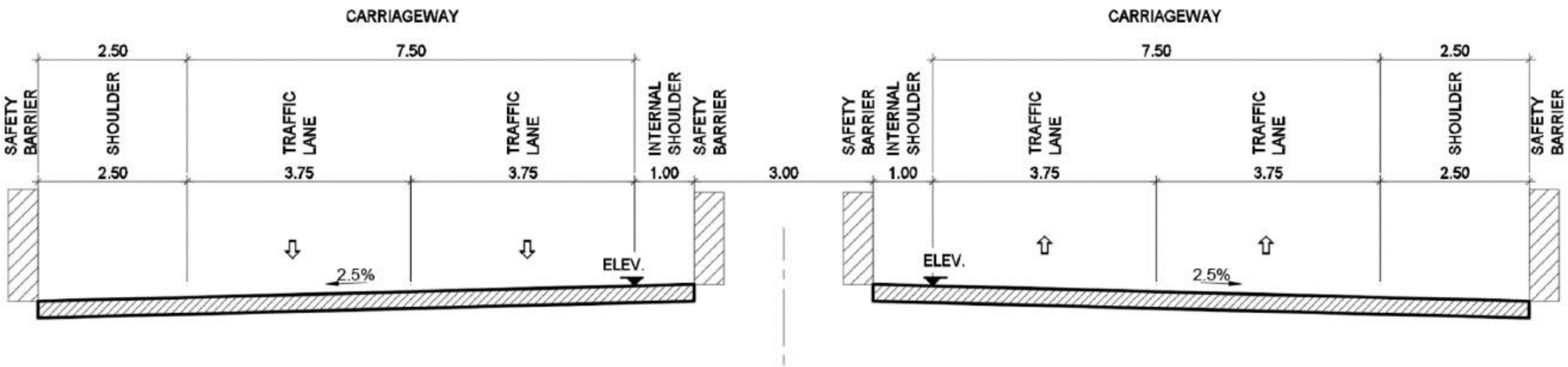
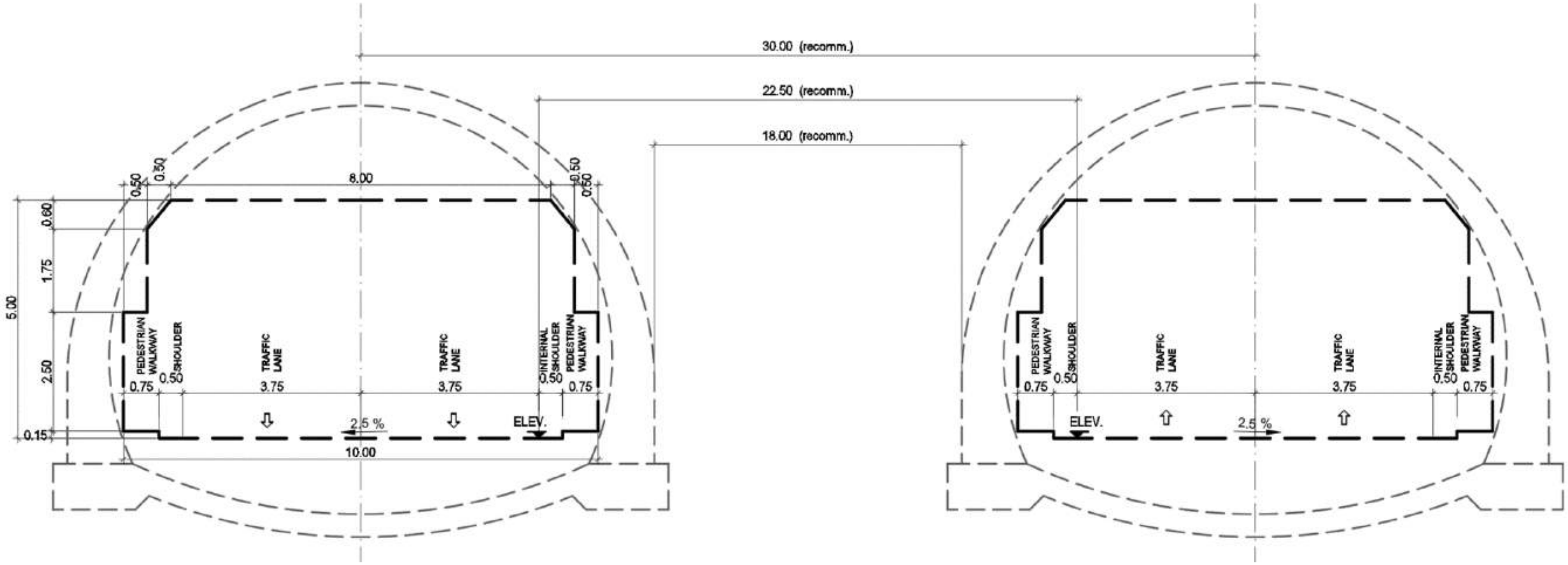


Figure B-16: Cross Section in Tunnels



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:

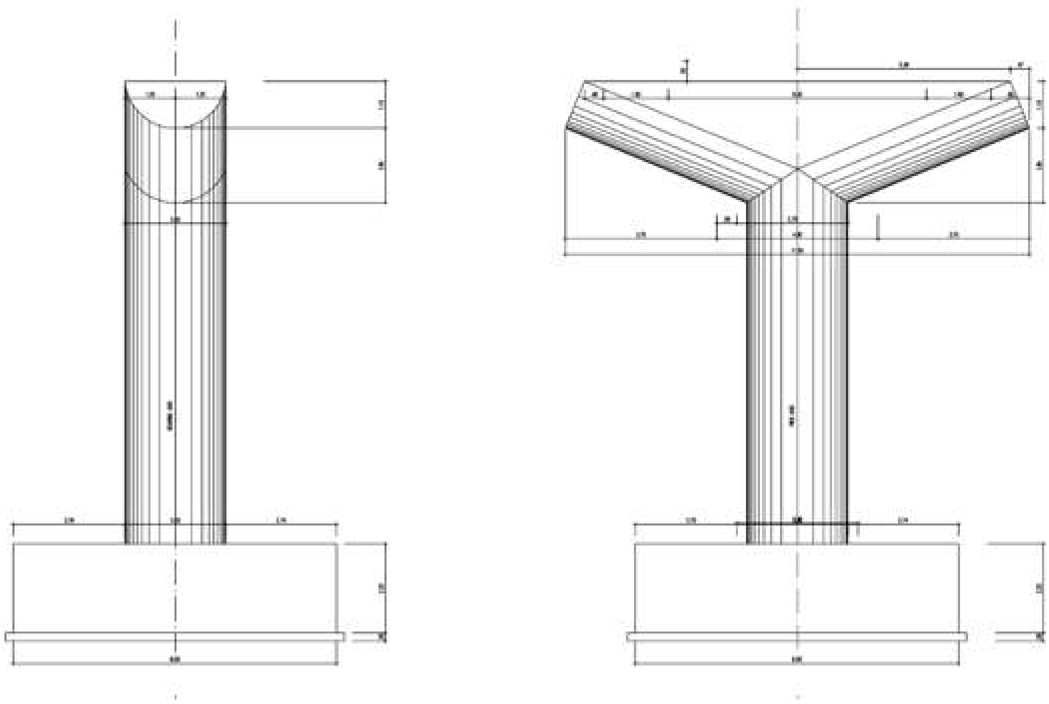
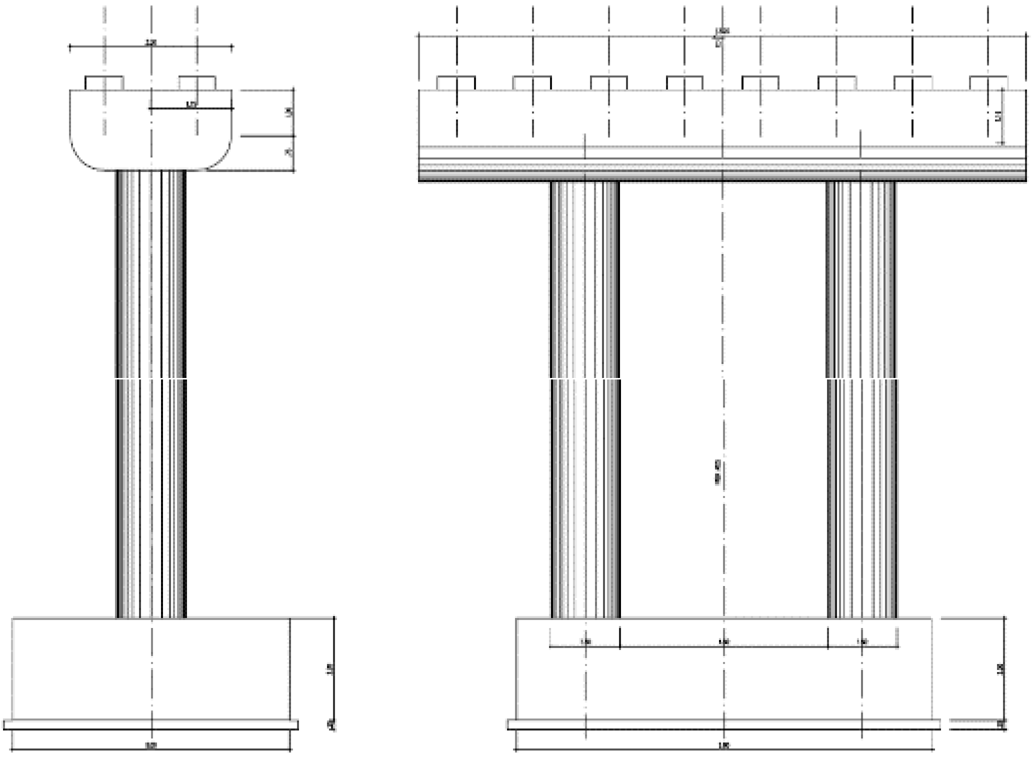
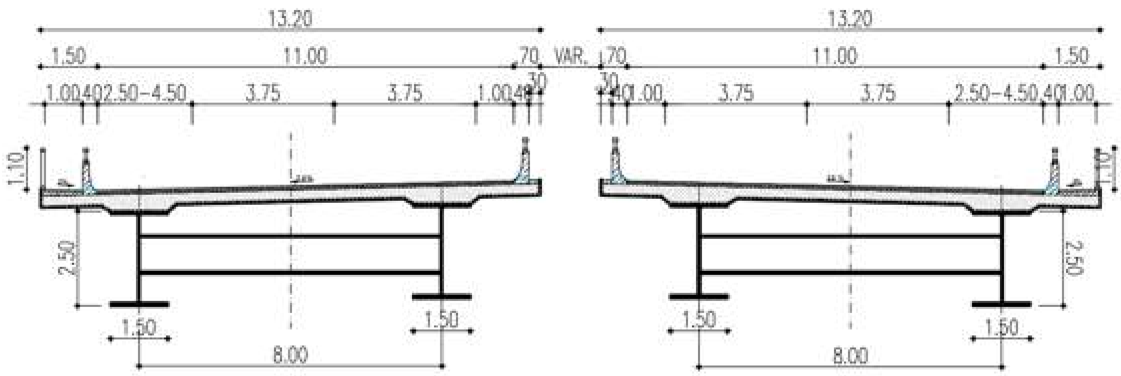


Figure B-18: For pre-stressed precast PSC beams bridges – type 2



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.

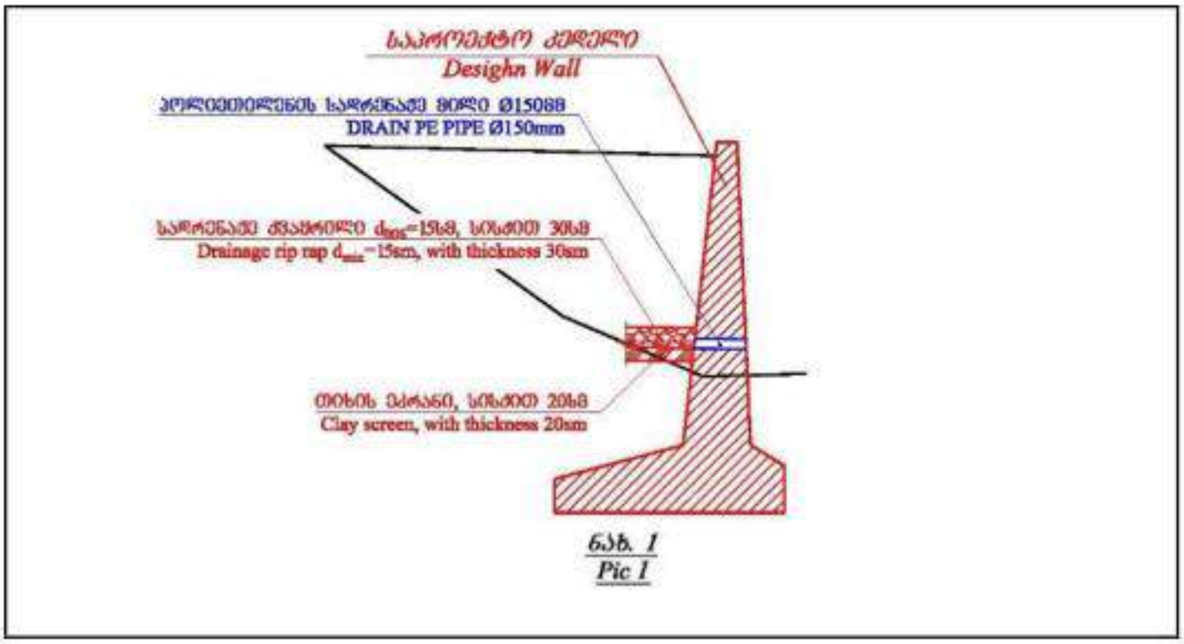
B.8 Retaining Walls

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



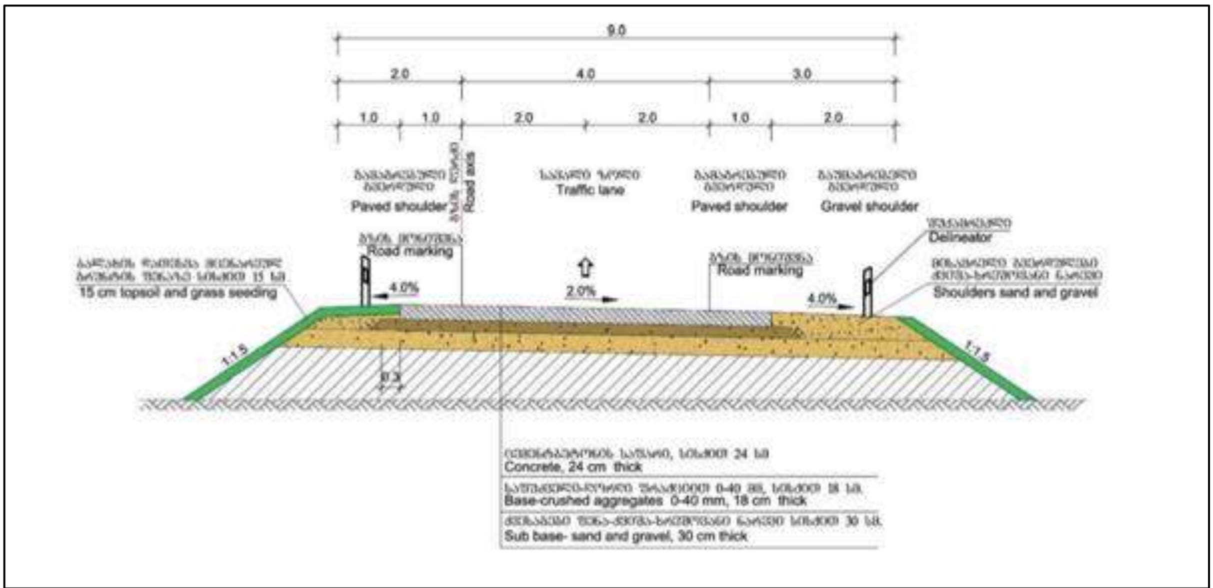
B.9 Interchanges

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. Control of the Expected Deformation Response may come about by: • 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; • 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; • 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 • 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

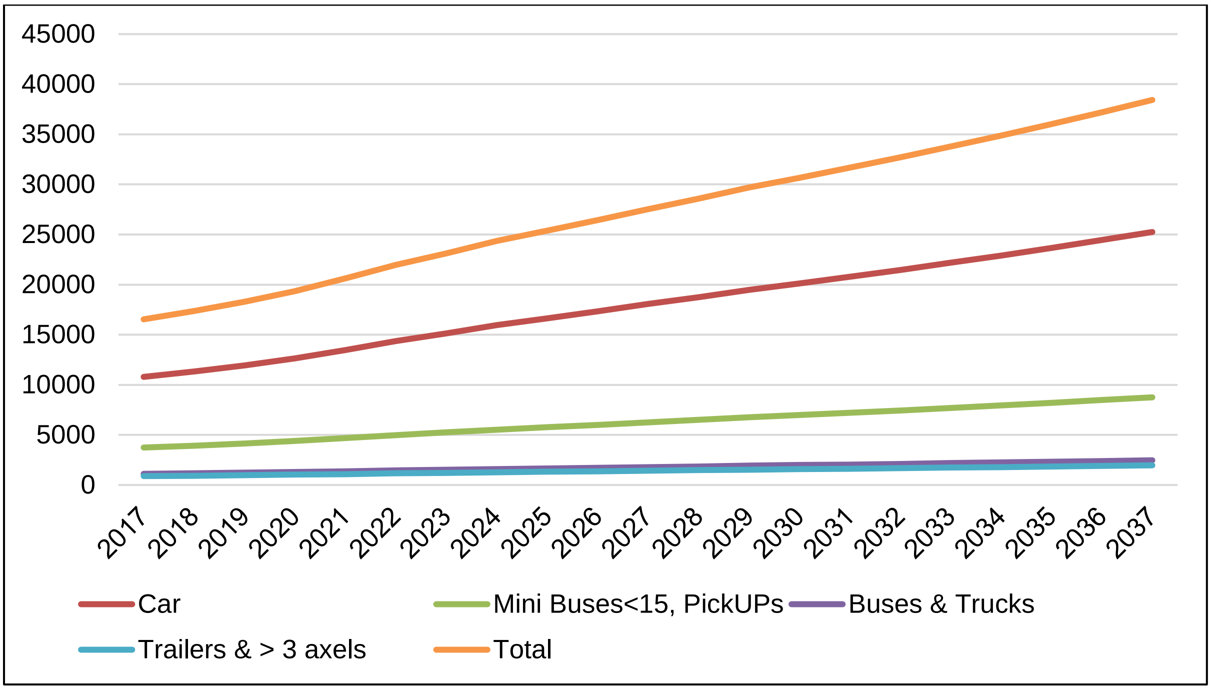
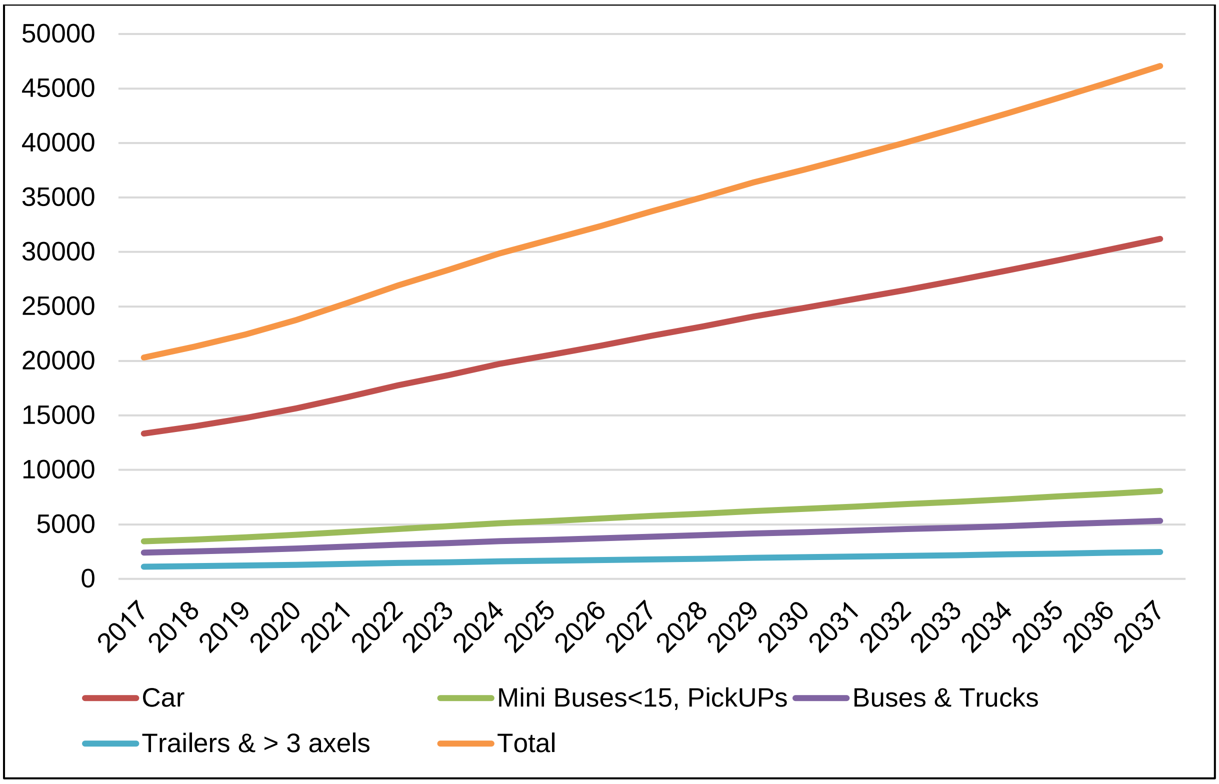


Figure B-23: Forecasted Traffic, Argveta (approx. KM 14), 2017 - 2037



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

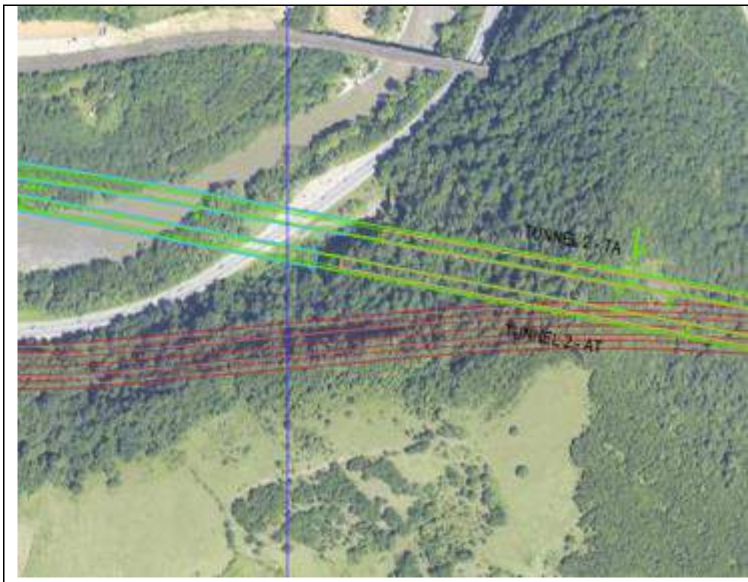
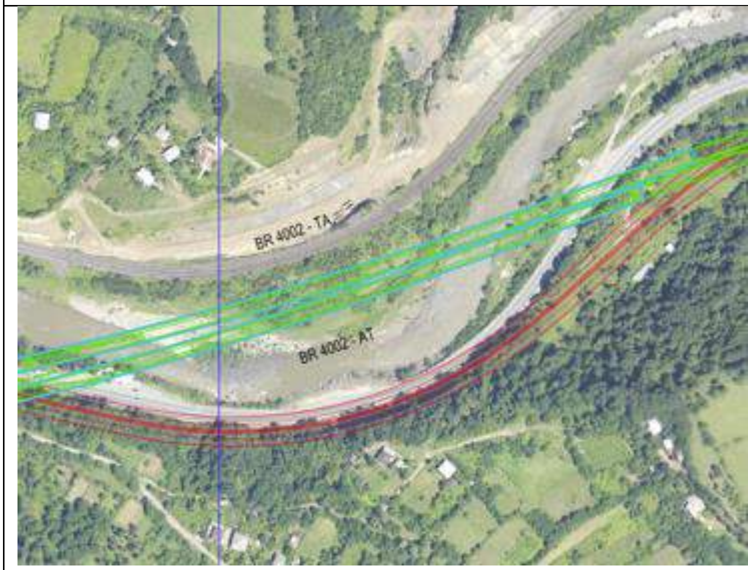
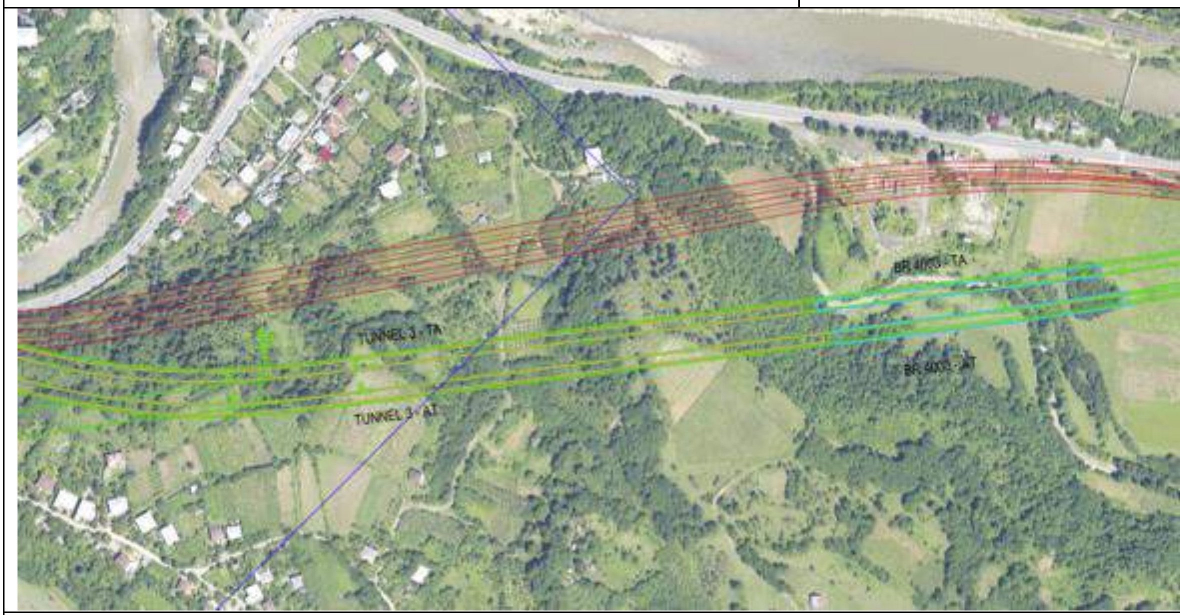
220. Given the complex topography of the region and Georgia in general, there are no other feasible alternative corridors that would be able to compete with the existing corridor in terms of travel times. In addition the Project forms part of the overarching program to upgrade the E-60 motorway which 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

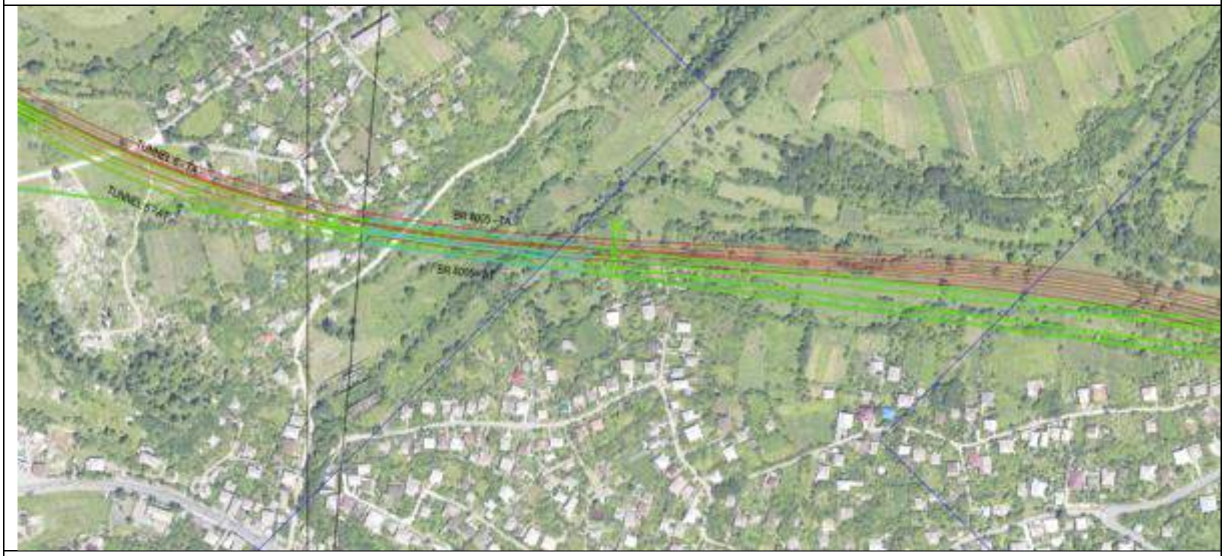
221. As noted above, the Project forms part of a program upgrading the E-60. The Khevi – Argveta section of the E-60 (including section F4) if one of the last remaining sections of the road requiring upgrading. Accordingly, the Project is focusing on the upgrading of the E-60 and will not consider any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

C.5 Alternative Alignments

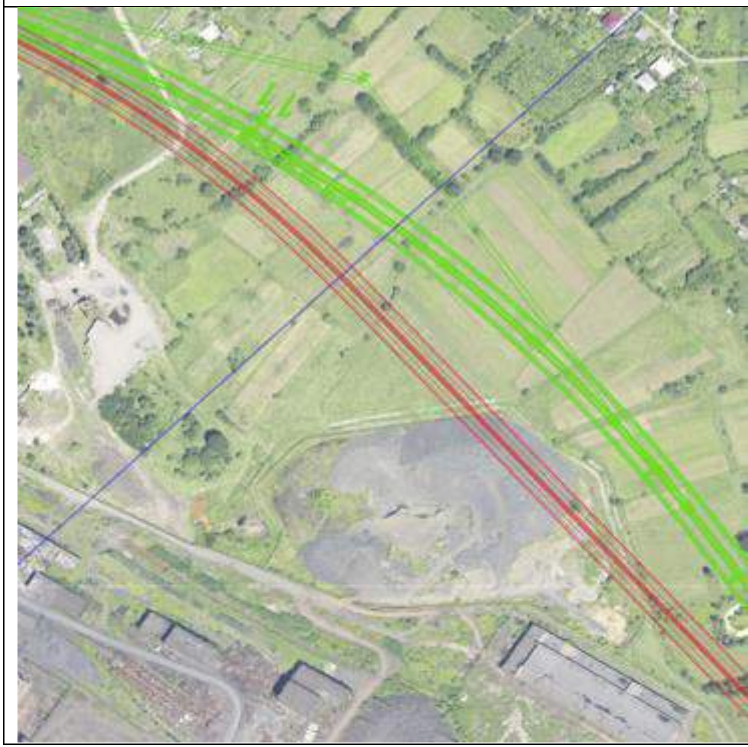
222. During the Projects Feasibility Phase a number of alignments were considered that broadly follow the existing E-60 corridor. The result of the Feasibility Report was a draft final corridor which the detailed design would use as a basis for the final road alignment (horizontal and vertical). During 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: a. EIA report; 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. c. Notification about a confidential part of a submitted application, if applicable; d. Copy of the document evidencing payment of the fee (500 GEL) in accordance with the existing legislation. 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: a. The content and brief description of the issue to be discussed, format of the discussion; b. The time, place and rules of the public hearing; 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. 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 Law No.5603 on Ecological Expertise Law No 890-II Environmental Assessment Code 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 Law No.5603 on Ecological Expertise Law No 890-II Environmental Assessment Code 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 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:

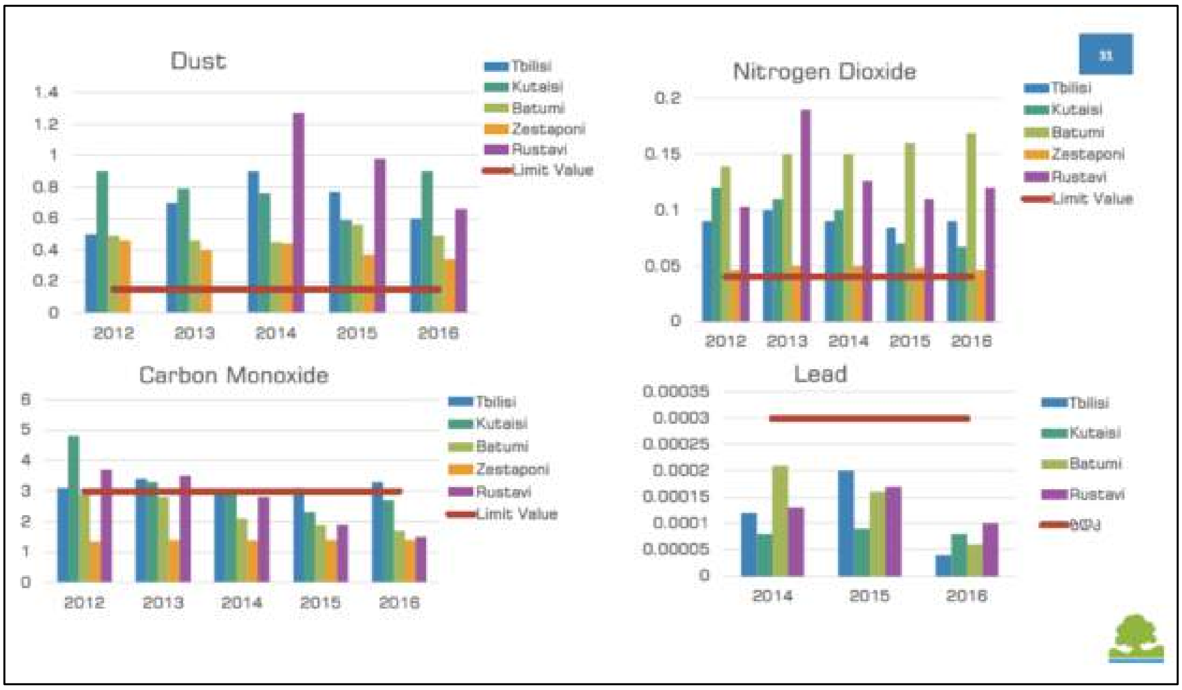
- Physical Resources (air quality, hydrology, topography, etc.);
- Ecological Resources (flora, fauna, protected areas);
- Economic Resources (infrastructure, land use, etc.);
- Social and Cultural Resources (health, education, noise, cultural resources, etc.)

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:

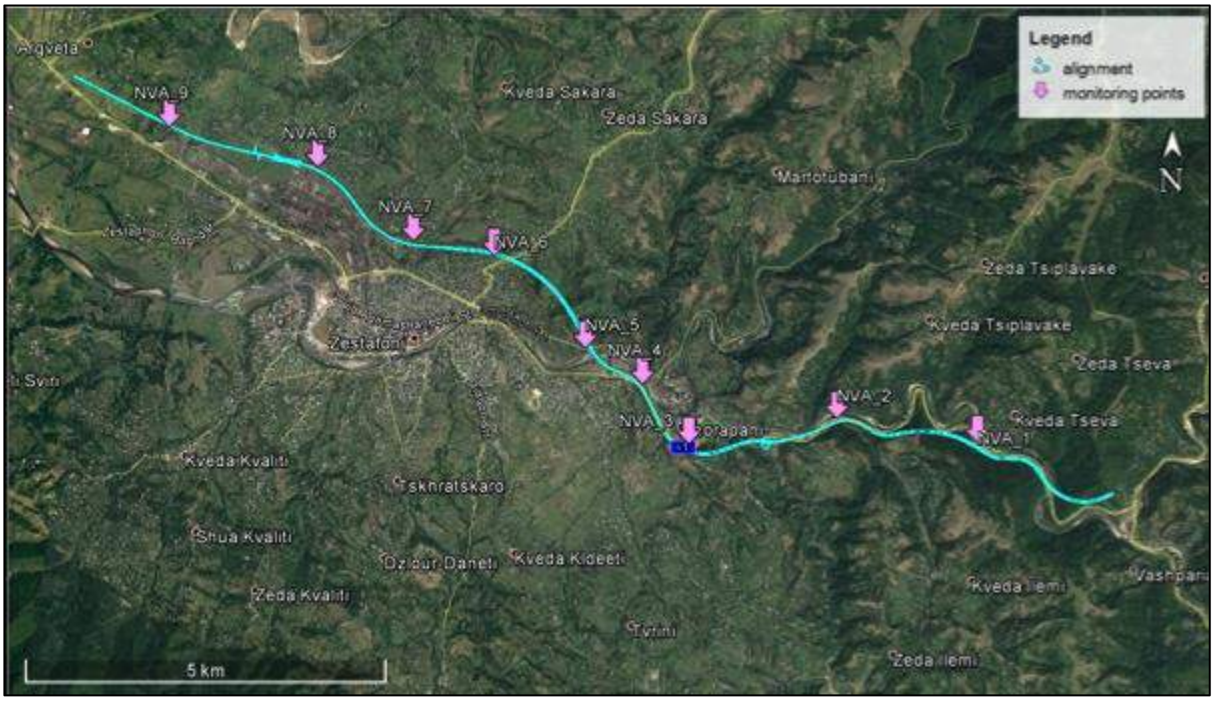
- Total Suspended Particulates (TSP), or Dust;
- Carbon Monoxide (CO);
- Nitrogen Dioxide (NO_2);
- Sulfur Dioxide (SO_2); and
- Particulate Matter (PM_{10} and $PM_{2.5}$)

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

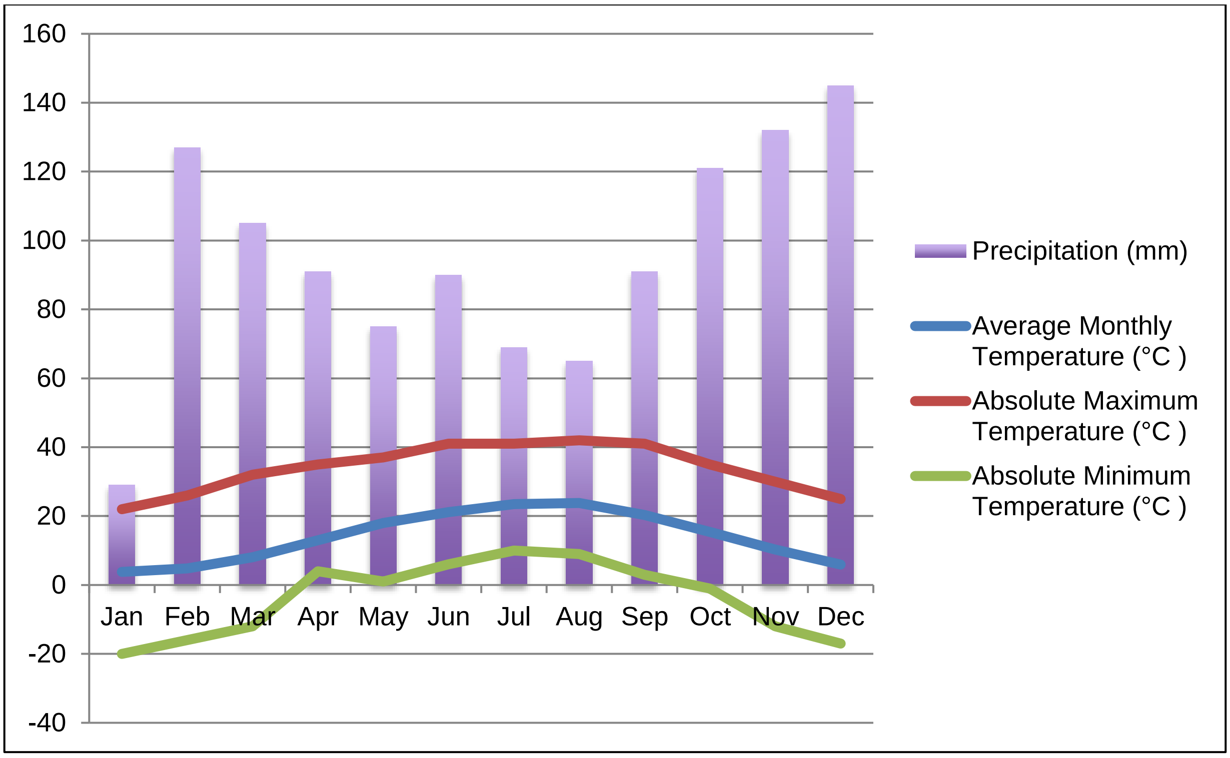
305. Due to the peculiar geographical position of Georgia between the Black and Caspian seas and the presence of powerful natural climatologic in the North of the Main Caucasus Range, and also owing to the large range of elevations above sea level, the climate of Georgia is varies quite widely for a 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**).

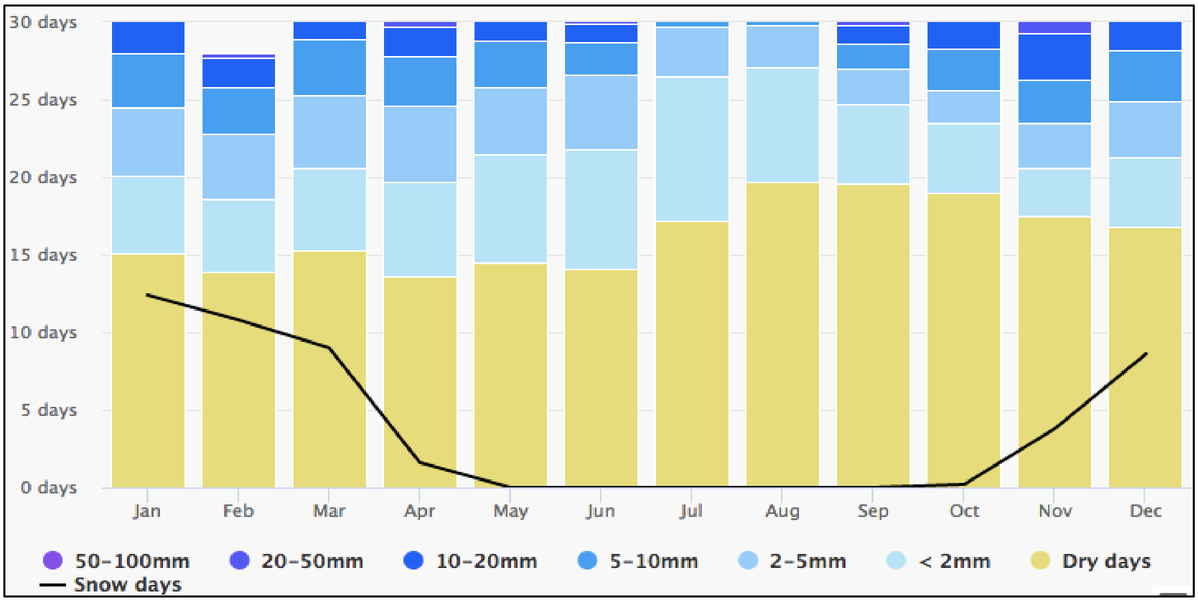
Figure E-4: Temperature and Precipitation (mm), Zestafoni



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

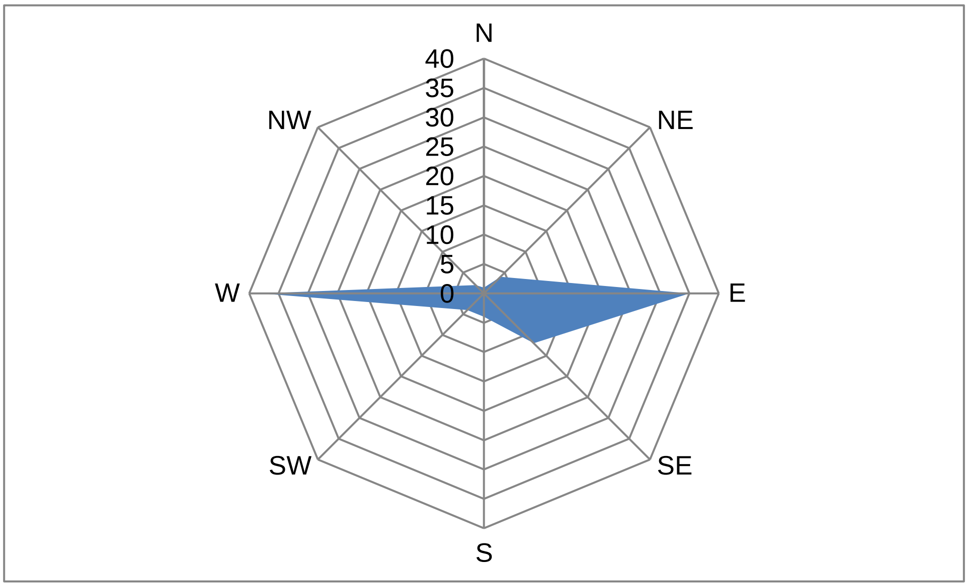
310. Thunderstorms occur in all months of the year. The maximum number of days with thunderstorms refers to June (6 days), and the average duration of thunderstorms in the afternoon with thunderstorm is 1.5 hours and the maximum continuous – 12.3 hours.

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

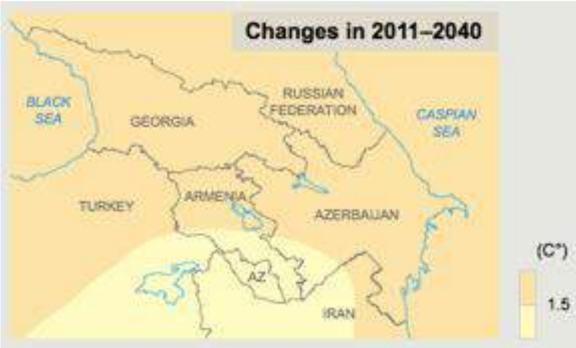
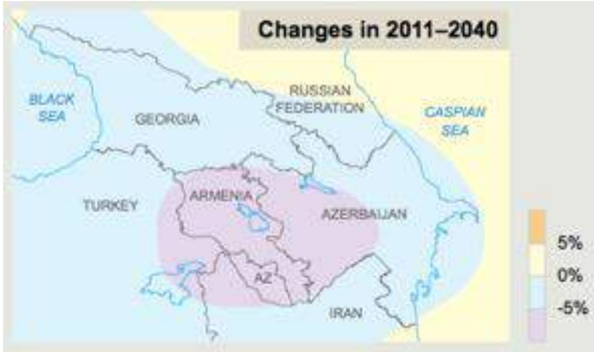


Figure E-9: Forecasted changes of annual precipitation in Georgia



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

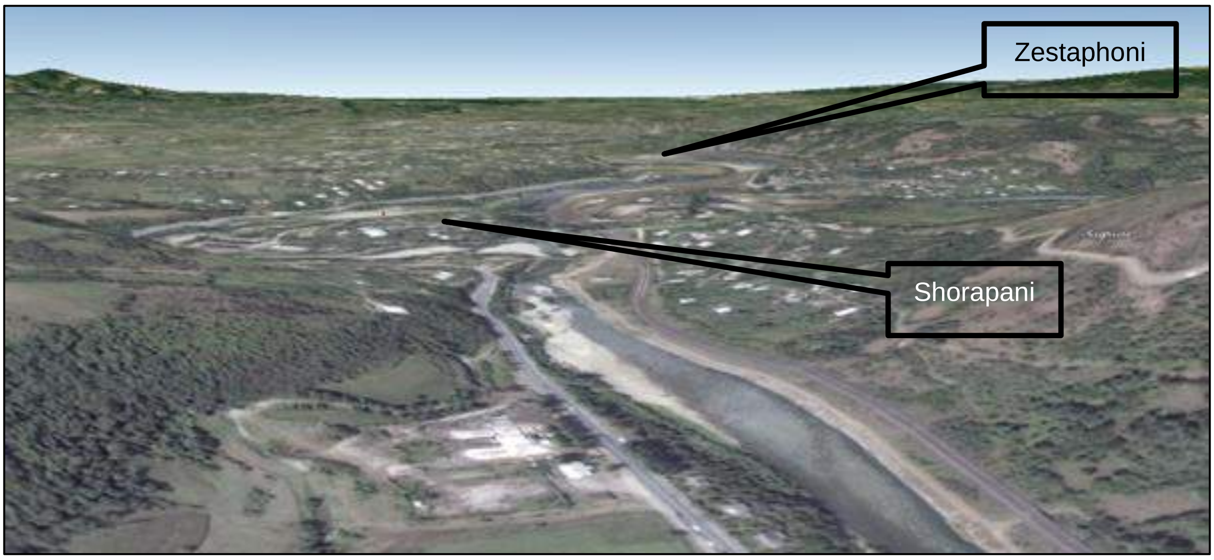
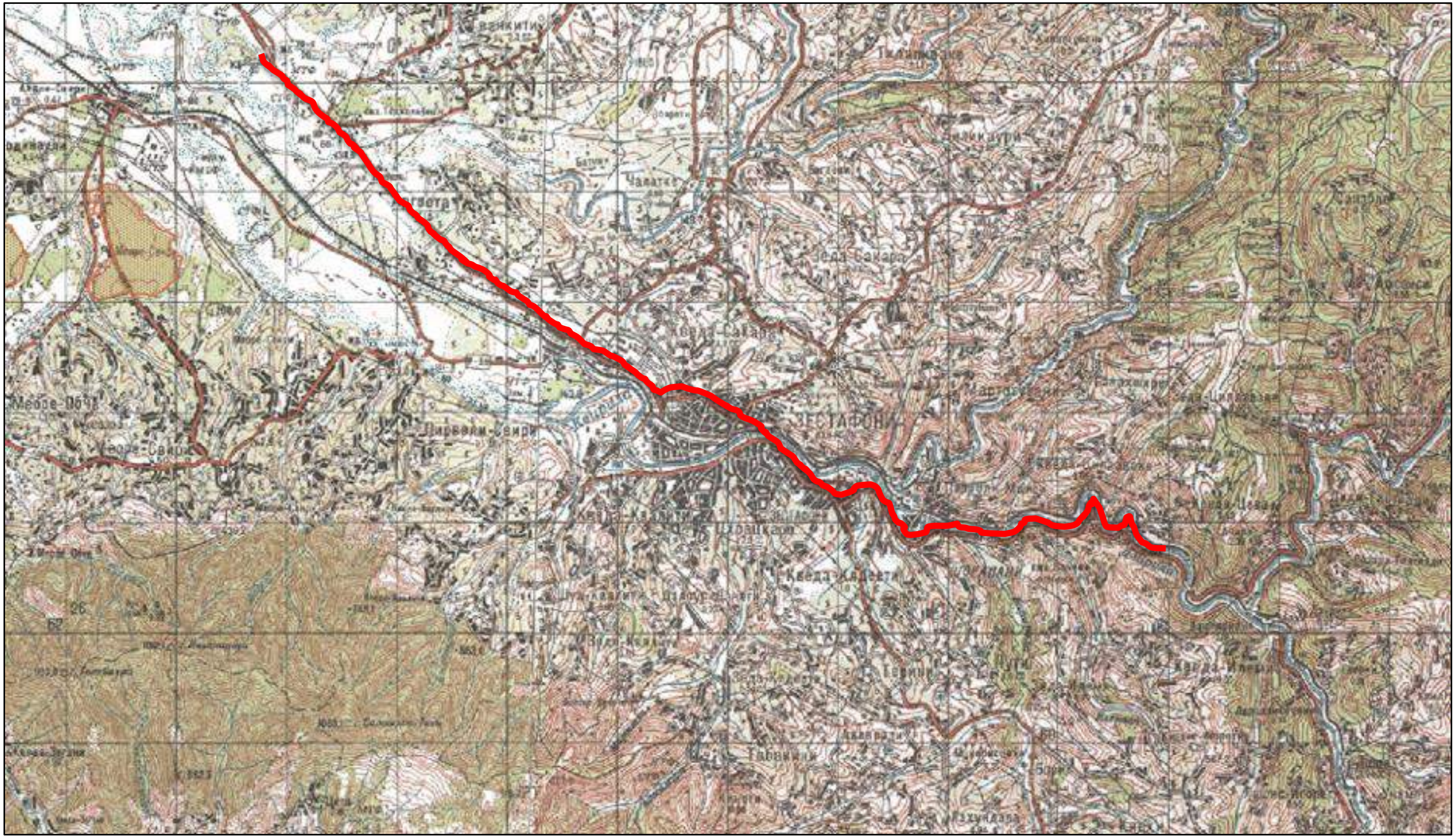


Figure E-12: Topography of the Project Area with Existing Road



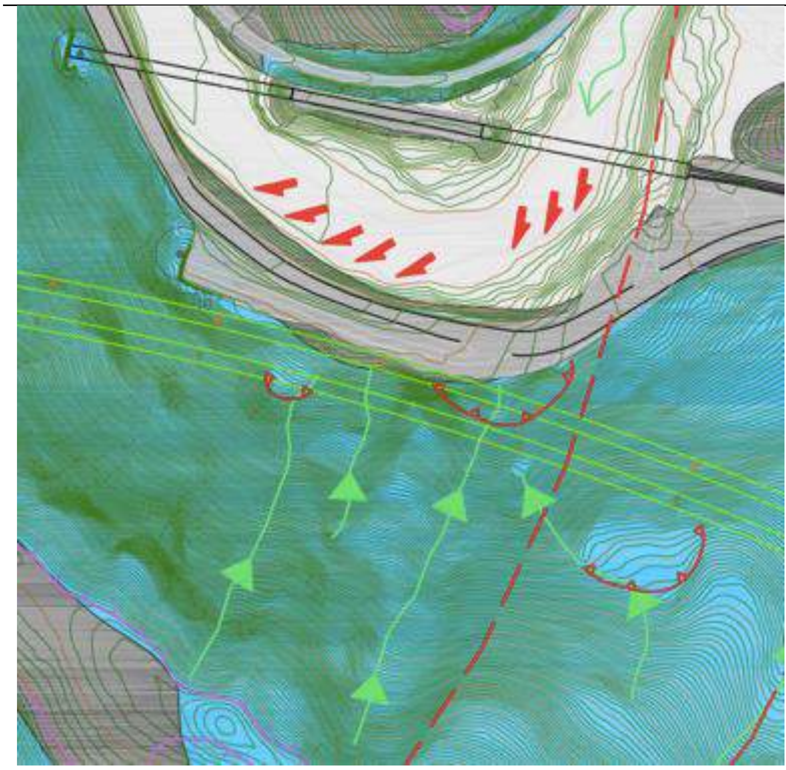
E.1.4 Natural Hazards

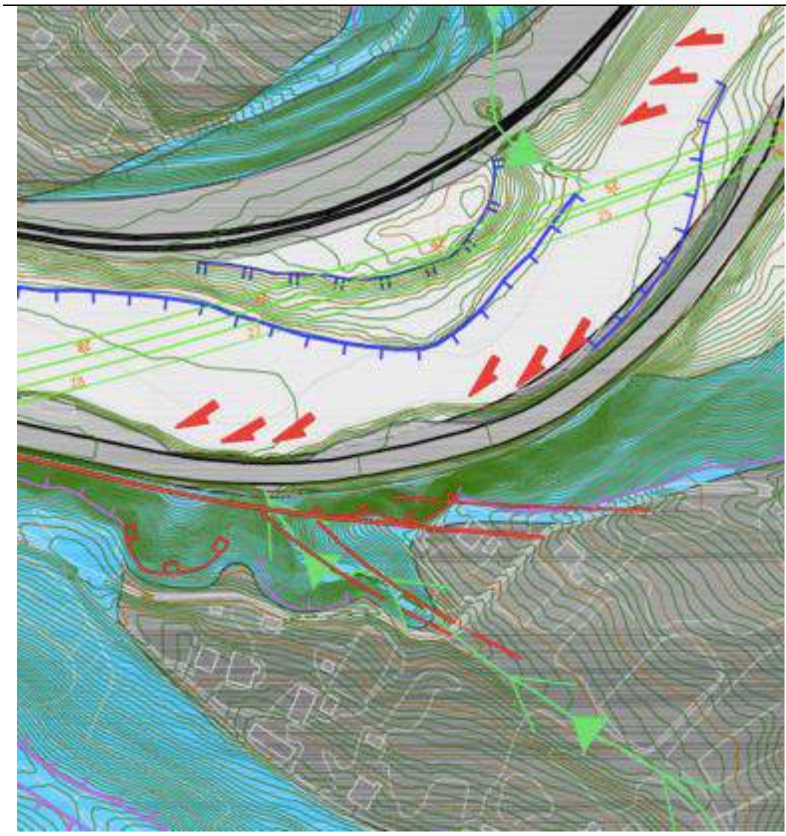
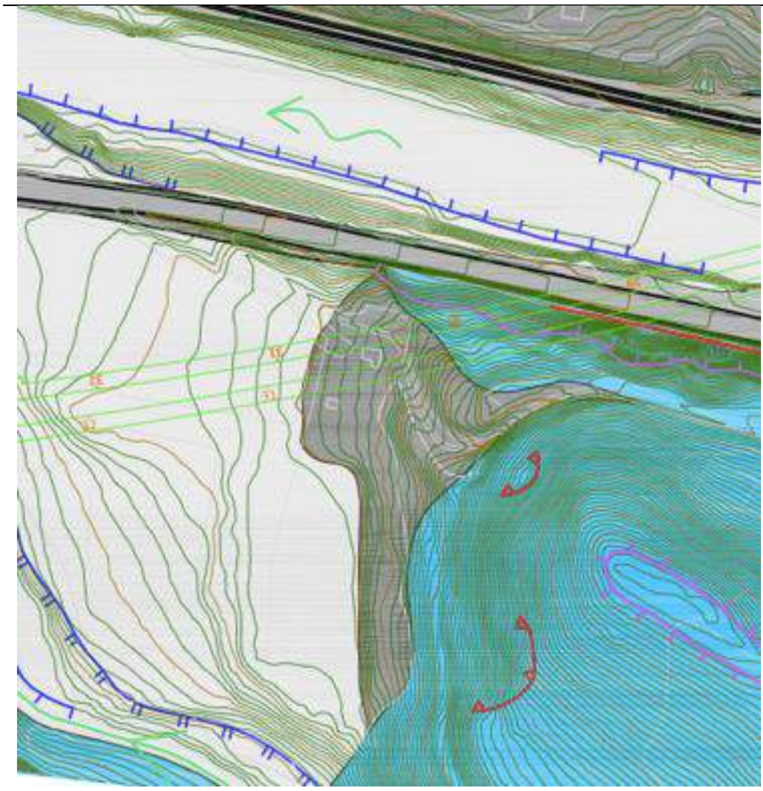
319. Regional Context - Georgia is one of the more complex mountainous regions living through the development of natural disasters, in which multi-spectral natural hazards are distinguished by their high recurrence rates and negative consequences for the population and infrastructure, as well as high 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.

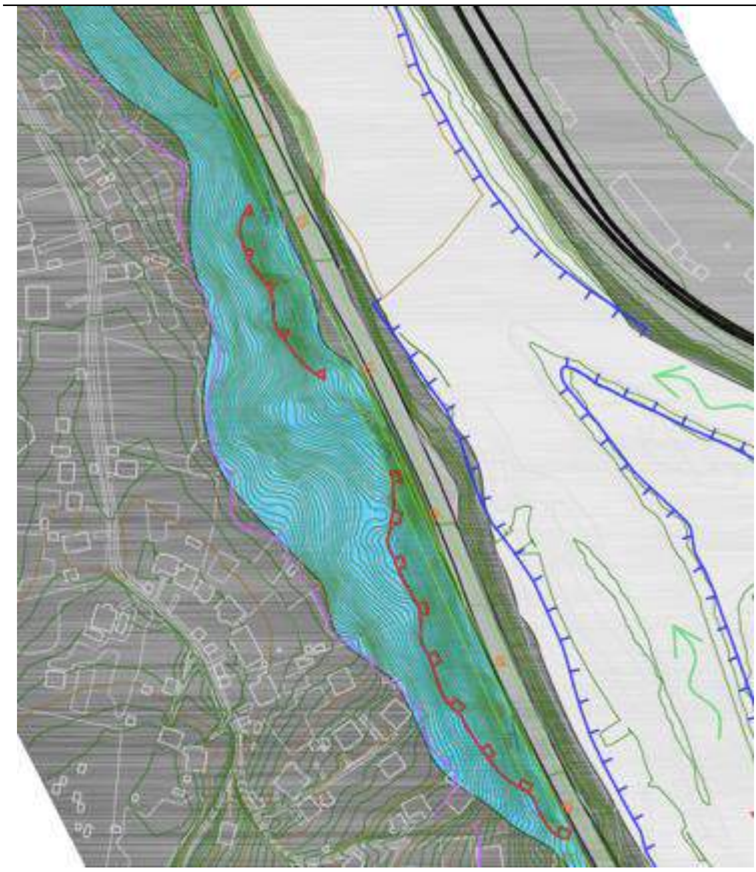
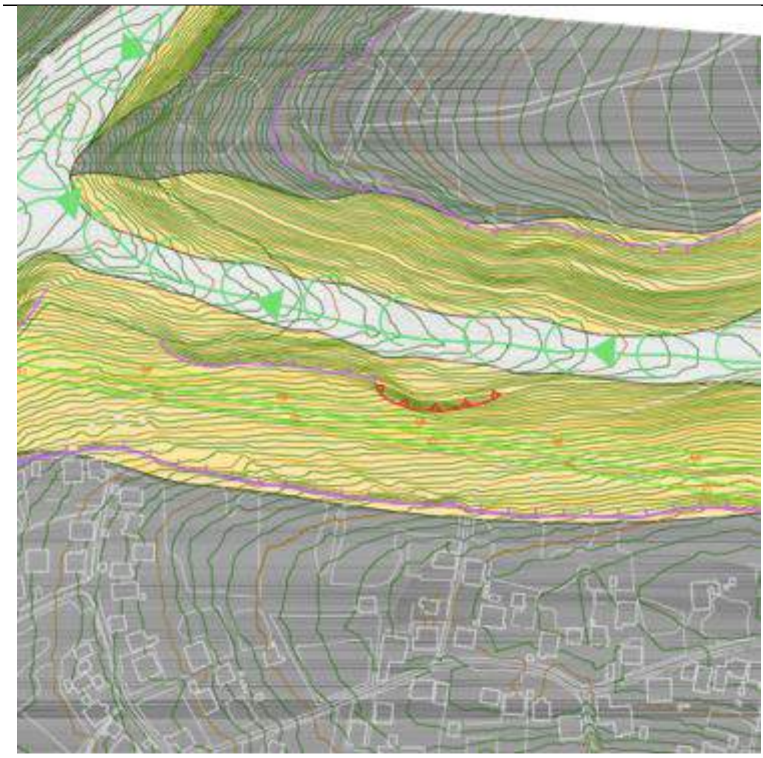
320. Almost all morphological-climatic zones in Georgia, starting with the sea coastline up to the high altitude mountain alpine-nival zone, have experienced damage to different extents. Over 50,000 landslides of different sizes and over 3,000 mudflow-transforming watercourses (rivers, canyons) have 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.

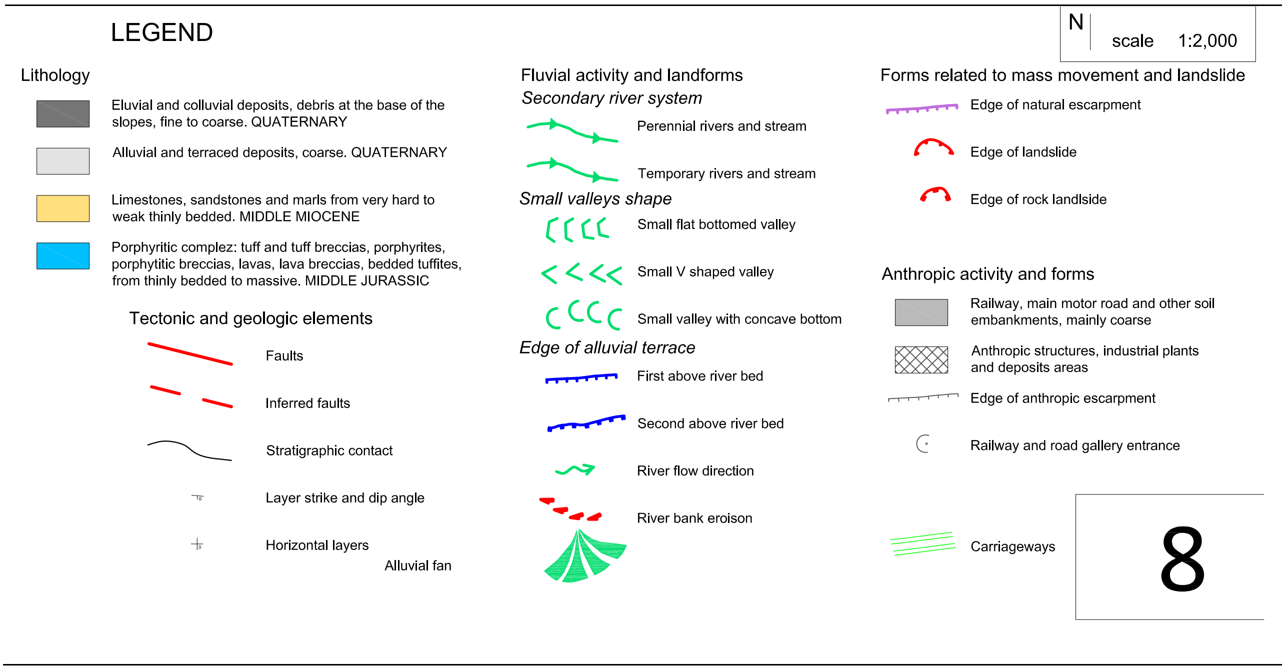
321. Landslides – Within the Project area a few areas prone to landslides have been identified. **Table E-3** provides the locations of the landslides.

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.

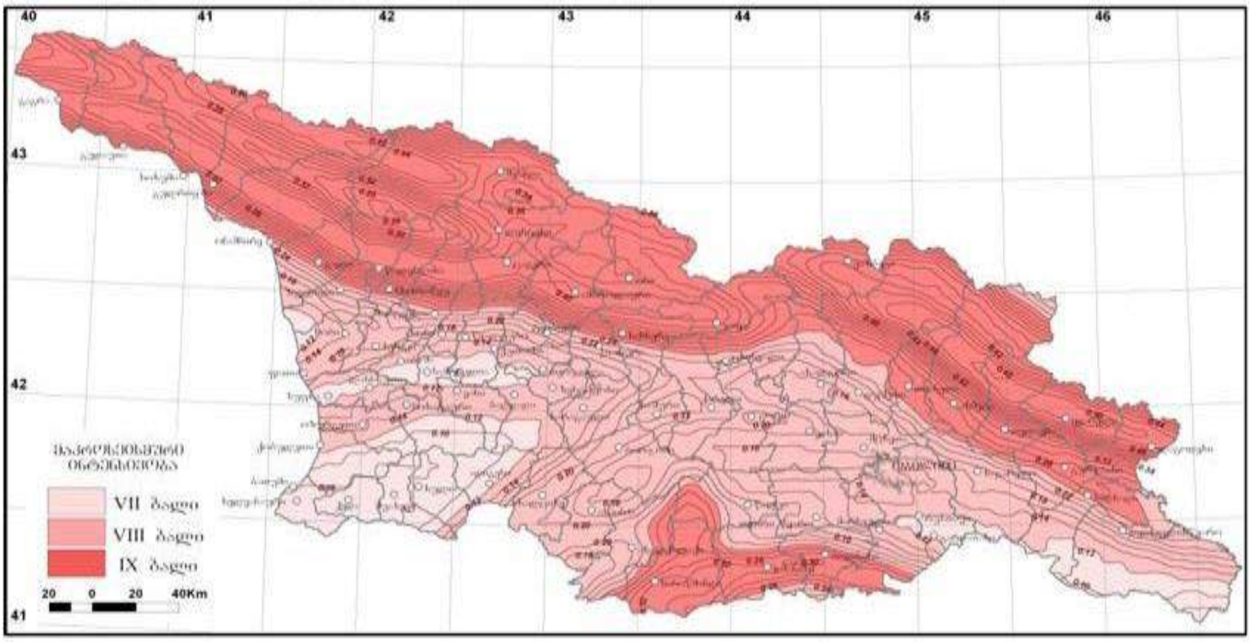
	Between KM 4.8 and 5.2 – located immediately above the new alignment.
	KM 8.7 – located immediatel== to the north of the new alignment.



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. <u>Seismicity</u> - 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.

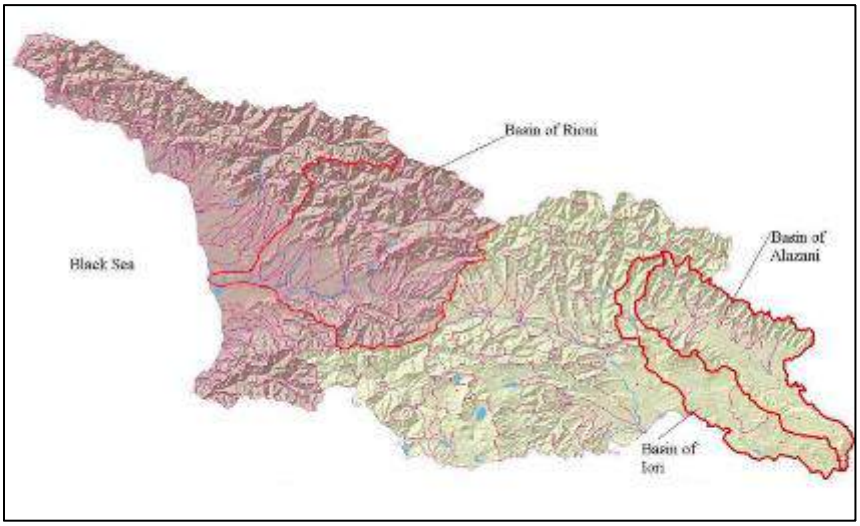


Figure E-14: Rioni Sub-basin

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.

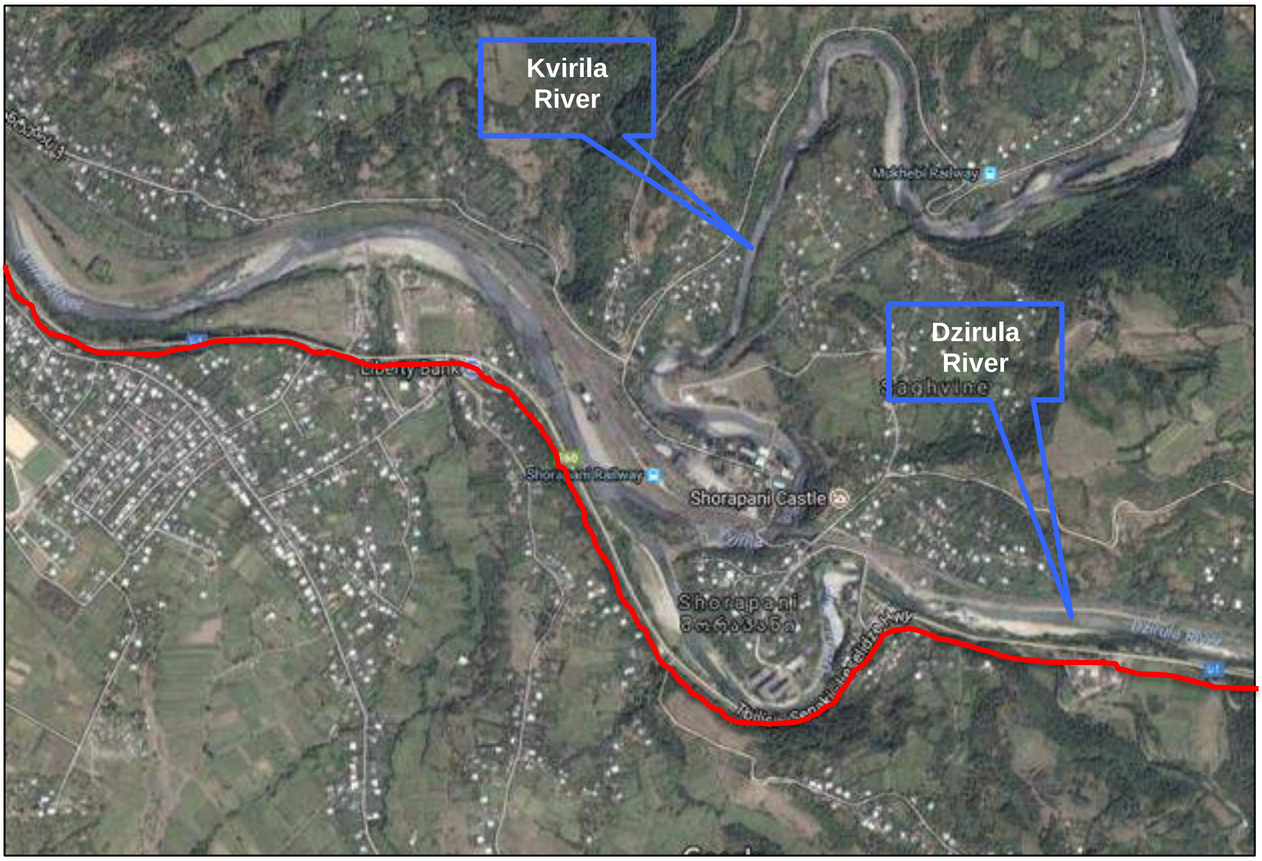
326. Local Context – Two main rivers can be found within the Project area, the Kvirila and the Dzirula. The confluence of the two rivers is in Shorapani adjacent to the Project road at Km 5.0, see **Figure E-15**.

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 (km²)	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 (km²)	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]

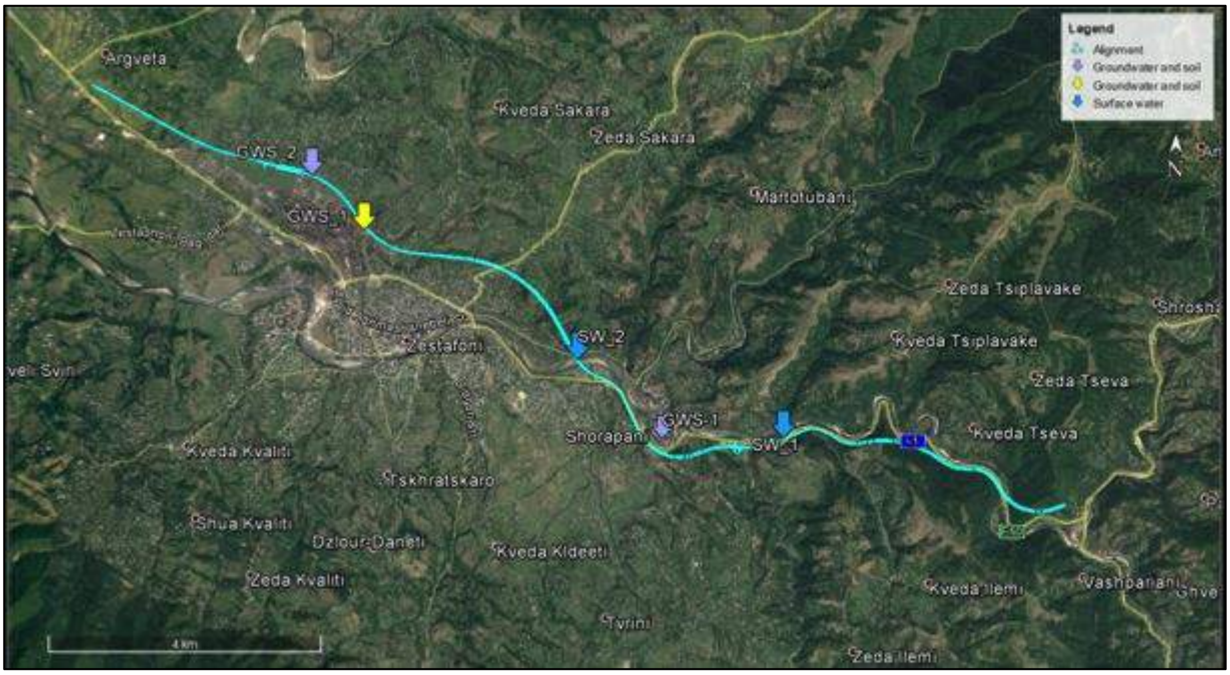
339. To further assess the status of water quality in the Project area, including the Kvirila and Dzirula rivers monitoring was undertaken in September, 2017. A total of two surface water samples were collected and analyzed to determine the baseline water quality levels. **Table E-5** describes the sample 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. $N1^2$ (m) - Marls.
    b. $N1^2$ - 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 J2b2 (B) formation and the mainly pyroclastic rocks of the J2b2 (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 J2b2 (B) formation; bridges are expected to have their abutments and piers on quaternary deposits (aQ, aaQ and mQ with a variable thick) covering the J2b2 (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 $N1^2$ formation, overlaying with a stratigraphic limit the J2b2 (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 J2b2 (A) and (B) formations) and in the $N1^2$ formation; one bridge crosses a colluvial deposit overlaying the $N1^2$ formation; one cut is expected to be excavated in the $N1^2$ 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

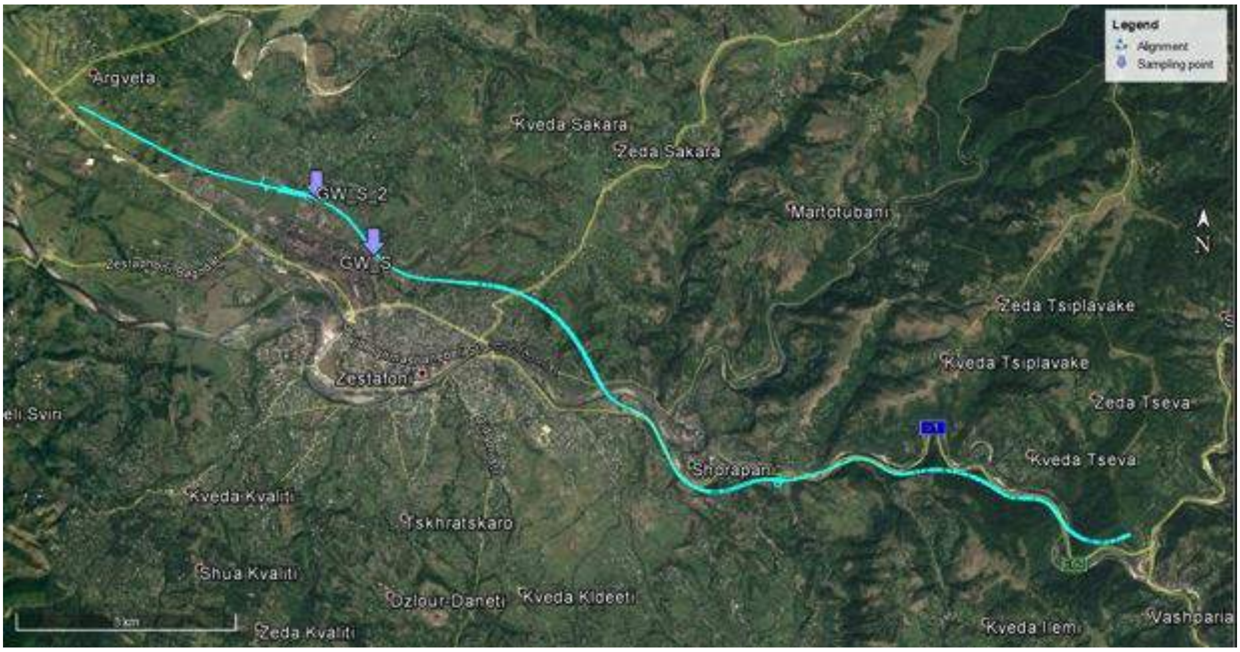
349. Hazardous wastes generated by the GAA, Chiatura manganese enrichment plant, and many small-size smelters operating in various settlements of Imereti have been identified as potential sources of soil pollution. [11]

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



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[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.

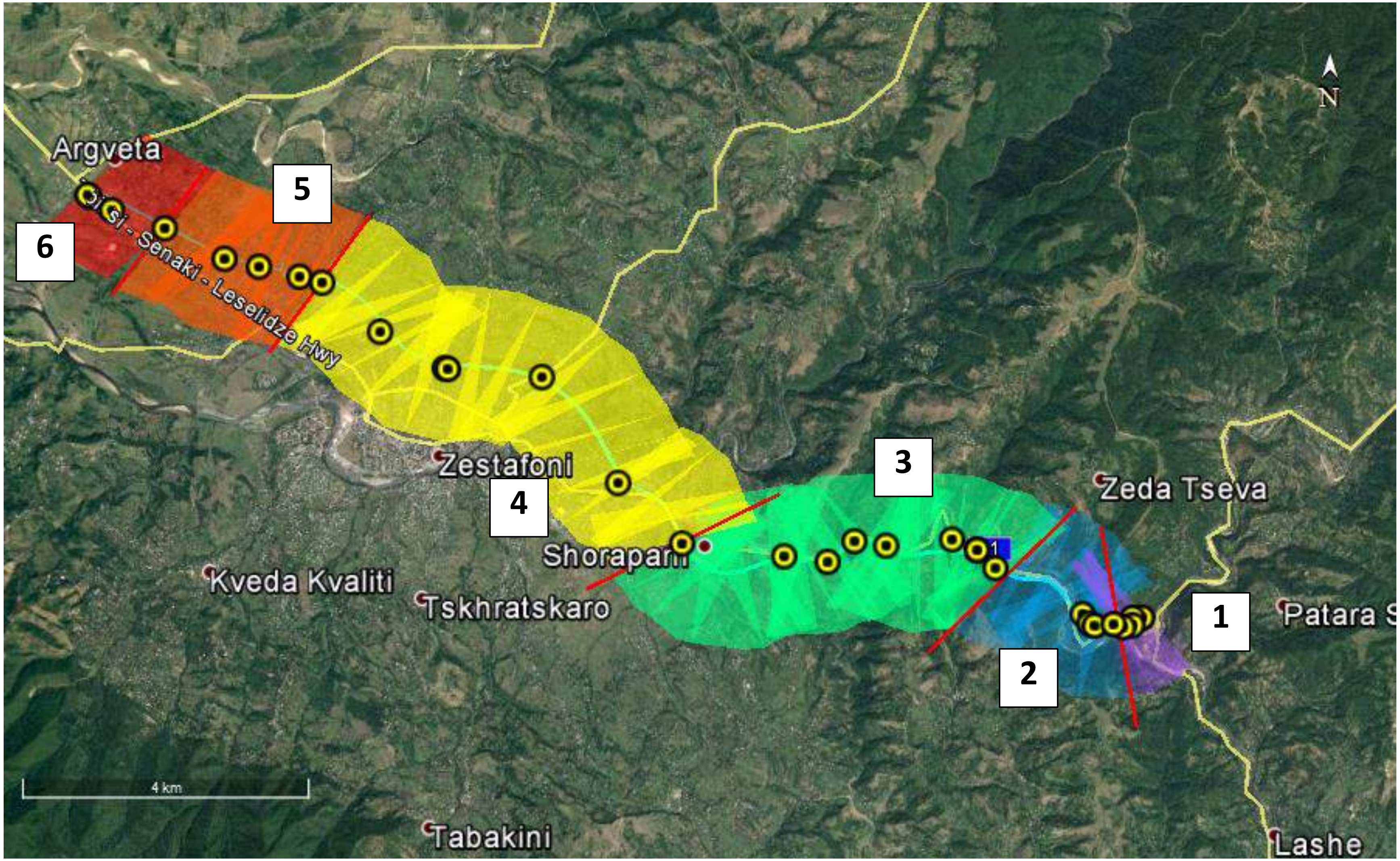
357. Due to human pressures natural vegetation has been taken over by agricultural crops and other human development. In these areas arable lands and pastures have developed. Some of the animal species typical for the area have moved to other areas in away from human activity. Over the time the fauna 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
The 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 (coordinates X=4661669.72, Y=345296.51; X=4662103.27, Y=340960.28)
Conservation Status of the Habitat = LOW
Located 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. 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. 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 ($0\text{-}5^0$), 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

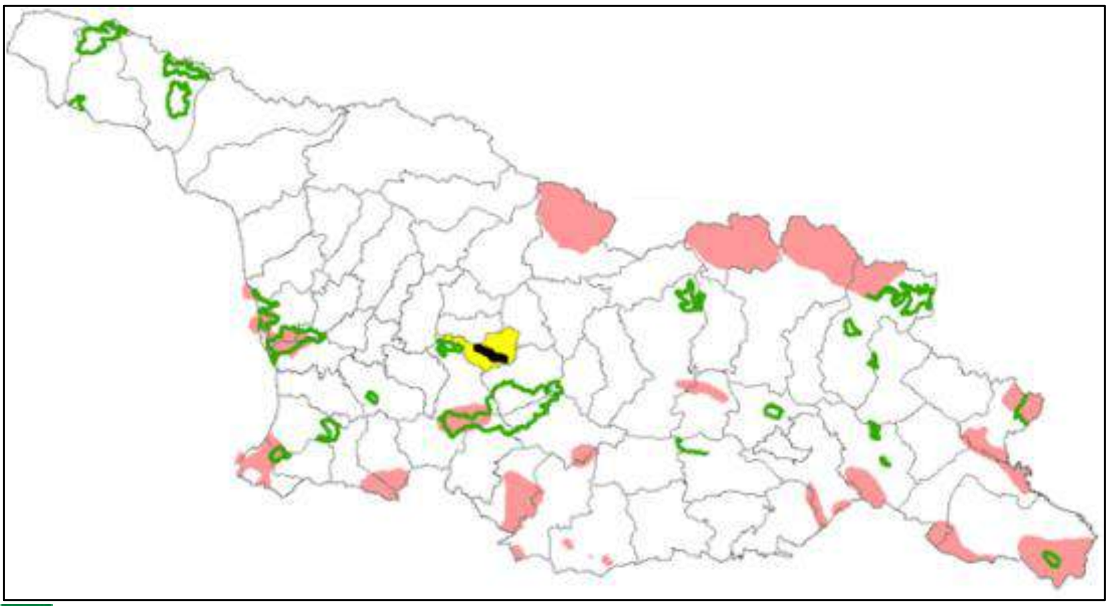
№	Scientific Name	English Name	Georgian Name	National Red List	International Red List
1.	*Epilohmannia cylindrica*	-	-	NE	NE
2.	*Rhysotritia ardua*	-	-	NE	NE
5.	*Tectocepheus velatus*	-	-	NE	NE
6.	*Oppiella fallax*	-	-	NE	NE
7.	*Quadroppia quadricarinata*	-	-	NE	NE
8.	*Suctobelbella falcate*	-	-	NE	NE
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



Protected areas
Bird protection areas (IBAs)
Zestaphoni municipality
Study area

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)

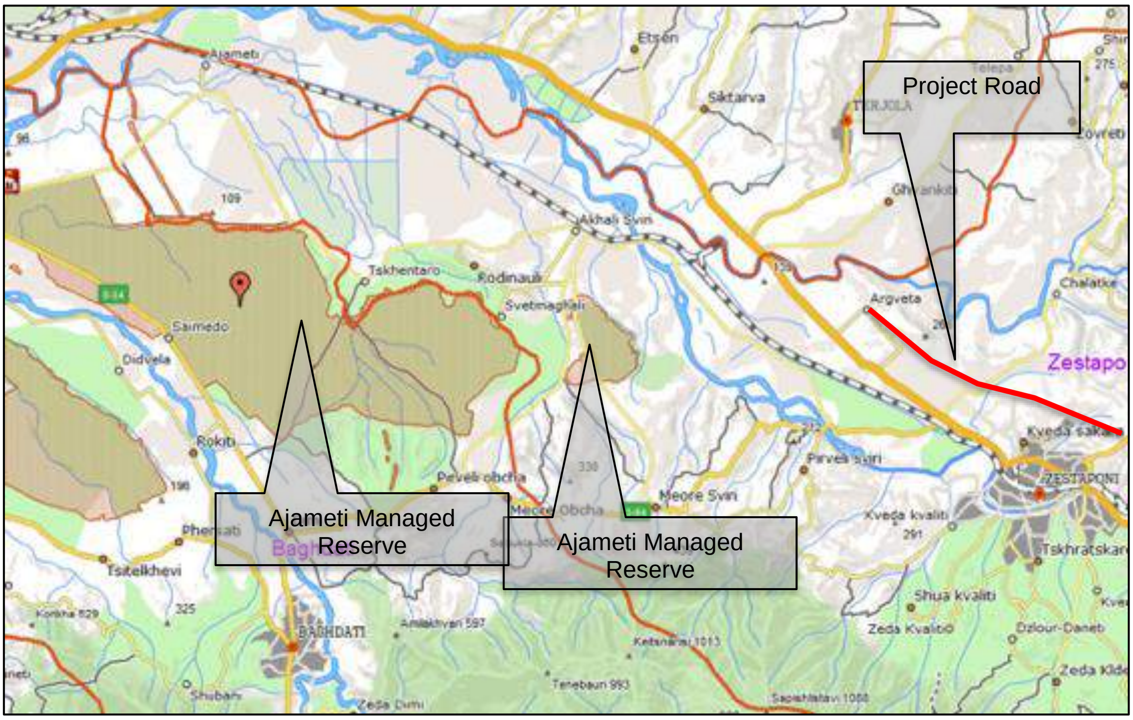
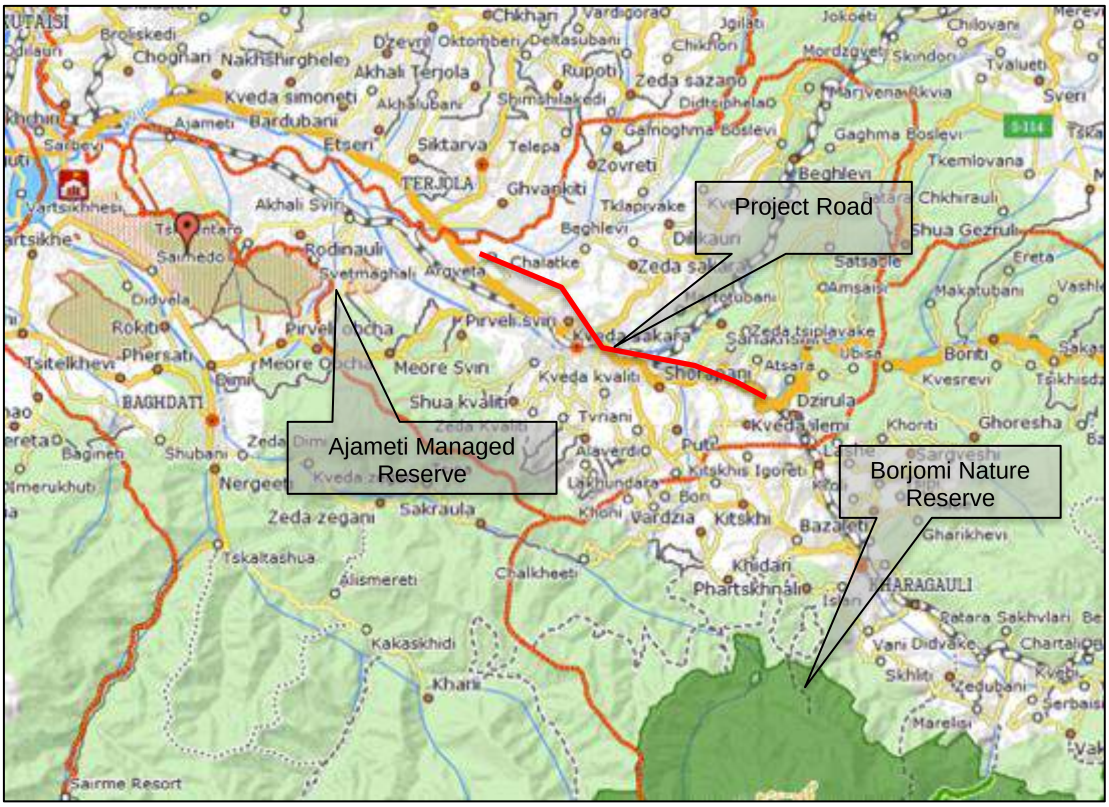


Figure E-29: Ajameti Managed Reserve

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

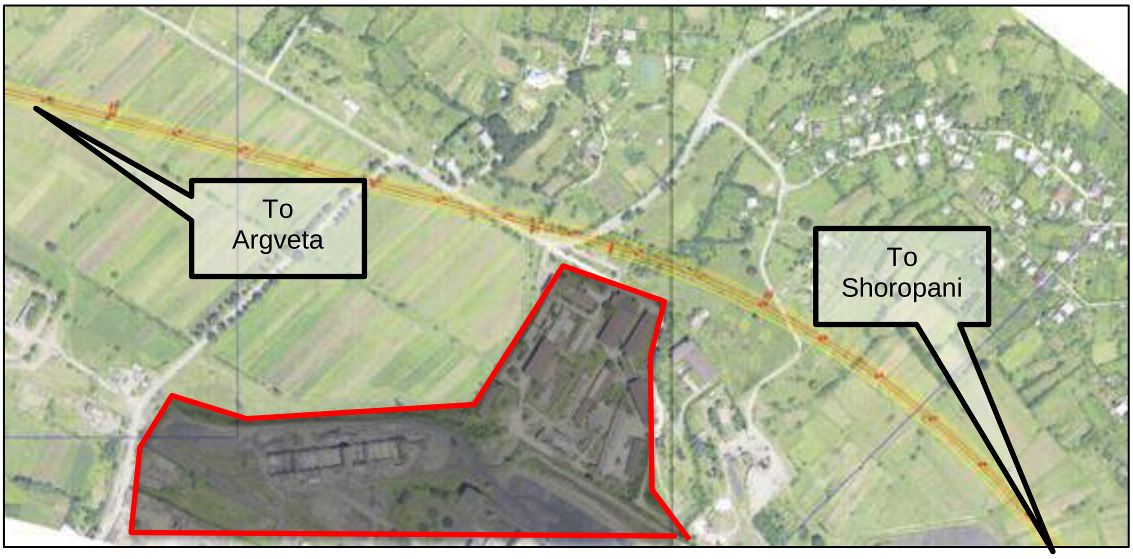
400. Viticulture is the main economic activity in the municipality of Zestaphoni providing 80% of agricultural output. Its development is supported by favorable soil-climatic conditions. Vineyards occupy 5,000 hectares within the municipality. There are two active wine producing factories in the municipality.

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

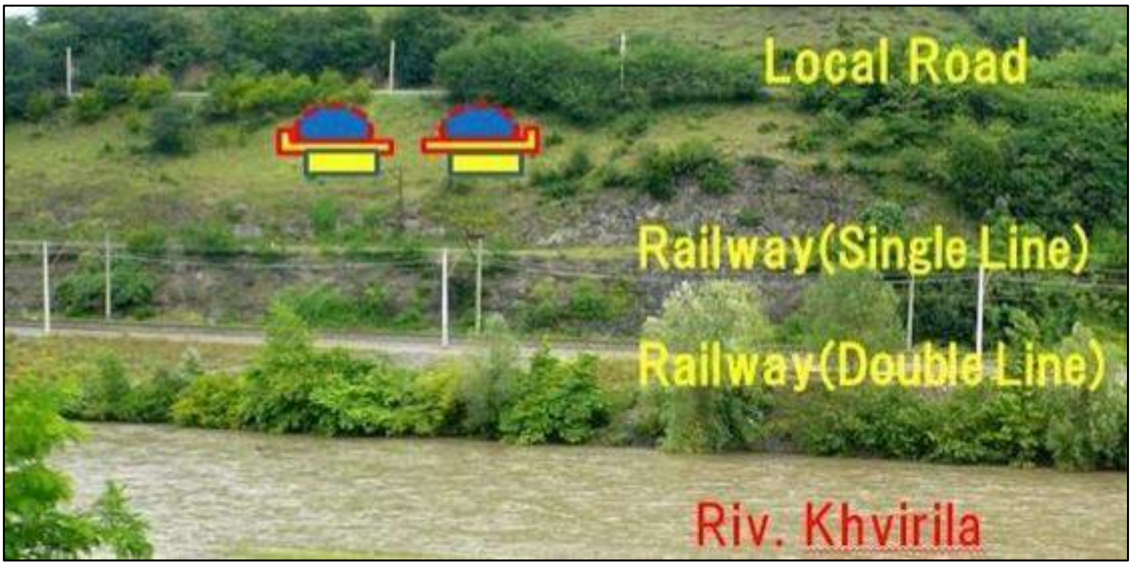
E.3.2 Infrastructure and Transportation facilities

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)

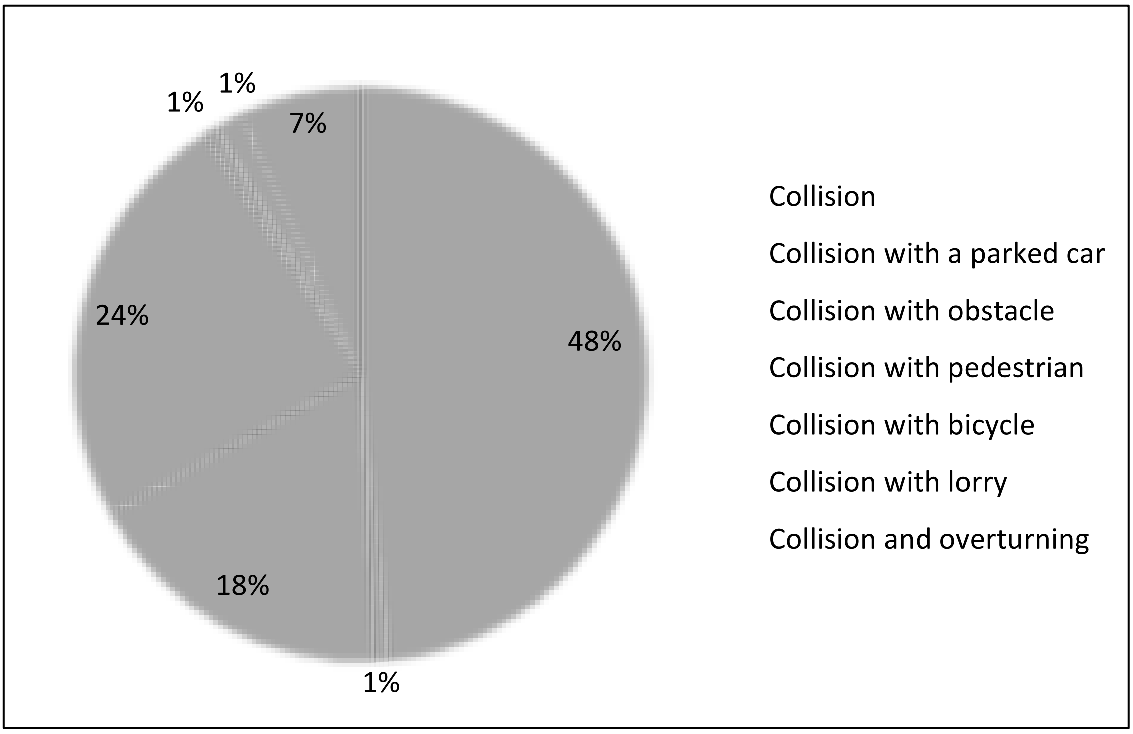
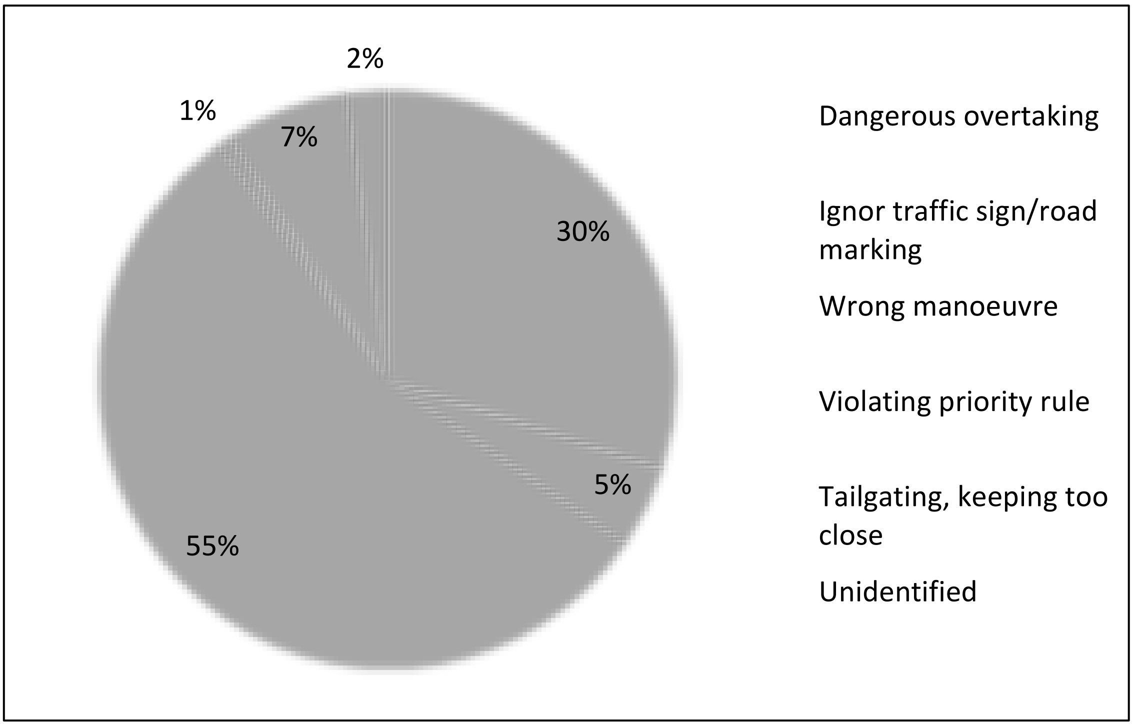


Figure E-38: Collisions by cause (section F4, period 2012 – 2016)



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:

- <u>Shorapani Fortress</u> - 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.

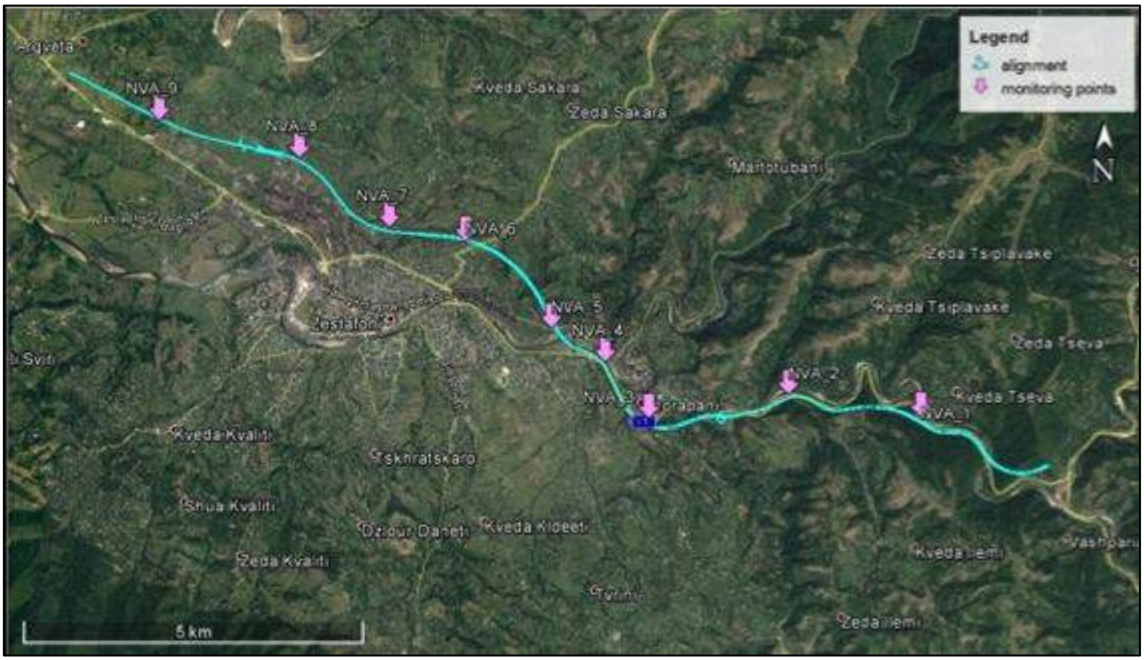
E.4.6.2 Existing Noise & Vibration Levels

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) 45 (Night)	55 (Day) 45 (Night)	60 (Day) 55 (Evening) 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) 45 (Night)	55 (Day) 45 (Night)	60 (Day) 55 (Evening) 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) 45 (Night)	55 (Day) 45 (Night)	60 (Day) 55 (Evening) 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) 45 (Night)	55 (Day) 45 (Night)	60 (Day) 55 (Evening) 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) 45 (Night)	55 (Day) 45 (Night)	60 (Day) 55 (Evening) 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) 45 (Night)	55 (Day) 45 (Night)	60 (Day) 55 (Evening) 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) 45 (Night)	55 (Day) 45 (Night)	60 (Day) 55 (Evening) 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) 45 (Night)	55 (Day) 45 (Night)	60 (Day) 55 (Evening) 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) 45 (Night)	55 (Day) 45 (Night)	60 (Day) 55 (Evening) 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 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 High, medium or low conservation importance Vulnerable or threatened Rare, common, unique, endemic
	Importance or value of receptor	High, medium or low concern to some or all stakeholders High, medium or low value to some or all stakeholders (for example, for cultural beliefs) Locally, nationally or internationally important Protected by legislation or policy
	Severity or degree of change to the receptor	Gravity or seriousness of the change to the environment Intensity, influence, power or strength of the change 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 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) Possible (impact may occur but could be influenced by either natural or project related

	factors) Unlikely (impact unlikely unless specific natural or Project related circumstances occur)
Reversibility/Sustainability	Potential for recovery of the endpoint from a negative impact 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 Data uncertainty – restrictions introduced by incomplete or incomparable information, or by insufficient measurement techniques 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 • Receptors highly sensitive and/or are of conservation importance • Substantial deterioration, nuisance or harm to receptors expected • Relevant thresholds often exceeded • Significant public concern expressed during stakeholder consultation • Receiving environment has an inherent value to stakeholders	• Large number of receptors affected • Receptors highly amenable to positive change • Receptors likely to experience a big improvement in their situation • Relevant positive thresholds often exceeded
	Moderate	• Some receptors affected • Receptors slightly sensitive and/or of moderate conservation importance • Measurable deterioration, nuisance or harm to receptors • Relevant thresholds occasionally exceeded • Limited public concern expressed during stakeholder consultation • Limited value attached to the environment	• Some receptors affected • Receptors likely to experience some improvement in their situation • Relevant positive thresholds occasionally exceeded
	Minor	• No or limited receptors within the zone of impact • Receptors not sensitive to change • Minor deterioration, nuisance or harm to receptors • Change not measurable or relevant thresholds never exceeded • Stakeholders have not expressed concerns regarding the receiving environment	• No or limited receptors affected • Receptors not sensitive to change • Minor or no improvement in current situation • Change not measurable • 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:

<u>Design and Pre-construction Phase</u>

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.

<u>Construction Phase</u>

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.

<u>Operational Phase</u>

467. <u>General</u> - 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. <u>Time frame of the model</u> - 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. <u>Spatial domain and receptors</u> - 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)

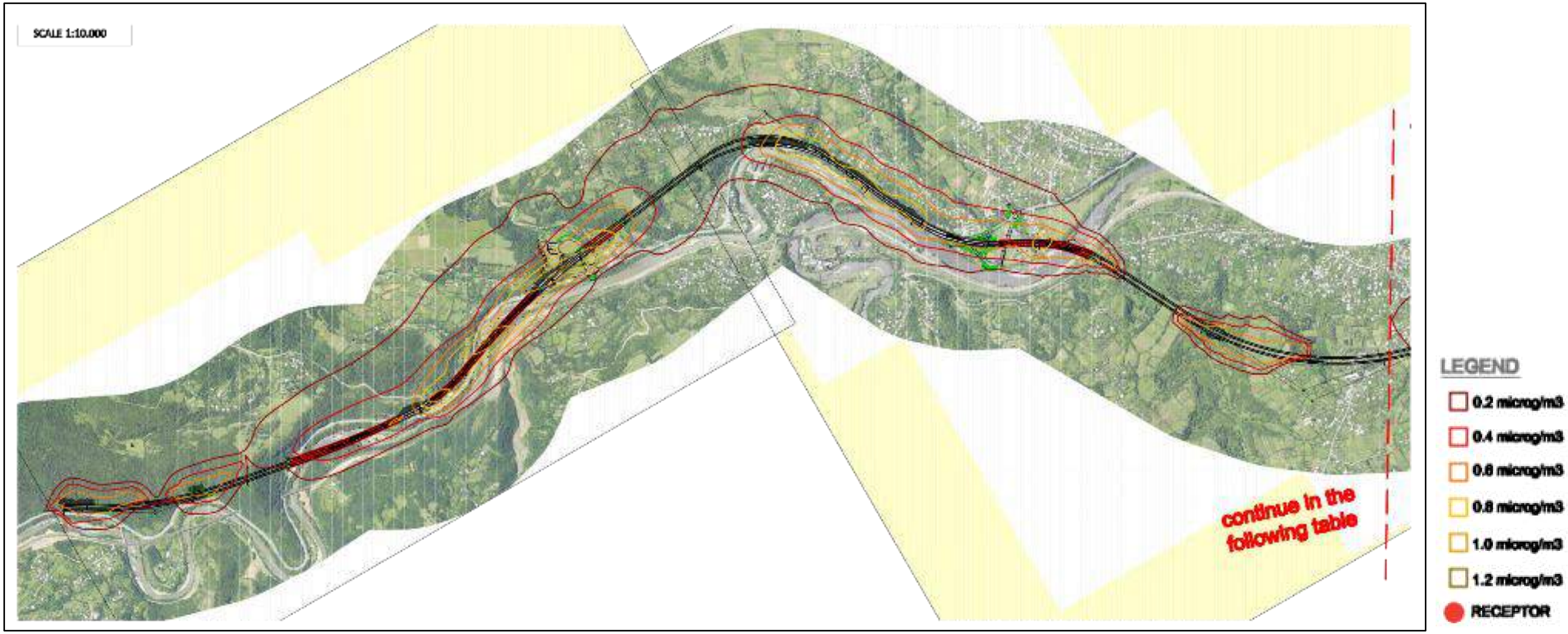


Figure F-2: PM10, 2034 (Km 0 – Km 8)

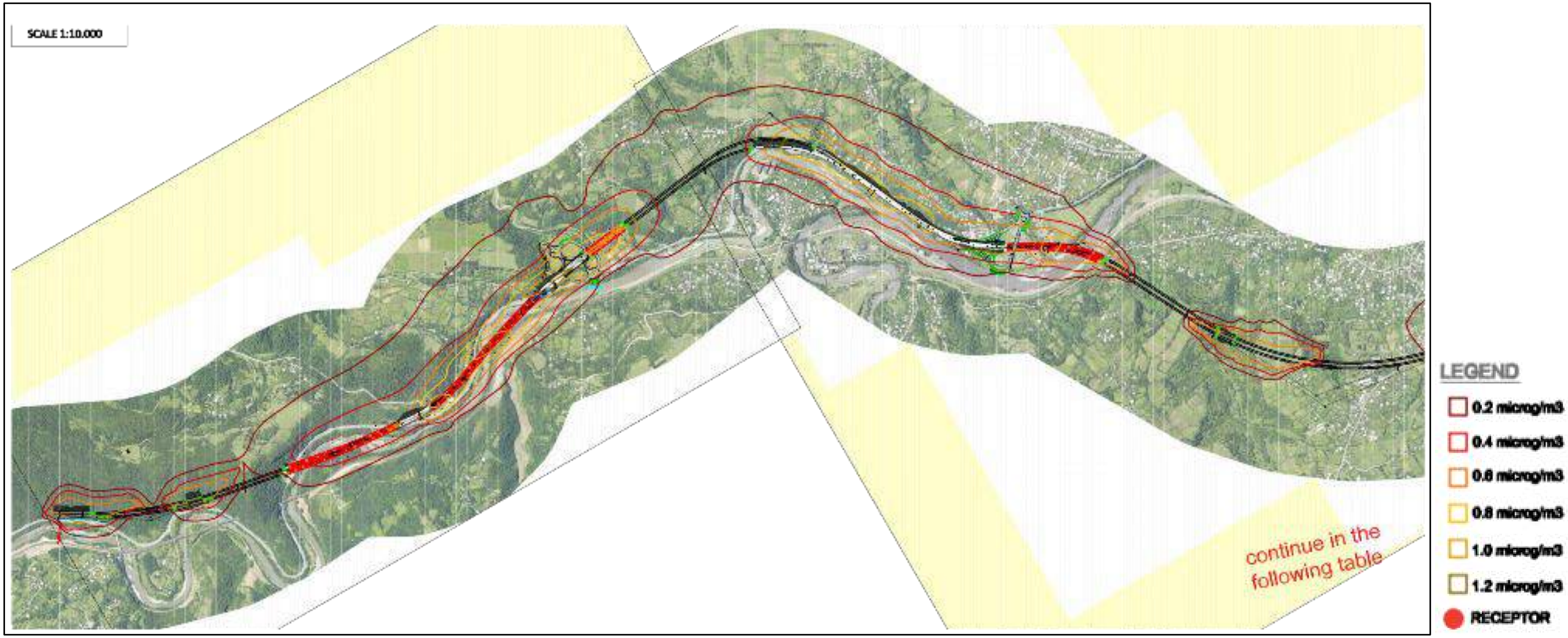


Figure F-3: PM10, 2019 (Km 8 – Km 14.7)

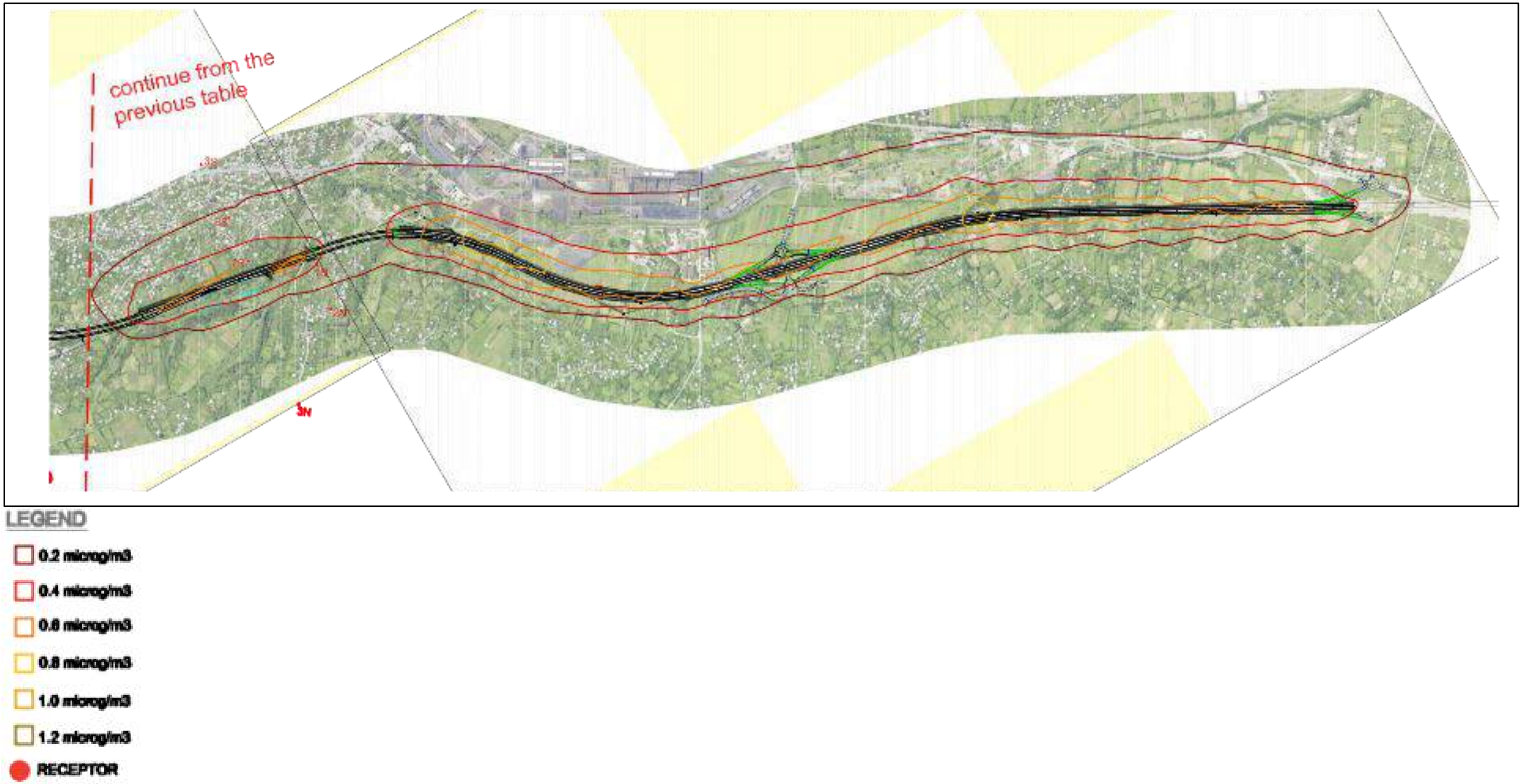
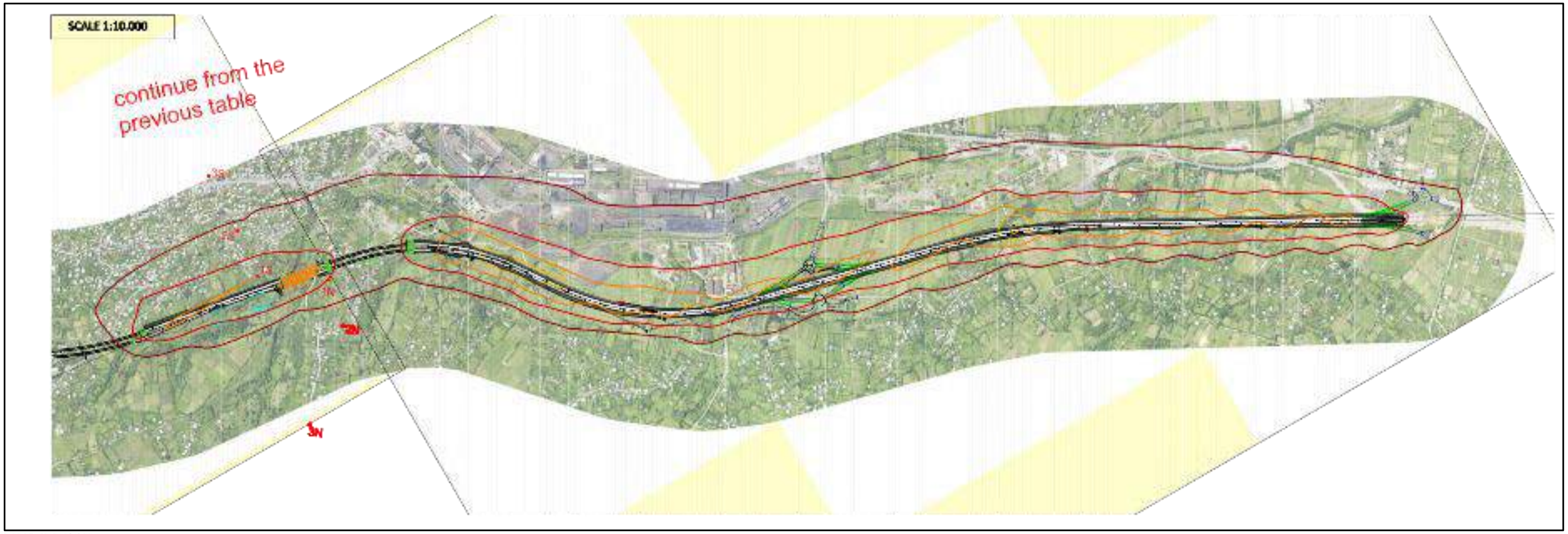


Figure F-4: PM10, 2034 (Km 8 – Km 14.7)



LEGEND

- 0.2 microg/m3
- 0.4 microg/m3
- 0.6 microg/m3
- 0.8 microg/m3
- 1.0 microg/m3
- 1.2 microg/m3
- RECEPTOR

Figure F-5: NO2, 2019 (Km 0 – Km 8)

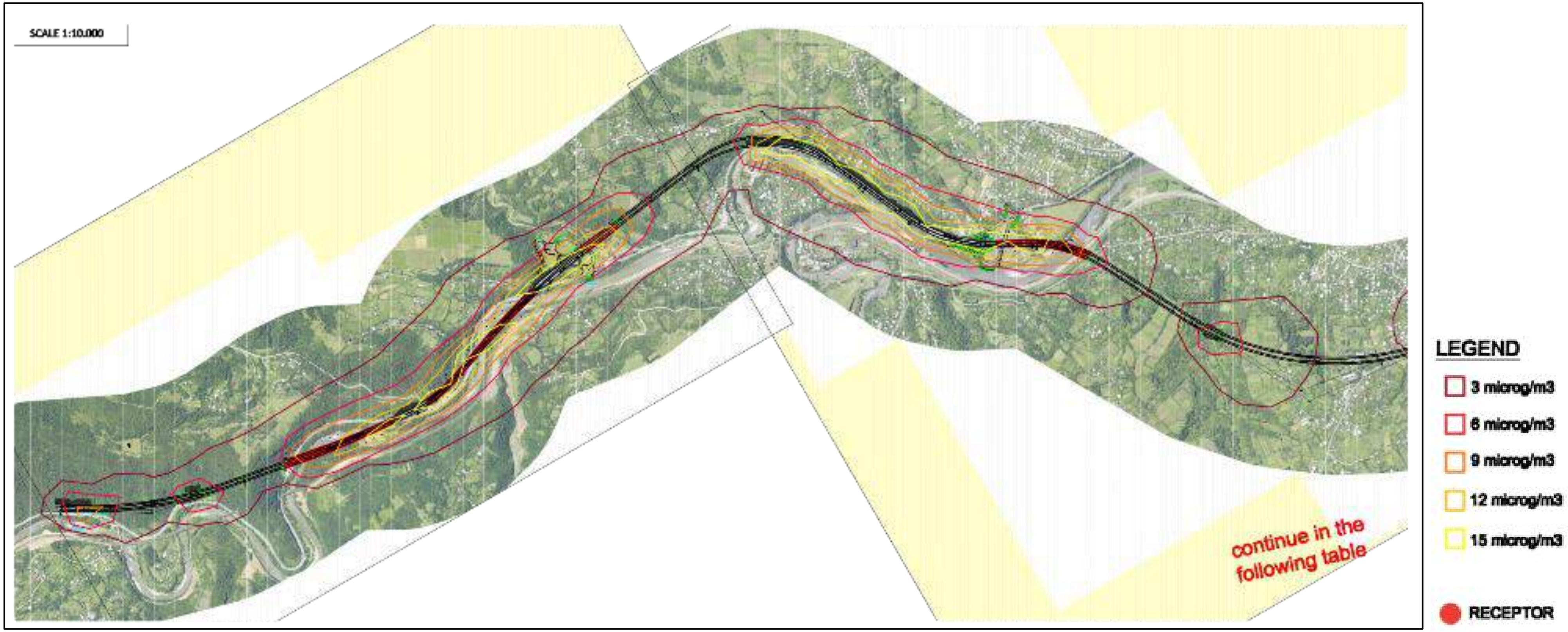


Figure F-6: NO2, 2034 (Km 0 – Km 8)

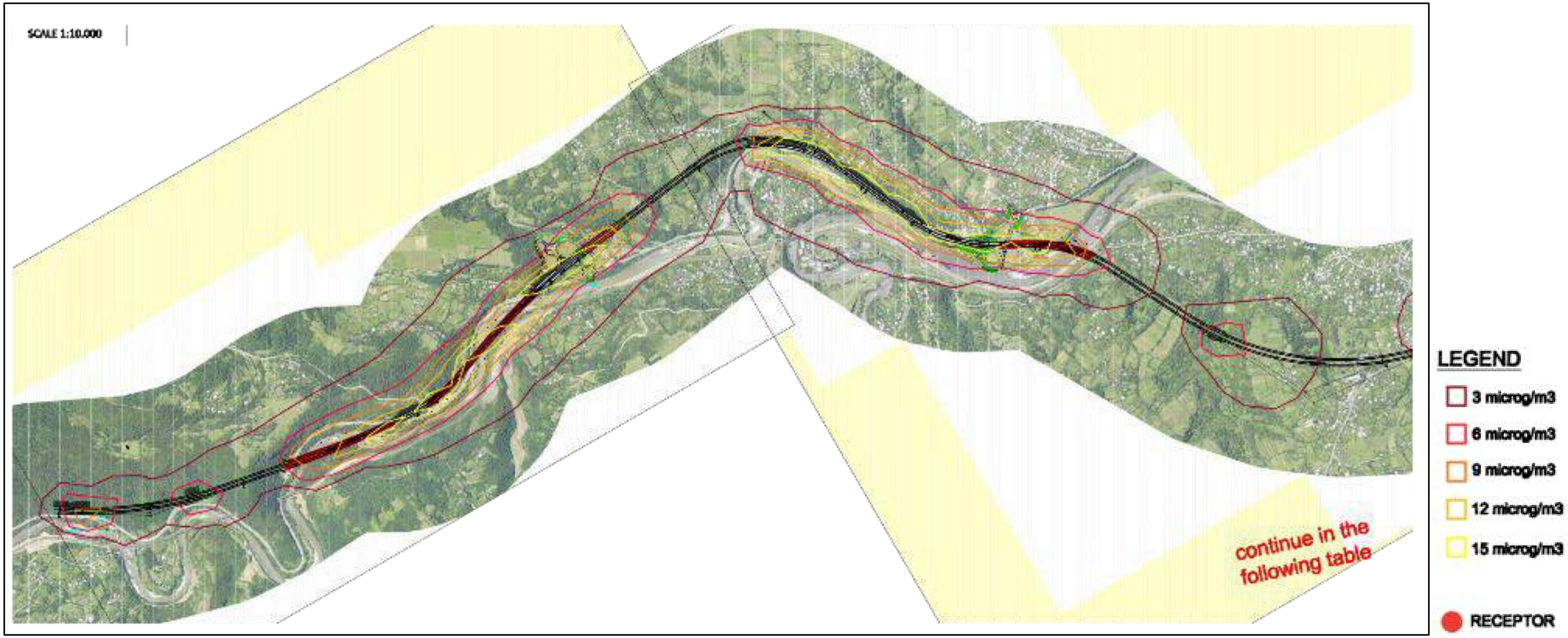


Figure F-7: NO2, 2019 (Km 8 – Km 14.7)

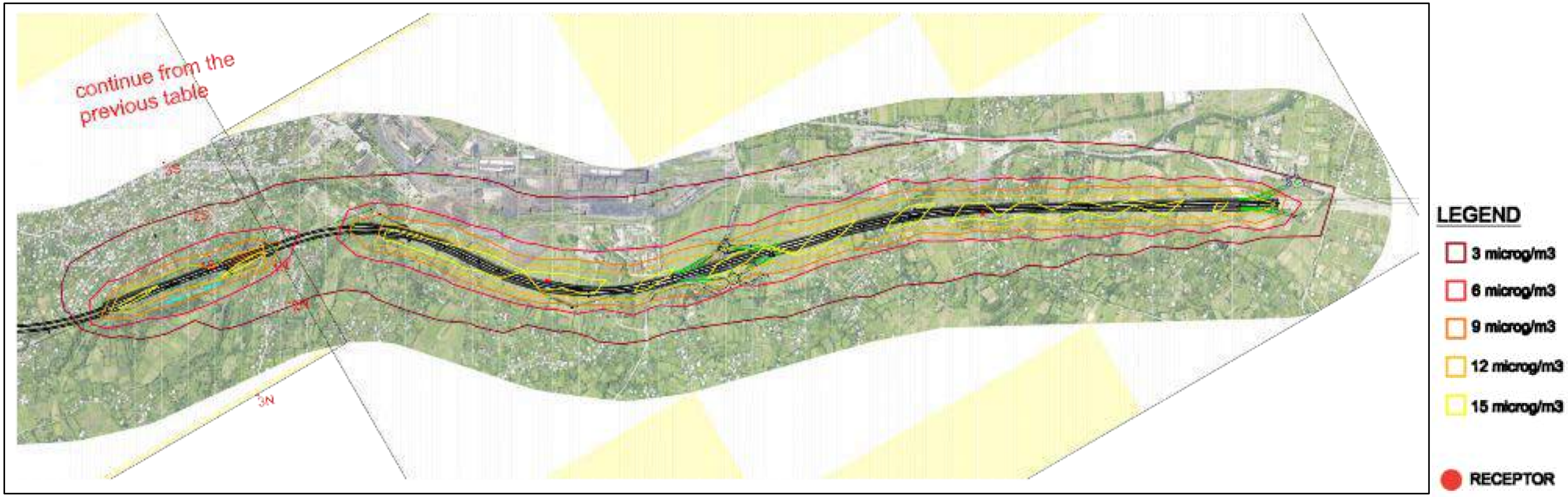


Figure F-8: NO2, 2034 (Km 8 – Km 14.7)

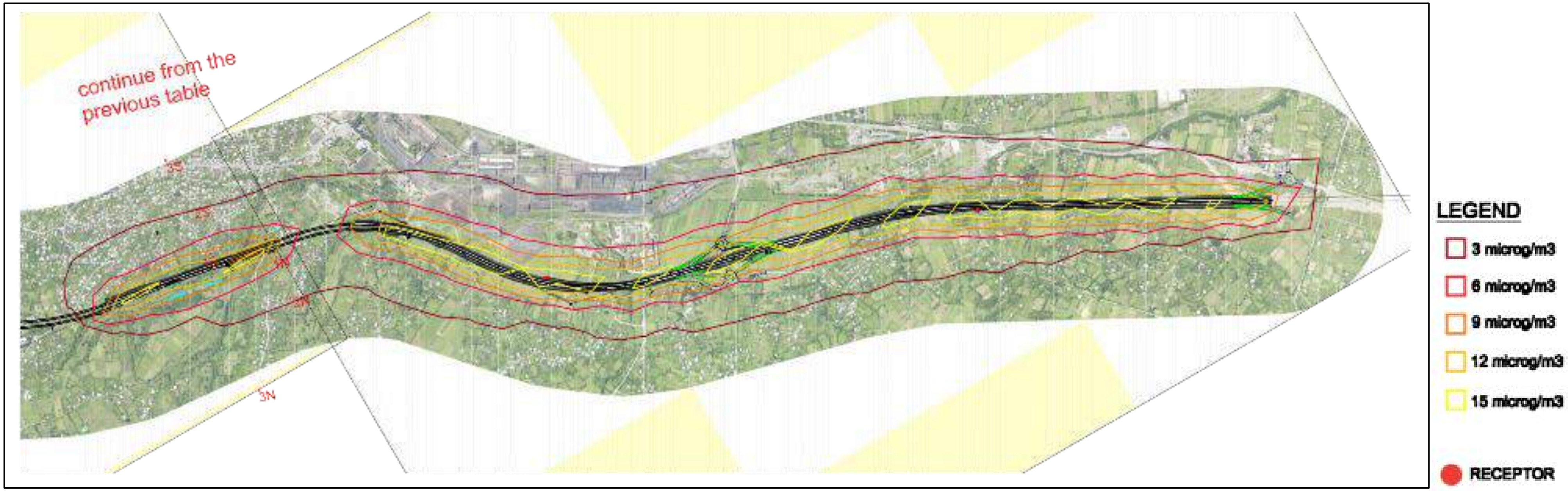


Figure F-9: CO, 2019 (Km 0 – Km 8)

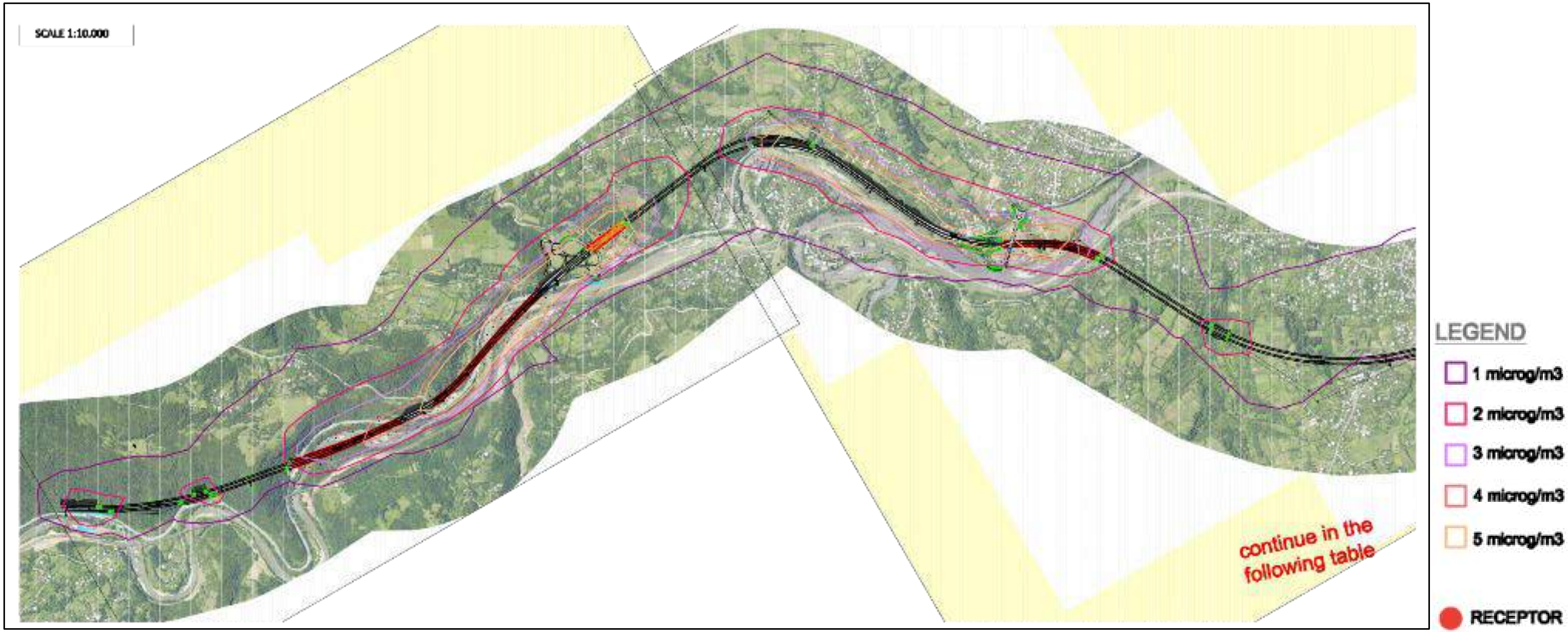


Figure F-10: CO, 2034 (Km 0 – Km 8)

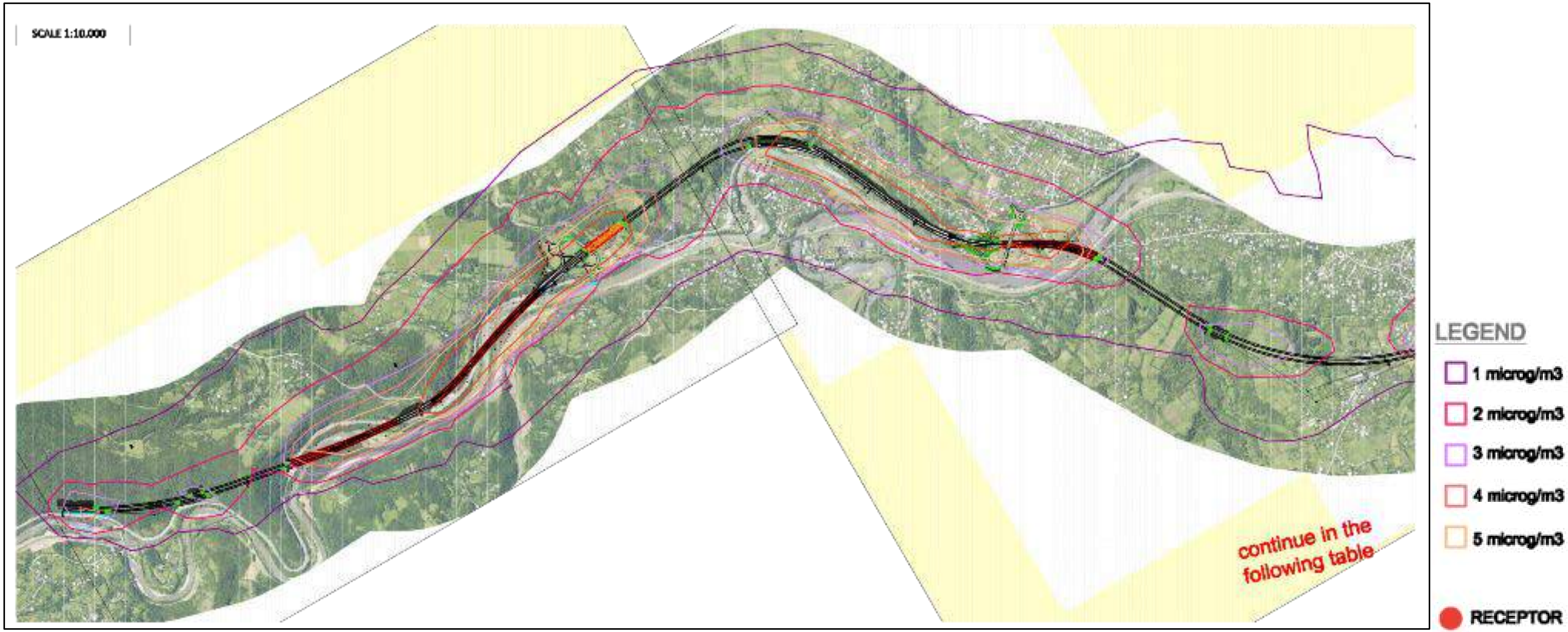


Figure F-11: CO, 2019 (Km 8 – Km 14.7)

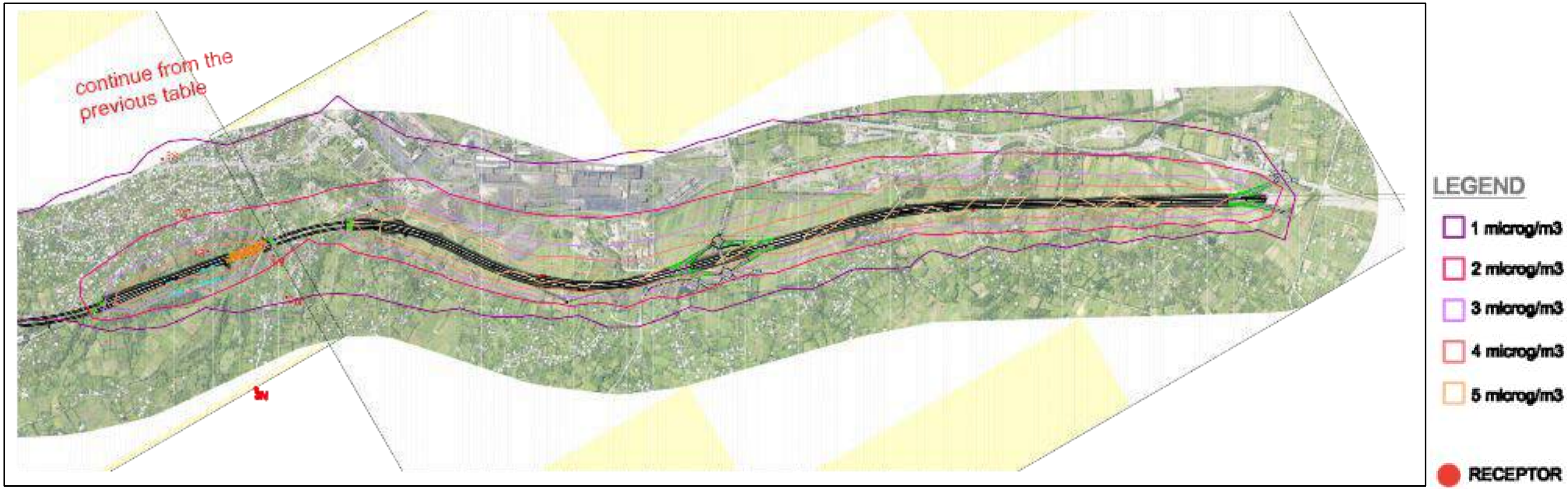
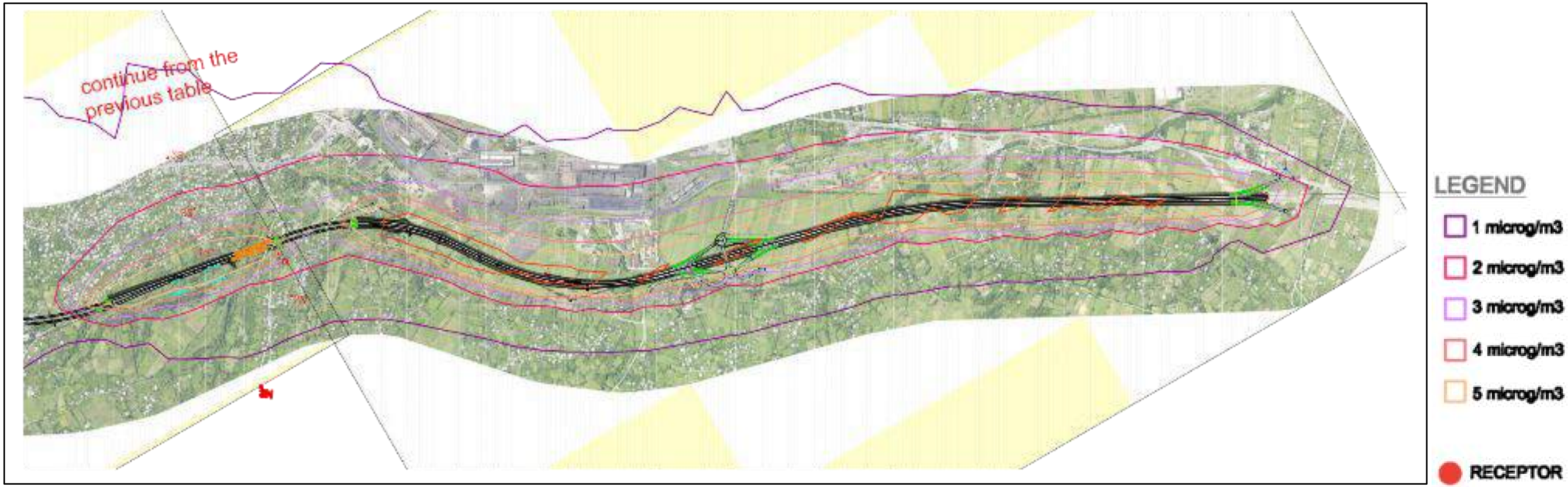


Figure F-12: CO, 2034 (Km 8 – Km 14.7)



481. 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; it can also be pointed out that no air quality limits will be exceeded even considering that the composition of the fleet of vehicles is maintained. The higher values are recorded to the south of the road due to the main wind directions and morphology, these values are anyhow lower than the limits.

482. 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.

F.5.3 Climate Change

Potential Impacts Caused by the Project

483. Greenhouse Gas (GHGs) Emissions – The Greenhouse Gas (GHG) emissions resulting from road construction have been estimated to be 2.14 ktCO_2/km for a 26m wide road. Including operational and maintenance costs over a 40 year period this figure rises to 3.94 ktCO_2/km. Given a road length of 14.77 km, this would result in around 58,200 tCO_2 of GHG emissions from the construction and O&M phases of the Project over a 40 year period.

Table F-5: Estimated Energy Consumption, CO_2 Emissions and GHG Emissions for a Concrete Pavement 13 m wide.

Phase	Energy Consumption, TJ/km (26m pavement)	CO_2 Emissions ktCO_2/km (26m pavement)	All GHG Emissions ktCO_2/km (26m pavement)
Construction	11.51 (23.02)	1.00 (2.00)	1.07 (2.14)
Maintenance – 40 years	2.99 (5.98)	0.19 (0.38)	0.20 (0.40)
Operation – 40 years	12.60 (25.20)	0.66 (1.32)	0.70 (1.40)
Total	27.09 (54.18)	1.85 (3.70)	1.97 (3.94)

Source: IEA ETSAP – Technology Brief T14 –August 2011

484. GHG emissions from traffic using the road have been calculated using the traffic forecasts presented in **Section B**. The existing road traffic is estimated to generate around 259 tons of CO_2 per day, or 94,661 tons of CO_2 per annum. A decrease of 13% of GHG emissions can be achieved when driving at 90 km/h as opposed to transient driving at 60 km/h. If we apply this condition to the traffic forecasts in 2037 a figure of approximately 186,000 tons of CO_2 would be generated by traffic using the road per year. However, this figure could reduce dramatically over the coming years as the performance of cars increase including the use of electric cars running of renewable energy.

Potential Impacts Upon the Project

485. 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:

- 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).
- Changes in temperature will also impact the behaviour of permafrost and thus the infrastructure lying on permafrost.
- Changes in precipitation and water levels will impact road foundations.
- 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.
- Stronger or faster velocity of water flows will also impact bridge foundations.
- Increased wind loads and storm strengths will impact long span bridges, especially suspension and cable-stayed bridges.
- High levels of precipitation may threaten embankment stability.
- Increase in scouring of roads, bridges, and support structures. [18]

Mitigation Measures

486. Detailed pavement implications for climate change are scarce but growing in number and include work on the effect of rising average temperatures, changes in precipitation patterns, and increasing freeze-thaw cycling on pavement performance. The focus of these efforts is to integrate climate change into pavement design and predict pavement performance based on future climate scenarios. Most work has offered general advice or predictions but has stopped short of recommending immediate changes in practice. [19]

487. 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:

- Increase ditch and culvert capacity;
- Maintain positive cross slope to facilitate flow of water from surface;
- Increase resistance to rutting;
- Reduce splashing/spray through porous surface mixtures;
- More frequent use of elevated pavement section;
- Improve visibility and pavement marking demarcation; and
- Ensure that all embankments are seeded to help increase stability.

F.5.4 Soils

Potential Impacts

488. Potential impacts to soils include:

- Loss of Topsoil - Several impacts to topsoil may occur during the construction phase, including; removal of top soil for construction outside the ROW; compaction of topsoil; loss of top soil by wind and water erosion and covering of top soil by project works.

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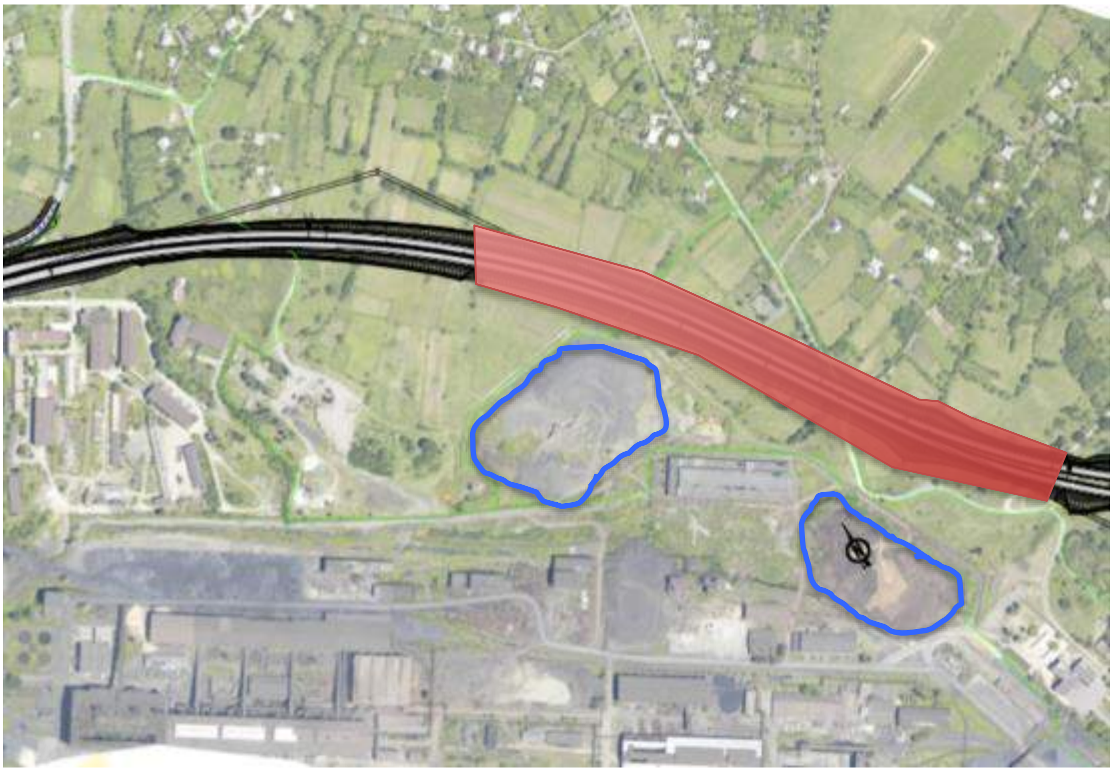
[18] Climate Proofing ADB Investment in the Transport Sector. ADB, 2014.
[19] Climate Change Adaptation for Pavements. US Department of Transport, Federal Highways Administration, 2015

- Erosion - It is possible, that without adequate protection measures soil erosion could occur on road embankments and bridge embankments. It is also possible, that stockpiles of soil located close to surface waters could infiltrate the water courses during heavy rainfall and cause siltation of the rivers.
- Borrow Pits – Potential impacts relating to borrow pits are discussed under **Section F.7.5 –** Borrow Pits.
- Induced Changes - Induced changes in the Project Area leading to industrial and commercial development are conceivable, thereby decreasing soil availability for agricultural purposes.
- Contamination Due to Spills or Hazardous Materials - Potential soil contamination is a possibility resulting from poorly managed fuels, oils and other hazardous liquids used during the project works.
- Contaminated Land - 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 the proposed new national limits. 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 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 (see **Figure F-13**). 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.

Figure F-13: Location of Potentially Contaminated Land (spoil heaps in blue)



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 prior to their disposal to ensure that they are not contaminated and can be disposed of as non-hazardous waste.

Mitigation Actions

Pre-construction phase

489. Loss of Soil for Agricultural Production - Before the commencement of the construction works of the Project, the RD must prepare the LARP. **Section F.7.2** – Land Use, discusses this issue in more detail.

490. Borrow Pits – Mitigation relating to borrow pits is discussed under **Section F.7.5** – Borrow Pits.

491. Contaminated Land - An additional four samples will be taken as part of this EIA and the results presented as an addendum to this report. Two of the samples will be taken in the area identified in **Figure F-13** and two within the alignment to the east and west of this area. If the results show that the monitored parameters are within the proposed national limits of outlined in **Table E-13**, **Table E14** and **Table E-15** 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:

- The Contractor shall identify a temporary storage area for material excavated from the area identified in **Figure F-13**. The area should be fenced and signposted. The area shall comprise an impermeable surface to prevent leachate from the stockpiles potentially contaminating soils and groundwater in the area of the storage area.
- The Contractor shall strip the topsoil in the area of **Figure F-13** in batches of 5,000 m^2 and store the mixed material in the temporary storage area (the stockpile). The height of the stockpile shall be no more than 2 meters. The Contractor may choose to have more than one stockpile, depending upon the rates of excavation in this area.
- The Contractor shall then divide the stockpile into quadrants of $250m^3$. The Engineer will hire a certified laboratory to take a soil sample from each of the quadrants for further chemical analysis (a stockpile of $2,500m^3$ would require 10 samples). Sampling should be uniformly distributed throughout the stockpile, including sampling at depth. The Engineer will be present during the sampling to confirm that the correct number of samples were taken and that the sampling was undertaken in line with the relevant national legislative requirements.
- If the results show the all of the samples are within the proposed national limits of outlined in **Table E-13**, **Table E14** and **Table E-15** and the Dutch target values the material can be removed from the stockpile area and disposed of as non-hazardous material.
- If any of the ten samples show elevated levels of contamination the material from the respective contaminated quadrants of 250 m^3 will be disposed of as hazardous waste. Any other non-contaminated quadrants may be disposed of as non-hazardous waste. Final disposal of any contaminated soil must be undertaken at a waste management facility licensed to handle such wastes. As with normal waste materials, the Contractor will be obliged to keep records of any hazardous materials removed from the site, including:

  - Volume of soil removed;
  - Details of any identified contamination;
  - Soil stockpile (and/or storage container) unique identifier;
  - Date excess soil was excavated from each location and subsequently transported to a disposal facility;
  - Details of the vehicle transporting the soil to a disposal facility;
  - Details of the disposal facility; and
  - Date the excess soil arrived at the disposal facility.
- The Contractor will also provide a copy of the licensed waste management contractors contract to the Engineer before any contaminated soil is removed from the site. The Engineer will also be responsible for undertaking an additional due diligence review of the waste management contractors disposal site.

492. 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. The plan will be submitted to the Engineer for approval.

493. In many countries the concept of 'the polluter pays' is attributed to issues such soil contamination. It is likely that any contamination found in this area would have originated from the GAA, but the GAA has changed ownership several times during its life and it may be difficult to apportion liability to the current owners of the site. Accordingly, if any elevated levels of contamination are found that need to be removed during construction works the costs of removal and disposal should be bourn by the RD. The Contractor will be responsible for implementation of the Contaminated Soil Management Plan.

<u>Construction Phase</u>

494. Potential adverse impacts will be avoided or otherwise mitigated by ensuring the Contractor complies with the following:
- Erosion - During construction, the Contractor will be responsible for ensuing material that is less susceptible to erosion will be selected for placement around bridges and culverts. In addition, he will ensure re-vegetation of exposed areas including; (i) selection of fast growing and grazing resistant species of local grasses and shrubs; (ii) immediate re-vegetation of all slopes and embankments if not covered with gabion baskets; (iii) placement of fiber mats to encourage vegetation growth. The Engineer and the Contractor will both be responsible for ensuring that embankments are monitored continuously during construction for signs of erosion.
- Topsoil – To reduce impacts to topsoil the following measures will be employed by the Contractor; locate topsoil stockpiles outside drainage lines and protect stockpiles from erosion; construct diversion channels and silt fences around the topsoil stockpiles to prevent erosion and loss of topsoil; rip ground surface prior to the spreading of topsoil; and remove unwanted materials from topsoil such as roots of trees, rubble and waste etc. Specifically regarding soil compaction, the Contractor will confine operation of heavy equipment within the ROW, as much as possible, to avoid soil compaction and damage to privately owned land. If in case private lands are disturbed, the contractor should promptly inform the owner and agree on the ways to remedy the situation.
- Borrow Pits – Mitigation relating to borrow pits is discussed under **Item F.7.5 – Borrow Pits**.

- Conversion of Agricultural Soils Due to Indirect/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.
- Contamination Due to Spills or Hazardous Materials. The Contractor, with oversight from the Engineer, will ensure that:
    - All fuel and chemical storage (if any) will be sited on an impervious base within a bund and secured by fencing. The storage area will be located away from any watercourse or wetlands. The base and bund walls will be impermeable and of sufficient capacity to contain 110% of the volume of tank (or one tank if more than one tank is located in the bund).
    - The construction camp maintenance yard will be constructed on impervious hardstanding with adequate drainage to collect spills, there will be no vehicle maintenance activities on open ground.
    - Filling and refueling will be strictly controlled and subject to formal procedures. Drip pans will be placed under all filling and fueling areas. Waste oils will be stored and disposed of by a licensed contractor.
    - All valves and trigger guns will be resistant to unauthorized interference and vandalism and be turned off and securely locked when not in use.
    - The contents of any tank or drum will be clearly marked. Measures will be taken to ensure that no contaminated discharges enter any soils.
    - No bitumen drums or containers, full or used, will be stored on open ground. They will only be stored on impervious hardstanding.
    - Areas using bitumen will be constructed on impervious hardstanding to prevent seepage of oils into the soils.
    - No bitumen drums or containers, full or used, will be stored on open ground. They will only be stored on impervious hard standing.
    - Areas using bitumen will be constructed on impervious hard standing to prevent seepage of oils into the soils.

F.5.5 Hydrology

Potential Impacts

<u>Pre-construction Phase</u>

495. The following potential impacts to hydrological conditions exist within the Project corridor:

- Drainage & Flooding - Inadequate assessment of the hydrological conditions in the Project Area and poor design could result in damage to Project structures, including bridges and culverts. This in turn would result in several impacts including cost to rebuild the structures, potential flooding of agricultural land and property and impacts to surface water quality.
- Construction Camps – Improper siting and design of construction camps can have negative impacts to hydrology, both surface and groundwater, through improper disposal of liquid waste and spills of hazardous liquids.

<u>Construction Phase</u>

496. 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 biodiversity of the rivers. Excavation of river bed materials will be required during the construction of the bridge piers (only around 5 piers will be constructed within the river itself). Surface

water monitoring did not indicate any elevated levels of contamination in the groundwater of both the Dzirula or the Kvirila rivers as such it is considered highly unlikely that the river bed silt is contaminated by manganese or any other pollutant and will therefore not need to be disposed of as hazardous waste. No other pollution of riverbed sedimentation is anticipated as a result of the construction activities in the river.

497. Hazardous Liquids - From the construction activities, there will be significant use of fuel and lubricant and other hazardous liquids such as paints. Without standardized materials handling and storage protocol in place, spills and contamination of groundwater and soils is possible. Other impacts to groundwater could occur from the washing out of concrete mixers onto bare soils and a lack of oil and grease interceptor tanks in camp drainage systems.

498. Water Use – 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.

499. Tunnel Construction – Impacts associated with tunnel construction are discussed under **Section F.7.6** below.

500. No fisheries have been identified within the Project area, or residents that rely on fishing as a livelihood. As such no impacts to livelihoods or fisheries or activities downstream are anticipated.

<u>Operational Phase</u>

501. Drainage of run-off from bridge decks could flow directly to the rivers if correct drainage is not installed on the bridges. This could be a problem if the bridges have accumulated oils and grease during dry periods and they are suddenly washed out during heavy rainfall.

Mitigation Actions

<u>Pre-construction Phase</u>

502. Drainage and Flooding - 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. 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. If, during the operational phase of the Project, the rehabilitated road does result in increased run-off and flooding, the RD will be responsible for rectifying this issue.

503. Bridges - All bridges will be designed for the life expectancy of 100 years. The design loading and design of all structural components will conform to the bridge design standards provided in the Employer’s Special Requirements. Bridge designs will ensure that drainage from bridge decks over 50 meters does not discharge directly to the watercourses beneath the bridges. The bridge run-off waters will lead to an interceptor tank, or filter pond adjacent to the bridge in order to trap oil and grease run-off. The bridge design and layout must also be aesthetically pleasing and in harmony with the existing environment. Finally, 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.

504. Construction Camps – In the first instance, no construction camp, permanent or temporary, will be located within 500 meters of any river, or irrigation channel (not including drainage channels) identified in this report, including the Dzirula, Kvirila and Borimela rivers. The Contractor will also be responsible for the preparation of a Construction Camp Site Plan which will form part of the SSEMP. The Plan will indicate the system proposed and the locations of related facilities in the site, including latrines, holding areas, septic tanks, etc. The Contractor will ensure the following conditions are met within the Plan:

- Wastewater arising on the site will be collected, removed from the site via a suitable and properly designed temporary drainage system and disposed of at a location and in a way that will cause neither pollution nor nuisance.
- There will be no direct discharge of sanitary or wash water to surface water, including the surface water courses identified in this report, including the Dzirula, Kvirila and Borimela rivers. Disposal of materials such as, but not limited to, lubricating oil and onto the ground or water bodies will be prohibited.
- Liquid material storage containment areas will not drain directly to surface water (including wetlands).
- Lubricating and fuel oil spills will be cleaned up immediately and spill cleanup materials will be maintained (including spill kits) across the Contractors construction camp and ancillary facilities, e.g. asphalt plant.
- Construction and work sites will be equipped with sanitary latrines that do not pollute surface waters.
- Discharge of sediment-laden construction water directly into surface watercourses or wetlands will be forbidden. Sediment laden construction water will be discharged into settling lagoons or tanks prior to final discharge.
- Spill cleanup equipment will be maintained on site. The following conditions to avoid adverse impacts due to improper fuel and chemical storage:
- Fueling operations will occur only within containment areas.
- All fuel and chemical storage (if any) will be sited on an impervious base within a bund and secured by fencing. The storage area will be located away from any watercourse or wetlands. The base and bund walls will be impermeable and of sufficient capacity to contain 110% of the volume of tanks.
- Filling and refueling will be strictly controlled and subject to formal procedures and will take place within areas surrounded by bunds to contain spills / leaks of potentially contaminating liquids.
- All valves and trigger guns will be resistant to unauthorized interference and vandalism and be turned off and securely locked when not in use.
- The contents of any tank or drum will be clearly marked. Measures will be taken to ensure that no contaminated discharges enter any drain or watercourses.
- Disposal of lubricating oil and other potentially hazardous liquids onto the ground or water bodies will be prohibited.
- Should any accidental spills occur immediate cleanup will be undertaken and all cleanup materials stored in a secure area for disposal. Disposal of such was will be undertaken by a waste management company contracted by the Contractor. The waste management company must have the required licenses to transport and dispose of hazardous waste before any such waste is removed from the site. The Contractor will keep copies of the company’s licenses and provide waste transfer manifests at his camp site for routine inspection by the Engineer.

505. Site plans will be devised to ensure that, insofar as possible, all temporary construction facilities are located at least 100 meters away from any surface water course. If determined warranted by the Engineer, the Contractor will provide a wash pit or a wheel washing and/or vehicle cleaning facility at the exits from the Contractors camp sites. If so requested, the Contractor will ensure that all vehicles are properly cleaned (bodies and tires are free of sand and mud) prior to leaving the site areas. The Contractor will provide necessary cleaning facilities on site and ensure that no water or debris from such cleaning operations is deposited off-site.

Construction Phase

506. Construction Camps and Storage Areas – The Engineer will undertake regular monitoring of the Contractors construction camp and storage areas to ensure compliance with the SSEMP and the Contractors Construction Camp Site Plan.

507. Water supply – 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 specified in **Section 2**.

508. Bridge Construction - Concerning bridge construction works, the Contractor will:

- Divert the water flow near the bridge piers.
- Provide coffer dams, silt fences, sediment barriers or other devices to prevent migration of silt during construction within streams.
- Perform dewatering and cleaning of cofferdams to prevent siltation by pumping from cofferdams to a settling basin or a containment unit.
- Carry out bridge construction works without interrupting the traffic on the Project Road with the provision of suitable diversions.
- Ensure no waste materials are dumped in the river, including re-enforced concrete debris.
- Place generators more than 20 meters from the river.
- Ensure that no concrete waste is dumped in the river.
- Carefully collect all polystyrene (from expansion joints) so that it does not litter the local environment.
- Ensure that no hazardous liquids are placed within 10 meters of the river.
- Provide portable toilets at bridge construction sites to prevent defecation by workers into the river.
- Ensure that workers are provided with correct PPE including harnesses.
- During piling works ensure that pumped water is filtered through a silt trap before being discharged to the river.
- Provide areas where concrete mixers can wash out leftover concrete without polluting the environment. This may be in the form of a lined settling pond at each bridge site. Drivers will be informed of these locations and the requirements to use these settling ponds on a routine basis by the Engineer. Dried waste from the settling ponds can be used as backfill for culverts, etc.

509. 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.

510. Tunnel Construction - Mitigation associated with tunnel construction are discussed under **Section F.7.6** below.

F.5.6 Natural Hazards

Potential Impacts

511. Potential flood events are discussed above under **Section F.5.5 - Hydrology**) and increased precipitation is discussed above under **Section F.5.3 Climate Change.**

512. 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 considered 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.

513. 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.

Mitigation Actions

514. None required.

F.6 Ecological Resources

F.6.1 Flora

Potential Impacts

515. Flora within the Project corridor has been classified as either low or high quality mainly dependent on the presence of Georgian red list species of trees which have been identified in the State Forest Fund areas.

516. A number of trees will need to be cut within the Project area, both on private land and within State Forest Fund areas. 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.

517. <u>Private Land</u> - 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.

518. <u>State Forest Fund</u> – 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.

Mitigation Actions

519. 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.

520. Private Land - Compensation shall be paid to all affected tree owners as per the Project LARP.

521. State Forest Fund – An inventory of the species to be de-listed has been prepared as part of this EIA and is provided in **Appendix G**. 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.

522. 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.

523. The National Forest Agency provides free service for special marking and issuing timber origin certificate for transportation of timber resources. The timber resources obtained as a result of cutting of the trees from the SFF, shall be sorted out according to species by the Contractor and collected at the area indicated by National Forest Agency and transferred to the National Forest Agency by the Contractor to a specified state property land plot.

524. No compensation in the form of re-planting is required under this resolution unless specified by the MoENRP in the Conclusion of Ecological Expertise. Not withstanding the above, 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. The Red-Listed seedlings are available at the following nursery-gardens: (a) Gori nursery- garden, (b) LEPL Sartichala nursery-garden, and (c) nursery-garden Green Service Ltd. 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.

F.6.2 Fauna

Potential Impacts

525. Impacts during the construction phase may occur, including:

- 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;
- Small-sized animals may fall in trenches and pits and may be injured;
- During the movement of construction vehicles and construction equipment, collision with animals may be expected;
- Emission of noise, dust and combustion products, as well as human intensive activities will cause animal disturbance and migration to other places;
- 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;
- Night lighting systems at construction camps may cause disturbance of animals and disorientation of birds;
- There may be the cases of poaching by staff;
- Street lighting impacting birds;
- Temporary impacts on fish may include direct contact by construction equipment with, 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
- Bridge works could impact upon the habitat of otters.

526. Road kill – During the operational phase of the Project there may be greater risk of accidents involving cattle due to the increased number of vehicles on the road and increased speeds.

Mitigation Actions

527. The following mitigation measures shall be applied relating to Fauna:

- The Contractor shall consult with the MoENRP to determine when works in rivers should be suspended in order to limit impacts to fish spawning periods. In addition, mitigation measures outlined in **Section F.5.5 – Hydrology**, will reduce the potential for impacts in surface waters.
- Mitigation measures outlined in **Section F.5.1 – Air Quality**, **F.7.3 – Waste Management** and **F.8.6 – Noise** will mitigate impacts relating to these issues.
- 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.
- Ensure that lower wattage lamps are used in street lights which direct light downwards to reduce glare.
- Tree cutting shall not occur during bird nesting seasons.

F.6.3 Forests and Protected areas

Potential Impacts

528. No protected areas or forest reserves are located within the Project area. 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.

Mitigation Actions

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

F.7 Economic Development

F.7.1 Transportation Facilities & Utilities

Potential Impacts

Transportation Facilities

530. 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. The main area that is likely to be impacted is portion around KM 5.5 close to Shorapani.

531. 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. Blocking of access routes will be temporary while structures, such as side drains and culverts, are constructed, however access via diversions or temporary access routes must be provided at all times.

532. 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. Specific attention needs to be paid by construction workers in this area to ensure that they are not involved with an accident on the line. In addition, the Contractor needs to take care to ensure that any construction equipment interferes with passing trains. Special care will also need to be undertaken when excavating the tunnel portal in this area to avoid rock falling on the tracks. Vibration from bridge piling may also affect the railways tracks.

533. Notwithstanding the above, the potential beneficial impacts to transport are significant. The road, when complete, will offer reduced travel times, smoother ride (resulting in less vehicle maintenance and less damage to perishable goods) and safer driving conditions.

Utilities

534. 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.

Mitigation Actions

Transportation

535. 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;
- Provide information to the public about the scope and schedule of construction activities and expected disruptions and access restrictions;
- Allow for adequate traffic flow around construction areas via diversions or temporary access roads;
- If temporary access roads are to be constructed with a gravel surface they shall be routinely watered by the Contractor during dry weather to reduce dust impacts; and
- Provide adequate traffic signs, appropriate lighting, well-designed traffic safety signs, barriers and flag persons for traffic control.
- Access roads for borrow pits, batching plants, etc, should be maintained during the construction phase and rehabilitated at the end of construction.

536. The volume of construction traffic is considered to be intensive truck traffic and will need to be managed both in terms of surface damage. A road condition survey will need to 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.

537. 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. The statement shall address issues relating to:
- Restrictions relating to blasting;
- Excavation of the tunnel portal;
- Vibration impacts on tracks;
- Working above live tracks; and
- Coordination with GR.

Utilities

538. During construction all utilities in the Project area shall be kept operational, particularly during the winter months. Facilities may require temporary relocation during the construction phase and as such the Contractor will be responsible for liaising with the relevant utilities operators to ensure they remain operational. Should utilities need relocating in a different location the Contractor will consult with the relevant utilities and local community to ensure that there is no change in supply as a result of these changes.

F.7.2 Land use

Potential Impacts

539. 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.

Mitigation Actions

540. 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.

F.7.3 Waste Management

Potential Impacts

541. General Construction Waste - Road construction will inevitably generate solid and liquid waste products including:

- Inert waste – for example, concrete, metal, wood and plastics.
- Hazardous waste – acids and alkaline solutions, waste oils and oily sludge, batteries, and bitumen.

542. 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. As well as being a cause of complaints by the local population, this may lead to contravention of local regulations and fines being imposed on the Contractor.

543. The main construction waste produced will waste concrete (solid and sludge) and possible asphalt, depending upon how much can be re-used as sub-base material. **Table F-11** indicates the main types of waste and an estimate of volumes (based on similar road construction projects).

Table F-11: Waste Types and Estimated Volumes

#	Waste Type	Hazardous	Estimated Volume
1	Concrete	No	200 m^3
2	Asphalt	No	Currently unknown
3	Bituminous Mixtures	Yes	1 t
4	Wood	No	1 t
5	Uncontaminated Metal	No	5 t
6	Uncontaminated Plastic	No	1 t
7	Contaminated metal (paint tins, etc.)	Yes	2 t
8	Contaminated plastic (oil containers)	Yes	3 t
9	Domestic waste (food stuffs)	No	5 t
10	Domestic Waste (non-foodstuff)	No	40 t
11	Sewage Water	Yes	150 m^3
12	Tyres	Yes	150 t
13	Hazardous liquid waste	Yes	20 m^3
14	Hazardous solid waste	Yes	10 t

544. It is noted that the waste management situation in Georgia is still developing, and that the waste management facilities in the Project area have been closed. Accordingly, the Contractor needs to ensure that waste materials are disposed of in a manner that does not cause pollution to the environmental or result in potential health impacts.

545. Tunnel and Other 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. 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.

546. Assuming that the most of the embankments 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.

547. 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.

Mitigation Actions

548. To ensure waste management is adequately controlled during both the construction and operational phase of the Project, the Contractor shall be responsible for a range of measures including:

1. <u>Waste Management Plan (WMP)</u> – The WMP shall include items relating to the safe handling and management of:

- Domestic waste
- Food waste
- Recycled Waste
- Plastic
- Metals
- Wood
- Construction Waste
- Hazardous Waste
- Liquid Waste

<u>2. Recycling and Reuse</u> – Where possible, surplus materials will be reused or recycled – this should include asphalt, concrete, wood, plastic, metal and glass. A

plan for the recycling of materials should be included in the WMP. As noted above, approximately 1,519,000 m^3 of spoil material will be re-used for embankments.

<u>3. Storage of Hazardous Wastes</u> – Oils, fuels and chemicals are substances which are hazardous to human health. They need to be stored properly in correctly labeled containers, both within the construction camp and also at construction areas. Oil and fuel should be stored in tanks with lined bunds to contain spillage (the bund should be able to contain at least 110% of the volume of the largest storage tank within the bund).

<u>4. Waste Disposal</u> – Waste, both hazardous and non-hazardous, shall be collected and disposed of by a licensed waste management contractor. The Contractor will keep copies of the waste management company's licenses on file at his site office. The Contractor shall also keep a record of the waste volumes and types removed from the site and the waste transfer notes provided by the waste management contractor.

<u>5. Waste Spoil Material</u> - The responsibility for identifying the final disposal areas for tunnel and embankment spoil material identified above, 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 Kutaisi bypass. If the Contractors for F4 and Kutaisi 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 site. There are several important steps the Contractor should follow before temporary storage of spoil material can commence:

1. The Georgian EIA regulation states that the spoil storage areas shall be agreed with the local municipality and MoENRP.
2. As soon as the area is identified the MoENRP will request a Spoil Disposal Plan for Arrangement of Spoil Disposal Area and a Re-cultivation Plan from the Contractor. This plan shall be prepared in accordance with regulation N 424 on Approval the Rules for Removal, Storage and Use of Topsoil and Re-cultivation.
3. The plan will indicate:
    a. The location of disposal area (layout, coordinates etc).
    b. Agreement with the land owner.
    c. Category of the land.
    d. Distance from the surface water source.
    e. Provide information on route of spoil transportation and means of transport (including routes avoiding, where possible, sensitive receptors).
    f. Schedule of the timing of material transport (excluding night-time transport on local roads (but not the existing E-60) between 10pm and 6am).
    g. Any necessary improvements to local roads to cater for the increased level and types of trucks using the roads.
    h. The scheme of dumping.
    i. The maximum height of disposed soil and anti erosion measures.
    j. Describe re-cultivation of disposal area.
    k. Provide coordinates of the spoil area.
    l. Provide profile drawings of the spoil area.

    m. Provide time stamped photographs of the pre-disposal site conditions.

4. 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.

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 employer. 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.

Excavation for tunnels 4.0.01-AT/TA, 4.0.02-AT/TA and 4.0.03-AT/TA shall start at portals located adjacent to the existing road and as such materials can be moved directly from the portals to the disposal areas using the existing road. Tunnels 4.0.04-AT/TA, 4.0.05-AT/TA and 4.0.06-AT/TA are located north of Zestaphoni and Shoropani. Materials from these tunnels will need to be transported along local roads, some of which may need to be upgraded to accommodate the trucks using these roads. The Contractor will be responsible for upgrading any local roads and ensuring that they are maintained to acceptable levels to allow local traffic to continue to use these roads during all weather. If any access roads are gravelled they will be regularly sprayed with water during the construction phase to limit the impacts of dust.

It should be noted that by using Kutaisi bypass as a disposal location for the spoil, all truck journeys will have to pass through the urban centre of Zestafoni.

<u>6. Liquid Waste –</u> The issue of liquid waste, including concrete sludge, camp run-off water, vehicle washing water, batching plant wastewater, etc., is discussed above under item **F.5.5 – Hydrology** and **F.7.4 Construction Camps.**

F.7.4 Construction Camps & Batching Plants

Potential Impacts

549. 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. Specific issues may arise as a result of the following:

550. <u>Design and Siting</u> - Improper siting and design of construction camps can have negative impacts to hydrology through inappropriate disposal of liquid waste and spills of hazardous liquids. Poor management of sanitary waste and accidental spills of hazardous liquids from construction camps can also have negative impacts on ground and surface water. Rock crushing plants and concrete batching plants can also have impacts on sensitive receptors located downwind of the sites if the plants are too close to the urban areas.

551. <u>Concrete Batching Plants</u> - Potential pollutants in batching plant wastewater include cement, sand, aggregates and petroleum products. The main sources of wastewater at batching plants are; contaminated storm water runoff, dust control

sprinklers, the agitator washout station, the agitator charging station, the slumping station, and cleaning and washing areas. These substances can adversely affect the environment by:

- Increasing water pH.
- Increasing the turbidity of waterways (turbidity is a measure of the cloudiness of a suspension).

552. Asphalt Plants – Several impacts are associated with asphalt plants:

- Emissions – including dust from the transport and handling of aggregates and emissions from the combustion process in the dryer.
- Noise - Noise occurs at different places in the process for examples in the conveyor belts, dryer and mixer drum, internal and external traffic. The noise is estimated to be in the range of 90 to 100 dBA (Leq) at a few metres from the equipment.
- Storage of Bitumen – Drums of bitumen will be stored safely and securely to prevent accidents and pollution.
- Storage and Use of Hazardous Materials – Some materials used during asphalt production, such as Kraton, can be explosive or a fire hazard. These materials need to be stored and managed appropriately.
- Health and Safety - Asphalt Plants can be very dangerous, accidents may occur at any time. Hence it is important to have a proper policy for the Health and Safety Issues.
- Vehicle Movement – a large number of trucks will be required to transport the hot asphalt from the plant to the work site, this may be a distance of up to 25 kilometers.

Mitigation Actions

553. Construction Camps – Prior to commencement of works, the contractor must identify the location of the camp, with approval from the Engineer, and then agree on/receive a permit for its use from the state or the land owner. No construction camp will be located within one kilometer of an urban area and at least 50 m from any surface water course.

554. The Contractor will be responsible for the preparation of a Construction Camp Site Plan which will form part of the SSEMP. The Plan will indicate the system proposed and the locations of related facilities in the site, including latrines, holding areas, etc. The Contractor will ensure the following conditions are met within the Plan:

- Rain-water run-off arising on the site will be collected, removed from the site via a suitable and properly designed temporary drainage system and disposed of at a location and in a manner that will cause neither pollution nor nuisance. The drainage system will be fitted with oil and grease interceptors.
- There will be no direct discharge of sanitary or wash water to surface water.
- In the absence of functioning sewerage and sewage treatment facilities it is recommended that the Contractor provides his own on-site wastewater treatment facilities. For sites servicing a small number of employees (less than 150), septic tanks may be used. For larger sites, liquid wastes will as a minimum receive primary treatment in anaerobic tank or pond preceded by a bar screen to remove large solid objects (e.g. sticks, rags). Primary treatment (also referred to as clarification, sedimentation or settling) is the process where wastewater is allowed to settle for a period (around 2 hours) in a settling tank. This leads to separation of a liquid effluent which includes oils and grease and a liquid-solid

sludge. Primary treatment leads to reduction in suspended solids, biological oxygen demand and removal of floating material (e.g. faeces). There will be no direct discharge of untreated sanitary or oily wastewater to surface water bodies.

- Licensed contractors will be required to collect and disposal of liquid waste from the septic tanks on regular basis.
- Disposal of materials such as, but not limited to, lubricating oil and onto the ground or water bodies will be prohibited.
- Liquid material storage containment areas will not drain directly to surface water.
- Waste water from vehicle washing bays will be free of pollutants if the wash bay has been constructed correctly.
- Lubricating and fuel oil spills will be cleaned up immediately and spill cleanup materials will be maintained at the storage area.
- Construction and work sites will be equipped with sanitary latrines that do not pollute surface waters and are connected to septic tanks, or waste water treatment facilities.
- Discharge of sediment-laden construction water directly into surface watercourses will be forbidden. Sediment laden construction water will be discharged into settling lagoons or tanks prior to final discharge.
- Washing out concrete trucks at construction sites will be prohibited unless specific concrete washout areas are provided for this purpose at the construction site (e.g. a bridge site). The washouts will be impermeable and emptied when 75% full.
- Spill cleanup equipment will be maintained on site (including at the site maintenance yard and vehicle fueling areas). The following conditions to avoid adverse impacts due to improper fuel and chemical storage:
    - Fueling operations will occur only within containment areas.
    - All fuel and chemical storage (if any) will be sited on an impervious base within a bund and secured by fencing. The storage area will be located away from any watercourse or wetlands. The base and bund walls will be impermeable and of sufficient capacity to contain 110% of the volume of tanks.
    - Filling and refueling will be strictly controlled and subject to formal procedures and will take place within areas surrounded by bunds to contain spills / leaks of potentially contaminating liquids.
    - All valves and trigger guns will be resistant to unauthorized interference and vandalism and be turned off and securely locked when not in use.
    - The contents of any tank or drum will be clearly marked. Measures will be taken to ensure that no contaminated discharges enter any drain or watercourses.
    - Disposal of lubricating oil and other potentially hazardous liquids onto the ground or water bodies will be prohibited.
    - Should any accidental spills occur immediate cleanup will be undertaken and all cleanup materials stored in a secure area for disposal to a site authorized to dispose of hazardous waste.

555. If determined warranted by the Engineer, the Contractor will provide a wash pit or a wheel washing and/or vehicle cleaning facility at the exits from the sites. If so requested, the Contractor will ensure that all vehicles are properly cleaned (bodies and tires are free of sand and mud) prior to leaving the site areas. The Contractor will provide necessary cleaning facilities on site and ensure that no water or debris from such cleaning operations is deposited off-site. The Engineer will undertake regular monitoring of the construction camps to ensure compliance with the SSEMP and the Construction Camp Site Plan.

556. The Contractor will be responsible to maintain and cleanup campsites and respect the rights of local landowners. If located outside the ROW, written agreements with local landowners for temporary use of the property will be required and sites must be restored to a level acceptable to the owner within a predetermined time period.

557. The Contractor will also ensure that potable water for construction camps and workers meets the necessary water quality standards of the GoG. If groundwater is to be used it will be tested weekly to ensure that the water quality meets the GoG drinking water standards specified in **Section 2**.

558. <u>Concrete Batching Plants</u> – The following measures will be followed to limit the potential for pollution from batching plants:

- To limit impacts from dust, the following conditions will apply:
  - Batching plants will be located downwind of urban areas and not within one kilometer of any urban area.
  - The entire batching area traversed by vehicles – including driveways leading into and out of the area – will be paved with a hard, impervious material.
  - Sand and aggregates will be delivered in a dampened state, using covered trucks. If the materials have dried out during transit they will be re-wetted before being dumped into the storage bunker.
  - Sand and aggregates will be stored in a hopper or bunker which shields the materials from winds. The bunker should enclose the stockpile on three sides. The walls should extend one metre above the height of the maximum quantity of raw material kept on site, and extend two metres beyond the front of the stockpile.
  - The hopper or bunker will be fitted with water sprays, which keep the stored material damp at all times. Monitor the water content of the stockpile to ensure it is maintained in a damp condition.
  - Overhead storage bins will be totally enclosed. The swivel chute area and transfer point from the conveyor will also be enclosed.
  - Rubber curtain seals may be needed to protect the opening of the overhead bin from winds.
  - Conveyor belts which are exposed to the wind and used for raw material transfer will be effectively enclosed, to ensure dust is not blown off the conveyor during transit. Conveyor transfer points and hopper discharge areas will be fully enclosed.
  - Conveyor belts will be fitted with belt cleaners on the return side of the belt.
  - Weigh hoppers at front-end loader plants will be roofed and have weigh hoppers shrouded on three sides, to protect the contents from the wind. The raw materials transferred by the front end loader should be damp, as they are taken from a dampened stockpile.
  - Store cement in sealed, dust-tight storage silos. All hatches, inspection points and duct work will be dust-tight.
  - Silos will be equipped with a high-level sensor alarm and an automatic delivery shut-down switch to prevent overfilling.
  - Cement dust emissions from the silo during filling operations must be minimised. The minimum acceptable performance is obtained using a fabric filter dust collector.
  - Totally enclose the cement weigh hopper, to ensure that dust cannot escape to the atmosphere.

  - An inspection of all dust control components will be performed routinely – for example, at least weekly.
- All contaminated storm water and process wastewater will be collected and retained on site.
- All sources of wastewater will be paved and bunded. The specific areas that will be paved and bunded include; the agitator washout area, the truck washing area, the concrete batching area, and any other area that may generate storm water contaminated with cement dust or residues.
- Contaminated storm water and process wastewater will be captured and recycled by a system with the following specifications:
  - The system's storage capacity must be sufficient to store the runoff from the bunded areas generated by 20 mm of rain.
  - Water captured by the bunds will be diverted to a collection pit and then pumped to a storage tank for recycling.
  - An outlet (overflow drain) in the bund, one metre upstream of the collection pit, will divert excess rainwater from the bunded area when the pit fills due to heavy rain (more than 20 mm of rain over 24 hours).
  - Collection pits should contain a sloping sludge interceptor, to separate water and sediments. The sloping surface enables easy removal of sludge and sediments.
  - Wastewater will be pumped from the collection pit to a recycling tank. The pit will have a primary pump triggered by a float switch and a backup pump which automatically activates if the primary fails.
  - Wastewater stored in the recycling tank needs to be reused at the earliest possible opportunity. This will restore the system's storage capacity, ready to deal with wastewater generated by the next rainfall event. Uses for recycling tank water include concrete batching, spraying over stockpiles for dust control and washing out agitators.

559. <u>Asphalt Plants</u> – the following measures will be applied by the Contractor:

- Emissions & Noise:
  - Asphalt plants will be located downwind of urban areas and not within one kilometer of any urban area.
  - Adequate Personal Protective Equipment (PPE) will be provided to staff working in areas of high noise and emissions.
- Storage and Use of Hazardous Materials (including bitumen):
  - Ensure all hazardous materials are stored (including within suitable sized bunds for liquids), handled and disposed of according to their Material Safety Data Sheet (MSDS).
  - Copies of MSDS will be kept on site with all hazardous materials.
  - The Contractor will keep a log of the type and volume of all hazardous wastes on site.
  - The Contractor will keep a plan of site indicating where all hazardous materials are stored.
- Vehicle Movement:
  - The Contractor will include the asphalt plant in his Traffic Management Plan, including haul routes from the plant.
- Health and Safety:
  - To prevent bitumen burns it will be compulsory for the workers handling hot bitumen to wear full-body protection.
  - All transportation, handling and storage of bitumen will be handled safely by experienced personnel.

- The dust from the manufacturing process may pose respiratory hazards, hence protective air mask will be provided to the operators for the loading and unloading of aggregates.
- Ear-muffs will be provided those working on the plant.
- First Aid kit will be available on site for the workers in case of emergency.
- The MSDS for each chemical product will be made accessible onsite and displayed.

F.7.5 Borrow Pits

Potential Impacts

560. 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.

Mitigation Measures

561. Several mitigation measures are recommended for 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. This will include review of the borrow pits operational license and its potential environmental impacts, such as its proximity to sensitive receptors. A copy of the agreement between the operator and the Contractor will also be provided to the Engineer.
- 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). The BAP will be submitted to the Engineer prior to the start of construction. The plan will identify the locations of all proposed borrow pits which will also be approved by both the Engineer, MoENRP and the RD. The plan will ensure that:
  - Pit restoration will follow the completion of works in full compliance with all applicable standards and specifications.
  - Arrangements for opening and using material borrow pits will contain enforceable provisions.
  - The excavation and restoration of the borrow areas and their surroundings, in an environmentally sound manner to the satisfaction of the Engineer will be required before final acceptance and payment under the terms of contracts.
  - Additional borrow pits will not be opened without the restoration of those areas no longer in use.

562. While operational, the Contractor will ensure that the following conditions are met at his borrow pits:

- Loss of top soil - Before the materials extraction the layer of top soil (about 20 cm) will be removed to the side of excavation area and kept until the area works will be finalized. Top soil stockpiles will be located at least 50 meters distance from any watercourses to avoid water siltation and obstruction. The height of stockpiles will not exceed three meters to avoid wind erosion and dust emissions.
- Fencing – if the Engineer deems the site to be hazardous to the local community (for example a pit could fill with water and people and animals could drown in it) he will request the Contractor to fence the site to prevent access and provide warning signs on the fencing.

- Soil compaction and disturbance to local flora and fauna species at access roads - The Contractor will take responsibility to provide an access road to the borrow site and all drivers will be instructed to use only this officially designated road. This will help to avoid additional soil compaction and disturbance to the local fauna species.
- Reinstatement - Full site reinstatement will be undertaken by the Contractor to avoid landscape damage and habitat loss. Rehabilitation measures will include: removing of all types of equipment from the site; removing of all types of waste or/and polluted soil and materials if any exist; slops grade reduction with use of unsuitable stockpiles and uncrushed rocks and; slope stabilization measure such as re-covering with top soil, and further seeding, grassing and planting of appropriate bushes or/and trees if reasonable.
- Haul Routes - Due to the sensitivity of the borrow pit locations, the Borrow haul routes will follow established transport corridors/rights-of-way, to the extent that is practicable. The routes will be indicated in the Contractors TMP. Haul routes shall not pass within protected areas or reserves.

F.7.6 Tunnels

Potential Impacts

563. The main typical environmental problems linked to the construction of underground works are listed below:

- Triggering of surface settlements, structures collapses and slope instabilities
- Drying up of springs and groundwater alterations
- Storage and use of excavated materials (Addressed in **Section F.7.3 – Waste Management** above).
- Noise (Addressed in **Section F.8.6 – Noise and Vibration** below).
- Vibrations (Addressed in **Section F.8.6 – Noise and Vibration** below).
- Pollution of groundwater, mainly after the realization of stabilization works by injections.

564. Surface Settlements & Slope Instabilities - The opening of underground works can lead to a deformation of the soils and rocks around the excavation area in some instances. Such deformations may trigger sudden collapses, subsidence and sinking that can damage both the work under construction and pre-existing nearby structures. The extent of settlements depends on the following elements:

- Excavation technique.
- Dimension and geometry of the excavation.
- Type of excavated material.

565. Geotechnical investigations for F4 have indicated that significant surface settlement will not occur as a result of Project works. Slope instabilities are discussed under the topic of landslides.

566. Dewatering - A key aspect of dewatering systems for tunnel and shaft construction is that they will generate water from pumped wells or from sumps and drains within the tunnel. Some of this water, particularly from sumps, will be ‘dirty water’ and will require some form of treatment (most commonly to remove suspended solids) before it can be disposed of. Some of the water may be ‘clean water’ (particularly from dewatering wells or tunnel drains) that may require little or no treatment.

567. Drying up of Springs and Groundwater – Tunnels located below the water table can seep into excavations that are below the water table, which can result in groundwater drawdown around the structures during construction and operation. This in turn may impact upon water levels in wells and natural springs (or artesian wells). Drawdown can also potential impact the flow of rivers and groundwater dependent trees. These phenomena can persist even after the tunnel construction if the final alignment is not completely waterproof.

Mitigation Measures

568. Drying up of Springs and Groundwater – The Contractor will develop a ground water management plan for each tunnel 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. If drawdown levels in wells are significant the Contractor will provide a temporary source of potable water to the affected persons until the construction works are finished. The Contractor shall continue to monitor the water levels in the affected wells for a period of two months after construction is completed at the tunnel sites. 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.

569. Dewatering – 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.

F.8 Social and Cultural Aspects

F.8.1 Employment Creation, Skills Enhancement and Local Business Opportunities

570. The Project is expected to generate positive impacts on the local economy and livelihoods in terms of employment and skills enhancement and local business opportunities through the procurement of goods and services.

571. Positive impacts will be primarily associated with the construction phase and therefore temporary in nature. The termination of construction contracts will occur once construction activities are completed. Workers who have relocated to the area for the Project are likely to leave the area in search of other opportunities, especially if they are permanent employees of Contractors and subcontractors.

572. Those who have worked on the Project will have an advantage when seeking alternative jobs on similar projects due to the experience and any training received through this Project.

573. The construction phase will last approximately 24 months and it is expected that approximately 400 direct employment opportunities will be available during the peak of construction. The breakdown of skills required during the construction phase will be as follows:

- Skilled labour: 58%;
- Semi-skilled labour: 20%; and
- Unskilled labour: 22%.

574. Local procurement is going to benefit the hospitality and service industries primarily, such as accommodation, catering, cleaning, transport and security services. Local businesses will benefit during the construction phase as there will be increased spending within the area by the wage labor who will have improved buying power while employed by the Project.

F.8.2 Community Health and Safety

Potential Impacts

575. The presence of the Project could affect the health, safety and security of the communities in the area of influence as a result of worker-community interactions, in-migration to the area, increased incomes in the local community that may be used for drugs, alcohol and prostitution, the risk of injury associated with construction and operational activities, increased pressure on health care resources and changes to the environment.

Construction Phase Impacts

576. Potential impacts due to the proposed construction can be identified as follows:

- Workforce, Jobseekers and Social Conflict. In some instances the local population may not be able to provide the necessary skilled workers for the Project. In such cases workers from other regions, or other countries may be employed by the Contractor. This could lead to social tensions and potential conflict if these workers are not aware of local customs and practices. An increase in disposable income within the Project area (among Project workers, both local and external) may also result in a change in spending habits and behavior resulting in increase in alcohol and drug abuse, increased incidences of prostitution and casual sexual relations, which poses a threat to community health and safety.
- Pressure on Social Infrastructure and Services. During the construction phase workers will be accommodated on-site and as such there will be no pressure on local housing stock. In addition, the Contractor will also have his own on-site medical facilities. Any serious injuries will be treated in Zestaphoni.
- Road Safety. Construction of the Project Road will require a large amount of vehicle movements, locally and regionally. These may result in a slight increase in the total number of road traffic accidents between vehicles, pedestrians and vehicles and livestock and vehicles.
- Air quality and noise. Potential air and noise issues and their impacts to the local population are discussed above under items **F.5.1 – Air Quality**, **Item F.7.4 – Construction Camps and Batching Plants** and **Item F.10.6 – Noise.**
- Blasting - Depending in the rock type and explosive strength, rocks can go up to 50 m and can potentially damage structures. For the above reason, surface blasting or blasting near the mouth of the tunnel is not recommended.

Operational Phase Impacts

577. Road Safety. Pedestrian overpasses and underpasses have been proposed as part of the Detailed Design. This will help reduce road accidents involving

pedestrians crossing the road. The improved road condition is also likely to lead to a reduction in traffic accidents.

578. Air Quality & Noise – These issues are discussed in detail under items **F.5.1 – Air Quality** and **Item F.10.6 – Noise.**

Mitigation Measures

Construction Phase Mitigation

579. Mitigation measures to limit community health and safety impacts include:

580. Road Safety – The Contractor will be responsible for preparing a traffic management plan (TMP) for the construction phase of the Project. The TMP will include specific conditions for traffic management around Shorapani and Zestaphoni.

581. 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.

582. Social Conflicts. The Contractor shall provide regular health and safety training to their workers which will include sessions on social and cultural awareness. The Contractor will also sub-contract an organization to develop and implement an HIV/AIDS policy and information document for all workers directly related to the Project. The information document will address factual health issues as well as behavior change issues around the transmission and infection of HIV/AIDS. In addition, the Contractor shall develop an induction program, including a Code of Conduct, for all workers directly related to the Project. A copy of the Code of Conduct is to be presented to all workers and signed by each person. The Code of Conduct must address the following aspects:

- Respect for local residents and customs;
- Zero tolerance of bribery or corruption;
- Zero tolerance of illegal activities by construction personnel including:
    - unlicensed prostitution;
    - illegal sale or purchase of alcohol;
    - sale, purchase or consumption of drugs; and
    - illegal gambling or fighting.
- No alcohol and drugs policy during working time or at times that will affect ability to work; and
- Description of disciplinary measures for infringement of the Code and company rules. If workers are found to be in contravention of the Code of Conduct, which they signed at the commencement of their contract, they will face disciplinary procedures that could result in dismissal.
- In addition, Project security guards shall not to violate the safety of local residents or other individuals involved in the project.

  In addition, 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. The minutes of meetings shall be recorded and a list of participants prepared (including signatures). Photos of each event shall be taken (with timestamps). The Contractor shall prepare a short monthly summary of the meetings including all of the above information and submit it for review to the Engineer and RD within a week of the meeting.

F.8.3 Workers' Rights & Occupational Health and Safety

583. Occupational Health and Safety - Accidents are common during a project of this size and scale. Accidents can occur if workers are not adequately trained or qualified for the job or if they have incorrect safety equipment and clothing.

584. Sexually Transmitted Diseases – See **Section F.8.2** above for impacts and mitigation relating to STDs.

585. Worker Rights - 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. These issues need to be considered not only for workers who are directly employed by the Project but also sub-contractors.

Potential Impacts

586. The Project is expected create more than 400 direct employment opportunities during the peak of the construction period, which will be approximately 30 months in duration. The majority of workers will be engaged by the Contractor and will consist of a semi-skilled to skilled workforce.

587. The expected impacts on worker rights and H&S as a result of construction, activities and Project operation are as follows:

- Risk to workers H&S due to hazardous construction activities; and
- Violation of workers' rights.

588. Construction activities will involve the operation of heavy equipment and trucks, working at height, construction traffic, use of electric devices, handling of hazardous materials and other hazardous activities. Due to the nature of the activities being undertaken during construction, worker H&S is a key risk with the potential for accidents that may result in injuries and fatalities as well as lost man-hours.

Mitigation Actions

589. An OHS Plan will be prepared by the Contractor to manage worker safety. The Plan will include the following items:

- Safety Training Program. A Safety Training Program is required and will consist of:
  - Initial Safety Induction Course: All workmen will be required to attend a safety induction course before they are allowed access to the Site.
  - Periodic Safety Training Courses: Period safety course will be conducted not less than once every six months. All Contractor (and any sub-contractor) employees will be required to participate in relevant training courses appropriate to the nature, scale and duration of the subcontract works. Training courses for all workmen on the Site and at all levels of supervision

and management. A list of training participants names and time-stamped photographic evidence of the training will be provided by the Contractor to the Engineer for his records.

- Safety Meetings. Regular safety meetings will be conducted on a monthly basis. The Engineer will be notified of all safety meetings in advance. The Engineer may attend in person or by representative at his discretion. The minutes of all safety meetings will be taken and sent to the Engineer within seven (7) days of the meeting and will include a list of participants names and time-stamped photographic evidence of the training.
- Safety Inspections. The Contractor will regularly inspect, test and maintain all safety equipment (including firefighting equipment), scaffolds, guardrails, working platforms, hoists, ladders and other means of access, lifting, lighting, signing and guarding equipment. Lights and signs will be kept clear of obstructions and legible to read. Equipment, which is damaged, dirty, incorrectly positioned or not in working order, will be repaired or replaced immediately by the Contractor.
- PPE – Workers will be provided (before they commence works) with of appropriate PPE suitable for electrical work such as safety boots, helmets, gloves, protective clothes, goggles, and ear protection at no cost to the workers.

- All construction plant and equipment used on or around the Site will be fitted with appropriate safety devices. These will include but not be limited to:
  - Effective safety catches for crane hooks and other lifting devices, and
  - Functioning automatic warning devices and, where applicable, an up-to-date test certificate, for cranes and hoists.
- Zones with noise level above 80 dBA must be marked with safety signs and appropriate PPE must be worn by workers.

590. In addition, all Project sub-contractors will be supplied with copies of the SSEMP. Provisions will be incorporated into all sub-contracts to ensure the compliance with the SSEMP at all tiers of the sub-contracting. All subcontractors will be required to appoint a safety representative who will be available on the Site throughout the operational period of the respective sub-contract unless the Engineers approval to the contrary is given in writing. In the event of the Engineers approval being given, the Engineer, without prejudice to their other duties and responsibilities, will ensure, as far as is practically possible, that employees of sub-contractors of all tiers are conversant with appropriate parts of the SSEMP. To implement the above items the Contractor will designate a qualified environmental, health and safety personnel.

F.8.4 Emergency Response Planning

Potential Impacts

591. Emergency situations may arise during the construction phase of the Project, for example, fires and explosions (through poor management and storage of fuels and chemicals).

Mitigation Measures

<u>Construction Phase</u>

592. The Contractor will be responsible for preparation of an Emergency Response Plan (ERP) which will include sections relating to:

- Containment of hazardous materials;
- Oil and fuel spills;
- Fire, gas leaks and explosions;
- Work-site accidents; and
- Earthquake and other natural hazards.

593. The plan will detail the process for handling, and subsequently reporting, emergencies, and specify the organizational structure (including responsibilities of nominated personnel). The plan will be submitted to the Engineer for approval. Implementation of the plan will be monitored by the Engineer. Any emergencies, and how they were handled, will be reported in monthly progress reports by the Contractor to the Engineer. The Engineer will also provide periodic monitoring of the Contractors works throughout construction to ensure the ERP is implemented effectively.

F.8.5 Physical and Cultural Resources

Potential Impacts

594. As noted by **Section E.4.4** and **Figure E-44**, 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.

595. In addition to the above, it is possible, given the rich cultural heritage of Georgia, that chance finds could occur during excavation works, particularly to the north of Zestafoni.

Mitigation Actions

596. The cemetery identified above 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.

597. According to the detailed design, the road at KM10.1 will pass within 15 meters of the natural spring. However, the road will be elevated in this area and a high embankment will be constructed that will extend out almost adjacent to the spring. A short section of noise barrier, around 20 meters is recommended in this area so that people may continue to use this spring. In addition, during the construction works the spring shall be fenced on the northern side to prevent construction works impacting upon the spring.

598. In the event of any chance finds during the construction works procedures shall apply that are governed by GoG legislation and guidelines. A chance finds procedure shall also be developed by the Contractor. **Appendix E** provides a sample chance find procedure which the Contractor could adopt.

F.8.6 Noise & Vibration

Potential Construction Noise Impacts

599. The potential noise related issue during construction of the project is disturbance to sensitive receptors in the Project area.

600. Noise levels within the Project area range depending upon the location. Baseline noise monitoring undertaken for this EIA indicates that noise levels range from between 35 in the rural locations to 72 dBA adjacent to the existing road.

601. The noise during the construction phase depends on the stage of construction work and equipment used at the site. The construction activities generating significant levels of noise can be divided as follows:

- Site clearing and preparation;
- Excavation and tunnel construction;
- Bored piling and concrete placement; and
- Erection of bridges.

602. The main sources of noise and vibration during construction of the project are as follows:

- Construction machinery;
- Drilling activities;
- Haulage and general vehicle movements;
- Concrete mixing and aggregate production systems; and
- Construction Camps / Ancillary Facilities.

603. The criteria for Determining Significance is the World Bank guidelines for noise require that the sound level in residential areas (and other sensitive receptors, such as schools and hospitals) should not exceed 55 dB(A) during the day and 45 dB(A) during the night. During construction period, it is possible that these standards will be exceeded for short duration during the day.

604. Construction noise levels at receptors would fluctuate depending on the type and number of equipment, their duration of use and the distance from receptor. In this analysis, first the noise level due to each piece of equipment, which is likely to be used in the construction, is calculated. The peak noise levels of construction equipment mainly used at a typical construction site, are shown in **Table F-12**. The list includes all equipment except vehicles and some minor pieces of equipment.

Table F-12: Typical Noise Levels from Construction Equipment

Equipment	dBA
Pavement	
Dozer	81.7
Excavator	80.7
Grader	85
Roller	80.0
Rock Drill	81.0
Dump Truck	76.5
Paver	77.2
Concrete Mixer Truck	78.8
Tunnel Mouth	
Jackhammer	88.9
Dozer	81.7
Dump Truck	76.5
Tunnel	
Blasting	94.0
Bridge	

Equipment	dBA
Piling	90.0
Dozer	81.7
Dump Truck	76.5
Paver	77.2
Boring Jack Power Unit	83.0

605. Assuming considering that not all pieces of equipment will be used at the same time in the same location the following maximum cumulative noise levels can be estimated:

- Pavement: 89 dBA
- Tunnel Mouth: 89.8 dBA
- Tunnel: 94 dBA
- Bridge: 91.6 dBA

606. In addition to work sites, an estimate of noise at construction camps have been made based on other road projects as follows:

- Construction Camp: 75 dBA
- Asphalt Plant: 80 dBA
- Rock Crushing Plant: 90 dBA
- Concrete Batching Plant: 80 dBA

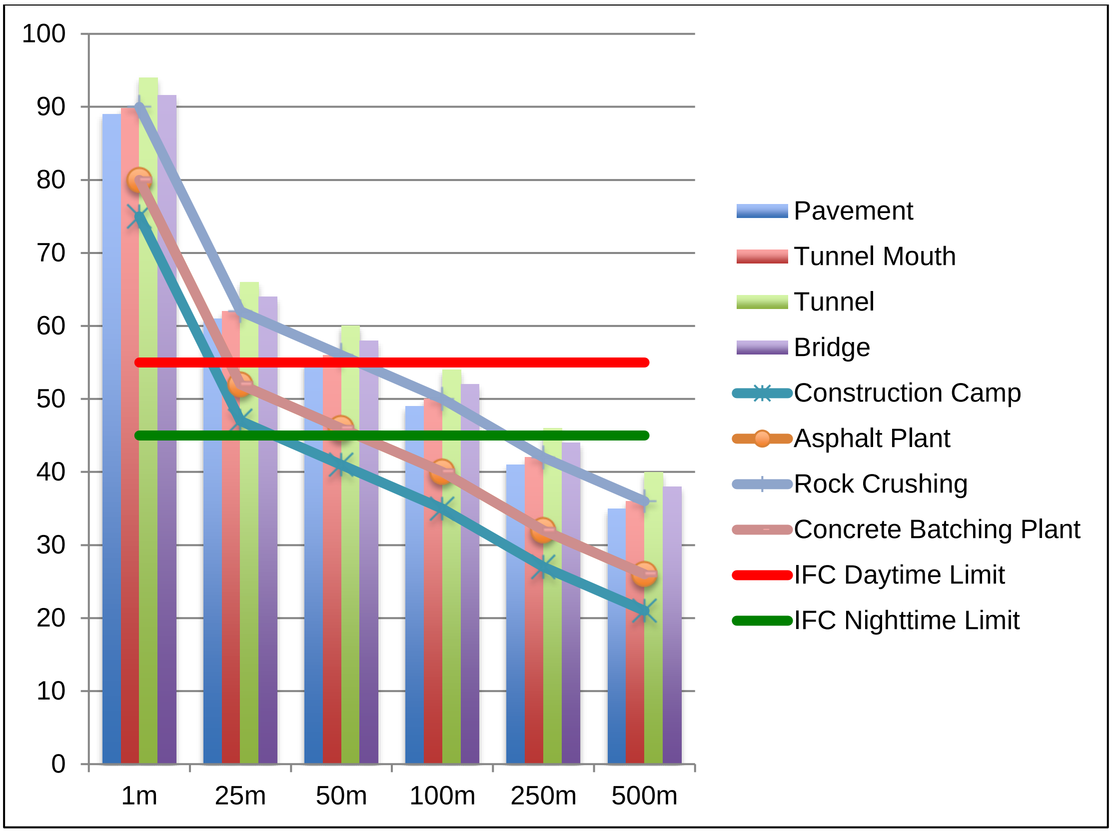
607. **Table F-13** assesses these cumulative noise levels at a range of distances from the source of noise.

Table F-13: Cumulative Noise Levels from Construction Equipment at a Range of Distances

Activity / Site	Average Estimated Noise Level (dBA)	25m	50m	100m	250m	500m
Pavement	89	61	55	49	41	35
Tunnel Mouth	89.8	62	56	50	42	36
Tunnel	94	66	60	54	46	40
Bridge	91.6	64	58	52	44	38
Construction Camp	75	47	41	35	27	21
Asphalt Plant	80	52	46	40	32	26
Rock Crushing	90	62	56	50	42	36
Concrete Batching Plant	80	52	46	40	32	26

608. **Figure F-15** shows these predicted noise levels against IFC daytime and nighttime standards.

Figure F-15: Estimated Construction Phase Noise



609. **Figure F-15** shows that construction activities within 25 – 50 meters of sensitive receptors will, in all instances, result in noise levels elevated above IFC daytime and nighttime guideline limits. At a distance greater than 100 meters all construction noise will be lower than IFC daytime limits, but still higher than IFC nighttime limits. At a distance of more than 250 meters construction noise levels are below both daytime and nighttime IFC limits.

610. Regarding camp sites and ancillary facilities, **Figure F-15** shows that the noise generated from concrete batching plant, asphalt plant and general construction camp noise levels will be below IFC nighttime and daytime limits at a distance of more than 250 meters.

Potential Operational Noise Impacts

611. The operational noise impacts have been assessed as part of a noise model, see **Section F-8.7** below.

Potential Construction Vibration & Settlement Impacts

612. Vibration from construction activities is a cause 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.

613. The effects of vibration can be assessed as:

- General annoyance, sleep disturbance, etc;
- Potential cosmetic damage to properties; and
- Potential structural damage to properties.

614. The sources of vibration can broadly divided into two parts:

1. Vibration Impact of Construction Activities on the Surface (General construction works including construction equipment movement, pile driving, compaction, hammering (hydraulic or pneumatic), operation of batching plant and generators, etc).; and
2. Vibration Impact of Tunnel Construction.

615. The propagation of vibration from construction activities are different in nature from the vibration from tunneling. The construction activities are undertaken essentially on ground surface and spreads basically as two-dimensional waves. In contrast, the tunneling is undertaken below the surface and spreads in three-dimension. For this reason, the impact of the two is assessed separately.

616. The Georgian Standards for vibration are provided in **Table D-11**. The proposed criteria for damage to buildings are shown in **Table F-14**. These are derived from British Standard BS 6472 and are German Standards DIN 4150-3:1999.

Table F-14: Criteria for Structural Damage Due to Vibration

No Damage Likely	PPV < 5 mm/s
Cosmetic Damage Risk	PPV 5 to 15 mm/s
Structural Damage Risk	PPV > 15 mm/s

617. <u>Vibration Impact of Construction Activities on the Surface</u> – **Table F-15** provides an indication of the approximate vibration levels that may be expected for various vibration sources.

Table F-15: Approximate Vibration Levels for Various Sources [20]

Activity	Typical Levels of Ground Vibration
Vibratory Rollers	Up to 1.5 mm/s at distances of 25 m Higher levels could occur at closer distances; however, no damage would be expected for any building at distances greater than approximately 12 m (for a medium to heavy roller)
Hydraulic rock breakers (levels typical of a large rock breaker operating in hard sandstone)	4.50 mm/s at 5 m 1.30 mm/s at 10 m 0.4 mm/s at 20 m 0.10 mm/s at 50 m
Compactor	20 mm/s at distances of approximately 5 m, 2 mm/s at distances of 15m. at distances greater than 30 m, vibration is usually below 0.3 mm/s
Pile driving/removal	1 to 3 mm/s at distances of 25 m to 50 m depending on soil conditions and the energy of the pile driving hammer
Bulldozers	1 to 2 mm/s at distances of approximately 5 m. at distances greater than 20 m. vibration is usually below 0.32 mm/s
Air track drill	4 to 5 mm/s at a distance of approximately 5 m, and 1.5

[20] Northern Expressway Environmental Report: Noise and Vibration technical Paper. 2007. http://www.southroad.sa.gov.au/__data/assets/file/0019/13780/Noise_and_Vibration_Technical_Pa per.pdf

Activity	Typical Levels of Ground Vibration
	mm/s at 10 m. at distances greater than 25 m, vibration is usually below 0.6 mm/s and at 50 m or more, vibration is usually below 0.1 mms
Truck traffic (smooth road surfaces)	0.01 to 0.2 mm/s at the footing of buildings located 10 to 20 m from a roadway
Truck traffic (over irregular surfaces)	0.1 to 2.0 mm/s at the footings of buildings located 10 m to 20 m from a roadway

618. These levels are well below the threshold of any possibility of damage to structures due to vibrations from typical construction activities related to roller, compactors, and movement of construction equipment.

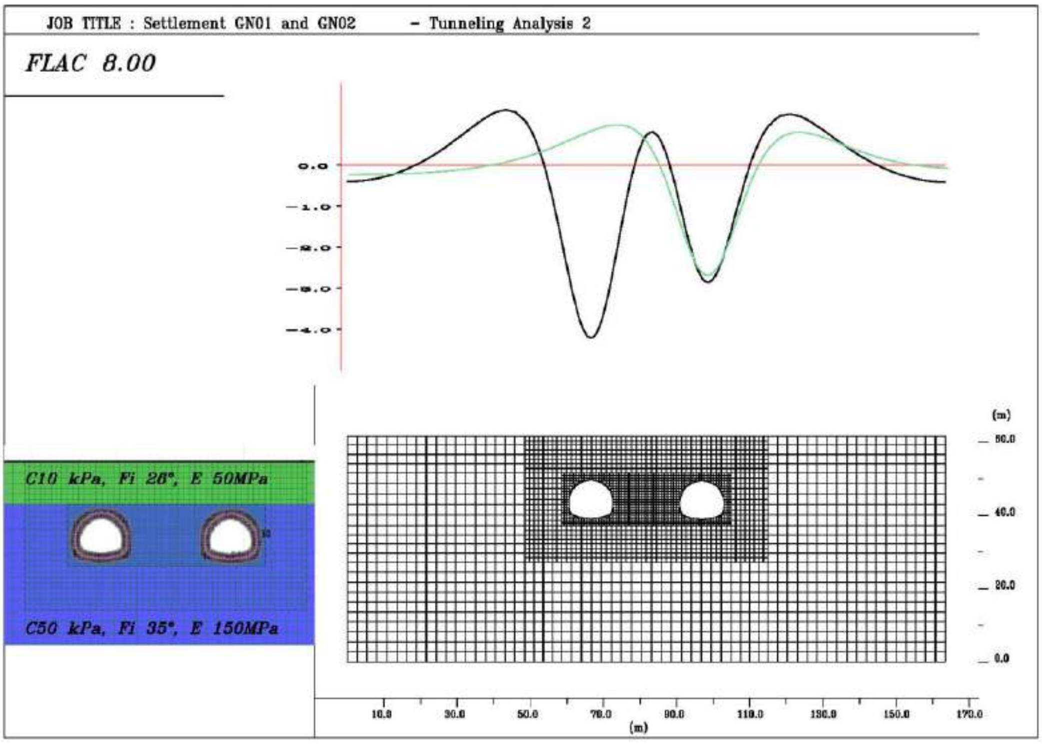
619. The piling for the bridge piers are likely to generate relatively more vibrations which depends on soil condition. However, even under extreme conditions, the vibration is unlikely to exceed 10 mm/s beyond 25 m. The following presents a summary of the properties within 25 meters of each bridge:

- BRI 4.1.01-AT/TA – No properties.
- BRI 4.1.02-AT/TA - Potentially one residential property and a road side restaurant are located within 25 meters. The restaurant will most likely be demolished to accommodate the bridge.
- BRI 4.1.03-AT/TA - No properties.
- BRI 4.1.04-AT/TA – No residential properties are located within 25 meters of the piers. However, several commercial and light industrial properties are located beneath the bridge. These may be need to be removed to accommodate the bridge.
- BRI 4.1.05-AT/TA – Four properties identified.

620. Settlement Impact of Tunnel Construction –There are six double tube tunnels in the F4 section. Analysis undertaken by the Design Team indicates that settlement of no more than 4.5mm will occur above all tunnels. **Figure F-16** illustrates the anticipated settlement for Tunnel TUN 4.0.06 AT/TA, the least overburden.

622. This analysis indicates that settlement will not impact upon structures above these tunnels and structural damage is not to be expected unless some unforeseen situation occurs or unless the Contractor doesn’t work properly. It is however possible that cosmetic damage could occur such as small cracks in plaster in wall joints and broken glass in windows as a result of vibration which is discussed below.

Figure F-16: Settlement Analysis for Tunnel TUN 4.0.06 AT/TA



623. Vibration Impact of Tunnel Construction - The main cause for concern in these tunnel areas is vibration nuisance for residents. In these tunnels (hard rock: porfirites) two tunneling techniques could potentially be used, blasting, or hydraulic hammering. Blasting is intermittent, with pauses between each blast to remove rock and set charges for the next blast. On the other hand hydraulic hammering is continuous causing uninterrupted vibration.

624. Tunnels TUN 4.0.06 AT/TA (and the last portion of TUN 4.0.05 AT/TA have less overburden and the potential vibration impacts could be greater than at the other tunnels. As such the use of the rod header which is the technology that minimize the vibrations during excavation is recommended. This technique is possible because the rock is softer in this area than in the other portions of the road (calcarenites).

625. In addition to the above, a basic analysis of the vibration impacts around the end portion of TUN 4.0.05 AT/TA and all of TUN 4.0.06 AT/TA was undertaken by the design team. The analysis indicated that levels of impact in these areas was reduced for standard buildings due to the proposed excavation technique and the attenuation provided by the cushion of weathered rock and arable/vegetal soil in this area. In addition the type of foundations of the buildings, shallow and small, will be an additional damping factor. On the other hand, the quality of the buildings in this area is poor, there are frequent "voluntary additions" such as terraces, and patios which are not properly built; these elements could be more sensitive to vibrations. However, the basic analysis suggests that the level of threshold, above 5 mm/s should not be reached for long periods and the peak energy of excavation should not produce vibrations able to reach the buildings with intensity and frequency in the damaging range.

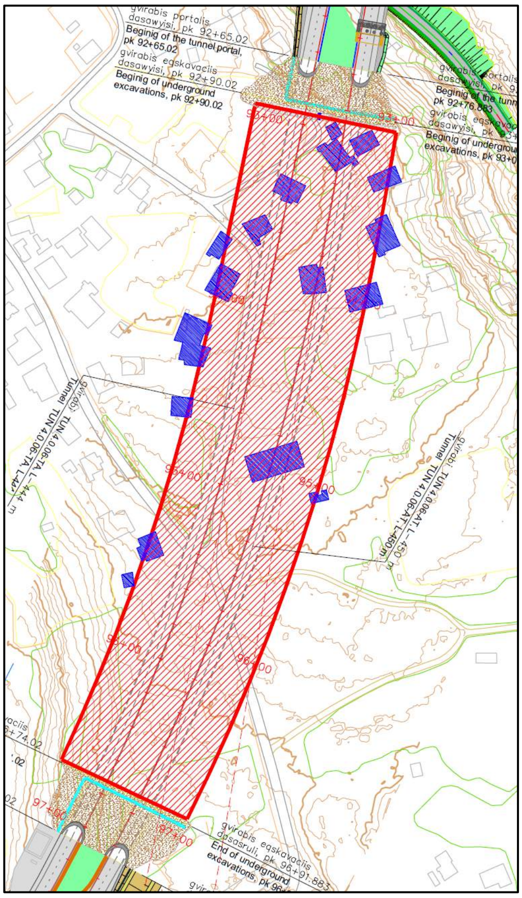
626. The vibration study carried out by the Design Teams vibration expert is provided by **Appendix I** of this EIA Report. The conclusion of this study is summarized below:

- The vibrations generated at the source will propagate with velocity of 10 mm/s;
- The vibration will travel in 2 meters of weathered calcarenite and 5 meters of alluvial soil (which present a much lower stiffness);
- In this superficial layer the vibrations will be strongly attenuated and the expected value at the surface will be 5-4 mm/s;
- At this point the coupling with the foundations will generate a further damping effect whose amount depends on the type of foundation.

For the above consideration an area of influence has to be considered with a distance from the source of 20 meters (total width about 75 meters) also in consideration of the poor quality of the building.

627. Following the conclusions of the vibration study it is recommended to proceed with photo-documentation of the state of the buildings, to avoid conflicts with the population and to set up a couple of monitoring stations to have reference data to provide in case of controversy (see **Figure F-17**).

Figure F-17: Area of influence and buildings potentially affected by excavation of tunnel TUN 4.0.06 AT/TA



628. The Contractor will be in charge of the monitoring of the vibrations in the receptors in the potentially impacted area under supervision by the Engineer and RD. The procedure of initial survey, monitoring during construction and managing of the possible claim of the household, as well as the competence and responsibility is described under paragraph 634 below, points 2, 6 and 7.

Potential Operational Vibration Impacts

629. Highway traffic is not likely to have any measurable impact on the structures or on comfort. The Federal Highway Administration of the USA has determined that "All studies the highway agencies have done to assess the impact of operational traffic induced vibrations have shown that both measured and predicted vibration levels are less than any known criteria for structural damage to buildings. In fact, normal living activities (e.g., closing doors, walking across floors, operating appliances) within a building have been shown to create greater levels of vibration than highway traffic." [21]

Design Phase Noise Mitigation

630. Correct siting of construction camps and ancillary facilities will reduce the potential for elevated noise levels to affect sensitive receptors. As indicated above, 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.

631. 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 that will include the mitigation measures outlined below for the construction phase.

Construction Phase Noise Mitigation

632. During the construction phase the Contractor will be responsible for the following:

- Time and Activity Constraints, i.e., operations will be scheduled to coincide with periods when people would least likely be affected; work hours and work days will be limited to less noise-sensitive times. Hours-of-work will be approved by the Engineer having due regard for possible noise disturbance to the local residents or other activities. Construction activities will be strictly prohibited between 10 PM and 6 AM in the residential areas. When operating close to sensitive areas (within 250 meters) such as residential, nursery, or medical facilities, the Contractor's hours of working shall be limited to 8 AM to 6 PM;
- Give notice as early as possible to sensitive receptors for periods of noisier works such as excavation. Describe the activities and how long they are expected to take. Keep affected neighbours informed of progress.
- Within normal working hours, where it is reasonable to do so:
  - schedule noisy activities for less sensitive times.
  - provide periods of respite from noisier works (for example, periodic breaks from jackhammer noise).
- The weekend/evening periods are important for community rest and recreation and provide respite when noisy work has been conducted throughout the week. Accordingly, work should not usually be scheduled during these times.
- All mechanical plant is to be silenced by the best practical means using current technology. Mechanical plant, including noise-suppression devices, should be

[21] http://www.fhwa.dot.gov/environMent/noise/regulations_and_guidance/analysis_and_abatem e nt_guidance/polguide09.cfm

maintained to the manufacturer's specifications. Internal combustion engines are to be fitted with a suitable muffler in good repair.

- Maintenance tools, machines and equipment so that they are in good conditions. When some wrong is found, they must be fixed immediately in order to reduce noise from the equipment.
- Fit all pneumatic tools with an effective silencer on their air exhaust port.
- Install less noisy movement/reversing warning systems for equipment and vehicles that will operate for extended periods, during sensitive times or in close proximity to sensitive sites. Occupational health and safety requirements for use of warning systems must be followed.
- Turn off plant when not being used.
- All vehicular movements to and from the site to only occur during the scheduled normal working hours, unless approval has been granted by the Engineer.
- Keep good conditions of trucks that use to transport construction materials so they cause no loud noise and control the truck speed, to be not exceeded 40 km/hr when driving through communities, and not exceeded 80 km/hr when driving on highways.
- Where possible, no truck associated with the work should be left standing with its engine operating in a street adjacent to a residential area.
- Provision of noise protection kits such as ear plug, earmuff, for workers who are working in the area with noise level is higher than 85 dB(A). It is designated as a regulation that workers must wear protection kits in case of working in a noisy area.

Operational Phase Noise Mitigation

633. Discussed below under **Section F.8.7 – Noise Model**.

Construction Phase Vibration Mitigation

634. The following phased mitigation measures for construction induced vibration are recommended:

Tunnels - TUN 4.0.01 AT/TA, TUN 4.0.02 AT/TA, TUN 4.0.03 AT/TA, TUN 4.0.04 AT/TA (potentially TUN 4.0.05 AT/TA)

1. 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 (see below for survey requirements). The TBP will also include a vibration monitoring plan to monitoring vibration levels and frequency around the blasting sites. The objectives of the monitoring will be to:
    a. Ensure that vibration levels in the communities are within the adopted criteria levels;
    b. Maintain record of vibration to settle any potential conflicts; and
    c. Monitor changes in the vibration levels due to possible changes in the rock formation and take appropriate corrective actions.

   Vibration data will be documented, reviewed, and preserved by the Contractor. It will be regularly shared with the Engineer, RD, JICA, ministry of Environment and the community as part of the monthly progress report.
2. A survey will be undertaken within a 250 meter corridor of tunnel TUN 4.0.02-AT/TA to determine the pre-blasting conditions of all buildings within the corridor. This tunnel is one of the most remote tunnels with a very low number of

properties within 250 meters. The survey will be commissioned by the Contractor at his own charge and will identify and record any existing damage to the structures. The survey will cover the following aspects:
   a. Overall condition of the structures, both exterior and interior;
   b. Documentation of defects observed in the structure using digital imagery along with notes, measurements and sketches; and
   c. Documentation of pre-existing cracks using digital imagery along with notes, measurements and sketches.

   The survey will be accompanied with consultations with the affected household to explain the extent and reason for the survey, confirm the findings of the survey (affected households shall sign the survey form saying they agree with the findings) and the process for reporting any grievances regarding vibration impacts. The households will be provided with materials that summarize the grievance redress process. If the households do not allow the survey they shall be informed by the Contractor that they will not be authorized in the future to claim any damage.
3. Tunneling shall then start from tunnel TUN 4.0.02-AT/TA at its western portal. In the initial stages, the blasting induced vibration shall be measured as a function of maximum instantaneous charge and distance from the blasting site. This data shall be then used to define damage risk zones in damage risk maps.
4. Using the damage risk map and the tunnel boring schedule, the Contractor in consultation with the RD and the Engineer, will identify the houses that are likely be affected and the impact duration and schedule. As noted above (and by **Figure E-X**), there is assumed no risk of structural damage for the houses, but the pressure of the blasting could cause some cosmetic damages, mainly relating to the breaking of windows. Before start of blasting, all residents shall be informed of the exact hour of the blasting and they will be invited to open the windows in order to avoid them breaking.
5. With respect to blasting the following are key recommended mitigation measures:
   a. No blasting will be carried out within 100 m of the portal of any tunnel.
   b. Blasting will be scheduled during the day only.
   c. Local communities will be informed of blasting timetable in advance and will be provided adequate notice of when blasts are required outside of the planned schedule.
6. Both during and after the tunnel excavation if any damage to properties is reported by the property owners the survey will be repeated to ascertain that the blasting is the cause of the damage comparing the damage with the previous survey. If this is the case, the Contractor will repair the damage and the cost will be on charge of the RD. If the Contractor has no previous survey to compare the cost of the repairs will be with him.
7. If the damages are significantly more than what expected, the Contractor shall change the method of blasting (decreasing the energy of blasting) or if this is ineffective, cease blasting and employ another less invasive method (rod header).
8. Regarding vibration nuisance it is strongly recommended that hydraulic hammering not be used in order to limit constant vibration nuisance. If the Contractor decides to use this method and substantial complaints are received from the community, the Contractor will be obliged to use an alternative technique.
9. In addition the following measures shall be applied relating to tunnel blasting;
   a. No blasting will be carried out within 100 m of the portal of the tunnel;
   b. Blasting will be scheduled during the day only; and

c. Local communities will be informed of blasting timetable in advance and will be provided adequate notice of when blasts are required outside of the planned schedule.

Tunnels - TUN 4.0.06 AT/TA (potentially TUN 4.0.05 AT/TA)

1. The Contractor will develop a detailed Tunnel Excavation Plan (TEP) for each tunnel as part of the overall construction schedule. The TEP shall follow exactly the same procedures as the TEP for the tunnels mentioned above, but shall include assessment shall include surveys of structural damage.
2. Despite the fact that the basic vibration analysis has indicated that blasting should not have significant impacts in this area, it is recommended that the tunneling technique be limited to the use of the rod header to minimize the vibrations during excavation and ensure no structural damage.

Construction Phase Vibration Mitigation - Bridges

635. It is noted that only a few properties will potentially suffer cosmetic damage from bridge piling works. It is however recommended that the Engineer undertakes cosmetic condition surveys of all properties within 50 meters of bridge piles as per the vibration surveys recommended above for the tunnels. If there are any claims or reports of damage the affected house will be surveyed against the pre-Project survey and repairs will be undertaken as appropriate by the Contractor.

F.8.7 Noise Model

F.8.7.1 Environmental Noise Model

636. To assess the impacts of operational noise within the Project area a noise model has been prepared.

637. The Environmental noise model is based on a specific set of conditions for which the noise is being estimated, it will be a fixed representation or 'snapshot' of a physical environment of interest; in practice the physical environment of the area of interest is constantly and randomly changing; the model intend to represent the most typical or frequently occurring conditions as reconstructed by the input data.
Modeling takes into consideration both worse scenario and the average conditions, the latter being a good representation in case of pretty constant traffic conditions. The key conditions for the development of a good noise model are:

- Knowledge of the noise source, or sources, for which associated environmental noise levels are of interest.
- The physical environment through which noise will transmit from the noise source(s) to the location or targets/region of interest. This includes the ground terrain, the built environment, and atmospheric conditions (e.g. wind, temperature, humidity).
- An approximation of the way in which sound will travel from the noise source(s) via the physical environment, to the receiver location or region of interest (building surface).

638. In complex scenarios, the environmental noise model is repetitiously calculated for the distribution of sound source (by using ray – tracing modeling), from the traffic to the receiver location. The total sound level at each position is then calculated by summing the contribution of each source and transmission path. The road will be considered as a linear source of noise, composed by a number of

vehicles considered as single sources moving along a line. Application of these calculations to each point on a uniformly distributed grid enables a noise contour map to be developed to depict regions of equal estimated noise level and depict trends in the spatial pattern of the sound field:

639. Information considered in the development of the model **- Table F-16** shows the requirements for specifying a noisy environment:

Table F-16: Factors in Acoustic Mapping

Stage	**Minimum**	**Other elements to be considered**
The noise sources to be investigated	Number of sound sources; Total sound power output of each source; Directional characteristics of each source; Height of each source; Frequency characteristics of each source	Time variations of emissions for example, a worst-case assessment would imply the use of the highest possible value irrespective of how frequently it may occur, whilst an assessment which related to 'typical' conditions could necessitate the use of an averaged value or some typically recurring upper value. (**In our case, impulsive noise from the source should be excluded)**
The physical environment through which noise will transmit to the receivers	Separating distances between all relevant noise sources and receivers Reflecting/ obstructing structures; amount and type of vegetation Height(s) of receiver(s) (Obtained from Maps or field survey of buildings)	Ground terrain profile characteristics of the ground cover Meteorological conditions relevant to the intentions of the including wind direction and speed, temperature, and humidity, (**not so relevant in our case due to the short distances from the source).**

640. To estimate the way in which noise will travel from the noise sources to the receivers, a range of sound propagation methodologies may be employed. Methods vary widely in their complexity and the scope of applications for which they can offer meaningful predictions.

641. In our model a standard hemi-spherical spreading is considered; this method accounts for the reduction in sound intensity as a sound wave front spreads over a larger area, with the consequence of increasing the area of the spherical surface where the energy (sound pressure wave) is distributed.

642. To calculate the propagation the algorithm takes into account:

- The absorption associated with the propagation of noise through the atmosphere ***(very low due to the short distance)***
- The change in noise level that occurs as a result of interactions between the sound wave travelling directly to the receiver and those reflected from the ground, buildings and accounting for influence of the ground cover type ***(calculated from the 3D model of soil and buildings obtained by field survey).***

- The attenuation offered by obstacles that fully or partly obstruct line of sight between a source and a receiver location ***(poor vegetation will not determine any attenuation).***
- The influence of atmospheric conditions that can change the direction of an advancing sound wave front by refracting the wave at points where there are significant changes in wind speed and/or temperature (not considered due to the short distance).
- The influence of reflecting surfaces which re-direct an advancing sound wave front (for the second row of buildings reflection/shielding will be the main factor of attenuation).

F.8.7.2 Variability

643. The noise sources considered in the model exhibit very large variability in space and time and during the construction phase also the background noise from the nearby existing road has to be considered. The following **Table F-17** gives examples of variations considered in the developed model.

Table F-17: Examples of Components Variations

Component	Examples of component variations
Source	Background noise: Changing traffic sound e.g. hourly, daily, and seasonal changes in the general traffic flow volume and composition, as well short term (wet or dry) and long term (road surface degradation) changes in road conditions.
Transmission	Position dependent sound propagation, e.g. varying separation distances due to sound source movement, varying degrees of sound path screening according to source and receiver location, and localized regions affected by reflections (not of capital importance in tour case due to linear modelization of traffic)

F.8.7.3 Algorithms for Outdoor Sound Propagation

644. The ability of mathematical algorithms to accurately represent sound propagation has been the focus of considerable researches, particularly given the role of noise prediction as an integral assessment tool in the fulfillment of the European Noise Directive (i.e. EU Directive 2002/49/EC, which requires member states to produce noise maps and action plans for urban areas and major transport infrastructures, including roads, railways and airports). As mentioned, the applied software fully complies with that and it is updated to the latest EU directives and norms. In particular the used Software SOUND PLAN VER. 7.2 considers the guidelines ISO 3891 e ISO 9613; the sound pressure has been calculated in accordance to the procedures stated in the model “Nouvelle Metode du Presion du Bruit - Routes 2008” and the following norms:

- Industrial Noise
  - ISO 9613 incl. VBUI (International, EC-Interim)
  - CONCAWE (International)
  - VDI 2714, VDI 2720 (Germany)
  - DIN 18005 (Germany)

  - ÖAL Richtlinie Nr. 28 (Austria)
  - BS 5228 (United Kingdom)
  - Nordic General Prediction Method (Scandinavia)
  - NORD 2000 (Scandinavia)
  - Ljud från vindkraftverk (Sweden)
  - Harmonoise, P2P calculation model (International)
  - NMPB08 - Industry (France)
  - CNOSSOS-EU (2014)
- Road Noise
  - NMPB-Routes-96 (France, EC-Interim)
  - RLS-90, VBUS (Germany)
  - DIN 18005 (Germany)
  - RVS 04.02.11 (Austria)
  - STL 86 (Switzerland)
  - SonRoad (Switzerland)
  - CRTN (United Kingdom)
  - TemaNord 1996:525 (Scandinavia)
  - Czech Method (Czech Republic)
  - NMPB-Routes-08 (France)
  - TNM (USA)
  - CNOSSOS-EU (2014) Industrial Noise

F.8.7.4 Standards, regulations and guidance notes

645. The following standards, regulations and guidance notes have been considered as part of the model:

- ISO 9613-2, Acoustics — Attenuation of sound during propagation outdoors Part 2: General method of calculation.
- BS 4142, Method for rating industrial noise affecting mixed residential and industrial areas.
- BS 5228-2, Noise and vibration control on construction and open sites — Part 2:Guide to noise and vibration control legislation for construction and demolition including road construction and maintenance.
- BS 7445, Description and measurement of environmental noise.
- IPPC H3 Horizontal Noise Guidance. Part 1 ‘Regulation and Permitting’ and Part 2 'Noise Assessment and Control'.
- Calculation of Road Traffic Noise 1988, Department of Transport, Welsh Office.
- Calculation of Railway Noise 1995. Department of Transport.
- The CAA Aircraft Noise Contour Model: ANCON Version 1. DORA Report 9120, Civil Aviation Authority 1992.
- PPG 24 Planning Policy Guidance: Planning and Noise. Department of the Environment 1994. TAN11 (Wales); PAN56 (Scotland).
- BS 9142: 2006 Assessment methods for environmental noise — Guide, 2003/01534 12 July 2006.

F.8.7.5 Simulation parameters

646. The modeling of the noise emissions and noise propagation from the new road takes into account that there are many houses very close to road side in certain sectors and others where urbanization is almost absent. The morphology, characterized by hills, and the presence of the river valley and riverbed plays a very important role mostly because this determine the

distribution and type of vegetation which is acting as noise barrier and the absence of obstacles for the propagation across the valley.

647. To model noise, the design study of the new road design and detailed traffic forecasts immediately after construction and for the next 20/25 years have been taken into account.

648. Modelling of noise level was performed using 2037 traffic flow for Day and Night time as provided in the Engineering Design documents package with a difference between day and night of 70% for light vehicles and 30% for trucks (see **Table F-18**).

Table F-18: Daily average vehicles/day (working day) (2017 – 2037)

Year	Car	Mini Buses<15, PickUPs	Buses & Trucks	Trailers & > 3 axels	Total
	65,6%	17,0%	11,9%	5,5%	
2017	13,335	3,448	2,410	1,116	**20,310**
2018	14,002	3,621	2,521	1,167	**21,311**
2019	14,757	3,816	2,645	1,225	**22,443**
2020	15,636	4,043	2,790	1,292	**23,761**
2021	16,663	4,309	2,958	1,369	**25,298**
2022	17,753	4,591	3,135	1,452	**26,930**
2023	18,712	4,838	3,290	1,523	**28,364**
2024	19,722	5,100	3,453	1,599	**29,874**
2025	20,550	5,314	3,586	1,660	**31,111**
2026	21,414	5,537	3,724	1,724	**32,399**
2027	22,313	5,770	3,868	1,791	**33,741**
2028	23,172	5,992	4,010	1,856	**35,030**
2029	24,064	6,222	4,157	1,925	**36,368**
2030	24,858	6,428	4,288	1,985	**37,559**
2031	25,679	6,640	4,423	2,048	**38,790**
2032	26,526	6,859	4,563	2,112	**40,060**
2033	27,401	7,085	4,706	2,179	**41,372**
2034	28,306	7,319	4,855	2,247	**42,727**
2035	29,240	7,561	5,007	2,318	**44,126**
2036	30,205	7,810	5,165	2,391	**45,571**
2037	31,201	8,068	5,328	2,467	**47,064**

649. These traffic fluxes are for ultra-conservative scenario in which full load of the road in year 2037 will occur (peak hour at day and maximum expected load at night) and also for the present day vehicle levels. In reality, it can be said with high probability that vehicle levels in Georgia will change by 2037 with the consequence of having lower emissions than predicted in the project design documents and used in this modelling. This will result from:

- Technological improvement (new models, hybrids, electric cars have and will have less and less noise emissions and the share of these vehicles in the whole vehicle cars will be significant);
- Full amortization of the old vehicles; and
- Possibly also from national regulations to limit the use of old vehicles producing excessive air pollution (the same categories of vehicles happen to be responsible for high noise emissions too).

F.8.7.6 Numeric model

650. The forecast of noise emissions or new urban road has been performed using SOUND PLAN VER. 7.2 ray tracing software. Noise sound pressure results on receiving point are based on method BNPM (Basic Noise Prediction Method) and on German regulation BNPM, which is based on DIN 18005.

F.8.7.7 Receptors to be investigated

651. In order to investigate noise levels in operation field and close to buildings, many receiving points have been ideally set in correspondence of building facades, at proper distance and height according to Georgian and international standard regulations. The model can evaluate not only general noise level in the area but also noise levels close to buildings, in position suggested by international regulations about residential buildings. Due to the absence of tall buildings, maximum height is four floors, and their distance from the source, there is no need to make a multi level computation at different heights.

F.8.7.8 Traffic forecasts

652. Currently last 5 year statistic data is available from Roads Department of Georgia for the main roads; data includes seasonal measurements during the year, specifically in April, July and October from these measurements AADT is derived.

653. According to German regulation BNPM, the vehicle fluxes must be divided in light and heavy means; accordingly the reported data has been divided assigning the class of light vehicles to cars and minibuses, the class of heavy vehicles to buses tracks and trailers. The traffic flux per day at 2017 is shown in **Table F-19**.

Table F-19: Traffic Flux Per Day, 2017

Year	Car	Mini Buses<15, PickUPs	Buses & Trucks	Trailers & > 3 axles	Total
2017	13335	3448	2410	1116	20310

654. This data has been collected in a period of 8 hours in the day reference period, so the average hour flux can be considered 2,540 vehicles per hour. Due to unstable patterns it was considered more reasonable to calculate Compound Annual Growth Rate (CAGR) to apply first year growth rate separately for Passenger and Freight Vehicles based on last few year traffic history. The compound annual growth rate is calculated by taking the root ^{nth} of the total percentage growth rate, where "n" is the number of years in the period being considered.

649. For the reasons above described, in our model as future traffic flux the traffic forecast values at 20 years from now data was the input data; in other words the traffic values after a period of about 18 years after road construction. The future vehicle flux used in calculations is 47,064 total vehicles.

655. To investigate the worst traffic condition for noise levels, this flux, according to BNPM method, has been evenly spread on road lanes, the average per day has been divided in a period of 8 hours, obtaining the above average flux per hour, 5,883 vehicles/hour with about 16% of heavy vehicles; speed has been set to 80 Km/h.

656. As far as regards the night reference time, considering the absence of any directly measured data and lacking of a study as detailed as daytime one, a vehicles flux of 70% of the daytime for cars and 30% for buses trucks and trailers has been chosen (see **Table F-20**). The assumption is based on experience in European countries, and corrected by direct observation of traffic reduction during night time in the investigation area.

Table F-20: Night Traffic

Year	Car (70%)	Mini Buses<15, PickUP (30%)s	Buses & Trucks(30%)	Trailers & >3 axle (30%)s	Total
2017	9334,5	1034,4	723	334,8	11426,7
2018	9801,4	1086,3	756,3	350,1	11994,1
2019	10329,9	1144,8	793,5	367,5	12635,7
2020	10945,2	1212,9	837	387,6	13382,7
2021	11664,1	1292,7	887,4	410,7	14254,9
2022	12427,1	1377,3	940,5	435,6	15180,5
2023	13098,4	1451,4	987	456,9	15993,7
2024	13805,4	1530	1035,9	479,7	16851
2025	14385	1594,2	1075,8	498	17553
2026	14989,8	1661,1	1117,2	517,2	18285,3
2027	15619,1	1731	1160,4	537,3	19047,8
2028	16220,4	1797,6	1203	556,8	19777,8
2029	16844,8	1866,6	1247,1	577,5	20536
2030	17400,6	1928,4	1286,4	595,5	21210,9
2031	17975,3	1992	1326,9	614,4	21908,6
2032	18568,2	2057,7	1368,9	633,6	22628,4
2033	19180,7	2125,5	1411,8	653,7	23371,7
2034	19814,2	2195,7	1456,5	674,1	24140,5
2035	20468	2268,3	1502,1	695,4	24933,8
2036	21143,5	2343	1549,5	717,3	25753,3
2037	21840,7	2420,4	1598,4	740,1	26599,6

F.8.7.9 Modeling Results

657. The results of the noise model are presented below in a series of maps (**Figure F-19** to **Figure F-58**). The Project road has been divided into ten 'portions' to allow a better visual analysis of the maps. **Figure F-18** shows the approximate location of each 'portion'.

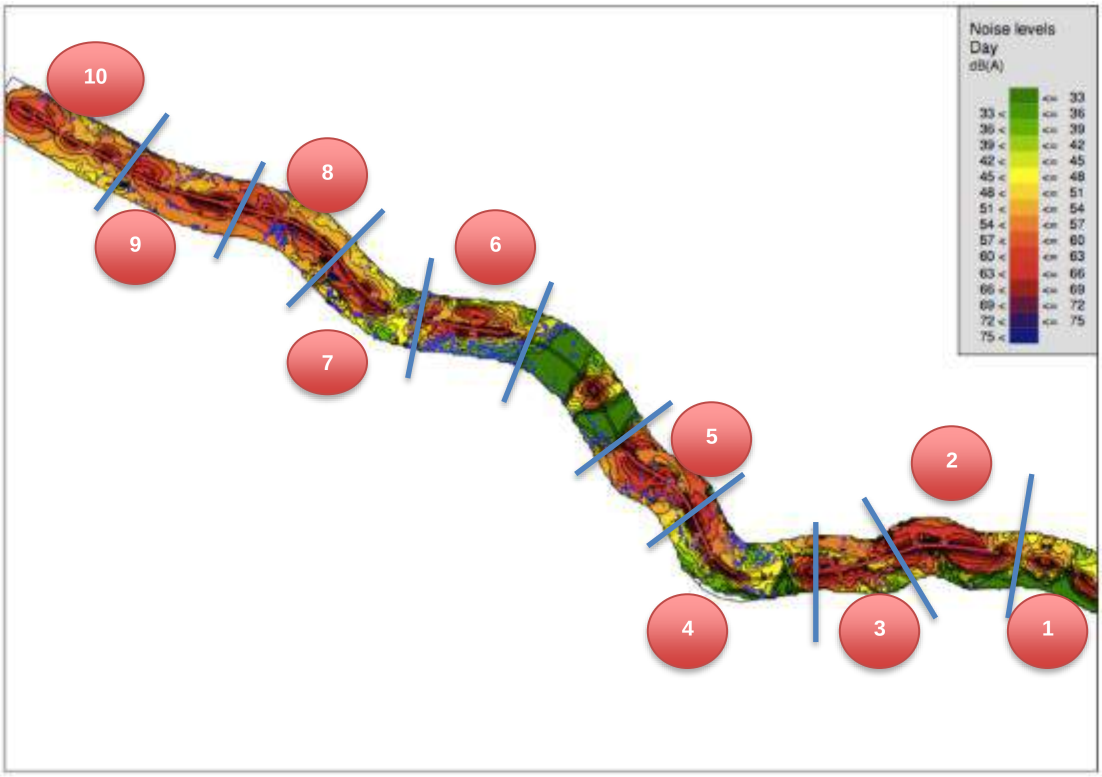
658. Each portion comprises a series of four maps with isolines representing the various predicted noise levels for:
1. Daytime noise – Without noise abatement
2. Daytime noise – With noise barrier
3. Nighttime noise – Without noise abatement
4. Nighttime noise – With noise barrier

659. The noise barrier has been developed based on a generic solid noise barrier type, with a height of 4 meters and is used only to illustrate the types of noise reduction that could be anticipated by employing such abatement measures. The exact locations of the noise barriers can be seen in **Appendix E**.

660. Next to each map a table is provided indicating the predicted noise levels at each identified receptor within the Project corridor (100 meters each side of the

road). The numbers highlighted in green indicate where they meet the IFC Guidelines limits for daytime and nighttime noise.

Figure F-18: Approximate Location of Portion



661. The model 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. 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.

662. **Table F-21** below summarizes the findings of the model, with and without noise barriers.

Table F-21: Noise Model Findings

Portion	Findings
1	Only three receptors are located in this portion. R1 and R2 will still be slightly above the nighttime IFC limit even with a noise barrier.
2	Receptor L1 and L2 are not impacted by elevated noise levels in any scenario. R5 will be expropriated and R6 is a commercial property (IFC guidelines of 70 dBA apply here). R4 is the only receptor effected and the noise barrier will not be able to reduce noise levels below IFC guideline limits.
3	All receptors are above the IFC daytime and nighttime limits without noise abatement measures. However, application of the noise barrier does not bring noise levels below the IFC standards especially around the intersection. Receptors R7 to R17 are however within only 3-5 dBA of the limits if noise barrier B5 is employed.
4	Only 5 receptors out of the 21 on the left hand side of the road require noise abatement measures (L9,L10,L13,L14 & L17), all other receptors are below the IFC guideline limits in all scenarios. The situation on the right side is a little

Portion	Findings
	different. Noise abatement has a very positive impact on receptors R23 to R34. However, after the noise barrier is not able to reduce noise levels below IFC guideline limits.
5	All receptors on the right side of the road (except R51 and R52) will be expropriated. Noise levels at R51 and R52 only just exceed IFC guideline limits with the noise barrier having almost no noise reduction impact on these properties. All receptors are subject to noise levels above IFC guideline limits in all scenarios.
6	Noise levels with and without noise abatement are broadly similar with around half of the receptors being exposed to elevated noise levels regardless of the scenario.
7	Most receptors are affected by elevated noise without abatement measures in place. However, the noise barrier scenario provides extremely effective noise reduction reducing noise levels at all receptors below IFC guideline limits.
8	All receptors are impacted by elevated noise levels without noise abatement. Noise barriers have a positive effect in the first half of this portion, but little effect close to the interchange.
9	All receptors are significantly affected without noise abatement. Noise barriers are effective at reducing noise levels quite considerably in this section, but not quite enough to meet IFC nighttime standards.
10	As with Portion 9, all receptors are significantly affected without noise abatement. Noise barriers are effective at reducing noise levels quite considerably in this section, but not quite enough to meet IFC nighttime standards.

663. Notwithstanding the above, the model is 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, but it is not an end in itself.

F.8.7.11 Operational Phase Noise Mitigation

664. **Figure F-19** to **Figure F-58** illustrate that noise barriers would, in some instances, be effective noise abatement and would help reduce road noise levels below IFC guideline limits. However, in other instances a noise barrier does not seem to have any major benefits and noise levels are still elevated above IFC limits even with the noise abatement.

665. Looking more closely at the results of the model the following comments are made about each portion and the potential for future installation of noise barriers within it.

- Portion 1: Only two receptors are slightly impacted by noise levels. Other noise abatement measures should be considered to replace the 200m noise barrier. This could include fencing around individual properties, planting of vegetation, and installation of noise proof windows.
- Portion 2: Only one receptor will be impacted. Other noise abatement measures should be considered to replace the 500 m of noise barrier. This could include fencing around individual properties, planting of vegetation, and installation of noise proof windows.
- Portion 3: Noise Barrier B6-1 and B6-2 do not have any significant effect on the receptors. However, Barrier B5 does reduce noise levels close to IFC limits and as such could be implemented in addition to other noise abatement measures,

such as fencing around individual properties, planting of vegetation, and installation of noise proof windows.

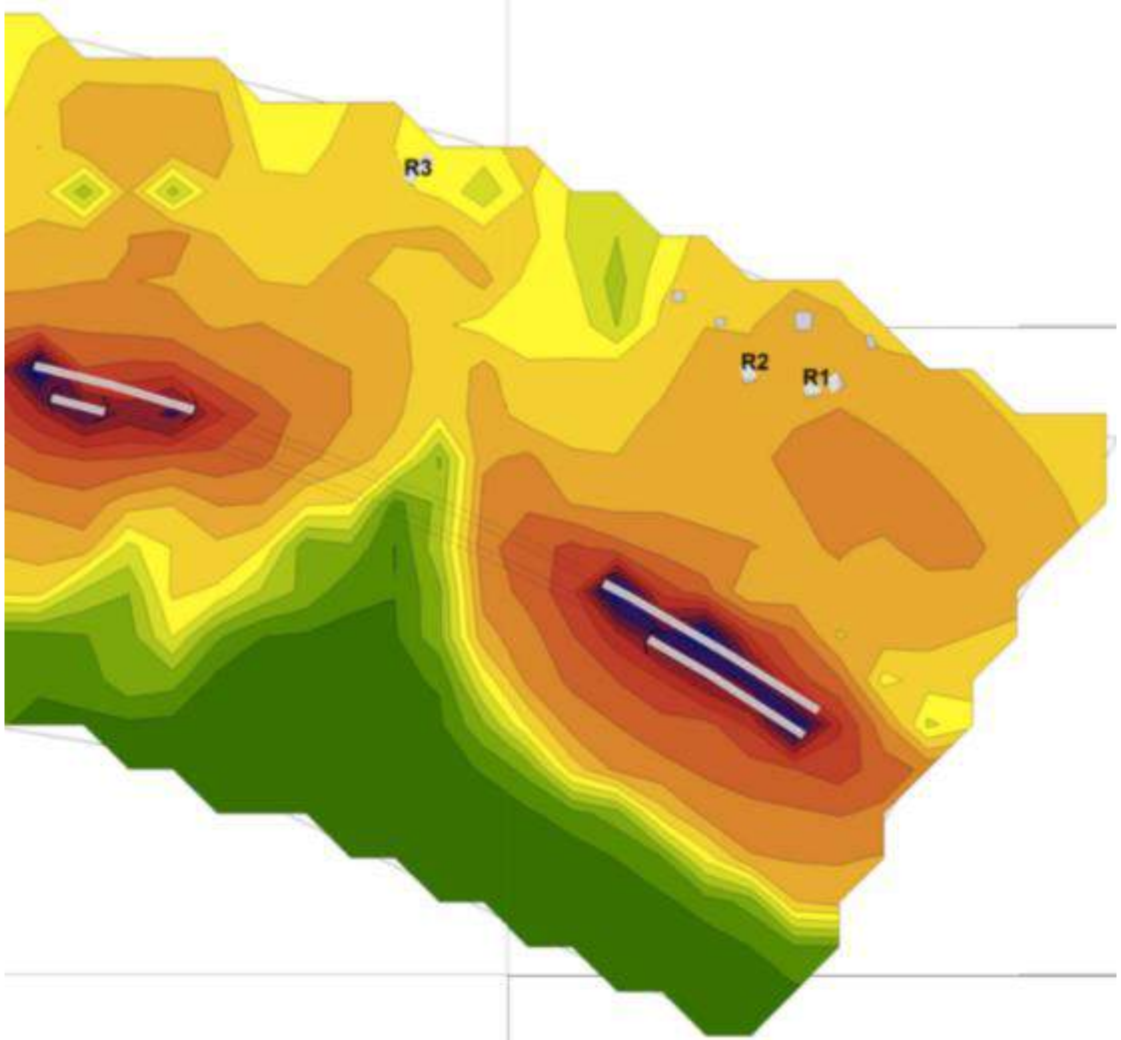
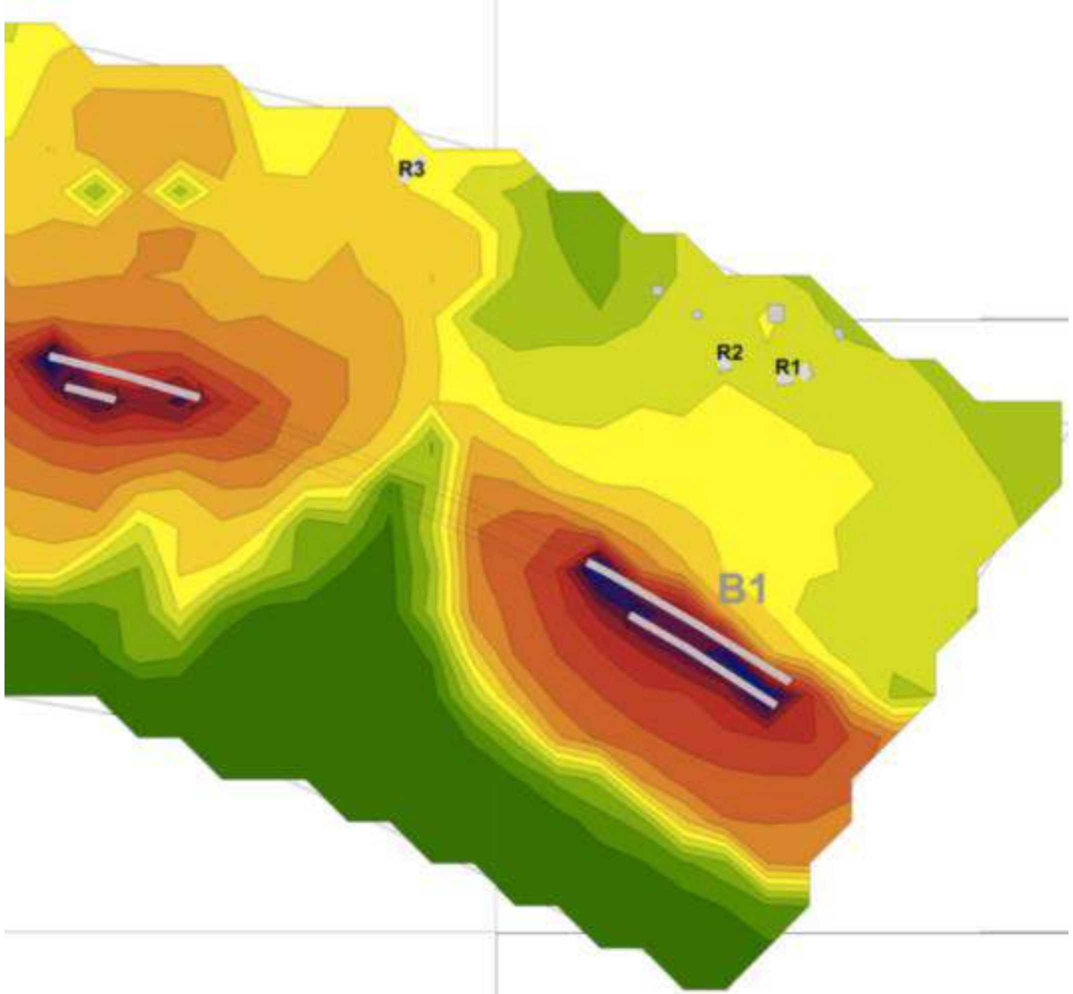


Figure F-19: Portion 1

Without Barrier / Daytime

Receptor	dBA
R1	56.3
R2	54.6
R3	50.4



Barrier B1 – L200m / H4m

Figure F-20: Portion 1

With Barrier / Daytime

Receptor	dBA
R1	47.4
R2	46.9
R3	50.4

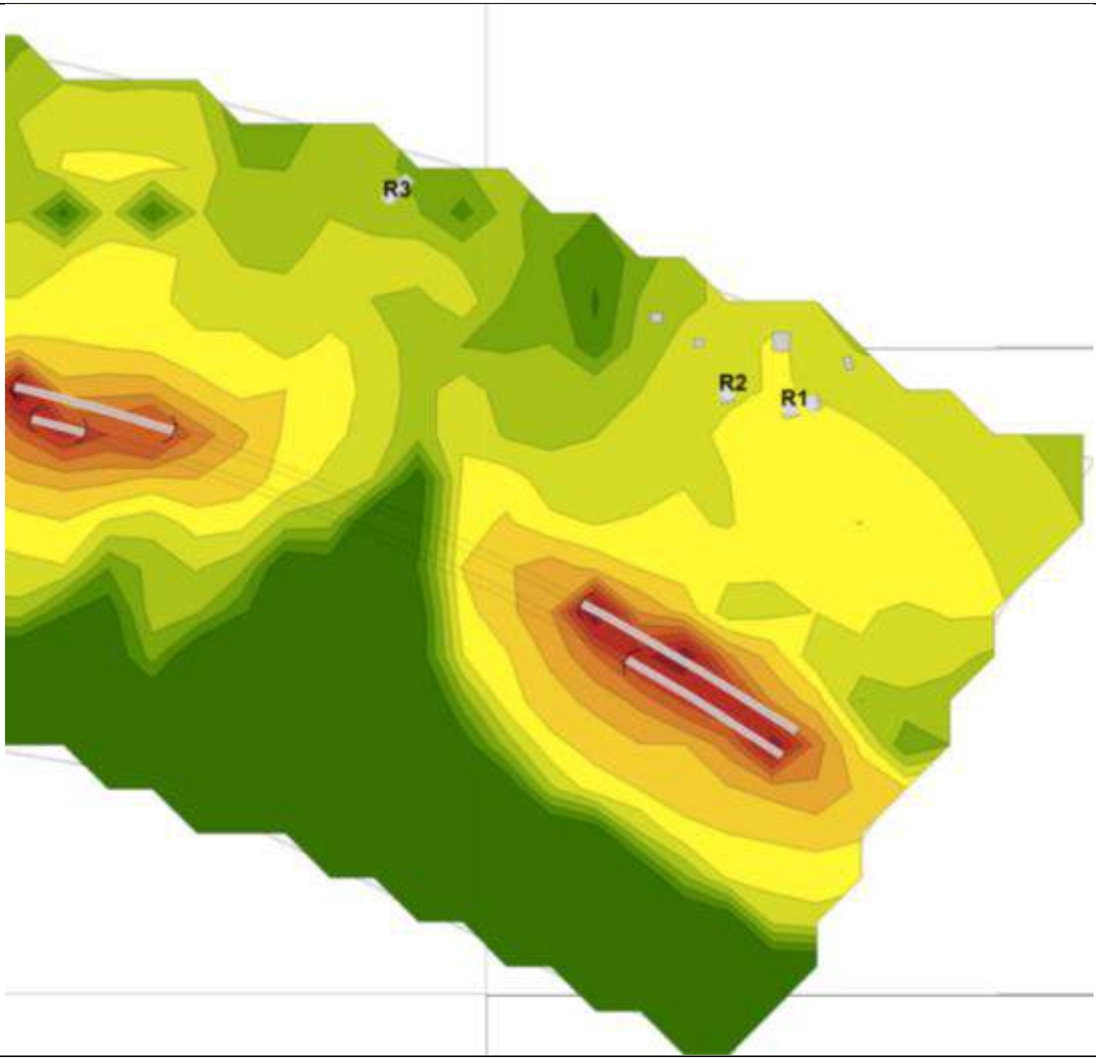
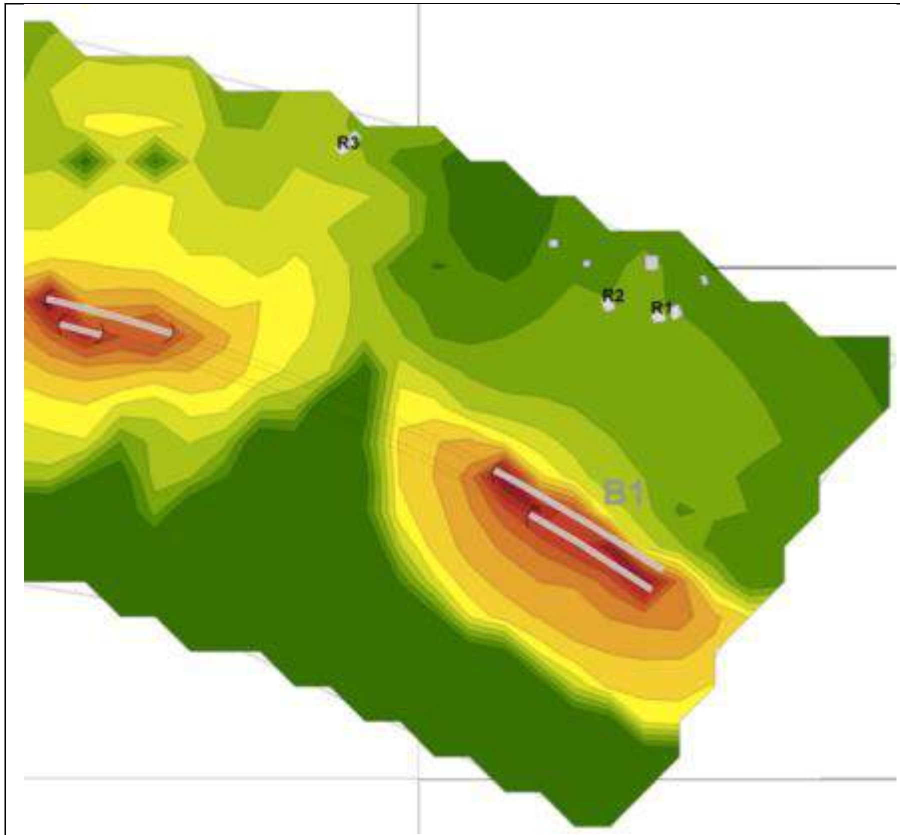


Figure F-21: Portion 1

Without Barrier / Nighttime

Receptor	dBA
R1	48.3
R2	46.6
R3	42.3



Barrier B1 – L200m / H4m

Portion 1 Results: Only three receptors are located in this portion. R1 and R2 will still be slightly above the nighttime IFC limit even with a noise barrier.

Figure F-22: Portion 1

With Barrier / Nighttime

Receptor	dBA
R1	39.3
R2	38.8
R3	42.3

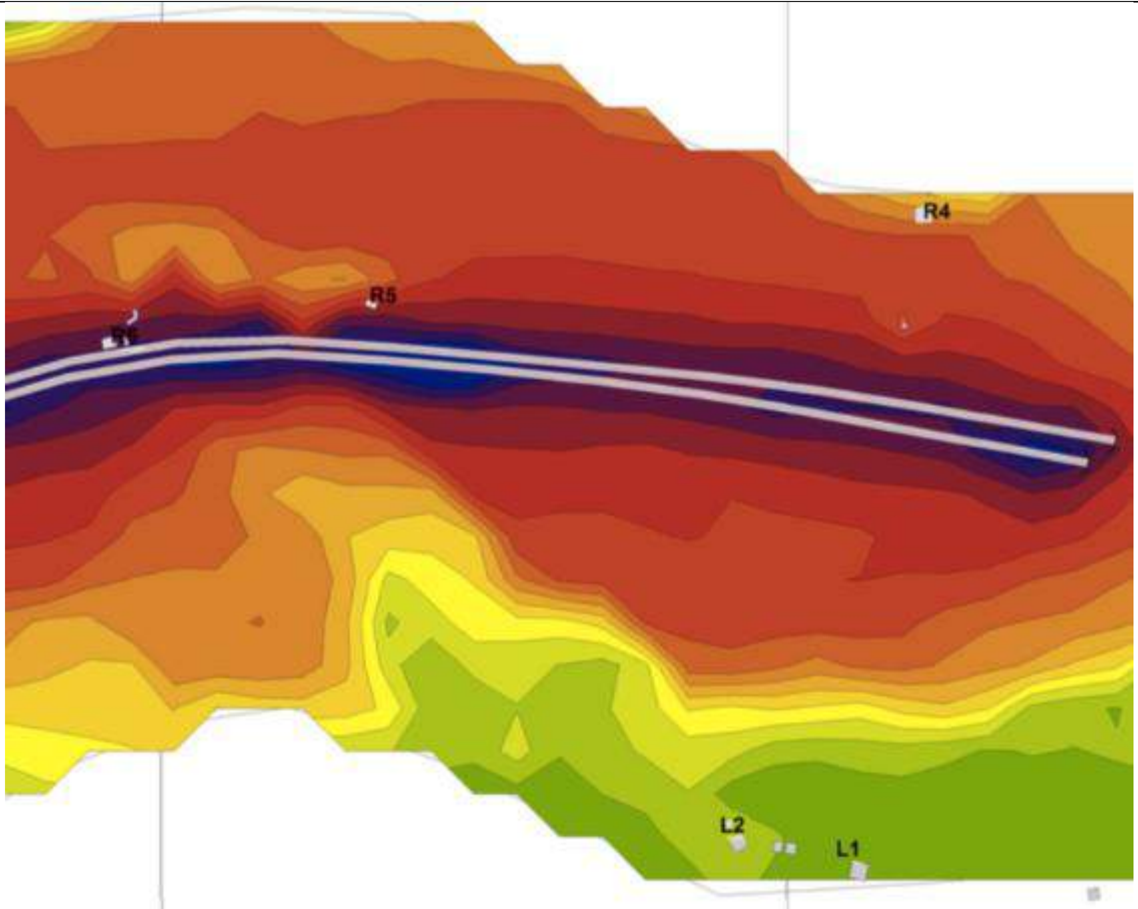
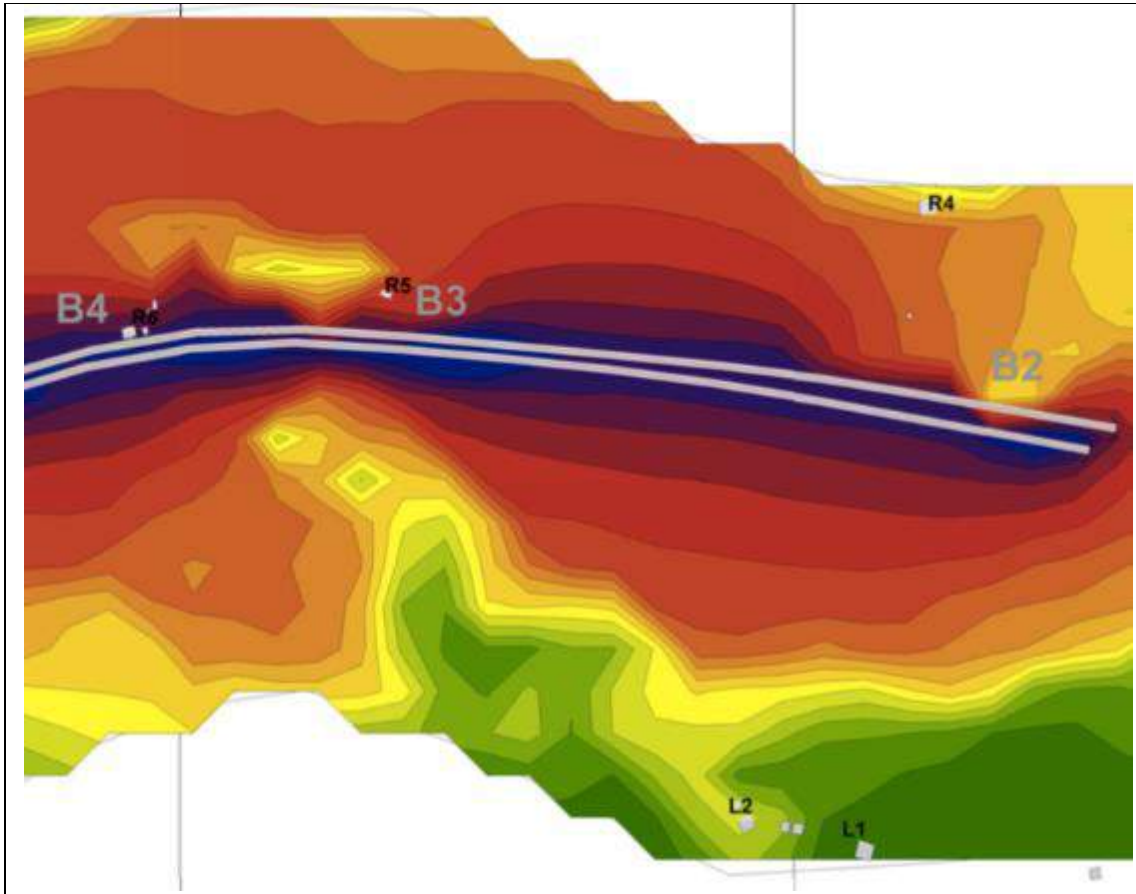


Figure F-23: Portion 2

Without Barrier / Daytime

Receptor	dBA
L1	31.6
L2	33.2
R4	64.5
R5*	71.9
R6**	78.5

*To be expropriated
**Commercial



Barrier B2 – L280m / H4m
Barrier B3 – L170m / H4m
Barrier B4 – L50m / H4m

Figure F-24: Portion 2

With Barrier / Daytime

Receptor	dBA
L1	31.6
L2	33.2
R4	60.0
R5*	67.1
R6**	+75.0

*To be expropriated
**Commercial

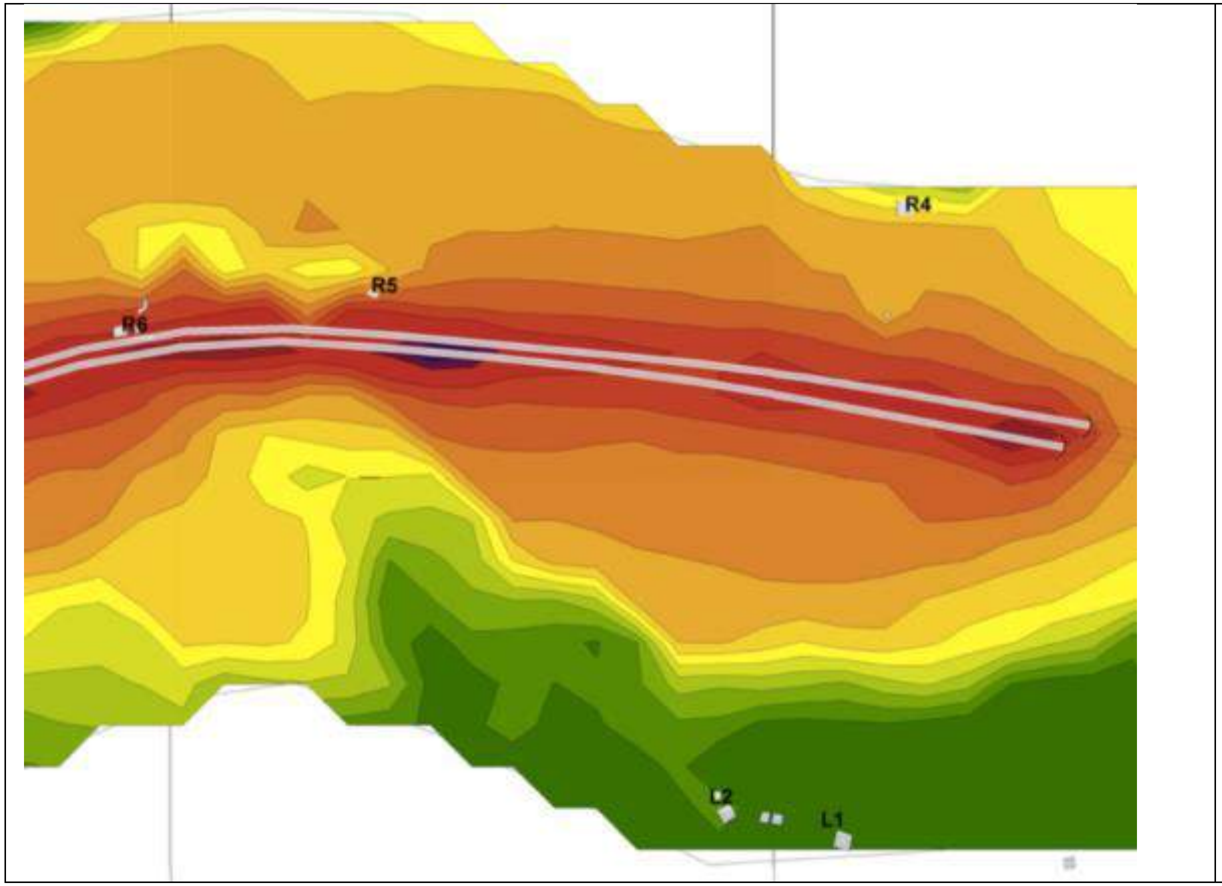
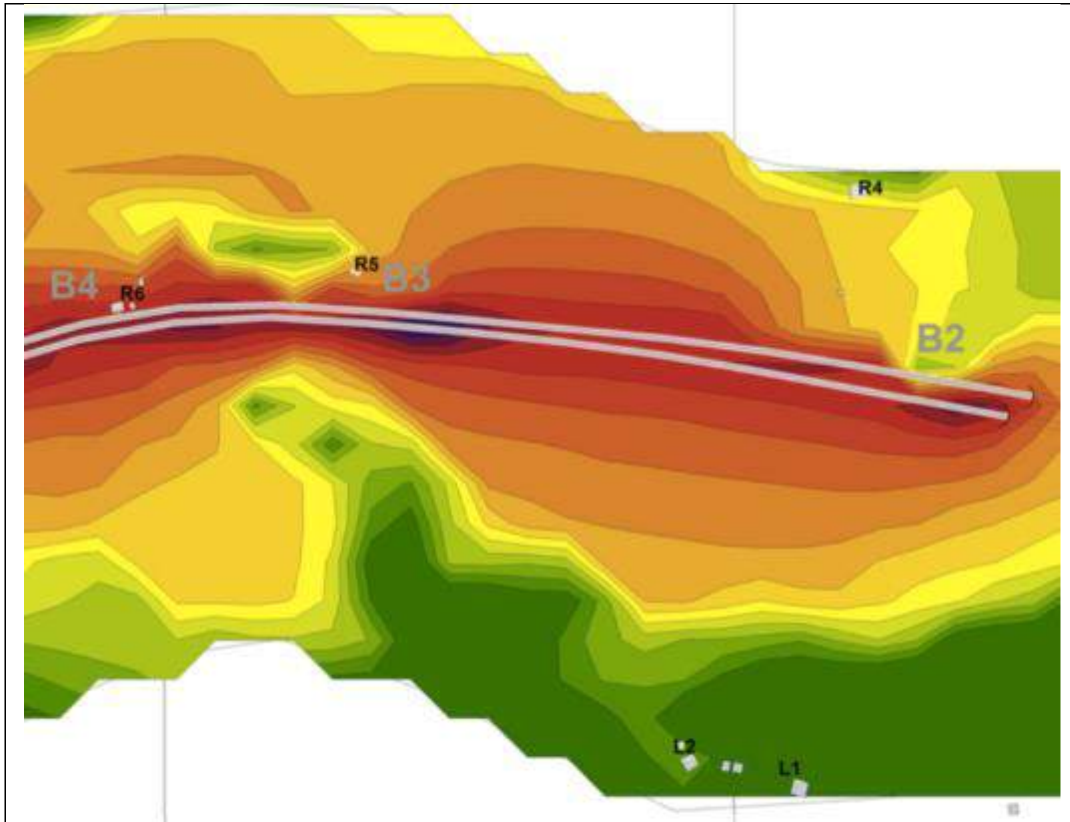


Figure F-25: Portion 2

Without Barrier / Nighttime

Receptor	dBA
L1	23.6
L2	25.2
R4	56.5
R5*	63.9
R6**	70.0

*To be expropriated
**Commercial



Barrier B2 – L280m / H4m
Barrier B3 – L170m / H4m
Barrier B4 – L50m / H4m

Portion 2 Results: Receptor L1 and L2 are not impacted by elevated noise levels in any scenario. R5 will be expropriated and R6 is a commercial property (IFC guidelines of 70 dBA apply here). R4 is the only receptor effected and the noise barrier will not be able to reduce noise levels below IFC guideline limits.

Figure F-26: Portion 2

With Barrier / Nighttime

Receptor	dBA
L1	31.6
L2	33.2
R4	51.9
R5*	59.0
R6**	66.0

*To be expropriated
**Commercial

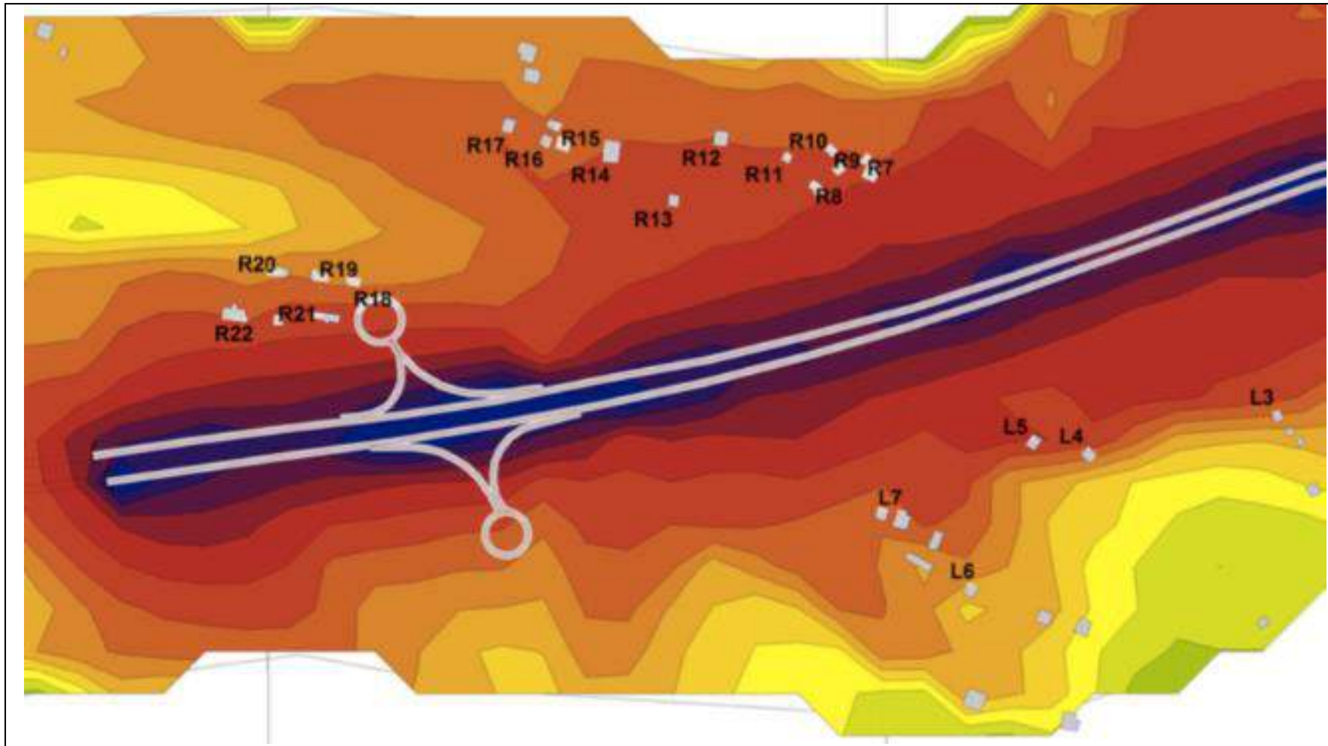


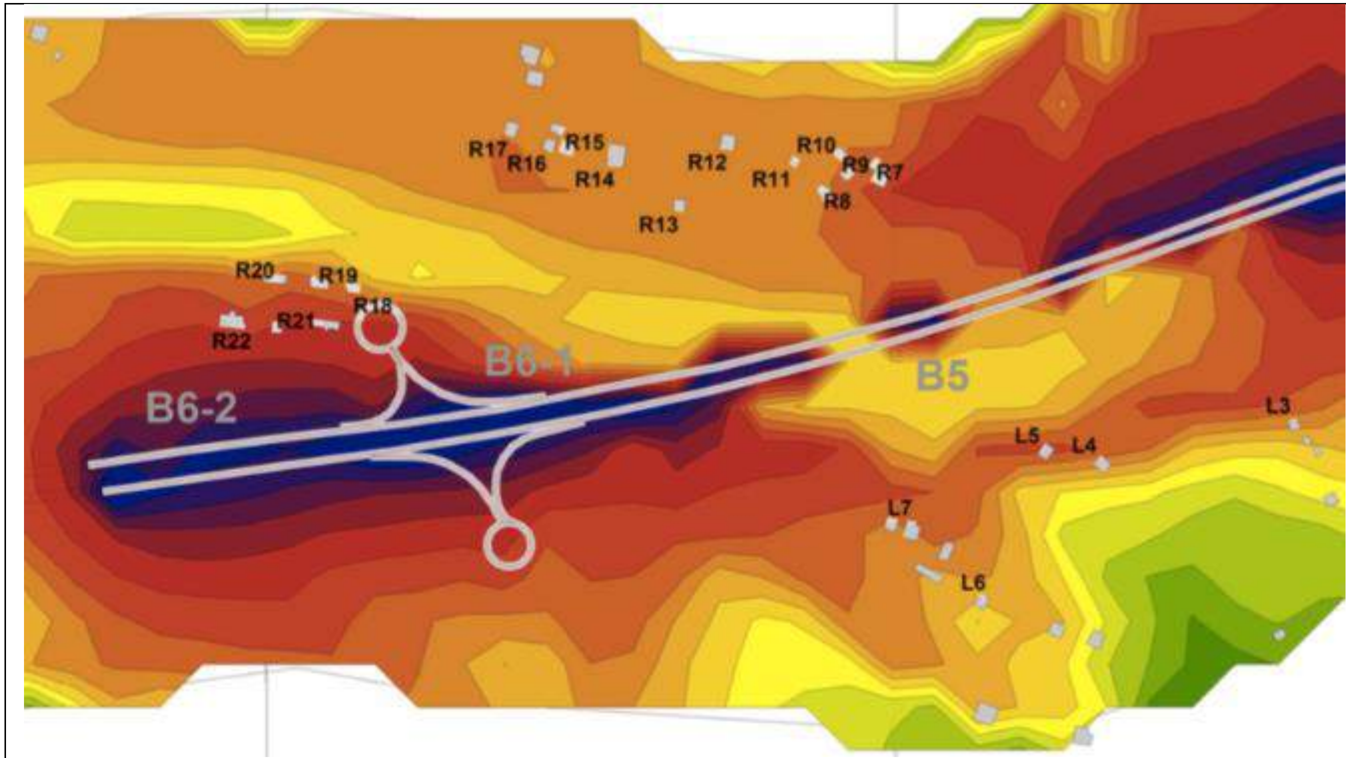
Figure F-27: Portion 3

Without Barrier / Day time

Receptor	dBA
L3	59.1
L4	64.7
L5	65.5
L6	57.9
L7	64.1
R7	66.1
R8	64.4
R8	65.6
R10	62.4
R11	63.7
R12	63.7
R13	65.3
R14	64.1
R15	63.3
R16	62.8
R17	61.9
R18	61.6
R19	58.3
R20	62.0
R21	66.9
R22	65.8

Figure F-28: Portion 3

With Barrier / Day time



Barrier B5 – L620m / H4m
Barrier B6-1 – L600m / H4m
Barrier B6-2 – L300m / H4m

Receptor	dBA
L3	57.4
L4	63.9
L5	64.5
L6	55.9
L7	61.8
R7	63.5
R8	59.1
R8	57.3
R10	57.4
R11	56.4
R12	57.9
R13	58.3
R14	59.2
R15	59.1
R16	59.0
R17	58.7
R18	60.1
R19	57.8
R20	61.5
R21	66.5
R22	65.7

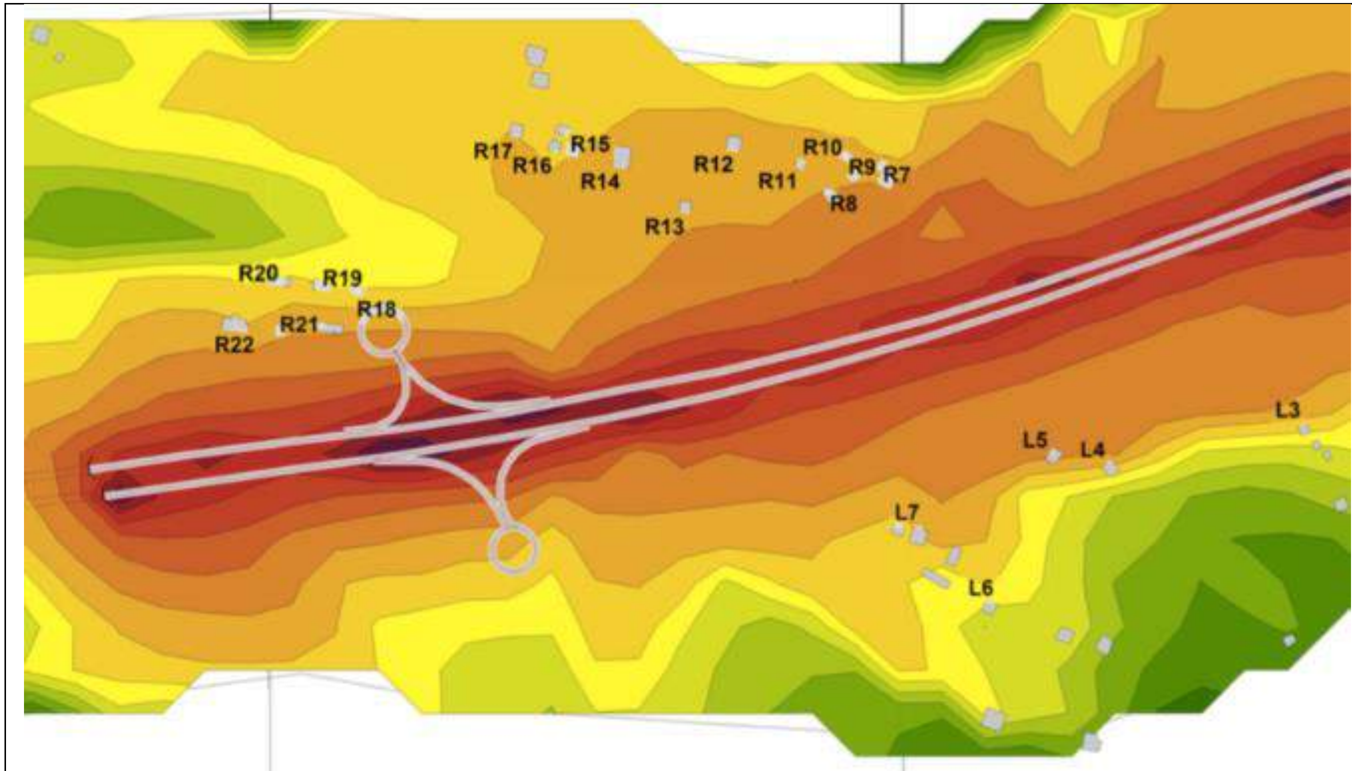


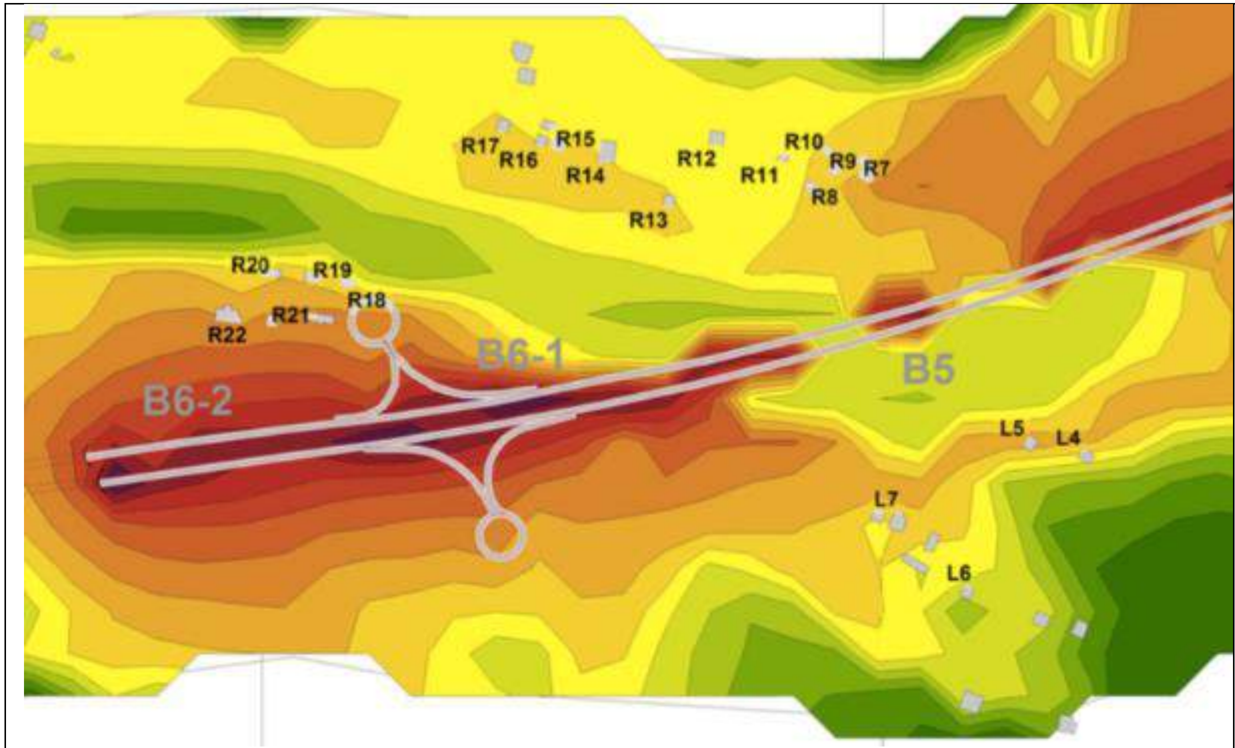
Figure F-29: Portion 3

Without Barrier / Nighttime

Receptor	dBA
L3	51.1
L4	56.7
L5	57.5
L6	49.9
L7	56.1
R7	58.0
R8	56.3
R8	57.6
R10	54.4
R11	55.7
R12	55.7
R13	57.3
R14	56.0
R15	55.3
R16	54.8
R17	53.9
R18	53.6
R19	50.3
R20	53.9
R21	58.8
R22	57.7

Figure F-30: Portion 3

With Barrier / Nighttime



Receptor	dBA
L3	49.4
L4	55.9
L5	56.5
L6	47.9
L7	53.7
R7	55.5
R8	51.1
R8	49.2
R10	49.4
R11	48.3
R12	49.8
R13	50.2
R14	51.1
R15	51.0
R16	50.9
R17	50.6
R18	52.0
R19	49.8
R20	53.4
R21	58.4
R22	57.6

Barrier B5 – L620m / H4m
Barrier B6-1 – L600m / H4m
Barrier B6-2 – L300m / H4m

Portion 3 Conclusion: All receptors are above the IFC daytime and nighttime limits without noise abatement measures. However, application of the noise barrier does not bring noise levels below the IFC standards especially around the intersection. Receptors R7 to R17 are however within only 3-5 dBA of the limits if noise barrier B5 is employed.

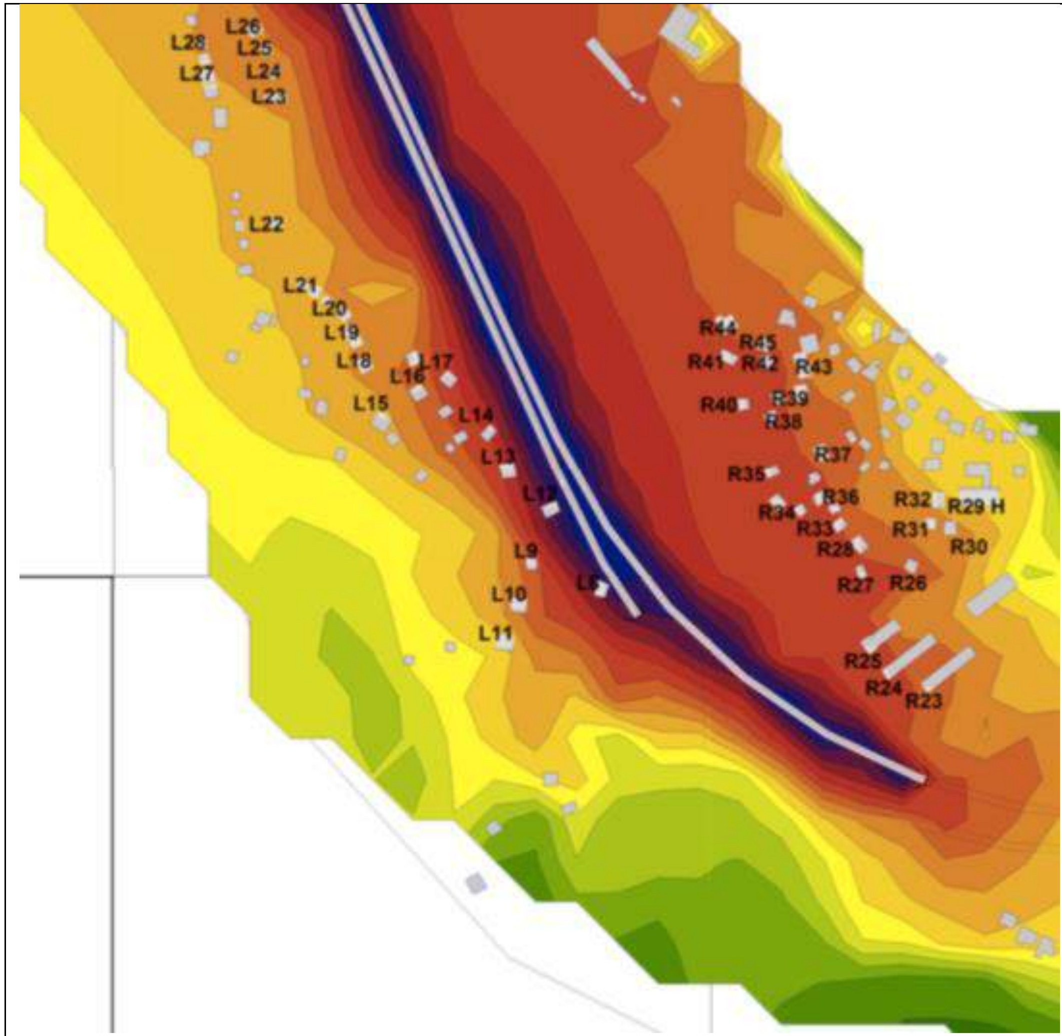
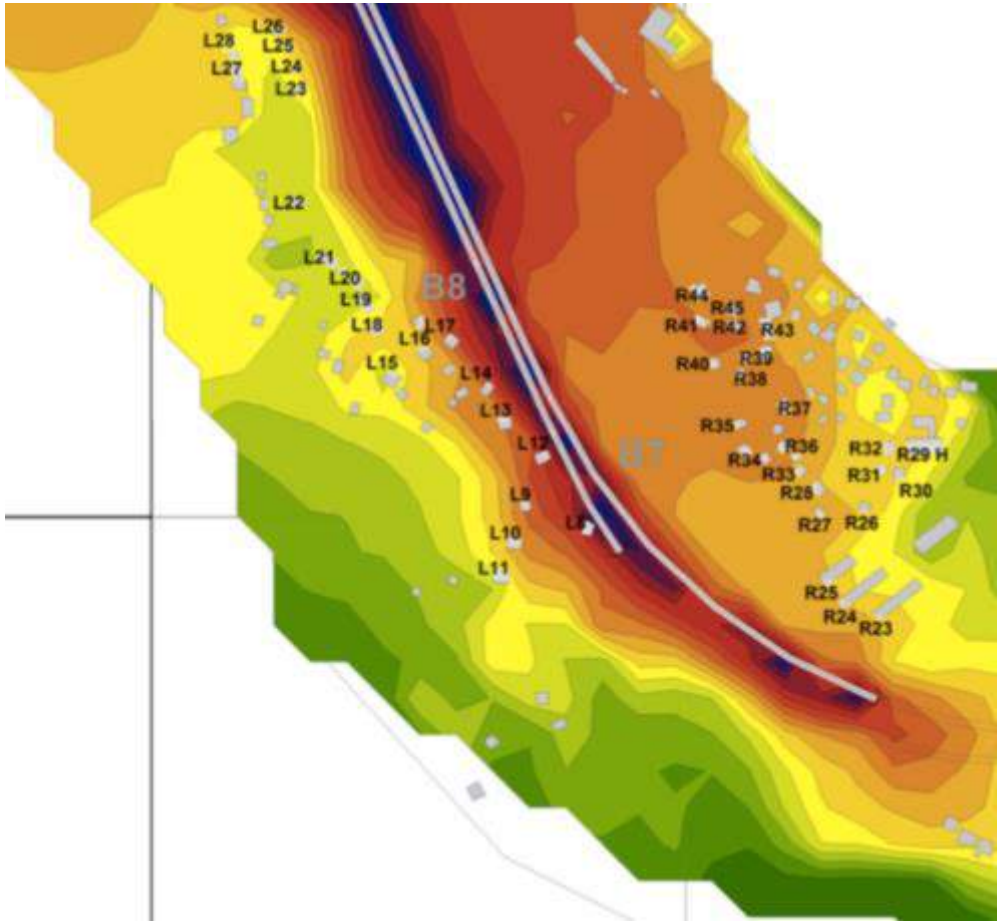


Figure F-31: Portion 4

Without Barrier / Day time

Receptor	dBA
L8*	77.0
L9	60.8
L10	59.7
L11	57.0
L12*	75.9
L13	69.0
L14	65.5
L15	50.2
L16	48.4
L17	58.7
L18	48.4
L19	46.8
L20	44.8
L21	42.9
L22	41.8
L23	47.2
L24	49.8
L25	49.4
L26	51.6
L27	41.3
L28	42.6
R23	61.7
R23	62.0
R24	62.5
R24	63.2
R24	63.5
R25	62.3
R25	63.2
R25	63.5
R26	60.6
R27	63.4
R28	62.7
R29 H	52.6
R29 H 1F	54.4
R30	56.0
R31	56.1
R32	51.9
R33	63.6
R34	64.0
R35	64.8
R36	63.6
R37	62.0
R38	63.1
R39	62.2
R40	64.6
R41	63.0
R42	62.4
R43	60.9
R44	64.0

* To be expropriated



Barrier B7 – L700m / H4m
Barrier B8 – L330m / H4m

Figure F-32: Portion 4

With Barrier / Day time

Receptor	dBA
L8*	57.3
L9	59.1
L10	56.0
L11	52.6
L12*	66.1
L13	61.6
L14	62.5
L15	49.3
L16	47.7
L17	57.6
L18	47.7
L19	45.8
L20	44.2
L21	42.2
L22	41.4
L23	46.6
L24	49.8
L25	49.3
L26	51.6
L27	41.3
L28	42.6
R23	54.4
R23	54.6

Receptor	dBA
R24	53.9
R24	54.6
R24	55.1
R25	53.4
R25	53.9
R25	54.5
R26	50.6
R27	54.1
R28	54.1
R29 H	45.3
R29 H 1F	46.6
R30	46.8
R31	47.6
R32	47.6
R33	56.2
R34	56.2
R35	58.4
R36	57.4
R37	57.1
R38	56.8
R39	58.3
R40	59.4
R41	57.5
R42	58.4
R43	57.9
R44	59.8

* To be expropriated

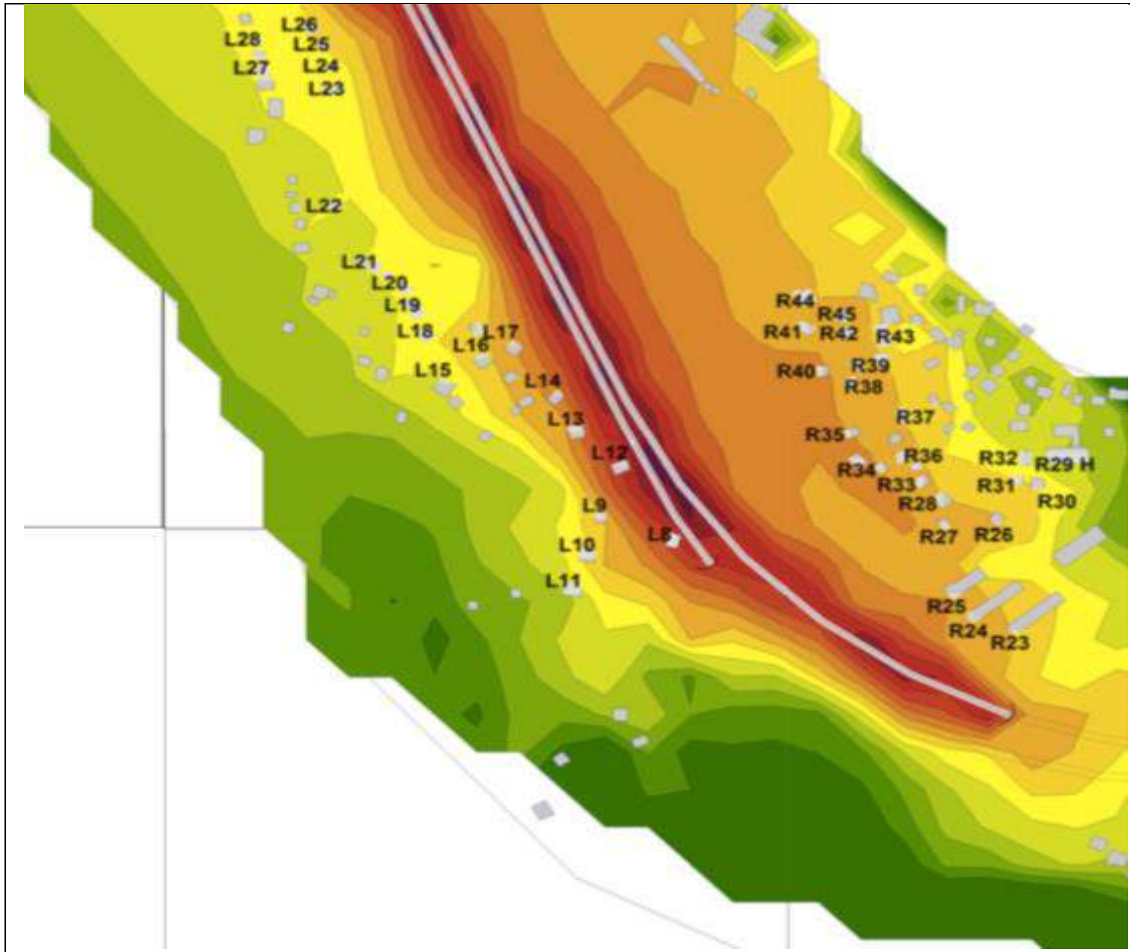


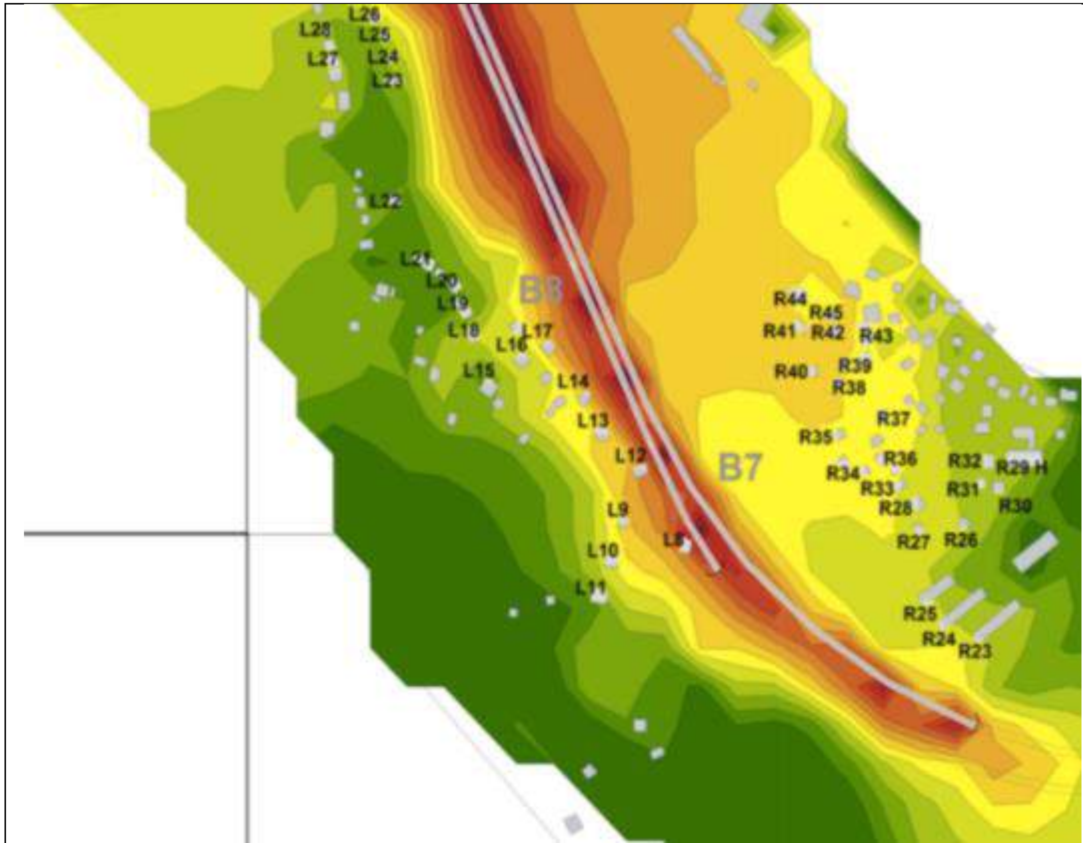
Figure F-33: Portion 4

Without Barrier / Nighttime

Receptor	dBA
L8*	69.0
L9	52.8
L10	51.6
L11	49.0
L12*	67.9
L13	61.0
L14	57.4
L15	42.1
L16	40.3
L17	50.7
L18	40.4
L19	38.8
L20	36.8
L21	34.9
L22	33.7
L23	39.1
L24	41.7
L25	41.4
L26	43.5
L27	33.2
L28	34.5
R23	53.6
R23	53.9

* To be expropriated

Receptor	dBA
R24	54.5
R24	55.1
R24	55.5
R25	54.3
R25	55.1
R25	55.5
R26	52.6
R27	55.4
R28	54.7
R29 H	44.5
R29 H 1F	46.4
R30	47.9
R31	48.1
R32	43.8
R33	55.5
R34	55.9
R35	56.8
R36	55.5
R37	53.9
R38	55.0
R39	54.2
R40	56.6
R41	55.0
R42	54.4
R43	52.9
R44	55.9



Barrier B7 – L700m / H4m
Barrier B8 – L330m / H4m

Portion 4 Conclusion: Only 5 receptors out of the 21 on the left hand side of the road require noise abatement measures (L9,L10,L13,L14 & L17), all other receptors are below the IFC guideline limits in all scenarios. The situation on the right side is a little different. Noise abatement has a very positive impact on receptors R23 to R34. However, after the noise barrier is not able to reduce noise levels below IFC guideline limits.

Figure F-34: Portion 4

With Barrier / Nighttime

Receptor	dBA
L8*	49.3
L9	51.1
L10	48.0
L11	44.6
L12*	58.1
L13	53.5
L14	54.5
L15	41.3
L16	39.6
L17	49.5
L18	39.7
L19	37.8
L20	36.1
L21	34.2
L22	33.3
L23	38.5
L24	41.7
L25	41.3
L26	43.5
L27	33.2
L28	34.5
R23	46.4
R23	46.6

* To be expropriated

Receptor	dBA
R24	45.9
R24	46.5
R24	47.1
R25	45.3
R25	45.9
R25	46.5
R26	42.6
R27	46.0
R28	46.0
R29 H	37.3
R29 H 1F	38.6
R30	38.7
R31	39.5
R32	39.5
R33	48.2
R34	48.2
R35	50.4
R36	49.3
R37	49.1
R38	48.8
R39	50.3
R40	51.4
R41	49.5
R42	50.3
R43	49.9
R44	51.7

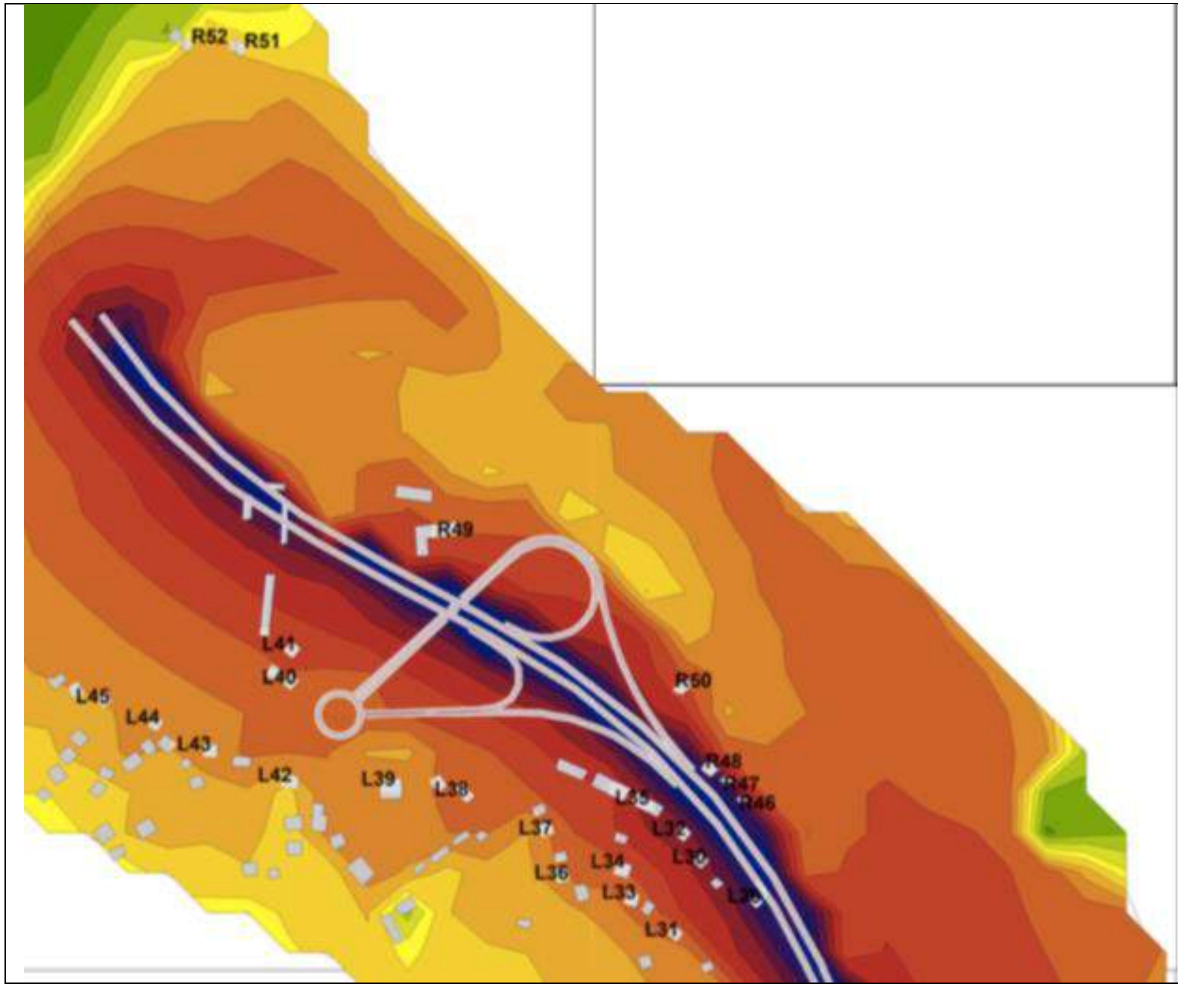


Figure F-35: Portion 5

Without Barrier / Day time

Receptor	dBA
L29	53.2
L30	73.2
L31	60.2
L32	73.9
L33	58.6
L34	60.9
L35	68.2
L36	58.7
L37	60.4
L38	62.4
L39	61.9
L40**	64.7
L41**	66.0
L42	63.3
L43	62.5
L44	61.4
L45	61.9

** Commercial

Receptor	dBA
R46*	73.6
R47*	70.5
R48*	70.4
R49*	60.7
R50*	63.1
R51	55.1
R52	54.7

* Subject to expropriation

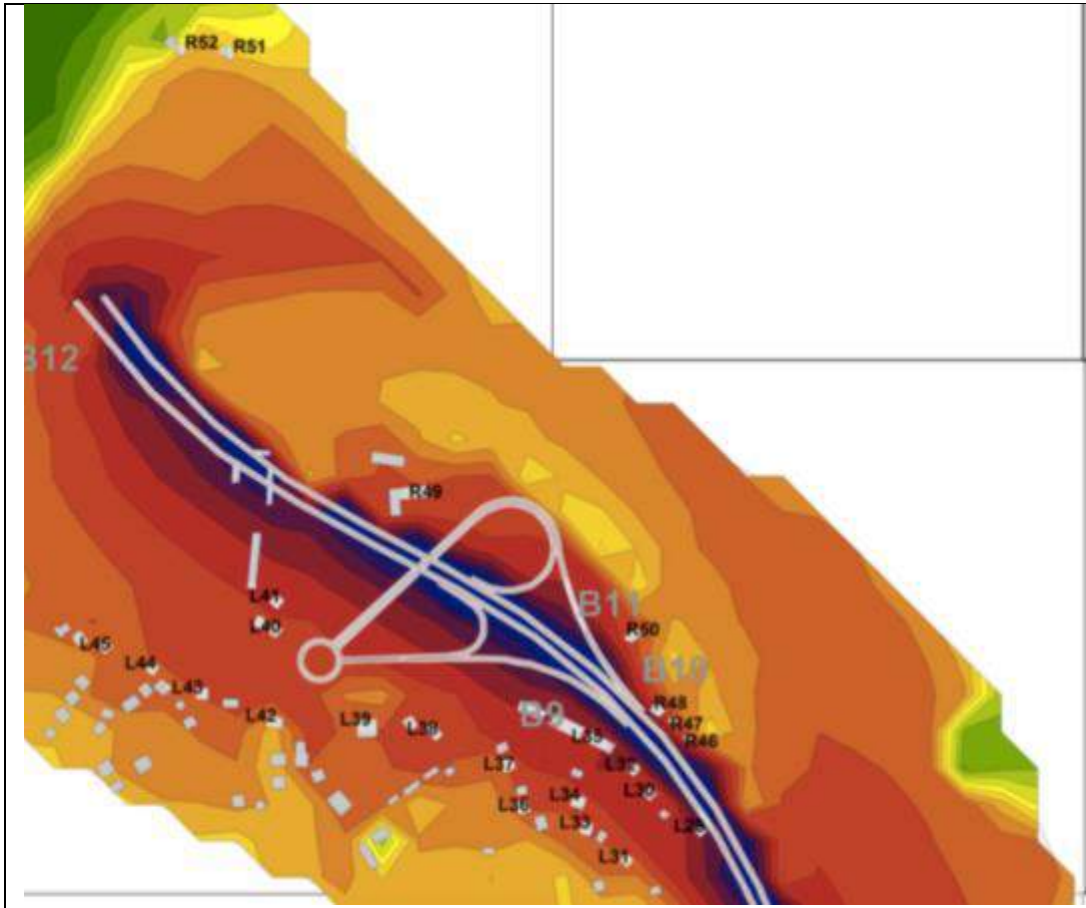


Figure F-36: Portion 5

With Barrier / Day time

Receptor	dBA
L29	52.9
L30	67.8
L31	60.2
L32	67.1
L33	58.6
L34	60.8
L35	61.6
L36	58.7
L37	60.4
L38	62.4
L39	61.9
L40**	64.7
L41**	66.0
L42	63.1
L43	62.4
L44	61.3
L45	61.6

**Commercial

Receptor	dBA
R46*	63.4
R47*	59.2
R48*	59.5
R49*	60.7
R50*	59.3
R51	55.1
R52	54.7

* Subject to expropriation

Barrier B9 – L300m / H4m
Barrier B10 – L110m / H4m
Barrier B11 – L50m / H4m
Barrier 12 – L50m / H4m

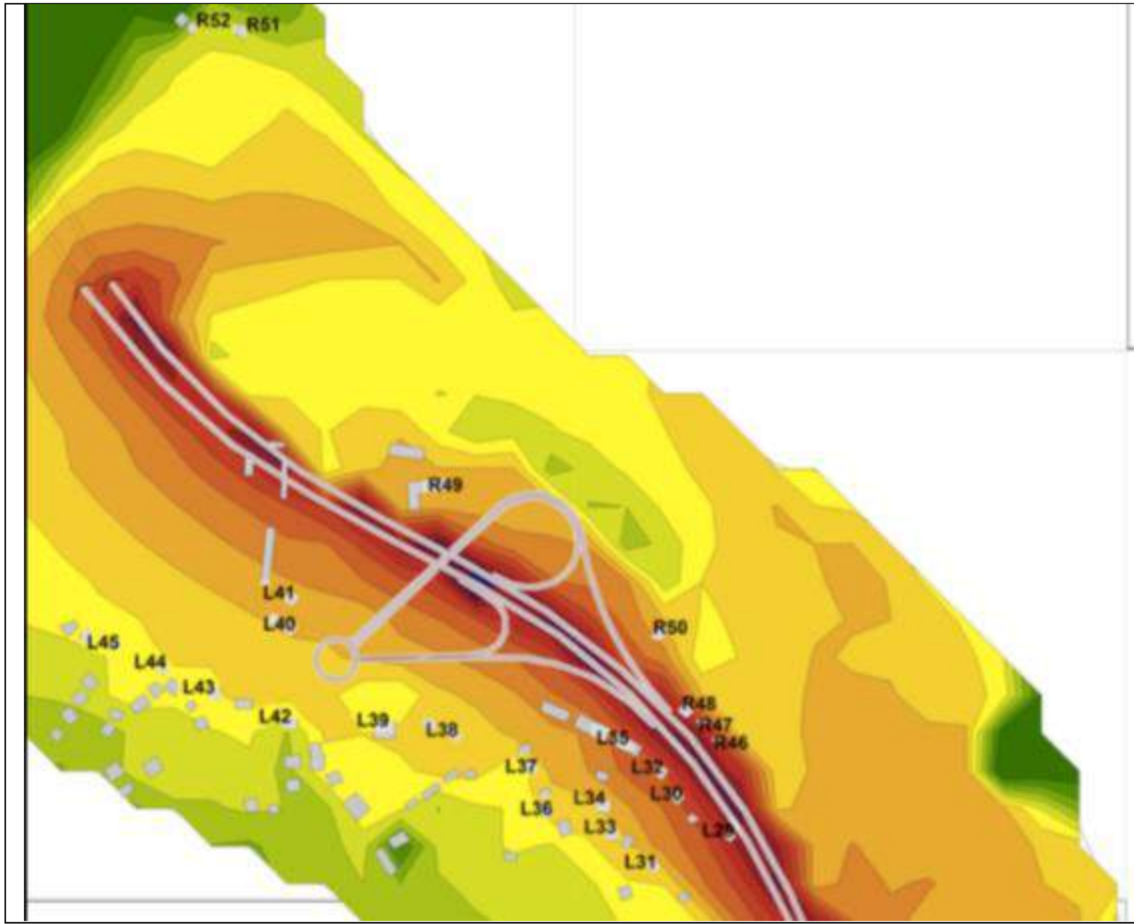


Figure F-37: Portion 5

Without Barrier / Nighttime

Receptor	dBA
L29	45.1
L30	65.2
L31	52.1
L32	65.9
L33	50.6
L34	52.8
L35	60.2
L36	50.6
L37	52.4
L38	54.4
L39	53.9
L40**	56.7
L41**	58.0
L42	55.2
L43	54.4
L44	53.4
L45	53.8

**Commercial

Receptor	dBA
R46*	65.5
R47*	62.5
R48*	62.4
R49*	52.6
R50*	55.1
R51	47.1
R52	46.6

* Subject to expropriation

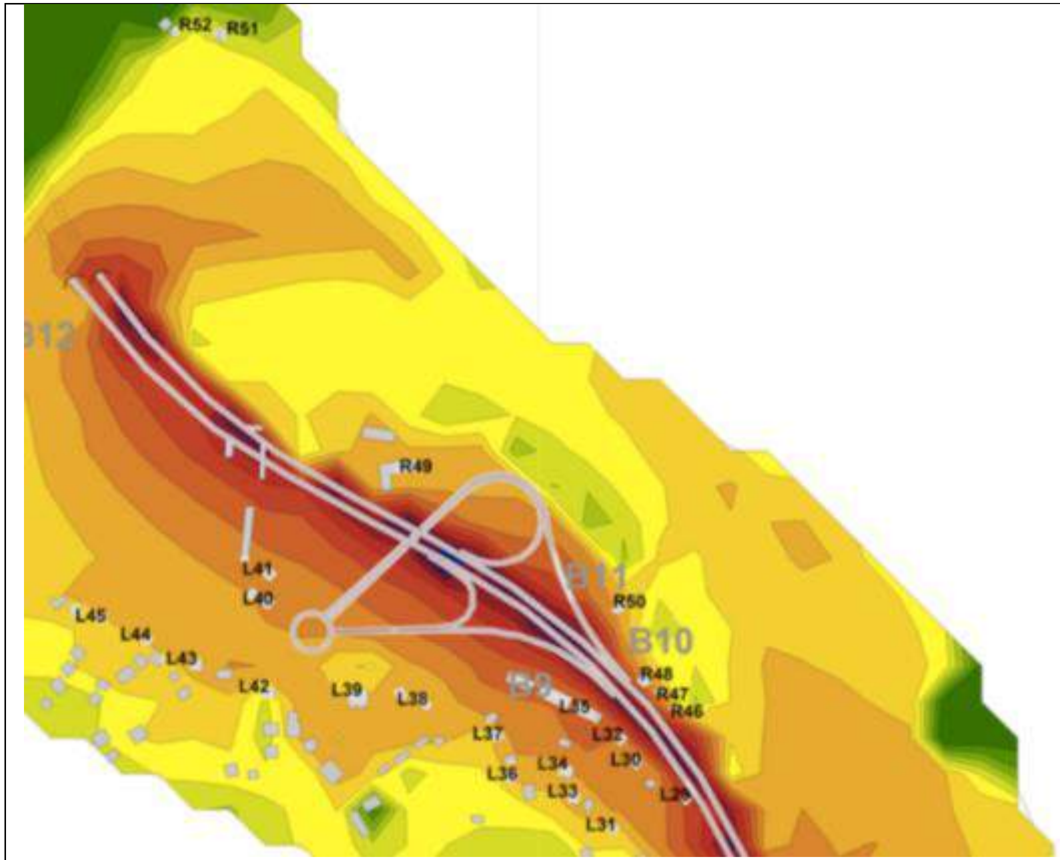


Figure F-38: Portion 5

With Barrier / Nighttime

Receptor	dBA
L29	44.8
L30	59.8
L31	52.1
L32	59.0
L33	50.6
L34	52.8
L35	53.6
L36	50.6
L37	52.4
L38	54.4
L39	53.9
L40**	56.7
L41**	58.0
L42	55.1
L43	54.3
L44	53.2
L45	53.6

**Commercial

Receptor	dBA
R46*	55.4
R47*	51.1
R48*	51.4
R49*	52.6
R50*	51.3
R51	47.0
R52	46.6

* Subject to expropriation

Barrier B9 – L300m / H4m
Barrier B10 – L110m / H4m
Barrier B11 – L50m / H4m
Barrier B12 – L50m / H4m

Portion 5 Conclusion: All receptors on the right side of the road (except R51 and R52) will be expropriated. Noise levels at R51 and R52 only just exceed IFC guideline limits with the noise barrier having almost no noise reduction impact on these properties. All receptors are subject to noise levels above IFC guideline limits in all scenarios.

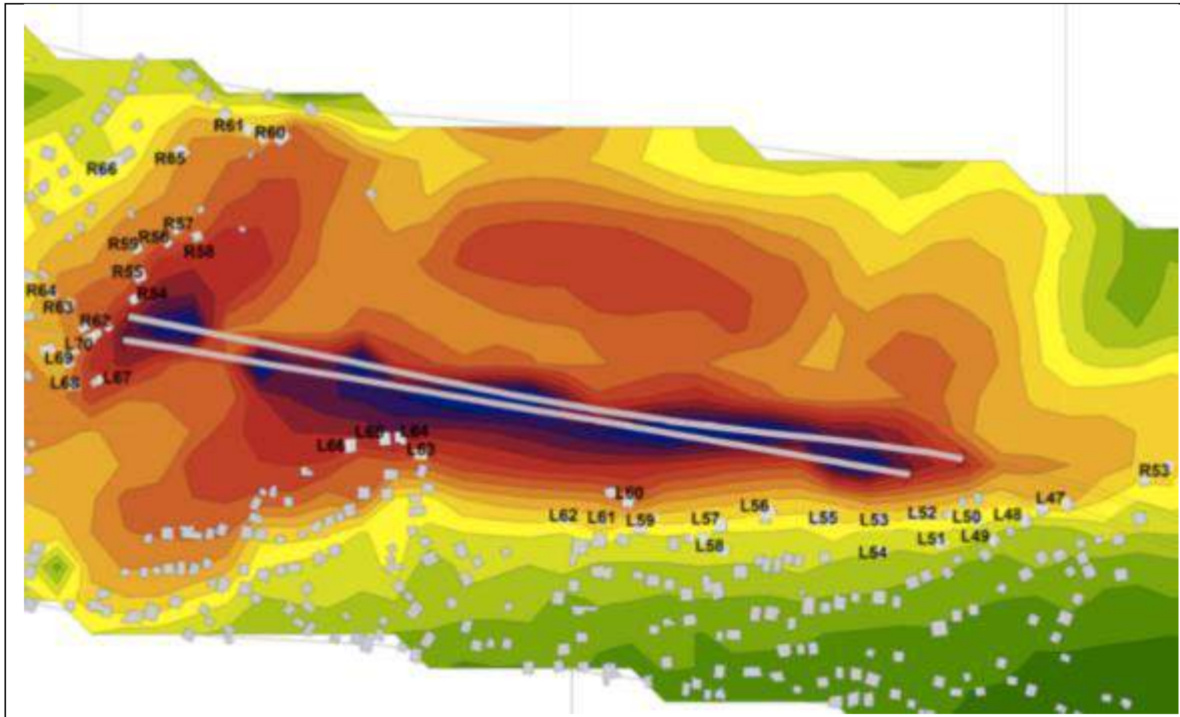
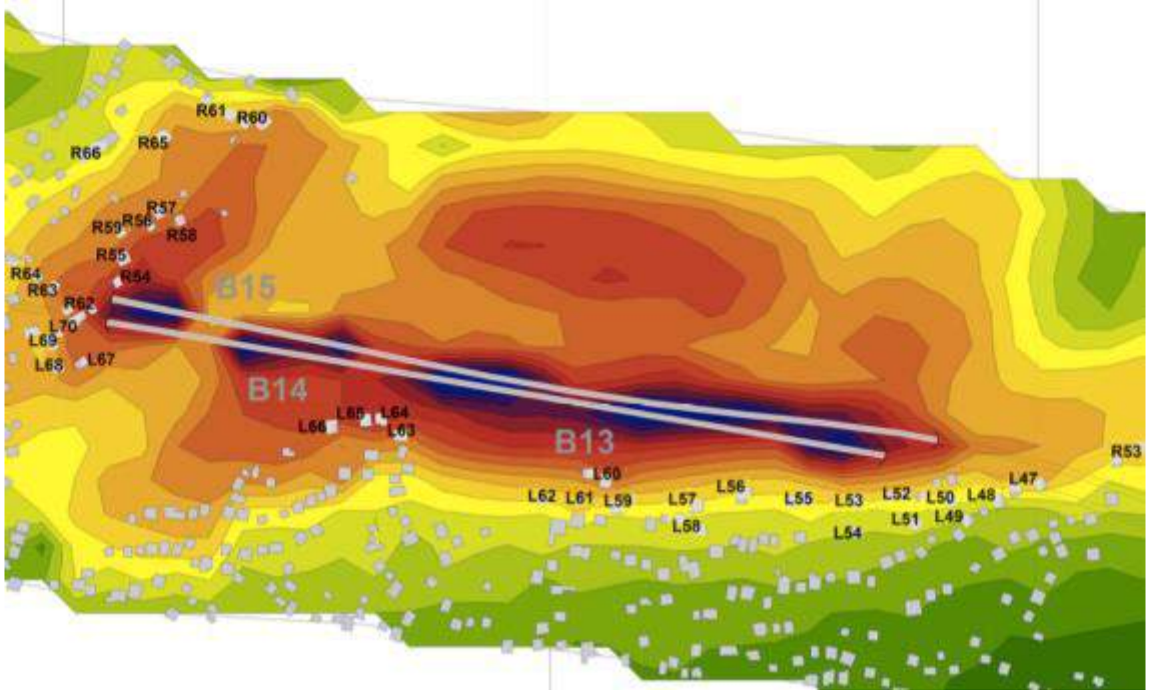


Figure F-39: Portion 6

Without Barrier / Day time

L47	51.0
L48	43.7
L49	41.9
L50	39.0
L51	40.0
L52	44.2
L53	49.1
L54	40.7
L55	49.1
L56	49.3
L57	46.4
L58	44.6
L59	46.6
L60	54.4
L61	47.9
L62	47.6
L63	61.9
L64	68.2
L65	67.5
L66	66.6
L67	64.7
L68	55.3
L69	62.2
L70	64.3

R53	51.7
R54	70.1
R55	66.3
R56	62.6
R57	60.7
R58	64.9
R59	60.4
R60	60.5
R60	58.4
R61	52.9
R61	53.2
R62	67.3
R63	57.4
R64	54.1
R65	51.5
R66	44.8



Barrier B13 – L170m / H4m
Barrier B14 – L280m / H4m
Barrier B15 – L310m / H4m

Figure F-40: Portion 6

With Barrier / Day time

L47	51.0
L48	43.7
L49	41.9
L50	39.0
L51	40.0
L52	44.2
L53	49.1
L54	40.7
L55	49.1
L56	49.1
L57	46.4
L58	44.6
L59	46.6
L60	53.7
L61	47.9
L62	47.5
L63	57.9
L64	63.3
L65	62.7
L66	62.8
L67	57.7
L68	52.0
L69	60.3
L70	63.4

R53	51.6
R54	69.2
R55	64.5
R56	61.6
R57	59.7
R58	63.2
R59	59.9
R60	58.0
R60	56.0
R61	52.9
R61	52.4
R62	67.1
R63	57.4
R64	54.1
R65	51.5
R66	44.8
R66	50.1

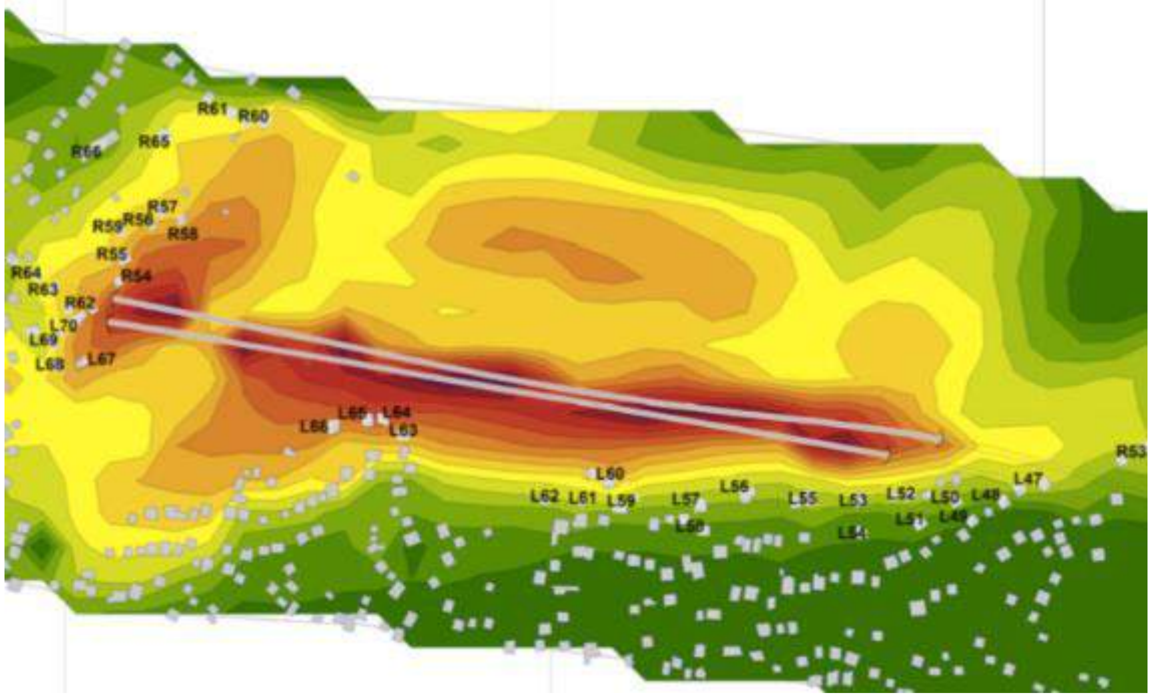


Figure F-41: Portion 6

Without Barrier / Nighttime

L47	42.9
L48	35.7
L49	33.8
L50	30.9
L51	32.0
L52	36.2
L53	41.0
L54	32.7
L55	41.1
L56	41.3
L57	38.3
L58	36.5
L59	38.6
L60	46.4
L61	39.8
L62	39.5
L63	53.9
L64	60.1
L65	59.4
L66	58.5
L67	56.7
L68	47.3
L69	54.1
L70	56.3

R53	43.7
R54	62.1
R55	58.2
R56	54.6
R57	52.7
R58	56.9
R59	52.4
R60	52.5
R60	50.4
R61	44.9
R61	45.1
R62	59.2
R63	49.3
R64	46.0
R65	43.4
R66	36.8

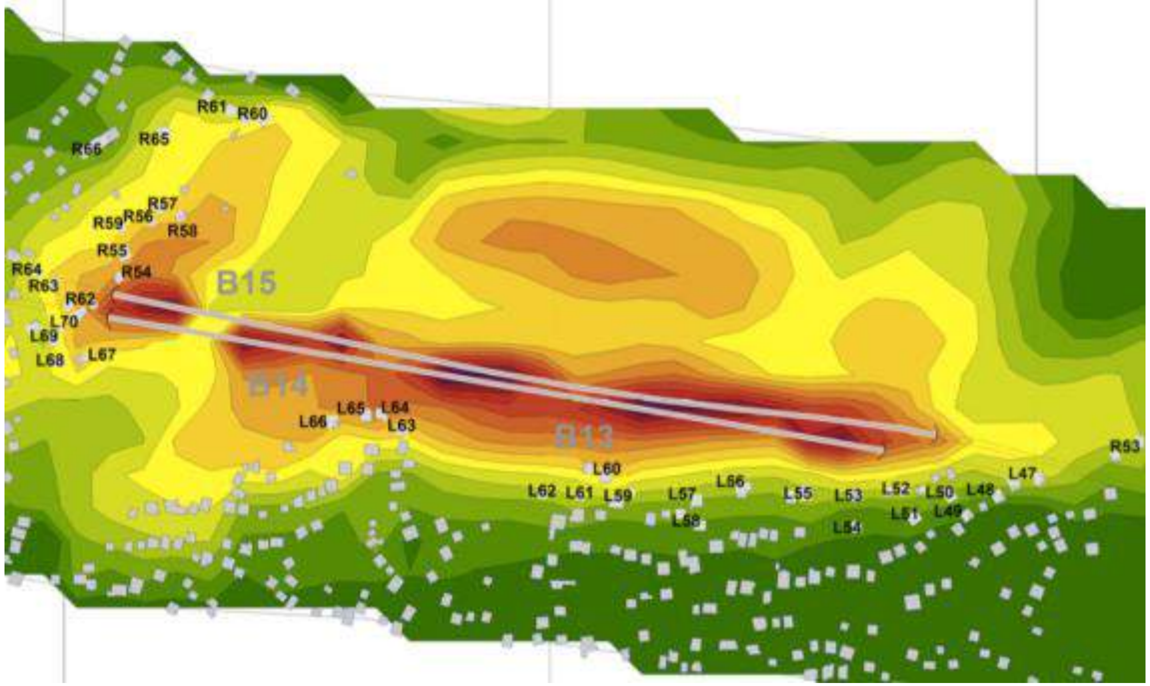


Figure F-42: Portion 6

With Barrier / Nighttime

L47	42.9
L48	35.7
L49	33.8
L50	30.9
L51	32.0
L52	36.2
L53	41.0
L54	32.7
L55	41.1
L56	41.3
L57	38.3
L58	36.5
L59	38.6
L60	45.6
L61	39.8
L62	39.5
L63	49.9
L64	55.3
L65	54.7
L66	54.7
L67	49.6
L68	43.9
L69	52.3
L70	55.4

R53	43.5
R54	61.1
R55	56.5
R56	53.6
R57	51.7
R58	55.2
R59	51.9
R60	50.0
R60	47.9
R61	44.9
R61	44.3
R62	59.1
R63	49.3
R64	46.0
R65	43.4
R66	36.8
R66	42.1

Barrier B13 – L170m / H4m
Barrier B14 – L280m / H4m
Barrier B15 – L310m / H4m

Portion 6 Conclusion: Noise levels with and without noise abatement are broadly similar with around half of the receptors being exposed to elevated noise levels regardless of the scenario.

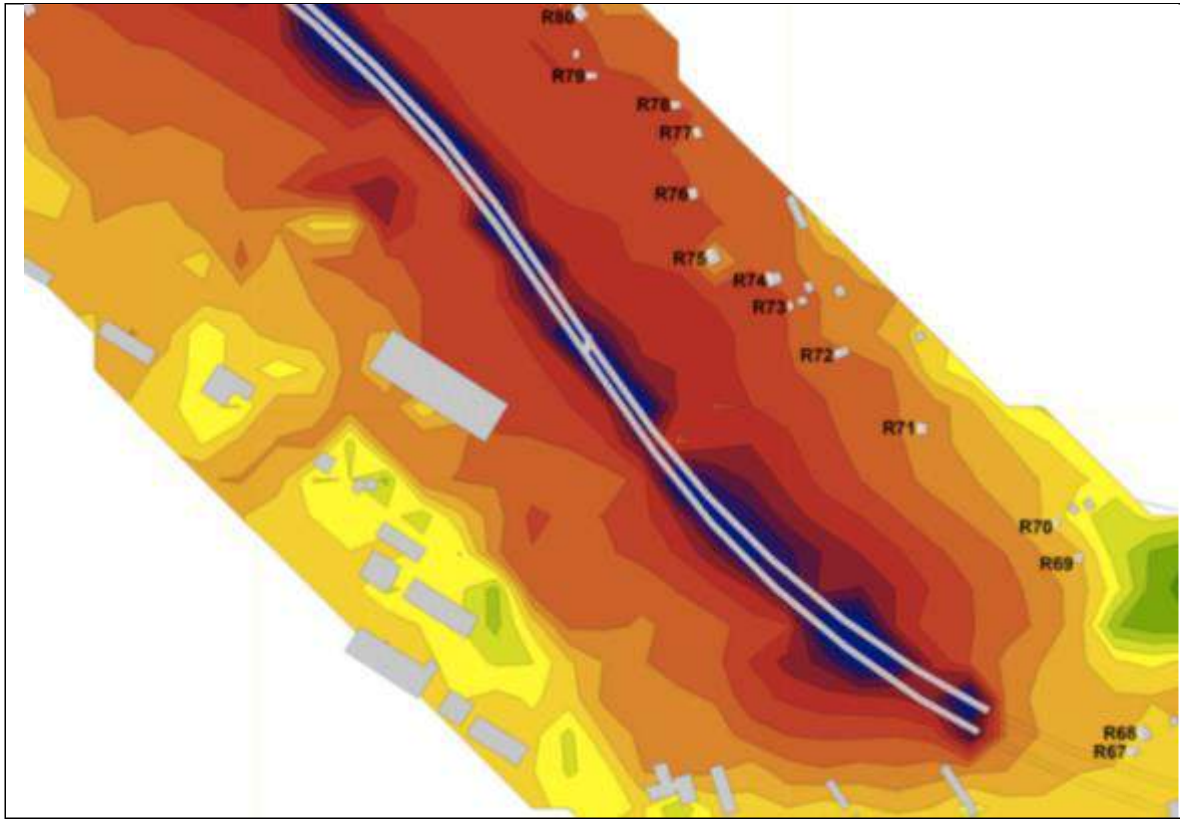


Figure F-43: Portion 7

Without Barrier / Day time

R67	52.0
R68	53.0
R69	49.8
R70	50.3
R71	56.7
R72	59.4
R73	61.4
R74	60.9
R75	63.7
R76	61.8
R77	61.5
R78	61.9
R79	62.8
R80	58.9

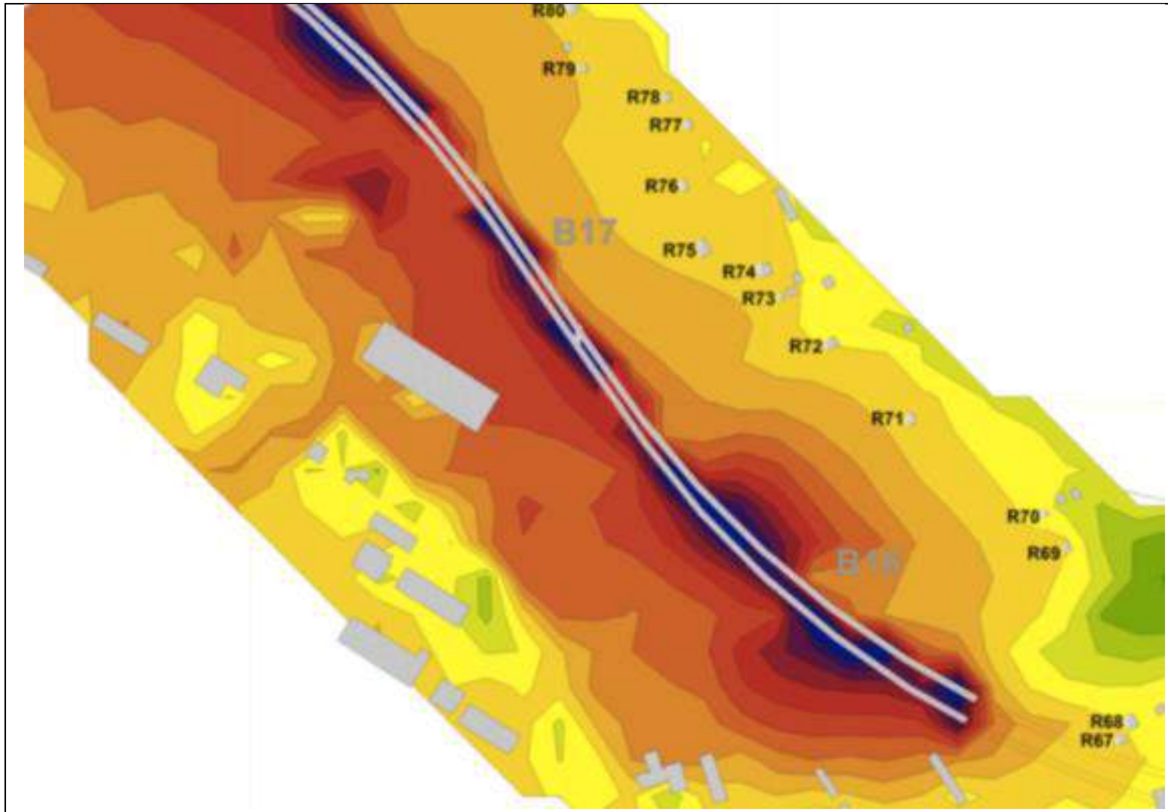


Figure F-44: Portion 7

With Barrier / Day time

R67	49.7
R68	49.2
R69	47.3
R70	48.0
R71	50.5
R72	49.6
R73	51.2
R74	50.2
R75	51.9
R76	50.6
R77	50.7
R78	50.6
R79	52.6
R80	50.6

Barrier B16 – L290m / H4m
Barrier B17 – L680m / H4m

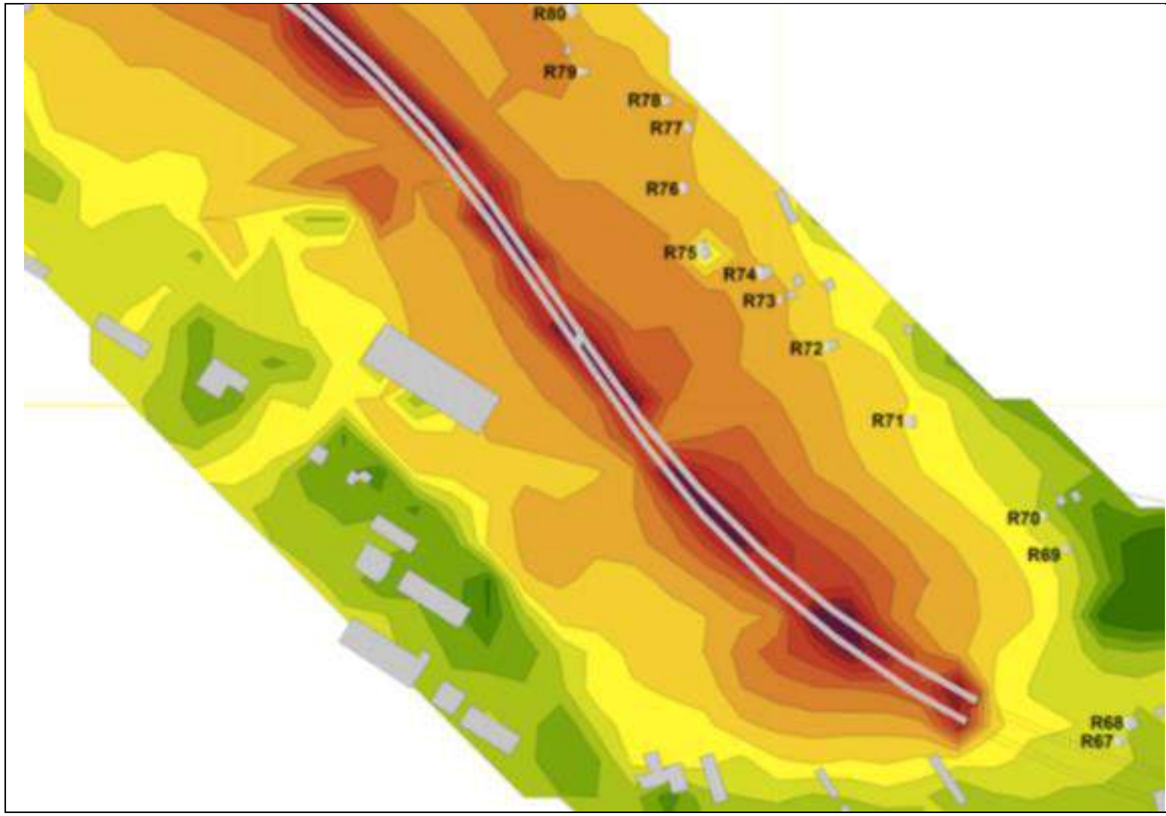


Figure F-45: Portion 7

Without Barrier / Nighttime

R67	52.0
R68	53.0
R69	49.8
R70	50.3
R71	56.7
R72	59.4
R73	61.4
R74	60.9
R75	63.7
R76	61.8
R77	61.5
R78	61.9
R79	62.8
R80	58.9

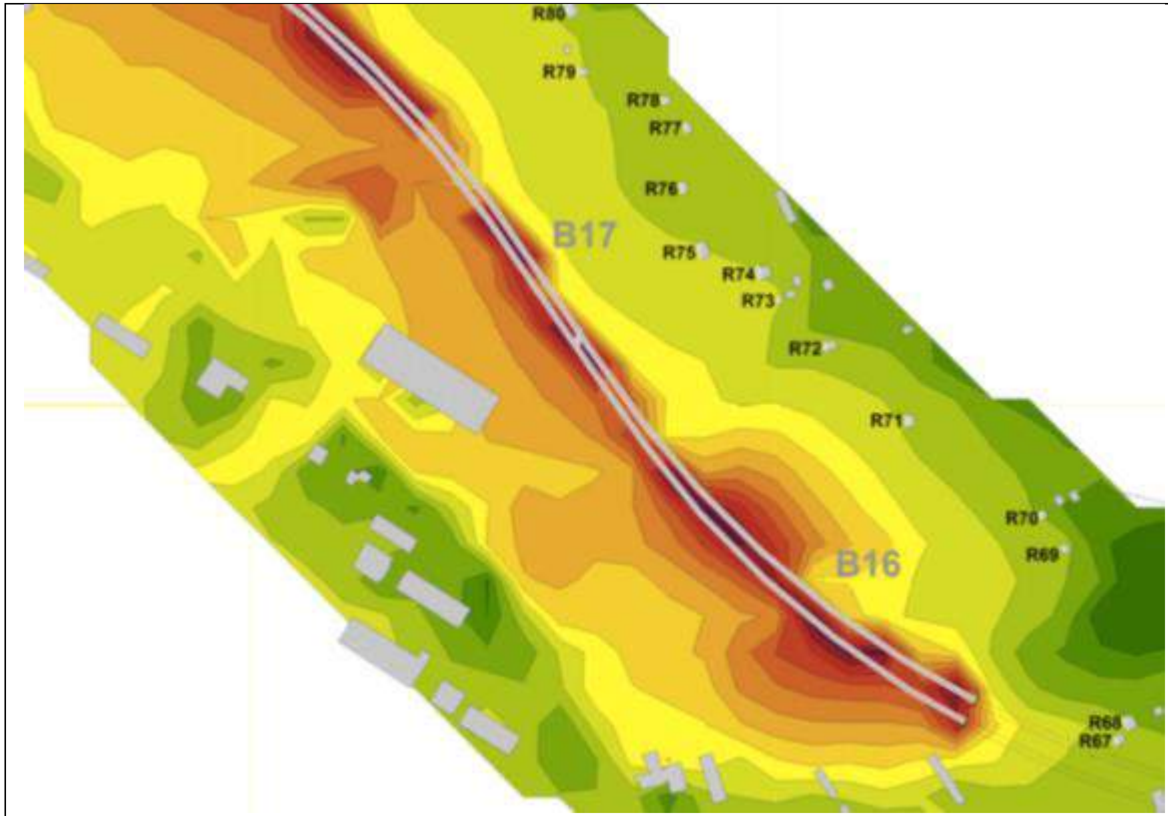


Figure F-46: Portion 7

With Barrier / Nighttime

R67	41.7
R68	41.1
R69	39.3
R70	40.0
R71	42.5
R72	41.5
R73	43.2
R74	42.2
R75	43.8
R76	42.6
R77	42.6
R78	42.5
R79	44.6
R80	42.6

Barrier B16 – L290m / H4m
Barrier B17 – L680m / H4m

Portion 7 Conclusion: Most receptors are affected by elevated noise without abatement measures in place. However, the noise barrier scenario provides extremely effective noise reduction reducing noise levels at all receptors below IFC guideline limits.

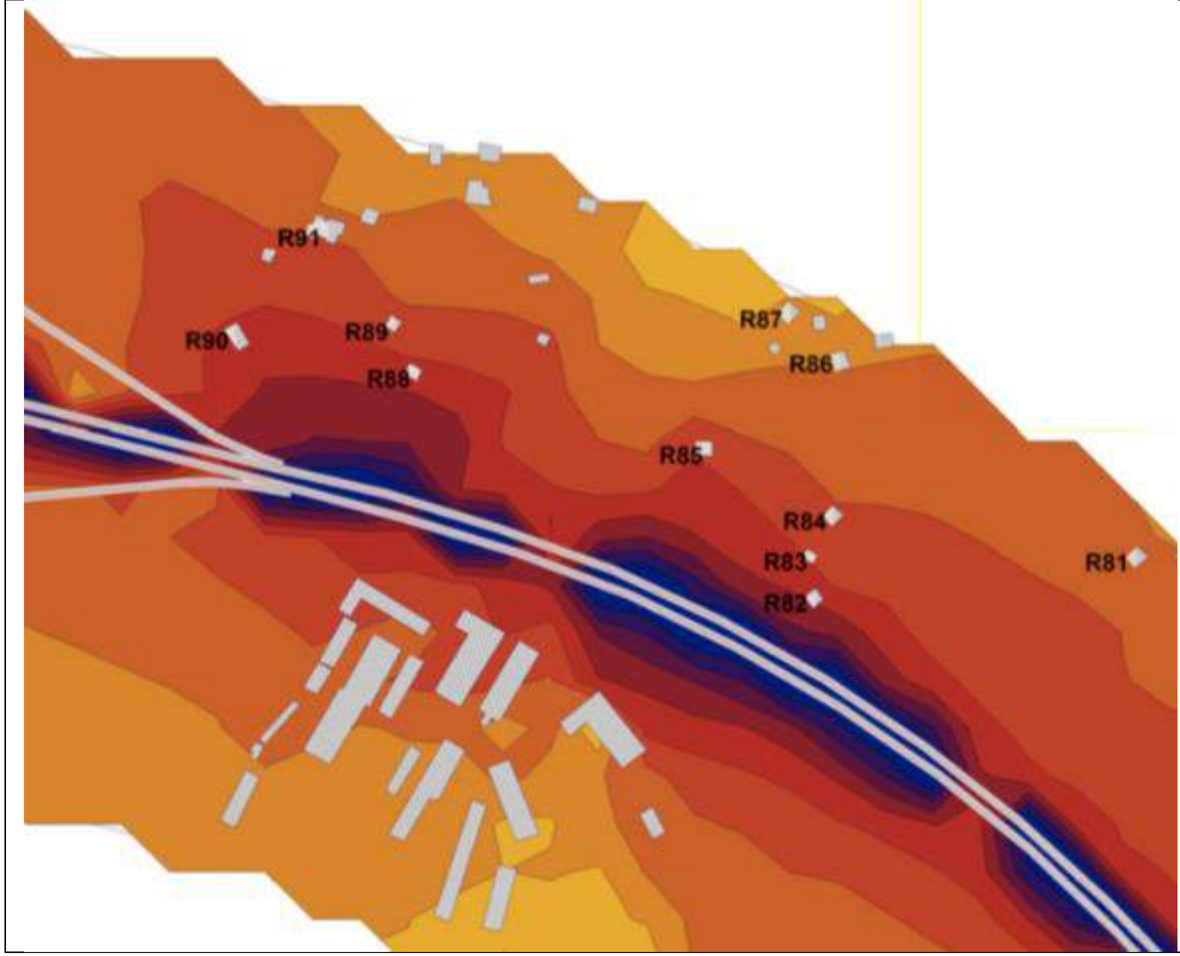


Figure F-47: Portion 8

Without Barrier / Day time

R81	61.2
R82	65.8
R83	63.5
R84	60.9
R85	61.4
R86	58.5
R88	65.8
R89	62.5
R90	64.9
R91	56.8

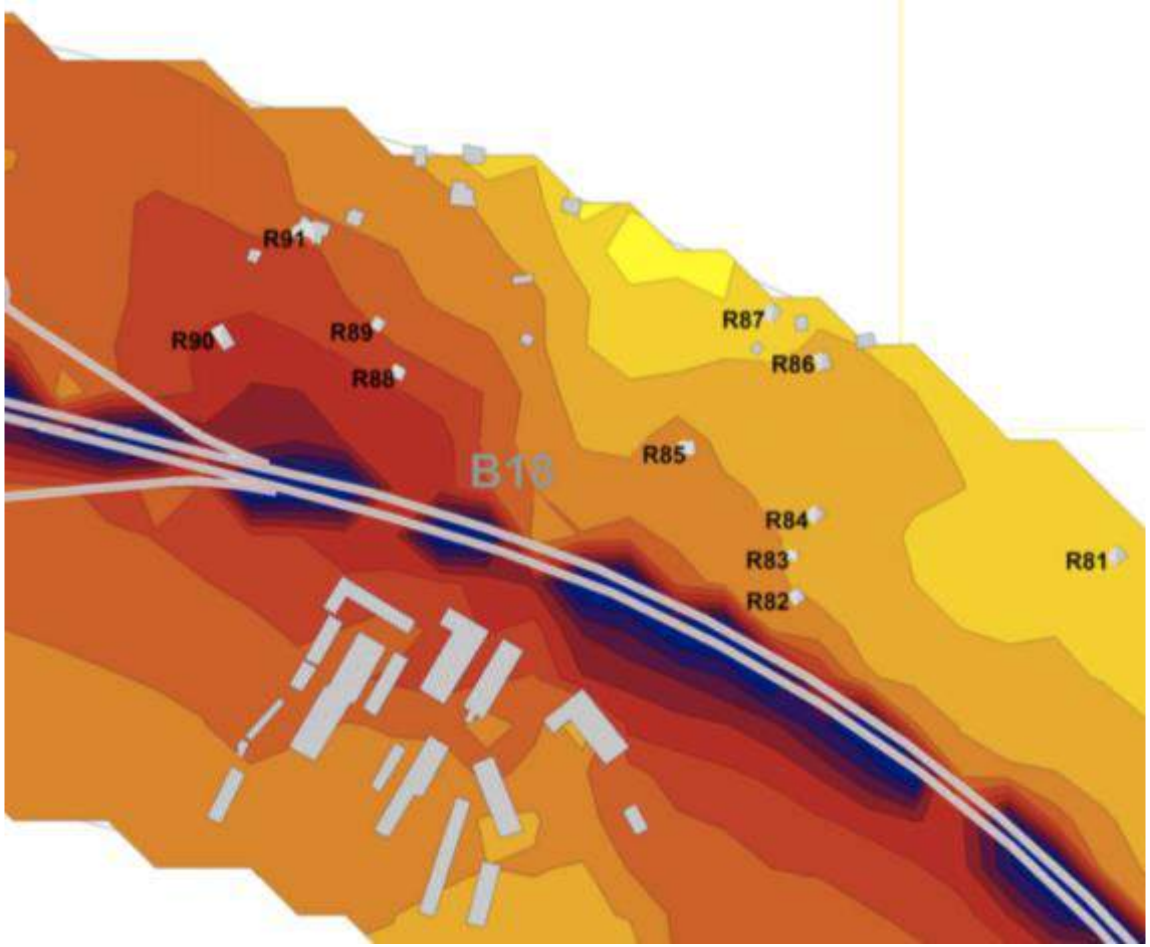


Figure F-48: Portion 8

With Barrier / Day time

R81	51.9
R82	54.8
R83	54.6
R84	53.6
R85	55.2
R86	53.5
R88	63.3
R89	61.5
R90	64.8
R91	56.2

Barrier B18 – L1000m / H4m

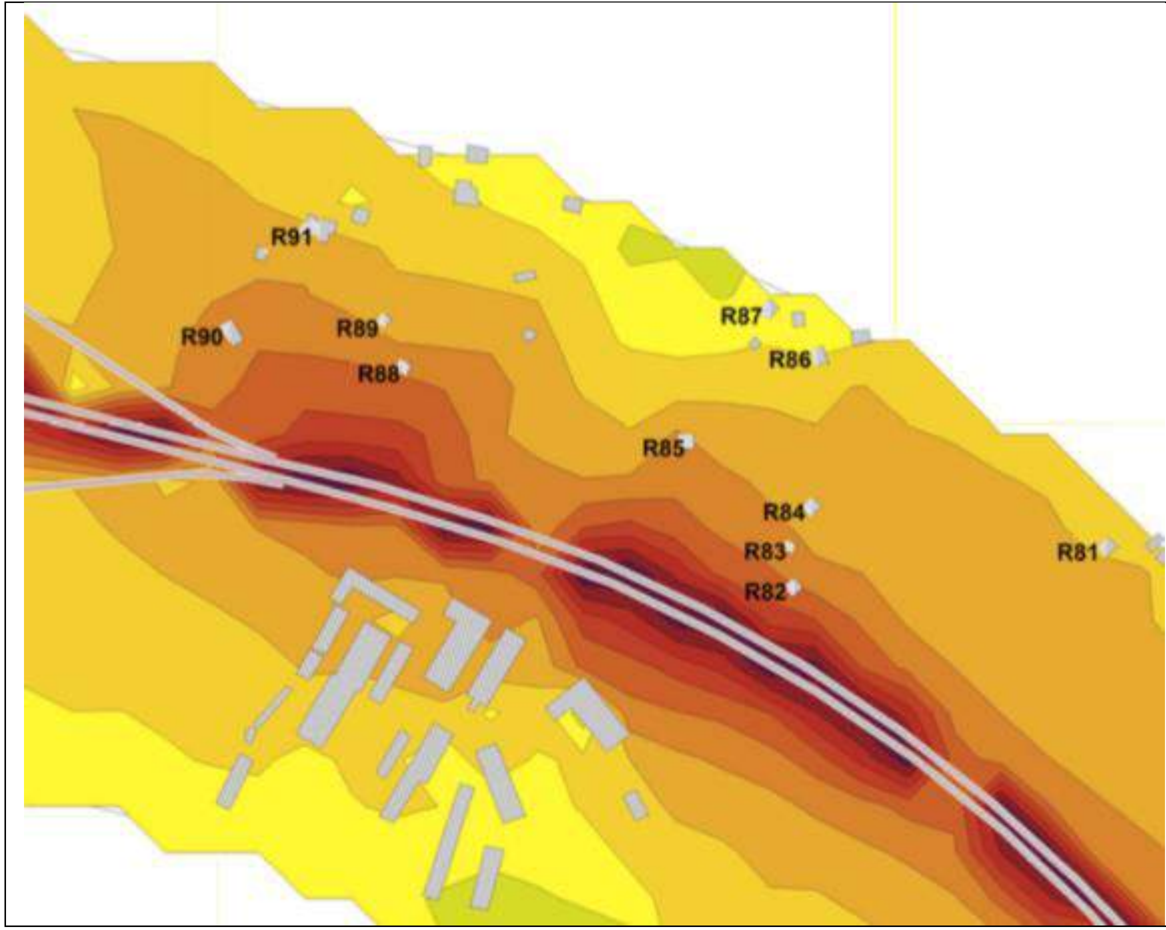


Figure F-49: Portion 8

Without Barrier / Nighttime

R81	53.1
R82	57.7
R83	55.5
R84	52.9
R85	53.3
R86	50.5
R88	57.8
R89	54.5
R90	56.8
R91	48.8

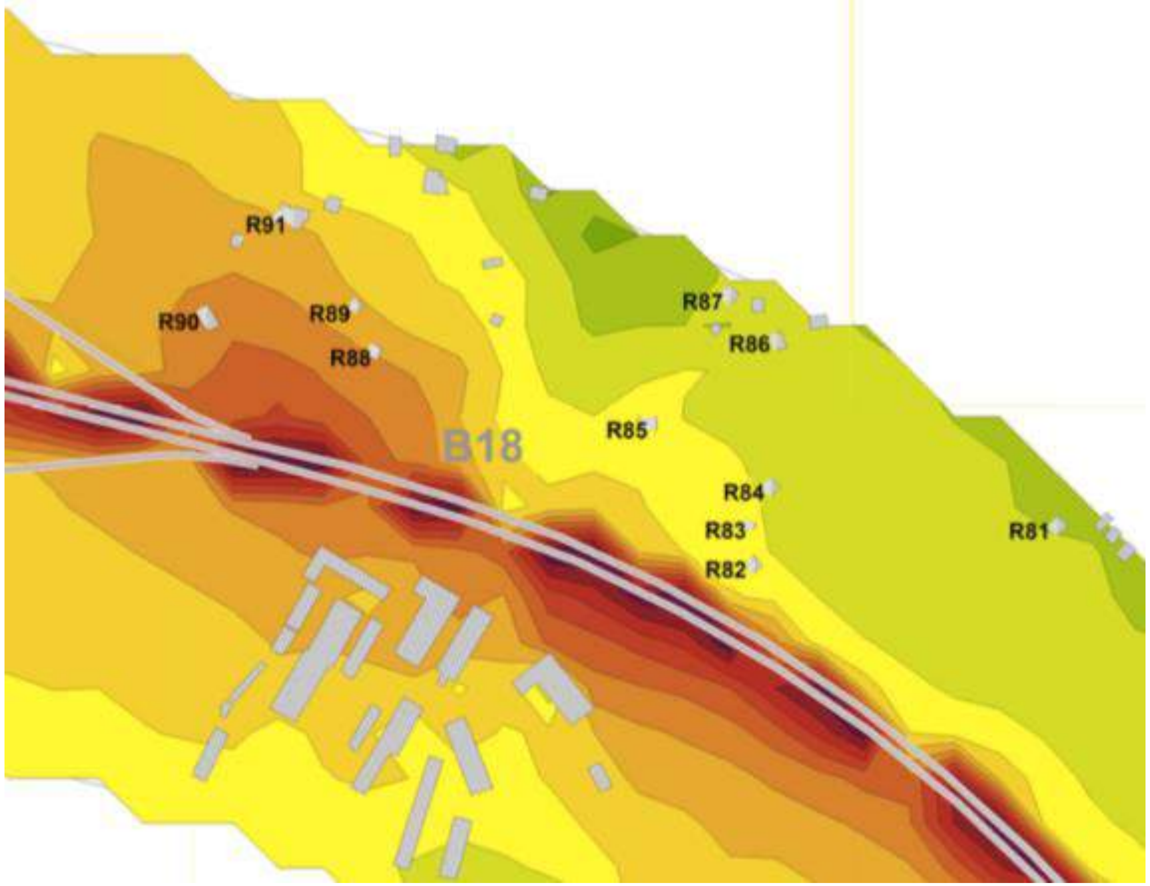


Figure F-50: Portion 8

With Barrier / Nighttime

R81	43.8
R82	46.8
R83	46.6
R84	45.5
R85	47.2
R86	45.5
R88	55.3
R89	53.4
R90	56.8
R91	48.1

Barrier B18 – L1000m / H4m

Portion 8 Conclusion: All receptors are impacted by elevated noise levels without noise abatement. Noise barriers have a positive effect in the first half of this portion, but little effect close to the interchange.

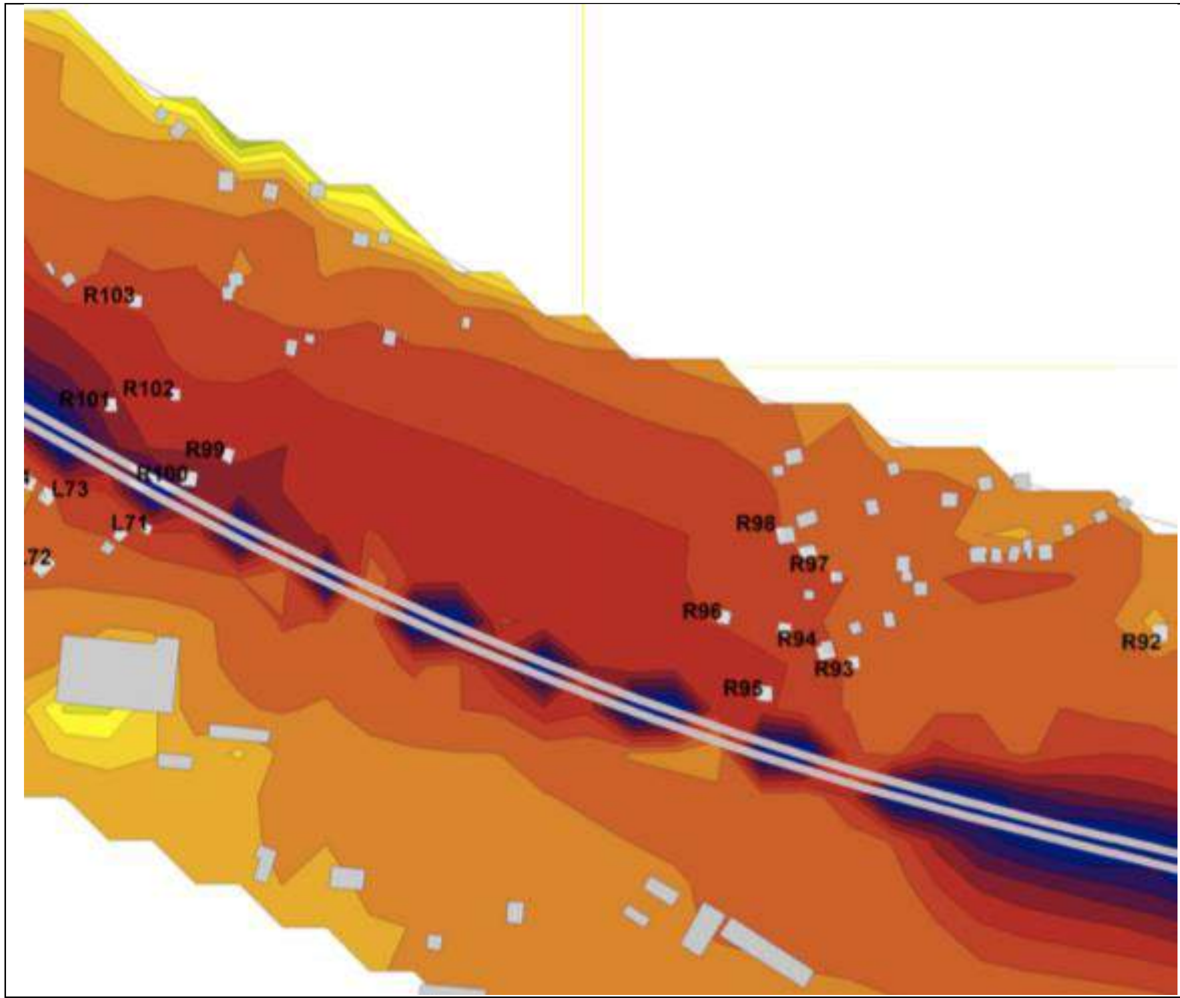


Figure F-51: Portion 9

Without Barrier / Day time

L71	62.3
L72	58.9
L73	62.1
R92	58.9
R93	62.9
R94	63.6
R95	66.0
R96	64.6
R97	62.9
R98	62.0
R99	67.8
R100	63.8
R101	67.8
R102	66.2
R103	63.9

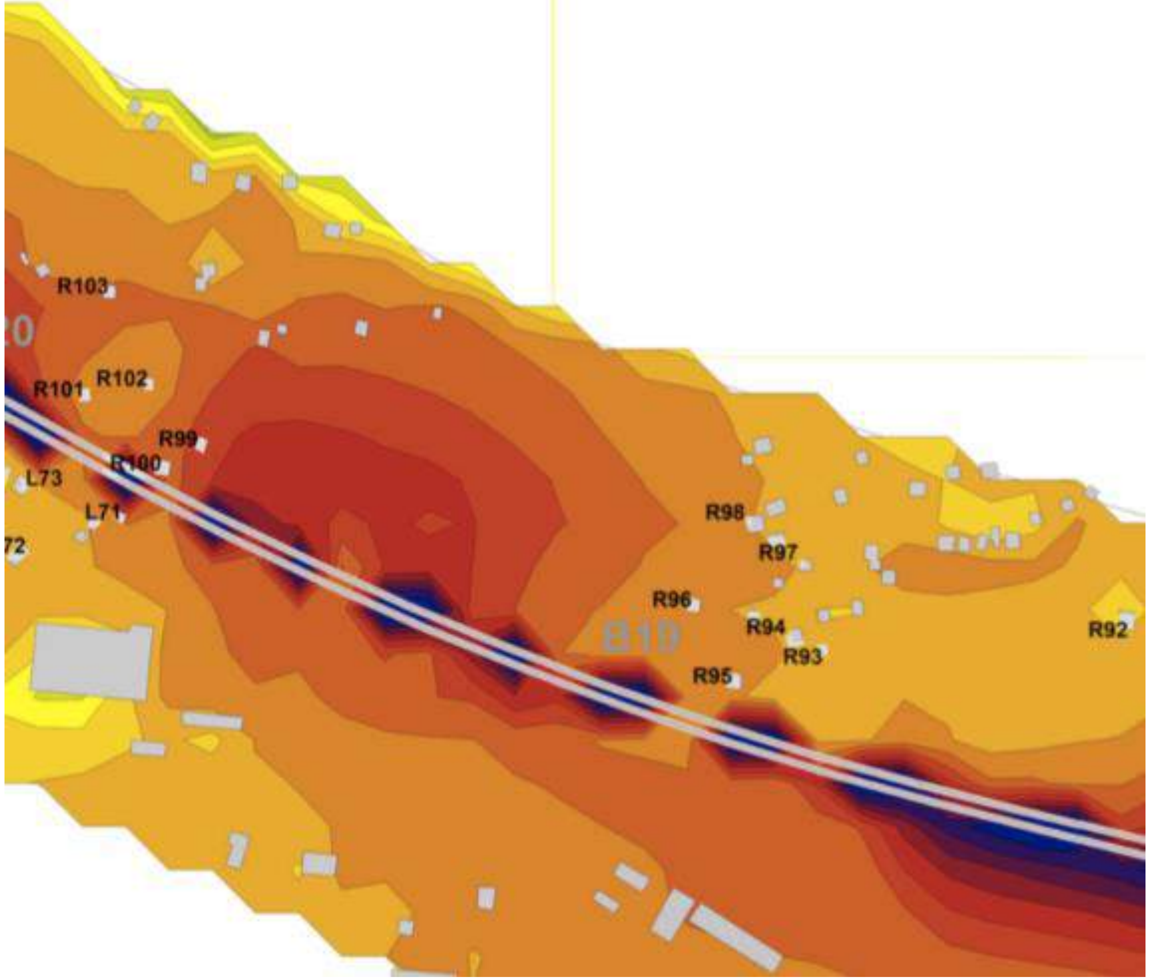


Figure F-52: Portion 9

With Barrier / Day time

L71	55.9
L72	53.4
L73	54.4
R92	54.3
R93	55.3
R94	55.2
R95	56.0
R96	56.3
R97	54.3
R98	54.6
R99	62.8
R100	57.5
R101	57.7
R102	57.9
R103	58.6

Barrier B19 – L380m / H4m

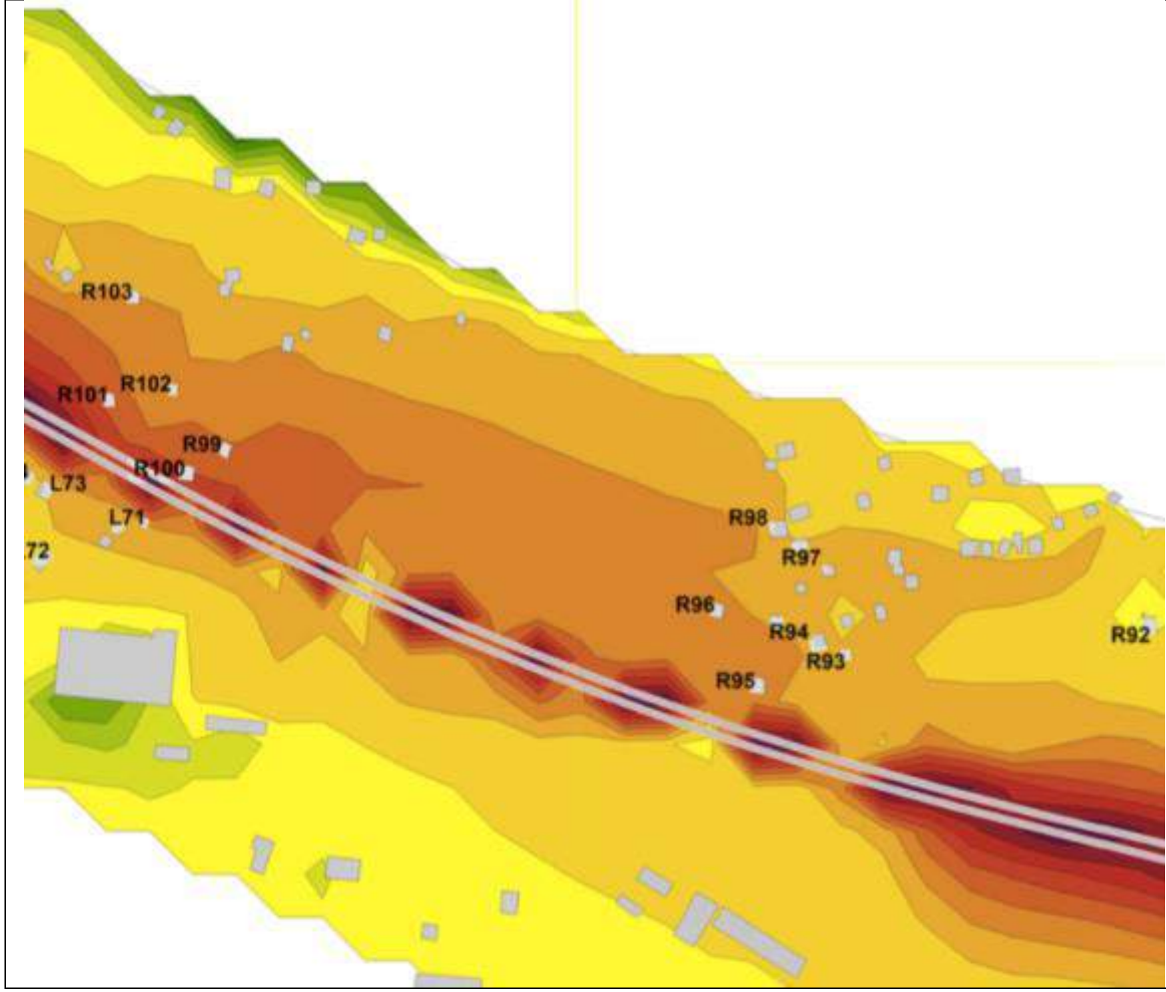
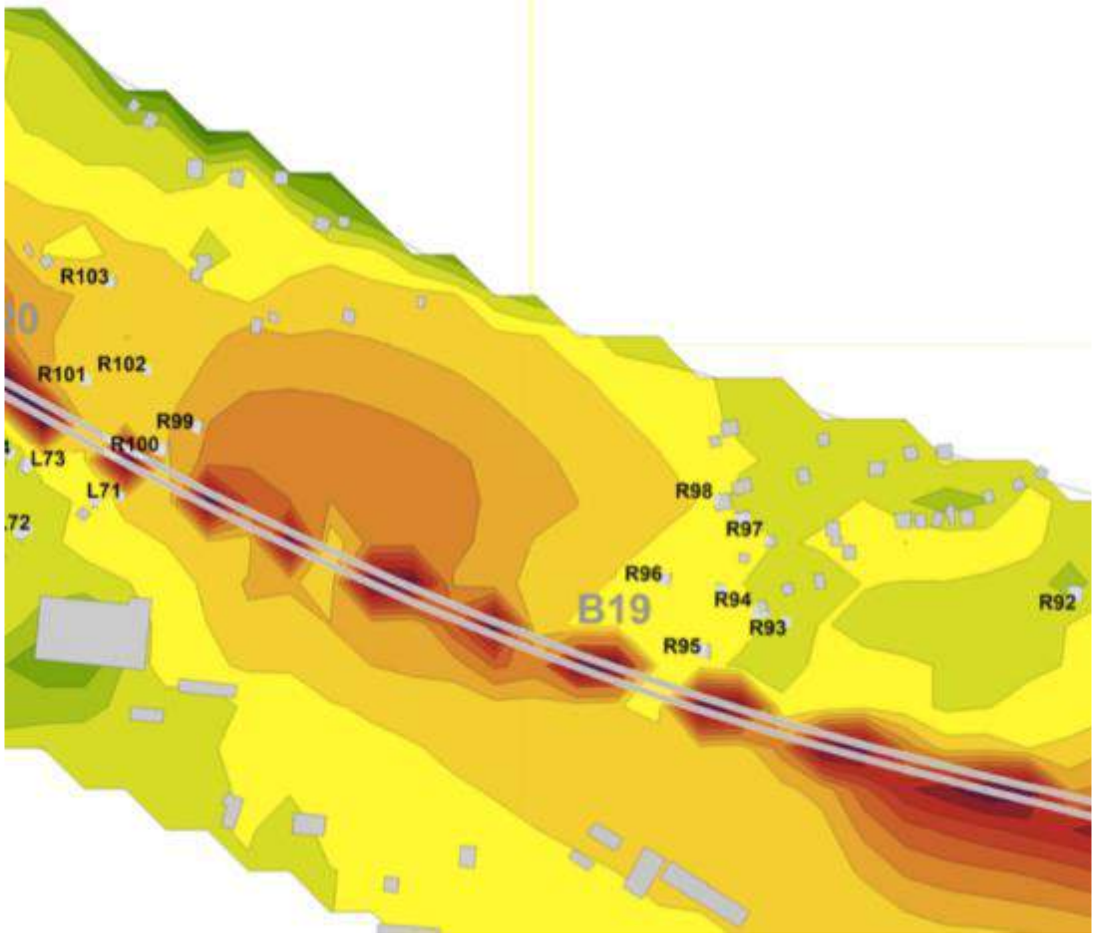


Figure F-53: Portion 9

Without Barrier / Nighttime

L71	54.3
L72	50.9
L73	54.0
R92	50.9
R93	54.8
R94	55.5
R95	58.0
R96	56.5
R97	54.8
R98	54.0
R99	59.8
R100	55.7
R101	59.8
R102	58.2
R103	55.9



Barrier B19 – L380m / H4m

Portion 9 Conclusion: All receptors are significantly affected without noise abatement. Noise barriers are effective at reducing noise levels quite considerably in this section, but not quite enough to meet IFC nighttime standards.

Figure F-54: Portion 9

With Barrier / Nighttime

L71	47.9
L72	45.4
L73	46.3
R92	46.2
R93	47.3
R94	47.2
R95	47.9
R96	48.3
R97	46.3
R98	46.6
R99	54.7
R100	49.4
R101	49.6
R102	49.8
R103	50.5

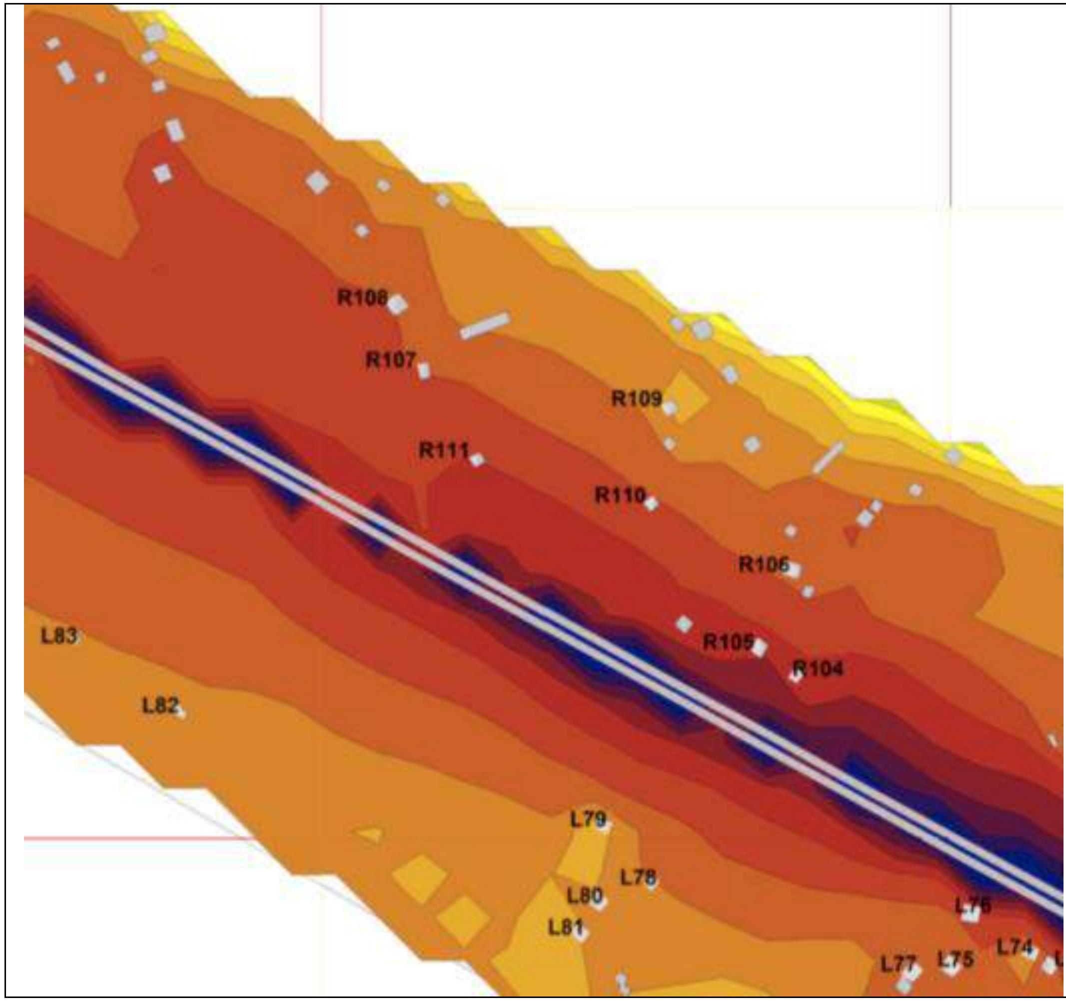


Figure F-55: Portion 10

Without Barrier / Day time

L74	62.2
L75	59.7
L76	62.6
L77	58.7
L78	56.9
L79	57.1
L80	54.6
L81	53.9
L82	58.0
L83	58.6
R104	67.7
R105	67.7
R106	60.9
R107	62.8
R108	61.1
R109	57.3
R110	62.4
R111	65.3

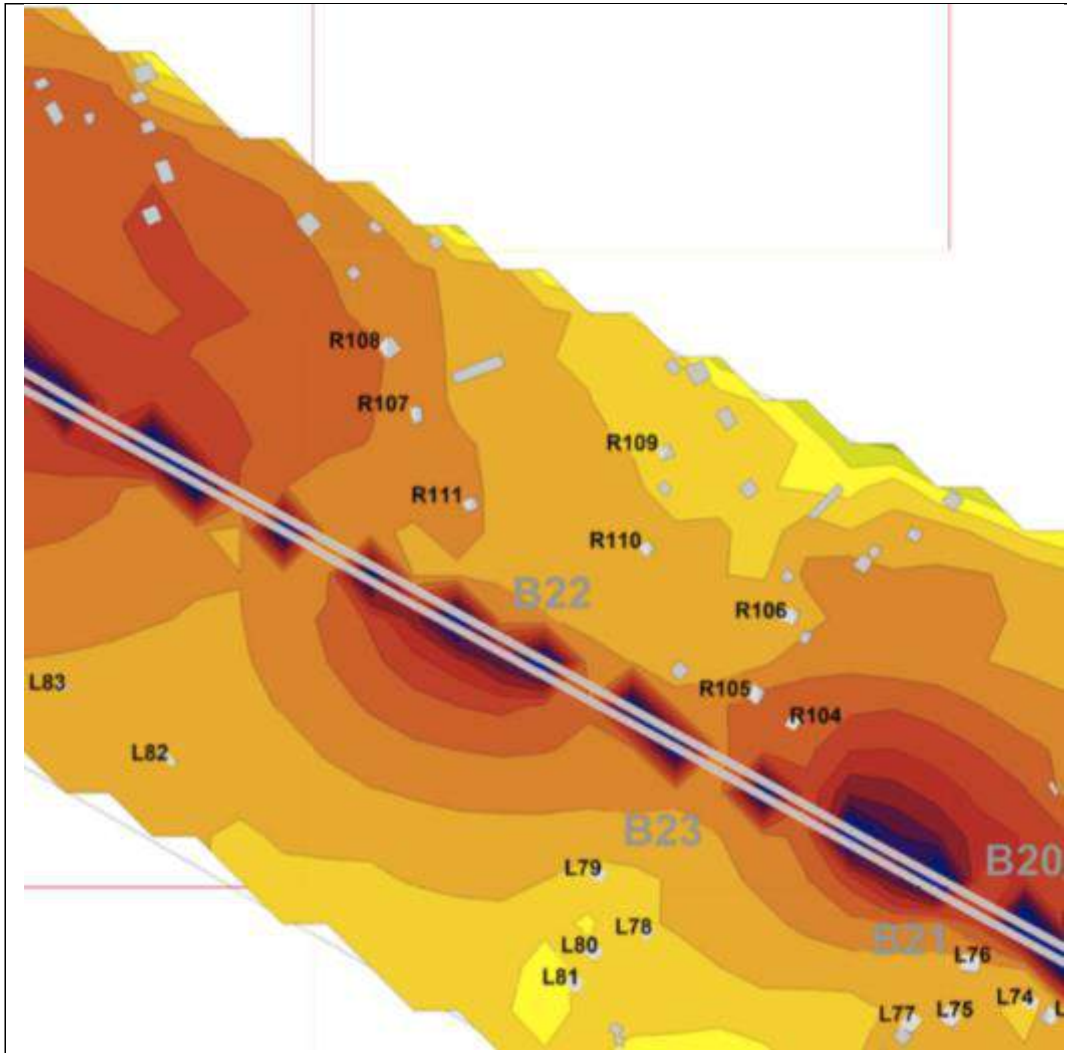


Figure F-56: Portion 10

With Barrier / Day time

L74	54.0
L75	53.0
L76	55.0
L77	52.6
L78	50.0
L79	50.6
L80	48.7
L81	49.6
L82	53.1
L83	54.6
R104	59.3
R105	56.9
R106	55.3
R107	57.9
R108	58.4
R109	52.9
R110	51.9
R111	56.3

Barrier B20 – L320m / H4m
Barrier B21 – L350m / H4m
Barrier B22 – L630m / H4m
Barrier B23 – L370m / H4m

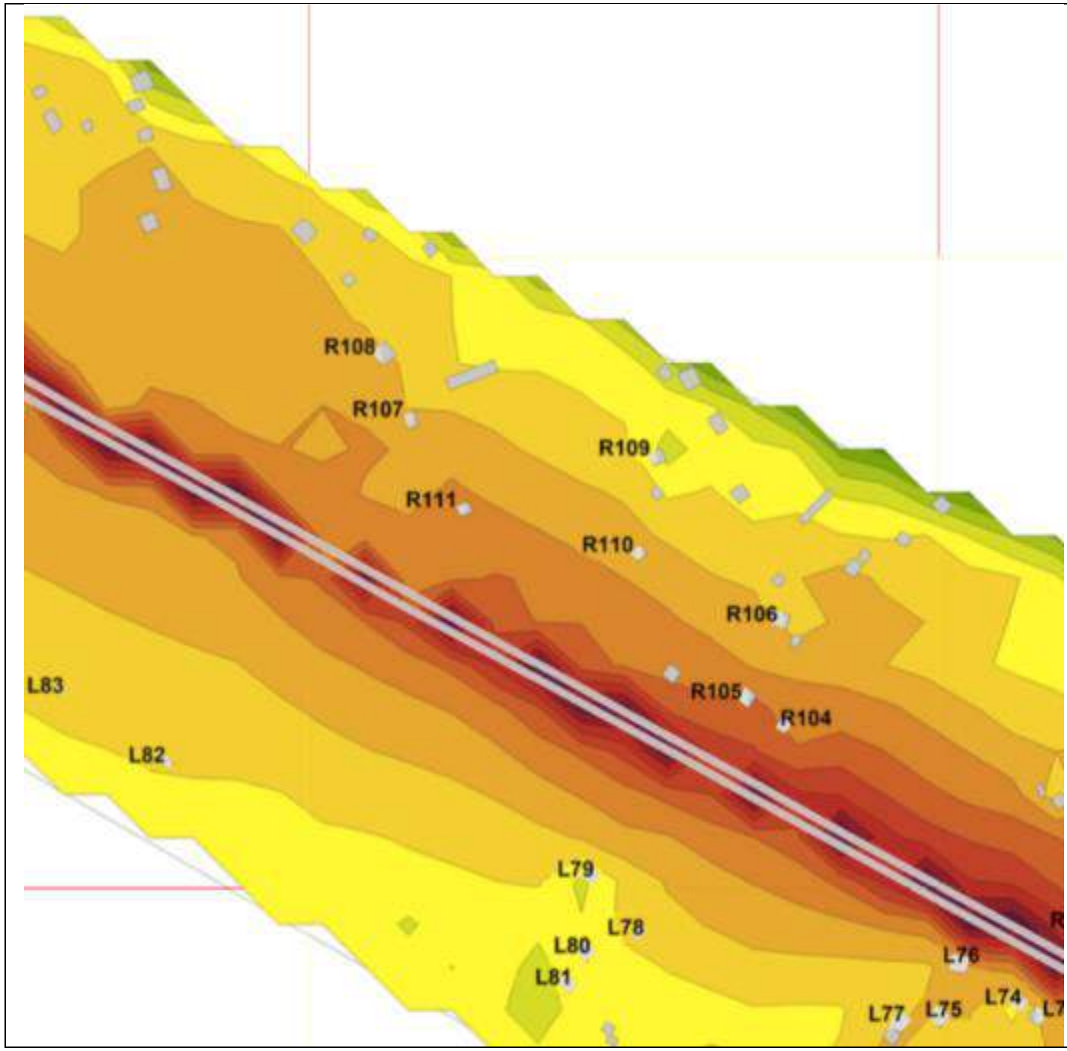
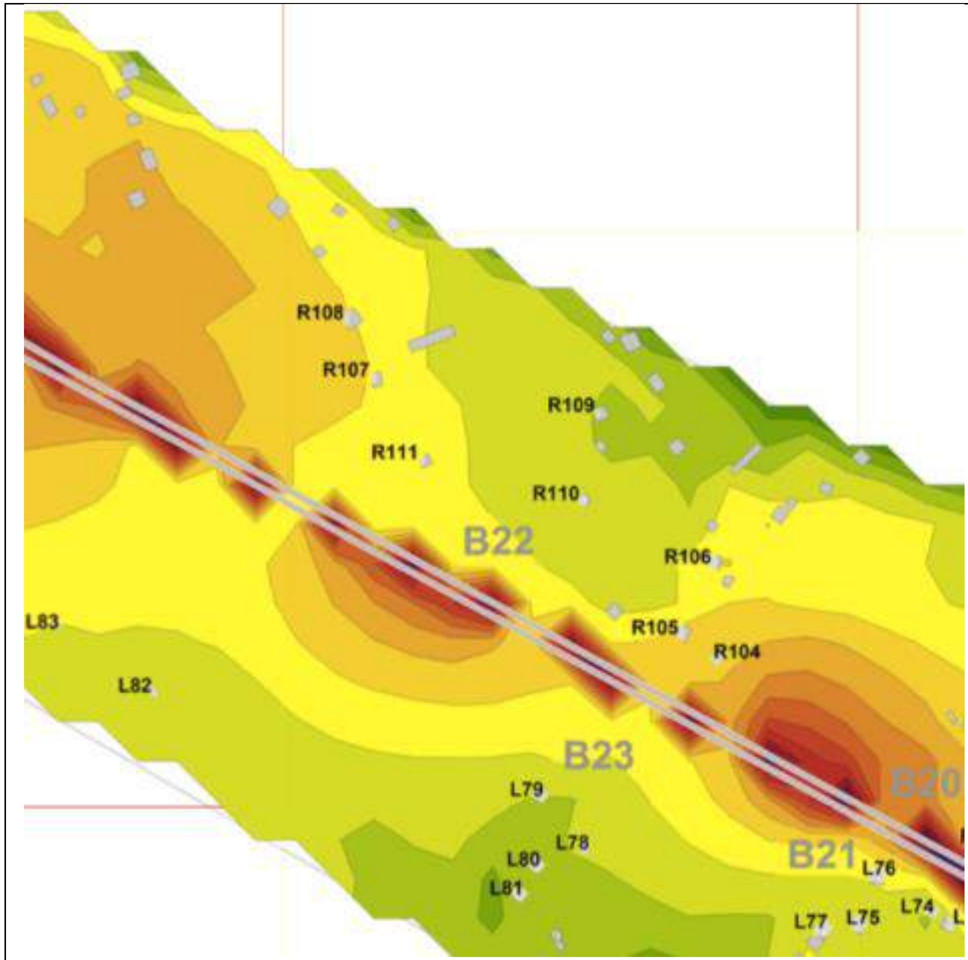


Figure F-57: Portion 10

Without Barrier / Nighttime

L74	54.1
L75	51.7
L76	54.5
L77	50.6
L78	48.8
L79	49.1
L80	46.5
L81	45.8
L82	49.9
L83	50.6
R104	59.6
R105	59.7
R106	52.9
R107	54.8
R108	53.1
R109	49.2
R110	54.4
R111	57.2



Portion 10 Conclusion: As with Portion 9, all receptors are significantly affected without noise abatement. Noise barriers are effective at reducing noise levels quite considerably in this section, but not quite enough to meet IFC nighttime standards.

Figure F-58: Portion 10

With Barrier / Nighttime

L74	45.9
L75	44.9
L76	47.0
L77	44.6
L78	42.0
L79	42.6
L80	40.6
L81	41.6
L82	45.1
L83	46.5
R104	51.2
R105	48.8
R106	47.2
R107	49.8
R108	50.3
R109	44.9
R110	43.8
R111	48.2

Barrier B20 – L320m / H4m
Barrier B21 – L350m / H4m
Barrier B22 – L630m / H4m
Barrier B23 – L370m / H4m

- Portion 4: Barrier B8 does not provide significant noise reduction for the receptors on the right side of the road, however, moving the noise barrier up the slope rather than adjacent to the side of the road may lead to significant noise reduction and as such this option should be considered. The five identified receptors on this side of the road exposed to elevated noise levels should be subject to alternative noise abatement, including expropriation due to their proximity to the road. Barrier B7 only provides suitable mitigation to meet IFC limits for its first half. All other receptors beyond this point are still subject to elevated noise levels, although the elevation is not significant (approximately 50 dBA for nighttime and around 55 dBA for daytime).
- Portion 5: Due to expropriation no barriers would be needed on the right hand side of the road. Barrier B9 does not provide any significant reduction in noise levels. Receptors L29 to L45 will all be subject to elevated noise levels during both daytime and nighttime. Alternative noise abatement measures need to be explored in this area.
- Portion 6: Noise barriers in this portion have no significant effect. Half of the receptors are below the IFC limits with or without barriers and half are above with or without barriers. Alternative noise abatement measures need to be explored in the areas above the IFC limits.
- Portion 7: Noise barriers B16 and B17 should be considered along this portion as it provides very good noise abatement reducing noise levels by 10 dBA.
- Portion 8: The noise barrier has a very positive impact on receptors R81 to R87. However, it is less effective closer to the interchange and the four receptors in this area should consider alternative noise abatement.
- Portion 9: Although noise barriers in this portion cannot, in all instances, meet IFC guideline limits, they get very close and as such noise barriers should be considered here as suitable abatement.
- Portion 10. Although noise barriers in this portion cannot, in all instances, meet IFC guideline limits, they get very close and as such noise barriers should be considered here as suitable abatement.

666. Given the above, approximately 5,950 meters of noise barrier is recommended for consideration as part of the Project. **Table F-22** below indicates the recommended barriers and their lengths for clarification.

Table F-22: Recommended Noise Barrier Locations and Lengths

Portion	Barrier No.	Suggested Length (m)	On Viaduct	Cut / Embankment
1	B1 - Not recommended	N/A		
2	B2 – Not recommended	N/A		
	B3 - Not recommended	N/A		
	B4 - Not recommended	N/A		
3	B5 - Recommended	620	620	
	B6-1 - Not recommended	600	203	397
	B6-2 - Not recommended	300	231	67
4	B7 - Recommended	700		700
	B8 – Recommended (in alternative location)	330		
5	B9 - Not recommended	N/A		
	B10 - Not recommended	N/A		
	B11 - Not recommended	N/A		
	B12 - Not recommended	N/A		
6	B13 - Not recommended	N/A		
	B14 - Not recommended	N/A		

Portion	Barrier No.	Suggested Length (m)	On Viaduct	Cut / Embankment
	B15 - Not recommended	N/A		
7	B-16 - Recommended	290		
	B-17 - Recommended	680		680
8	B-18 - Recommended	1000		928
9	B-19 - Recommended	380		380
10	B-20 - Recommended	320		320
	B-21 - Recommended	350		350
	B-22 - Recommended	630		630
	B-23 - Recommended	370		370
Total		**5,950**	**1,054**	**4,822**

667. As noted above, in some locations, even with the installation of a 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 (e.g. in Portion 1);
- 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.

668. 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. This point can be put into context when considering that many countries in the EU only use 45 dBA as nighttime standard *indoors*, not at the *border* of the property, which is used as the IFC standard.

669. Given that the 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 **Table F-22**. **Figure F-57** and **Figure F-58** illustrate the two types of foundation that would be required for the noise barriers, the first type being integrated with existing safety barriers and the second type being installed behind safety barriers. 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 or less in line with traffic counts as well as existing traffic counts at fixed counting points by the Engineer and/or RD for the remaining eighteen months of the defects liability period to catch seasonal factor as well.
- 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.

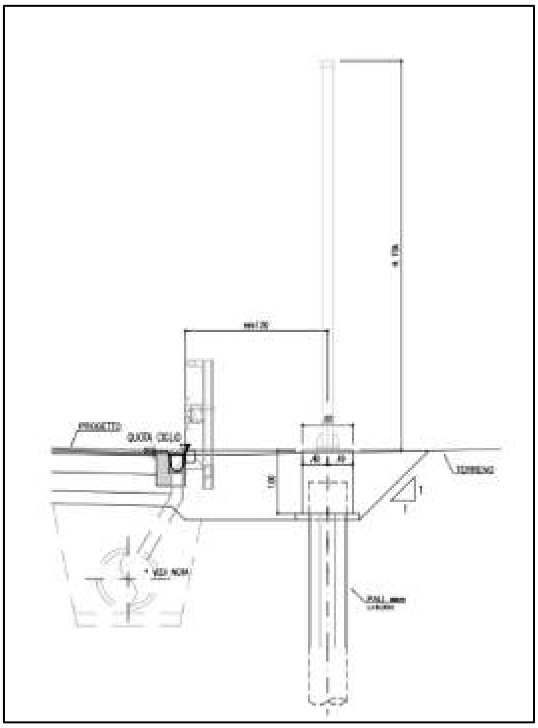


Figure F-59: Noise Barrier behind safety barrier

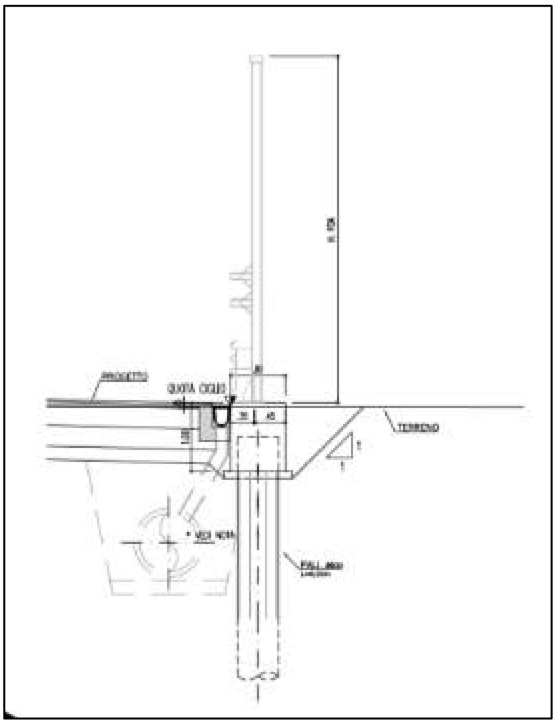


Figure F-60: Noise barrier integrated in safety barrier

F.8.8 Compliance Impacts

670. In addition to the impacts associated with the construction and operation phases of the project several compliance impacts have also been identified as follows:

1. Lack of Environmental Clauses in Contracts – The EIA is an environmental statement prepared by the RD. While it is prepared by the EIA consultant the EIA defines the commitment by the GoG through the proponent and its contractors and consultants, to implement the mitigation and monitoring actions listed in the EIA. For the measures proposed in the EIA's EMP to be taken seriously, they must become legally binding through inclusion as environmental clauses in the loan agreement between the GoG and JICA as well as the specifications in the contract-bid documents. This will be achieved by integrating the EMP into the contract specifications as a clause and using the EMP to prepare the SSEMP defining specific steps to be taken by the contractors and the government during the project construction phase. References to the EMP will be made in the loan agreement between the GoG and JICA. It will be the Engineers responsibility to review the environmental mitigation and monitoring activities undertaken by the Contractor, with payments made only after verification that each work component has been completed as prescribed.

2. Lack of Construction Compliance Inspection Services and Environmental Training – While the EMP and the environmental covenants can be very clear and specific, if there is no one knowledgeable to undertake compliance monitoring, inspection and regular reporting, little of the EMP will be implemented or completed. The Engineer, through his National Environmental Specialist (NES) and International Environmental Specialist (IES), will ensure that compliance inspections are undertaken on a regular basis. In addition, the Engineers IES will also provide training to the Contractor and his Environmental Officer in the correct implementation of the SSEMPs prior to the commencement of works.

G. Environmental Management Plans and Institutional Requirements

G.1 Introduction

671. The EMP herewith provides the overall Project environmental management framework. It provides summary information of the types of impacts, which are described in detail in **Section F**. It also provides detailed information about the required mitigation and monitoring measures, their implementation arrangements reporting requirements. In addition, the approximate costs of the EMP are outlined.

G.2 Environmental Management Plan

672. **Table G-1**, **Table G-2** and **Table G-3** provides the environmental mitigation and observational monitoring for the Project during the pre-construction, construction and operational phases of the Project respectively.

G.3 Instrumental Monitoring Plan

673. Regular monitoring of air quality, water quality and noise levels against Georgian and IFC standards shall be carried out throughout the construction and commissioning periods. The party responsible for monitoring will be the Engineer who will report the results monthly to the RD. The reports shall clearly indicate the monitoring dates, times, locations, weather conditions, types of equipment used and calibration information. **Table G-4** provides the monitoring actions required during the construction phase of the Project. **Table G-5** provides the monitoring actions for the operational phase of the Project.

Table G-1: Environmental Management Plan - Detailed Design / Pre-construction Phase

Subject	Potential Impact / Issue	Mitigation Measure	Responsibilities	Monitoring	Monitoring Responsibility & Schedule
Air Quality	Construction impacts	Preparation of an Air Quality Plan (AQP) which shall include the locations of haul routes and the items specified under **Section F.5.1** of this EIA.	• Contractor to prepare AQP • Engineer to review and approve AQP.	N/A	N/A
	Air quality impacts from stationary sources	• Locations for borrow pits and concrete batching plants require approval from the Engineer and MoENRP and all necessary permits. • All of the above facilities will also have the appropriate GoG permits and licenses. • No borrow pit or batching plant shall be located within 500 meters of any urban area or sensitive receptor.	• Contractor to select sites. • Engineer and MoENRP to approve sites.	N/A	N/A
Land Use	Loss of land and Property	Before the commencement of the construction works of the Project at any road, the RD must prepare the Land Acquisition and Resettlement Plan (the LARP), obtain the approval of JICA and then implement the plan and acquire the land.	• RD to prepare the RAP. • JICA to approve the RAP. • RD to implement the Plan.	N/A	N/A
	Tree cutting	The LARP shall also contain the compensation methods and payments for loss of trees on private land.	• RD to prepare the RAP. • JICA to approve the RAP. • RD to implement the Plan.	N/A	N/A
Climate Change	Damage to roads and drainage systems due to increased flooding and more intense rainfall.	As part of the detailed design, the following measures will be considered: • Increase ditch and culvert capacity; • Maintain positive cross slope to facilitate flow of water from surface; • Increase pavement resistance to rutting; • Reduce splashing/spray through porous surface mixtures; • More frequent use of elevated pavement section;	• Engineer to review design documents prior to the start of construction and make any additions as necessary.	• N/A	• N/A

		• Improve visibility and pavement marking demarcation; and • Ensure that all embankments are seeded to help increase stability.			
Soils	Loss of Agricultural Soils	Before the commencement of the construction works of the Project at any road, the RD must prepare the Land Acquisition and Resettlement Plan (the LARP), obtain the approval of JICA and then implement the plan and acquire the land.	• RD to prepare the RAP. • JICA to approve the RAP. • RD to implement the Plan.	N/A	N/A
	Soil contamination	• Analysis of four additional soil samples taken close to the GAA. • Addendum to this EIA including the results of the additional soil samples.	• DD Consultant to hire a licensed laboratory for the analysis. • DD Consultant to provide the results in an addendum to this EIA	JICA	Before the start of construction.
Borrow Pits and Quarry's	New Quarry Sites	Any new quarries must obtain the required permits prior to commencement of works at these sites, this shall include approval from MoENRP and the Engineer.	• Contractor to select quarry sites and apply for approval from MoENRP and any other regulatory agencies as necessary. • Engineer to review quarry locations, licenses and approvals from MoENRP.	• N/A	• N/A
	Existing Borrow Pits	• For existing borrow pits a due diligence review will be carried out by the Engineer to determine their suitability. • The due diligence review shall be undertaken before the Contractor signs any contract with the existing borrow pit owner.	• Engineer to undertake due diligence review. • Results of the due diligence review shall be presented to RD and Contractor clearly stating the reasons for any rejection of the site.	N/A	N/A

	New Borrow Pits	• Obtain all necessary permits from the regulatory authorities. • Prepare a Borrow Pit Action Plan (BAP) according to the requirements of **Section F.7.5 of the** EIA.	• Contractor to select borrow sites and apply for approval from MoENRP and any other regulatory agencies as necessary. • Engineer to review borrow locations, licenses and approvals from MoENRP.	N/A	N/A
Hydrology	Bridge Construction	• All new bridges shall be designed for the life expectancy of 100 years. • A design discharge of 100 years return period is considered for bridges. • Bridge designs should ensure that drainage from bridge decks over 50 meters does not discharge directly to the watercourses beneath the bridges. • The bridge run-off waters should lead to an interceptor tank, or filter pond adjacent to the bridge in order to trap oil and grease run-off and prevent pollution of surface water courses. • The bridge design and layout must be aesthetically pleasing and in harmony with the existing environment.	• DD Consultants • Engineer to review design documents prior to the start of construction.	N/A	N/A
		• 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.	• Contractor to consult with MoENRP regarding fish spawning periods. • Contractor to inform Engineer of any periods of construction restriction based on the consultations with MoENRP.	N/A	N/A
	Culverts	A design discharge of 50 years return period is considered for culverts.	• DD Consultants • Engineer to review design documents prior to the start of construction.	N/A	N/A

	Tunneling	Contractor shall 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.	• Contractor to prepare plan. • Engineer to review and approve plan.	N/A	N/A
	Siting of facilities	No construction camp, permanent or temporary, shall be located within 500 meters of any river, or irrigation channel (not including drainage channels) including the Dzirula, Kvirila and Borimela rivers.	• Contractor to select sites. • Engineer and MoENRP to approve sites.	N/A	N/A
Flora & Fauna	Land clearance	• The Contractor shall prepare a Clearance, Re-vegetation and Restoration Management Plan for prior approval by the Engineer. The Clearance Plan shall be followed strictly by the contractor. Areas to be cleared should be minimized as much as possible. • Prior to the commencement of works the Contractor shall stake the boundary of the entire site, including intersections and areas under bridges. The Contractor will then undertake a survey of all trees within 5 meters of the boundary of the staked site and identify if any Georgian red-list species are located within this zone. This survey will form part of the Contractors Clearance, Re-vegetation and Restoration Management Plan. • All temporary construction facilities should be located on already heavily disturbed ground where secondary forest growth has not yet become well-established.	• Contractor to prepare and implement Plan. • Engineer to review and approve plan. • Contractor to survey trees for vulnerable species.	N/A	N/A
	State Forest Fund	Prior to cutting trees in the identified State Forest Fund areas, it is required to obtain permit (Decree of the Government of Georgia on the "exclusion of certain areas from the State Forest Fund"), also known as 'delisting' the trees from the State Forest Fund and for compensation payments to be made.	• RD to obtain permit and submit to Engineer for review. • Engineer to review permit. • RD to make compensation payments.	N/A	N/A

	Impacts to Protected Areas	• No haul route will pass through a protected area. • No borrow pits or quarries will be allowed in a protected area.	• Contractor to implement mitigation. • Engineer to approve Borrow Pit Plans and Traffic Management Plans.	N/A	N/A
	Impacts to birds from street lighting	• Ensure that lower wattage lamps are used in street lights which direct light downwards to reduce glare.	• DD Consultants to incorporate the measures.	N/A	N/A
Construction Camps	Selection of Construction Camp Site	• Preparation of a Construction Camp Site Plan. • Preparation of a Spills Response Plan. • Construction camps shall not be located within one kilometer of an urban area and at least 50 meters from any surface water course and not within 2 kilometers of a protected area. • Coordinate all construction camp activities with neighboring land uses.	• Engineer to review & approve Plans. • Engineer and RD to approve camp locations.	N/A	N/A
Transportation and Utilities	Damage to roads	Prior to the commencement of works a road condition survey will be undertaken to record the condition of access roads to borrow pits, asphalt plants, camps, etc.	• Engineer to complete road condition survey. • Contractor to review and agree to the findings of the road condition survey.	N/A	N/A
	Traffic management	Preparation of a traffic management plan as part of the SSEMP.	• Contractor to prepare plan. • Engineer to review and approve plan.	N/A	N/A
Occupational Health and Safety	Worker Health and Safety	• Prepare an Occupational Health and Safety Plan (OHS Plan), including the items specified by **Section F.8.3** of this EIA. • Ensure that sub-contractors are provided with copies of the SSEMP and that they adhere to the content of the SSEMP.	• Contractor to prepare OHS Plan. • Contractor to provide copies of the SSEMP to sub-contractors prior to their access to the site. • Engineer to review and approve OHS Plan.	N/A	N/A

	Traffic Safety	Submit a Traffic Management Plan (TMP) to local traffic authorities prior to mobilization.	• Contractor to prepare TMP. • Engineer to approve TMP.	N/A	N/A
Emergency Response	Fires, explosions, earthquake, etc.	Preparation of an Emergency Response Plan (ERP).	• Contractor to prepare ERP • Engineer to review and approve ERP.	N/A	N/A
Waste Management	Management of waste materials	• Preparation of a waste management plan, including measures to re-use and recycle wastes and measures to dispose of hazardous waste. • Preparation of a construction camp management plan to manage liquid wastes.	• Contractor to prepare Plans • Engineer to review and approve Plans.	N/A	N/A
	Tunnel and Embankment Spoil	• Consultations between Kutaisi Bypass Contractor and RD to determine if the static balance from F4 can be re-used as embankment material for Kutaisi Bypass. • Preparation of a Spoil Re-use and Disposal Plan according to **Section F.8.3**.	• Contractor to consult with RD and Kutaisi Bypass Contractor. • Contractor to prepare plan. • RD and Engineer to review and approve the plan.		
PCR	Chance Finds	The Contractor shall prepare a chance find procedure in line with the requirements of the GoG. **Appendix E** provides a sample procedure.	• Contractor to prepare Plans • Engineer to review and approve Plans.	N/A	N/A
Noise	Noise barriers	Include areas for the installation of the identified noise barriers in **Table F-22** in the detailed design.	• Detailed Design Consultant.	N/A	N/A
Vibration	Construction vibration	The Contractor will develop a detailed Tunnel Blasting Plan (TBP) as part of the overall construction schedule.	• Contractor to prepare Plans • Engineer to review and approve Plans.	N/A	N/A
SSEMP Requirement	Preparation of SSEMP	Prepare SSEMP.	• Contractor to prepare SSEMP. • Engineer to review and approve SSEMP.	N/A	N/A
	Incorporation of Items into Bid Documents	A specific environmental and social section shall be included within the main Bid Documents indicating that the Contractor shall be responsible for conforming with the requirements of this EMP.	RD to ensure EMP is included within Bid Documents.	N/A	N/A

Table G-2: Environmental Management Plan - Construction Phase

Subject	Potential Impact / Issue	Mitigation Measure	Responsibilities	Monitoring	Monitoring Responsibility & Schedule
Air Quality	Open burning of waste materials	No burning of debris or other materials will occur at any camp or construction site.	Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.
	Rock-crushing plant	• Rock crushing plant equipment shall be fitted with water sprinklers that will run continuously while the plant is operational. • If the sprinklers stop working, the plant shall also cease operation until the sprinklers are functioning. • Water run-off from the sprinkler system shall not discharge directly to surface water courses without first passing through a silt trap or any other suitable device to prevent siltation of surface waters.	• Contractor to implement mitigation. • Engineer to routinely monitor Contractors activities.	Engineers NES	Daily site inspections, throughout construction period.
	Exhaust emissions from the operation of construction machinery	• 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.	• Contractor to implement mitigation. • Engineer to routinely monitor Contractors activities.	Engineers NES	Daily site inspections, throughout construction period.
	Emissions from Construction vehicles.	• 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 programs. • Drivers should be instructed on a routine basis by the Contractors EM on the benefits	• Contractor to implement mitigation. • Engineer to routinely monitor Contractors activities including vehicle maintenance records.	Engineers NES	• Daily site inspections, throughout construction period. • Annual inspection of vehicle maintenance records.

		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.			
	Fugitive emissions.	• Conveyor belts (e.g. at batching plants and rock crushing plants) shall be fitted with wind-boards, and conveyor transfer points and hopper discharge areas shall be enclosed to minimize dust emission. • All trucks used for transporting materials to and from the site will be covered with canvas tarpaulins. • 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 25C, or in windy weather. Avoid overwatering as this may make the surrounding muddy. • Earthwork operation to be suspended when the wind speed exceeds 20 km/h in areas within 500 m of any community.	• Contractor to implement mitigation. • Engineer to routinely monitor Contractors activities.	Engineers NES	Daily site inspections, throughout construction period.
Soils Erosion and Soil Contamination	Contamination of Soils	• All fuel and chemical storage will be sited on an impervious base within a bund and secured by fencing. • The storage area will be located away from any watercourse or wetlands. • The base and bund walls will be impermeable and of sufficient capacity to contain 110% of the volume of tank (or one tank if more than one tank is located in the bund). • The construction camp maintenance yard will be constructed on impervious hardstanding with adequate drainage to collect spills (including oil interceptor tanks), there will be no vehicle maintenance activities on open ground. • Filling and refueling will be strictly controlled and subject to formal procedures. • Drip pans will be placed under all filling and fueling areas. Waste oils will be stored and disposed of by a licensed contractor. • All valves and trigger guns will be resistant to	• Contractor to implement mitigation. • Engineer to review and approve bunding prior to the start of construction. • Engineer to review and approve vehicle fueling area prior to the start of construction.	Engineers NES	Daily site inspections, throughout construction period.

		unauthorized interference and vandalism and be turned off and securely locked when not in use. • The contents of any tank or drum will be clearly marked. Measures will be taken to ensure that no contaminated discharges enter any soils. • No bitumen drums or containers, full or used, will be stored on open ground. They will only be stored on impervious hardstanding. • Areas using bitumen will be constructed on impervious hardstanding to prevent seepage of oils into the soils. • No bitumen drums or containers, full or used, will be stored on open ground. They will only be stored on impervious hard standing. • Areas using bitumen will be constructed on impervious hard standing to prevent seepage of oils into the soils.			
	Loss of topsoil	• Locate topsoil stockpiles outside drainage lines and protect stockpiles from erosion. • Construct diversion channels and silt fences around the topsoil stockpiles to prevent erosion and loss of topsoil. • Rip ground surface prior to the spreading of topsoil. • Remove unwanted materials from topsoil such as roots of trees, rubble and waste etc. • Specifically regarding soil compaction, the Contractor will confine operation of heavy equipment within the RoW, as much as possible, to avoid soil compaction and damage to privately owned land. • If in case private lands are disturbed, the contractor should promptly inform the owner and agree on the ways to remedy the situation.	Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.

	Soil Erosion	• Material that is less susceptible to erosion will be selected for placement around bridges and culverts. • Re-vegetation of exposed areas including; (i) selection of fast growing and grazing resistant species of local flora; (ii) immediate re-vegetation of all slopes and embankments if not covered with gabion baskets; (iii) placement of fiber mats to encourage vegetation growth. • The Engineer and the Contractor will both be responsible for ensuring that embankments are monitored continuously during construction for signs of erosion.	Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.
	Contaminated Land	Should the results of the additional soil sampling in the pre-construction phase indicate any elevated levels of contamination further testing of the excavated soils in this area will be required. The procedure for any construction phase testing is as follows: • identify a temporary storage area for material excavated from the area identified in **Figure F-13**. The area should be fenced and signposted. The area shall comprise an impermeable surface to prevent leachate from the stockpiles potentially contaminating soils and groundwater in the area of the storage area. • strip the topsoil in the area of **Figure F-13** in batches of 2,500 m^2 and store the mixed material in the temporary storage area (the stockpile). The height of the stockpile shall be no more than 2 meters. It is possible to have more than one stockpile, depending upon the rates of excavation in this area. • divide the stockpile into quadrants of 250m^3. • hire a certified laboratory to take a soil sample from each of the quadrants for further chemical analysis (a stockpile of 2,500m^3 would require 10 samples). Sampling should be uniformly distributed throughout the stockpile, including sampling at depth. • If the results show the all of the samples are within the proposed national limits of outlined	• Contractor to implement mitigation. • Engineer to hire certified laboratory and review results. • Engineer to undertake periodic inspections of the stockpiles to ensure the correct procedures are being followed.	Engineers NES	Weekly inspections of stockpiles.

		in **Table E-13**, **Table E14** and **Table E-15** and the Dutch target values the material can be removed from the stockpile area and disposed of as non-hazardous material. • 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. • Final disposal of any contaminated soil must be undertaken at a waste management facility licensed to handle such wastes. As with normal waste materials, the Contractor will be obliged to keep records of any hazardous materials removed from the site, including: ▪ Volume of soil removed; ▪ Details of any identified contamination; ▪ Soil stockpile (and/or storage container) unique identifier; ▪ Date excess soil was excavated from each location and subsequently transported to a disposal facility; ▪ Details of the vehicle transporting the soil to a disposal facility; ▪ Details of the disposal facility; and ▪ Date the excess soil arrived at the disposal facility. • provide a copy of the licensed waste management contractors contract to the Engineer before any contaminated soil is removed from the site. The Engineer will also be responsible for undertaking an additional due diligence review of the waste management contractors disposal site.			

		Alternative treatment of contaminated land prior to disposal	• Contractor responsible for the preparation of a Contaminated Spoil Treatment Plan. • Plan approved by the Engineer. • Contractor to implement treatment measures and disposal. • Engineer to undertake periodic review and assessment of the activity and results.	Engineers NES	Weekly inspections of any proposed treatment activity.
Hydrology	Ground and surface water pollution.	• Implementation of the specific mitigation measures outlined under **Construction Camps**, below and **Soil Contamination** above. • Provide portable toilet facilities for workers at road work sites.	Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.
	Groundwater depletion	• Routine monitoring of groundwater levels in groundwater wells in the Project area will be undertaken on a weekly basis by the Contractor within the vicinity of each tunnel he is excavating, in line with his groundwater management plan. 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. • Monitoring shall continue for a two month period after the completion of the tunnels. If the wells fail to re-charge, new boreholes will be constructed for affected persons.	Contractor to implement mitigation	Engineers NES	Weekly review of groundwater monitoring reports.
	Bridges	The Contractor will: • Divert the water flow near the bridge piers. • Provide coffer dams, silt fences, sediment barriers or other devices to prevent migration of silt during construction within streams. • Perform dewatering and cleaning of cofferdams to prevent siltation by pumping from cofferdams to a settling basin or a	Contractor to consult with MoENRP and provide copies of letters confirming construction periods to the Engineer.	Engineers NES	Routine monitoring of bridge works to ensure they are in compliance with MoENRP guidelines.

		containment unit. • Carry out bridge construction works without interrupting the traffic on the existing road with the provision of suitable diversions. • Ensure no waste materials are dumped in the river, including re-enforced concrete debris. • Place generators more than 20 meters from the river. • Ensure that no concrete waste from concrete mixers is dumped in the river. • Provide areas where concrete mixers can wash out leftover concrete without polluting the environment. This may be in the form of a lined settling pond at each bridge site. Drivers will be informed of these locations and the requirements to use these settling ponds on a routine basis by the Engineer. Dried waste from the settling ponds can be used as backfill for culverts, etc. • Carefully collect all polystyrene (from expansion joints) so that it does not litter the local environment. • Ensure that no hazardous liquids are placed within 10 meters of the river. • Provide portable toilets at bridge construction sites to prevent defecation by workers into the river. • Ensure that workers are provided with correct PPE including harnesses. • During piling works ensure that pumped water is filtered through a silt trap before being discharged to the river. • 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.			
	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	Contractor to implement mitigation.	Engineers NES	Monitor drainage channels on a weekly basis.

		properties and land by flooding and silt washed down from the works. • Arrange with the village representatives those works which might interfere with the flow of irrigation waters to be carried out at such times as will cause the least disturbance to irrigation operations. • Should any operation being performed by the Contractor interrupt existing irrigation facilities, 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.			
	Dewatering of tunnels	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.	• Contractor to implement mitigation. • Engineer to review and approve settlement tank locations and designs.	Engineers NES	• Review of weekly water monitoring results. • Weekly inspection of settlement tanks.
	Water Supply	Only legally permitted water resources shall be used for technical water supply, including rivers.	Contractor to implement mitigation. Engineer to review all water extraction permits.	Engineers NES	• Weekly inspections, throughout construction period. • Annual review of permits.
Flora & Fauna	Tree cutting	• Trees cleared from private land plots will be compensated in accordance with the Land Acquisition and Resettlement Plan (LARP). • Tree cutting shall not occur during bird nesting seasons.	GoG to implement the LARP.	According to the LARP	According to the LARP

	State Forest Fund	• The Contractor will be provided with plans indicating the areas of State Forest Fund. • Tree-cutting works in the State Forest Fund areas shall be implemented under the supervision of specialists of the National Forestry Agency. • Contractor to remove the trees to a location specified by the National Forest Agency.	• RD to provide plans to Contractor. • Contractor to undertake tree cutting. • Contractor to remove trees.	National Forestry Agency	None
	Tree Re-planting	• Coordinate with the National Forest Agency to identify a site, or sites, within the Project area where 615 red-list species can be re-planted. • Plant maintenance will be carried out for at least two years. • 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% re-plant on a 1:1 basis to compensate for losses.	• Contractor to coordinate with NFA. • Contractor to purchase, plant and maintain the seedlings. • Contractor to plant additional seedlings if success rate not met.	• Engineer to monitor success rate (NFA to determine success rate criteria).	Monthly monitoring of success rate.
	Protection of Vulnerable Species	The Contractor will place protective wood fencing around the any Georgian red-list species identified within 5 meters of the site boundary in the pre-construction survey in order to protect the tree during construction works, including its root zones.	Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.
	Vegetation clearance	No chemicals shall be used to clear vegetation.	Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.
	Fish Spawning	The Contractor shall consult with the MoENRP to determine when works in rivers should be ceased in order to limit impacts to fish spawning periods.	Contractor to implement mitigation.	Engineers NES	Review of documentation provided by MoENRP.
	Impacts to habitat	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.	• Contractor to hire local ecologist. • Contractor to prepare method statement. • Engineer to review and approve method statement.	Engineers NES	Review method statement and periodically monitor works in this area.

	Poaching	Poaching of wildlife shall be strictly prohibited.	Contractor to implement mitigation.	N/A	N/A
Waste Management and Spoil	Recycling and re-use	• Where possible, surplus materials will be reused or recycled. • Used oil and grease shall be removed from site and sold to an approved used oil recycling company.	Contractor to implement mitigation.	Engineers NES	Monthly review of waste manifests to determine if wastes are being recycled.
	Spoil	• Under no circumstances shall the Contractor dump excess materials on private lands. • Excess spoil shall not be dumped or pushed into any river at any location. • Spoil re-use and disposal haul routes shall be included within the traffic management plan. • The Contractor will be responsible for upgrading and maintenance of any locals roads used for the transport of spoil materials. • Transport of spoil material from tunnels on local roads shall be prohibited between 10pm and 6am. • Routine spraying of haul routes during dry periods.	Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.
	Inert Solid & Liquid waste	• Provide refuse containers at each worksite. • Maintain all construction sites in a cleaner, tidy and safe condition. • Waste storage containers shall be covered, tip-proof, weatherproof and scavenger proof. • Train and instruct all personnel in waste management practices and procedures. • Collect and transport non-hazardous wastes to all approved disposal sites. • Keep copies of waste manifests on site. • Keep a record of waste on-site and waste removed.	• Contractor to implement mitigation and conduct training. • Engineer to approve any waste disposal site.	Engineers NES	Daily site inspections, throughout construction period. Regular review of Contractors training sessions.
	Asphalt and Concrete	• Waste asphalt will be recycled where possible for base material and shoulder material. • Unused or rejected tar or bituminous products shall be returned to the supplier's production plant. • Waste concrete shall be crushed and re-used as fill material, or base material where possible. • Under no circumstances should concrete	• Contractor to implement any recommendations for re-use of asphalt. • Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.

		mixers be washed out onto open ground at construction sites, such as bridges.			
	Hazardous Waste	• Storage of hazardous waste shall be in specific secure locations as identified by the waste management plan. • Hazardous liquids must be stored within impermeable bunds (the bund should be able to contain at least 110% of the volume of the largest storage tank within the bund). • Collect and temporarily store used hazardous waste separately in specialized containers and place in safe and fire-free areas with impermeable floors roofs, at a safe distance from fire sources and according to the requirements of their MSDS. • Training and suitable PPE will be provided to all personnel handling hazardous waste. • Disposal of waste materials shall be undertaken by a licensed waste management company. Keep copies of the companies licenses on record as well as the agreements with the company. • Keep records of the types and volumes of waste removed from the site on a weekly basis. • Keep copies of waste manifests.	• Contractor to implement mitigation. • Engineer to approve any waste disposal site. • Engineer to review waste manifests.	Engineers NES	Daily site inspections, throughout construction period. Monthly review of waste manifests.
Transport and Utilities	Transportation	The Contractor will: • Provide information to the public about the scope and schedule of construction activities and expected disruptions and access restrictions at least 24 hours before the disruptions; • Allow for adequate traffic flow around construction areas via diversions or temporary access roads; • If temporary access roads are to be constructed with a gravel surface they shall be routinely watered by the Contractor during dry weather to reduce dust impacts; and • Provide adequate traffic signs, appropriate lighting, well-designed traffic safety signs, barriers and flag persons for traffic control.	Contractor to implement mitigation.	Engineers NES	Weekly inspections, throughout construction period.

		• Access roads for borrow pits, batching plants, etc, will be maintained during the construction phase and rehabilitated at the end of construction.			
	Working Close to Railways Lines	• The Contractor will be responsible for the preparation of an Environmental, Health and Safety Method Statement for working in the area above the railway line at KM 6.3 and at Bridge BR 4.0.1.AT/TA.	• Contractor to prepare method statements. • Engineer to review and approve method statements	Engineers NES	Weekly monitoring of works in these areas.
	Utilities	• All utilities in the Project area shall be kept operational, particularly during the winter months. • The Contractor will be responsible for liaising with the relevant utilities operators to ensure all utilities remain operational. • Should utilities need relocating in a different location the Contractor will consult with the relevant utilities and local community to ensure that there is no change in supply as a result of these changes.	Contractor to implement mitigation.	Engineers NES	Weekly inspections, throughout construction period.
Borrow Pits and Quarry's	New Borrow Pits	• The Contractor will: ○ Before the materials extraction the layer of top-soil (about 20 cm) will be removed to the side of excavation area and kept until the area works will be finalized. ○ Top-soil stockpiles will be located at least 50 meters distance from any watercourses to avoid water siltation and obstruction. The height of stockpiles will not exceed three meters to avoid wind erosion and dust emissions. ○ Provide an access road to the borrow site. All drivers will be instructed to use only this officially designated road. • If the Engineer deems the site to be hazardous to the local community he will request the Contractor to fence the site to prevent access and provide warning signs on the fencing. • Due to the sensitivity of the borrow pit locations, borrow haul routes will follow	• Contractor to select borrow sites and apply for approval from MoENRP and any other regulatory agencies. • Engineer to review borrow locations, licenses and approvals from MoENRP. • Engineer to determine if the site requires fencing.	Engineers NES Engineers NES and IES to ensure reinstatement of borrow pits are completed satisfactorily.	Monthly inspections of borrow pits. Final inspection of reinstatement activities.

		established transport corridors/rights-of-way, to the extent that is practicable. • Full site reinstatement will be undertaken by the Contractor to avoid landscape damage and habitat loss. Rehabilitation measures will include: ○ Removing of all types of equipment from the site; ○ Removing of all types of waste or/and polluted soil and materials if any exist; ○ Slope stabilization measure such as re-covering with top soil, and further seeding, grassing and planting of appropriate bushes or/and trees if reasonable. • The excavation and restoration of the borrow areas and their surroundings, in an environmentally sound manner to the satisfaction of the Engineer will be required before final acceptance and payment under the terms of contracts. • Additional borrow pits will not be opened without the restoration of those areas no longer in use.			
	Existing Borrow Pits	• Due diligence review of borrow pit. • A copy of the agreement between the operator and the Contractor will be provided to the Engineer.	• Engineer to undertake due diligence review • Contractor to provide agreement to Engineer	N/A	N/A
	New Quarry Sites	• Any new quarries must obtain the required permits prior to commencement of works at these sites, this shall include approval from MoENRP and the Engineer. • No quarry shall be located within one kilometer of any urban area or sensitive receptor and not within one kilometer of a protected area./	• Contractor to select quarry sites and apply for approval from MoENRP and any other regulatory agencies. • Engineer to review quarry locations, licenses and approvals from MoENRP.	N/A	N/A
Asphalt Plants	Emissions & Noise	• Asphalt plants will be located downwind of urban areas and not within one kilometer of any urban area. • Adequate PPE will be provided to staff working in areas of high noise and emissions.	Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.

		• Storage and Use of Hazardous Materials (including bitumen): • Ensure all hazardous materials are stored (including within suitable sized bunds for liquids), handled and disposed of according to their Material Safety Data Sheet (MSDS). • Copies of MSDS will be kept on site with all hazardous materials. • The Contractor will keep a log of the type and volume of all hazardous wastes on site. • The Contractor will keep a plan of site indicating where all hazardous materials are stored.			Monthly review of hazardous waste log.
	Vehicle Movement	• The Contractor will include the asphalt plant in his Traffic Management Plan, including haul routes from the plant.	Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.
	Health and Safety	• To prevent bitumen burns it will be compulsory for the workers handling hot bitumen to wear full-body protection. • All transportation, handling and storage of bitumen will be handled safely by experienced personnel. • The dust from the manufacturing process may pose respiratory hazards, hence protective air mask will be provided to the operators for the loading and unloading of aggregates. • Ear-muffs will be provided those working on the plant. • First Aid kit will be available on site for the workers in case of emergency. • The Material and Data Sheet (MSDS) for each chemical product will be made accessible onsite and displayed.	Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.
Construction Camps	Pollution and Emissions	• The Contractor will ensure that all of the following conditions are met: • Rain-water run-off arising on the site will be collected, removed from the site via a suitable and properly designed temporary drainage system and disposed of at a location and in a manner that will cause neither pollution nor nuisance. The drainage system will be fitted with oil and grease interceptors.	Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.

		• There will be no direct discharge of sanitary or wash water to surface water. • In the absence of functioning sewerage and sewage treatment facilities it is recommended that the Contractor provides his own on-site wastewater treatment facilities. For sites servicing a small number of employees (less than 150), septic tanks may be used. For larger sites, liquid wastes will as a minimum receive primary treatment in anaerobic tank or pond preceded by a bar screen to remove large solid objects (e.g. sticks, rags). • There will be no direct discharge of untreated sanitary or oily wastewater to surface water bodies. • Licensed contractors will be required to collect and disposal of liquid waste from the septic tanks on regular basis. • Disposal of materials such as, but not limited to, lubricating oil and onto the ground or water bodies will be prohibited. • Liquid material storage containment areas will not drain directly to surface water. • Waste water from vehicle washing bays will be free of pollutants if the wash bay has been constructed correctly. • Lubricating and fuel oil spills will be cleaned up immediately and spill cleanup materials will be maintained at the storage area. • Construction and work sites will be equipped with sanitary latrines that do not pollute surface waters and are connected to septic tanks, or waste water treatment facilities. • Discharge of sediment-laden construction water directly into surface watercourses will be forbidden. Sediment laden construction water will be discharged into settling lagoons or tanks prior to final discharge. • Washing out concrete trucks at construction sites will be prohibited unless specific concrete washout areas are provided for this purpose at the construction site (e.g. a bridge site). The washouts will be impermeable and emptied when 75% full.			

		• Spill cleanup equipment will be maintained on site (including at the site maintenance yard and vehicle fueling areas). The following conditions to avoid adverse impacts due to improper fuel and chemical storage: • Fueling operations will occur only within containment areas. • All fuel and chemical storage (if any) will be sited on an impervious base within a bund and secured by fencing. The storage area will be located away from any watercourse or wetlands. The base and bund walls will be impermeable and of sufficient capacity to contain 110% of the volume of tanks. • Filling and refueling will be strictly controlled and subject to formal procedures and will take place within areas surrounded by bunds to contain spills / leaks of potentially contaminating liquids. • All valves and trigger guns will be resistant to unauthorized interference and vandalism and be turned off and securely locked when not in use. • The contents of any tank or drum will be clearly marked. Measures will be taken to ensure that no contaminated discharges enter any drain or watercourses. • Disposal of lubricating oil and other potentially hazardous liquids onto the ground or water bodies will be prohibited. • Should any accidental spills occur immediate cleanup will be undertaken and all cleanup materials stored in a secure area for disposal to a site authorized to dispose of hazardous waste. • If determined warranted by the Engineer, the Contractor will provide a wash pit or a wheel washing and/or vehicle cleaning facility at the exits from the sites. • If so requested, the Contractor will ensure that all vehicles are properly cleaned (bodies and tires are free of sand and mud) prior to leaving the site areas. • The Contractor will provide necessary			

		cleaning facilities on site and ensure that no water or debris from such cleaning operations is deposited off-site. • The Contractor will be responsible to maintain and cleanup campsites and respect the rights of local landowners.			
Concrete Batching Plants	Pollution and Emissions from Concrete Batching Plants	• To limit impacts from dust, the following conditions will apply: – Batching plants will be located downwind of urban areas and not within one kilometer of any urban area. – The entire batching area traversed by vehicles – including driveways leading into and out of the area – will be paved with a hard, impervious material. – Sand and aggregates will be delivered in a dampened state, using covered trucks. If the materials have dried out during transit they will be re-wetted before being dumped into the storage bunker. – Sand and aggregates will be stored in a hopper or bunker which shields the materials from winds. The bunker should enclose the stockpile on three sides. The walls should extend one metre above the height of the maximum quantity of raw material kept on site, and extend two metres beyond the front of the stockpile. – The hopper or bunker will be fitted with water sprays which keep the stored material damp at all times. Monitor the water content of the stockpile to ensure it is maintained in a damp condition. – Overhead storage bins will be totally enclosed. The swivel chute area and transfer point from the conveyor will also be enclosed. – Rubber curtain seals may be needed	Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.

		to protect the opening of the overhead bin from winds. – Conveyor belts which are exposed to the wind and used for raw material transfer will be effectively enclosed, to ensure dust is not blown off the conveyor during transit. Conveyor transfer points and hopper discharge areas will be fully enclosed. – Conveyor belts will be fitted with belt cleaners on the return side of the belt. – Weigh hoppers at front end loader plants will be roofed and have weigh hoppers shrouded on three sides, to protect the contents from the wind. The raw materials transferred by the front end loader should be damp, as they are taken from a dampened stockpile. – Store cement in sealed, dust-tight storage silos. All hatches, inspection points and duct work will be dust-tight. – Silos will be equipped with a high-level sensor alarm and an automatic delivery shut-down switch to prevent overfilling. – Cement dust emissions from the silo during filling operations must be minimised. The minimum acceptable performance is obtained using a fabric filter dust collector. – Totally enclose the cement weigh hopper, to ensure that dust cannot escape to the atmosphere. – An inspection of all dust control components will be performed routinely – for example, at least weekly. • All contaminated storm water and process wastewater will be collected and retained on site. • All sources of wastewater will be paved and			

		bunded. The specific areas that will be paved and bunded include; the agitator washout area, the truck washing area, the concrete batching area, and any other area that may generate storm water contaminated with cement dust or residues. • Contaminated storm water and process wastewater will be captured and recycled by a system with the following specifications: − The system's storage capacity must be sufficient to store the runoff from the bunded areas generated by 20 mm of rain. − Water captured by the bunds will be diverted to a collection pit and then pumped to a storage tank for recycling. − An outlet (overflow drain) in the bund, one metre upstream of the collection pit, will divert excess rainwater from the bunded area when the pit fills due to heavy rain (more than 20 mm of rain over 24 hours). − Collection pits should contain a sloping sludge interceptor, to separate water and sediments. The sloping surface enables easy removal of sludge and sediments. − Wastewater will be pumped from the collection pit to a recycling tank. The pit will have a primary pump triggered by a float switch and a backup pump which automatically activates if the primary fails. − Wastewater stored in the recycling tank needs to be reused at the earliest possible opportunity.			
Community Health and Safety	Blasting	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	Contractor to implement mitigation.	Engineers NES	Daily site inspections, throughout construction period.

		Engineer based on the safety standards) and evacuating it.			
	HIV / AIDS	• Subcontract with an Approved Service Provider to provide an HIV Awareness Program to the Contractor's Personnel and the Local Community. • Repeat the HIV Awareness Program at intervals not exceeding four months	• Contractor to implement mitigation. • Service Provider to implement training. • Engineer to review program.	Engineers NES	Annual review of awareness program activities.
	Code of Conduct	The Contractor shall develop an induction program, including a Code of Conduct, for all workers directly related to the Project. A copy of the Code of Conduct is to be presented to all workers and signed by each worker.	Contractor to implement mitigation.	Engineers NES	Routine assessment of workers staff to determine if the code of conduct has been presented.
	Monthly Meetings	The Contractor will be responsible for holding monthly community meetings within the Project area throughout the construction period.	Contractor to implement mitigation.	Engineers NES	Engineers NES to attend all community meetings.
Occupational Health and Safety	Worker Health & safety	• Initial Safety Induction Course: All workmen will be required to attend a safety induction course before they are allowed access to the Site. • Develop a Safety Training Program including training to recognize and respond to workplace chemical hazards. • Safety Meetings conducted on a monthly basis. • Regularly inspect, test and maintain all safety equipment. • Equipment, which is damaged, dirty, incorrectly positioned or not in working order, shall be repaired or replaced immediately. • All construction plant and equipment used on or around the Site shall be fitted with appropriate safety devices. • A fully equipped first aid base shall be provided at the Construction Camp and Asphalt Plant. • Coordinate with local public health officials and shall reach a documented understanding with regard to the use of hospitals and other community facilities. • Workers will be provided (before they	• Contractor to implement mitigation. • Engineer to review and approve training program.	Engineers NES	Daily site inspections, throughout construction period. Periodic attendance of training sessions to determine quality and numbers in attendance.

		commence works) with of appropriate PPE suitable for electrical work such as safety boots, helmets, gloves, protective clothes, goggles, and ear protection at no cost to the workers.			
	Sub-contractor H&S	• All sub-contractors will be supplied with copies of the SSEMP. • Provisions to be incorporated into all sub-contracts to ensure the compliance with the SSEMP. All sub-contractors will be required to appoint a safety representative who shall be available on the Site.	• Contractor to provide SSEMP. • Sub-contractors to ensure compliance with SSEMP	Engineers NES	Routinely monitor sub-contractors activities.
	Noise	Zones with noise level above 80 dBA must be marked with safety signs and appropriate PPE must be worn by workers.	Contractor to implement mitigation.	Engineers NES	Daily site inspections and monitoring (with smartphone technology) throughout construction period.
PCR	Impacts to Cemetery	During the construction phase the northern boundary of the cemetery (50 meters south of tunnel TUN 4.0.06-AT/TA) shall be fenced off to ensure that there is no encroachment into this area by construction workers or equipment.	Contractor to implement mitigation.	Engineers NES	Weekly site inspections of the fencing.
	Natural Spring	During the construction works the spring shall be fenced on the northern side to prevent construction works impacting upon the spring.	Contractor to implement mitigation.	Engineers NES	Weekly site inspections of the fencing.
	Impacts to Historical and archeological areas	In the event of any chance finds during the construction works procedures shall apply that are governed by GoG legislation and guidelines and as outlined in the Contractors Chance Find Procedure.	Contractor to implement mitigation.	Engineers NES	Daily site inspections throughout construction period.
Noise	Construction noise	• During the construction phase the Contractor will be responsible for the following: − Time and Activity Constraints, i.e., operations will be scheduled to coincide with periods when people would least likely be affected; work hours and work days will be limited to less noise-sensitive times. Hours-of-work will be approved by the Engineer having due regard for possible noise disturbance to the	Contractor to implement mitigation.	Engineers NES	Daily site inspections throughout construction period.

		local residents or other activities. Construction activities will be strictly prohibited between 10 PM and 6 AM in the residential areas. When operating close to sensitive areas (within 250 meters) such as residential, nursery, or medical facilities, the Contractor's hours of working shall be limited to 8 AM to 6 PM; – Give notice as early as possible to sensitive receptors for periods of noisier works such as excavation. Describe the activities and how long they are expected to take. Keep affected neighbours informed of progress. – Within normal working hours, where it is reasonable to do so: – schedule noisy activities for less sensitive times. – provide periods of respite from noisier works (for example, periodic breaks from jackhammer noise). – The weekend/evening periods are important for community rest and recreation and provide respite when noisy work has been conducted throughout the week. Accordingly, work should not usually be scheduled during these times. – All mechanical plant is to be silenced by the best practical means using current technology. Mechanical plant, including noise-suppression devices, should be maintained to the manufacturer's specifications. Internal combustion engines are to be fitted with a suitable muffler in good repair. – Maintenance tools, machines and equipment so that they are in good conditions. When some wrong is found, they must be fixed			

		immediately in order to reduce noise from the equipment. – Fit all pneumatic tools with an effective silencer on their air exhaust port. – Install less noisy movement/reversing warning systems for equipment and vehicles that will operate for extended periods, during sensitive times or in close proximity to sensitive sites. Occupational health and safety requirements for use of warning systems must be followed. – Turn off plant when not being used. – All vehicular movements to and from the site to only occur during the scheduled normal working hours, unless approval has been granted by the Engineer. – Keep good conditions of trucks that use to transport construction materials so they cause no loud noise and control the truck speed, to be not exceeded 40 km/hr when driving through communities, and not exceeded 80 km/hr when driving on highways. – Where possible, no truck associated with the work should be left standing with its engine operating in a street adjacent to a residential area. – Provision of noise protection kits such as ear plug, earmuff, for workers who are working in the area with noise level is higher than 85 dB(A). It is designated as a regulation that workers must wear protection kits in case of working in a noisy area.			
Vibration	Tunneling Vibration	The Contractor shall follow the procedures outlined in **Section F.8.6** of the EIA.	Contractor and Engineer to implement mitigation.	N/A	N/A
	Piling Vibrations	Condition surveys of all properties within 50 meters of bridge piles.	Engineer	N/A	N/A

	Blasting	• No blasting will be carried out within 100 m of the portal of the tunnel. • Blasting will be scheduled during the day only. • Local communities will be informed of blasting timetable in advance and will be provided adequate notice of when blasts are required outside of the planned schedule.	Contractor and Engineer to implement mitigation.	Engineers NES	Routine inspections of blasting activities.

Table G-3: Environmental Management Plan – Operational Phase

Subject	Potential Impact / Issue	Mitigation Measure	Responsibilities	Monitoring	Monitoring Responsibility & Schedule
Tree re-planting	Tree maintenance	If tree maintenance extends beyond the construction period the Contractor shall continue maintenance of the trees to complete the two-year maintenance period.	Contractor (during defects liability period) .	N/A	N/A
Noise	Traffic and road noise	Based on the results of the annual noise monitoring (see **Table G-5**) construct the noise barriers specified in **Table F-22**, or develop other noise mitigation measures, such as sound proof windows, in consultation with affected receptors.	Engineer (during defects liability period	N/A	N/A

Table G-4: Construction Phase Instrumental Monitoring

Issue	Monitoring	Locations	Schedule	Responsibilities	Reporting
Air Quality	Establish routine ambient air quality monitoring throughout the construction period. The following parameters shall be monitored: Particulate Matter (PM_{10} & $PM_{2.5}$).	• KM 4.4 • KM 5.8 • KM 6.4 • KM 9.2 • KM 12.6 • KM 13.3	Monitoring to be undertaken monthly during construction period (30 months)	The Engineer shall hire certified laboratory to perform the monitoring activities.	The certified laboratory shall provide the results to the Engineer within three days of the monitoring activity.
Noise	Ensure that routine noise monitoring is undertaken throughout the construction	• KM 4.4 • KM 5.8	Monitoring to be undertaken	The Engineer shall hire certified laboratory	The certified laboratory shall provide the

Issue	Monitoring	Locations	Schedule	Responsibilities	Reporting
	period. Parameters to be monitored include: Laeq 1h (dBA)	• KM 6.4 • KM 9.2 • KM 12.6 • KM 13.3	monthly both daytime and night-time measurements during construction period (30 months)	to perform the monitoring activities.	results to the Engineer within three days of the monitoring activity.
Vibration	Vibration sensors for PPV monitoring.	At each tunnel location	Throughout tunnel blasting period.	Contractor to purchase, install and monitor vibration.	Weekly reporting of vibration results to the Engineer.
Surface Water Quality	Establish routine water quality monitoring throughout the construction period. The following parameters shall be monitored: pH; Suspended Solids; BOD5; COD; Coliforms; Nitrate (NO3); Phosphate (PO4); Oil and Grease	50 meters upstream from all bridge sites crossing rivers (3 locations) during construction; 50 meters downstream of the bridge site.	Monitoring to be undertaken monthly during bridge construction works	The Engineer shall hire certified laboratory to perform the monitoring activities.	The certified laboratory shall provide the results to the Engineer within seven days of the monitoring activity.
Tunnel water	Monitoring of water from tunnel dewatering settlement tanks. Parameters will include all required to meet Georgian drinking water standards.	At all settlement tanks.	Weekly	The Engineer shall hire certified laboratory to perform the monitoring activities.	The certified laboratory shall provide the results to the Engineer within 5 days of the monitoring activity.
Ground water	Monitoring of groundwater levels.	Selection of ten sites	Weekly	The Engineer shall perform the monitoring activities.	Weekly reporting by the Engineer to affected parties.
Soils	If required, undertake a soil sampling program on the stockpiles of excavated material to the north of the GAA.	Contractor to divide the stockpiles into ten	Monitoring to be completed before materials can be removed from the	The Engineer shall hire certified laboratory to perform the monitoring activities.	The certified laboratory shall provide the results to the Engineer within 20 days of the

Issue	Monitoring	Locations	Schedule	Responsibilities	Reporting
	Parameters to be monitored: All parameters tested in **Table E-13**, **Table E-14** and **Table E-15** of this EIA.	quadrants of mixed soil.	stockpile site.		monitoring activity. The Engineer will immediately provide the results to the Contractor for disposal as hazardous or non-hazardous materials.

Table G-5: Operational Phase Instrumental Monitoring

Issue	Monitoring	Locations	Schedule	Responsibilities	Reporting
Air Quality	Air quality monitoring of PM_{10}, $PM_{2.5}$, NO_X, SO_X and CO.	Same as during the construction phase.	Bi-annually during DLP	Engineer (during defects liability period)	Bi-annual submission of results to JICA.
Noise	Noise monitoring - Laeq 1h (dBA) both daytime and nighttime periods.	At all receptors within Project corridor	Twice per year during DLP	Engineer (during defects liability period)	Annual submission of results to JICA for two years after the completion of the project.
Final noise barrier monitoring	Undertake noise monitoring at sensitive receptors behind finished noise barriers to ensure the barriers are functioning according to their design.	At all identified receptors.	Once, daytime and nighttime	Contractor	Provide final results to RD within one month of the completion of construction of any noise barrier.

G.4 EMP Costs

674. Most costs associated with the environmental recommendations of the EMP are a normal part of preparing the bid and contract documents and ensuring that proper environmental provisions are incorporated therein. The installation of septic systems at construction camps, for example, is an environmental necessity, but not generally considered an “environmental cost”. **Table G-6** lists the proposed mitigation measures and indicates where they would be “included in the project budget” as part of a bid document and where additional costs are a likely “environmental cost” beyond what would normally be included in a project budget.

Table G-6: EMP Costs

Activity	Item	Number of Units / Unit cost /US$	Cost estimate / US$	Responsibility	Source: JICA	Source: RD
Pre-construction						
SSEMP	SSEMP and associated plans	Included in Project Construction costs	-	Contractor	X	
Approval of Camp locations	Approval	Included in Project Construction costs	-	Engineer	X	
Incorporation of Environmental Items into Bid Documents	Item in Bid Document	Included in Detailed Design Budget.	-	RD		X
Obtain permits	Permits	Included in Project Construction costs	-	Contractor	X	
SFF	Compensation	Approx. 4,200	Approx. 4,200	Contractor		X
Total Pre-construction costs						$4,200
Construction						
Standard site management	Septic Tanks	Included in Project Construction costs	-	Contractor	X	
Additional environmental measures	Spill Kits	20 / US$200	4,000	Contractor	X	
	Bunds for fuel and oil storage	Included in Project Construction costs	-	Contractor	X	
	Waste containers	Included in Project Construction costs	-	Contractor	X	
	Waste Storage areas	Included in Project Construction costs	-	Contractor	X	
	Waste collection and disposal	Included in Project Construction costs	-	Contractor	X	
	Storage areas for hazardous materials	Included in Project Construction costs	-	Contractor	X	
	Sprinklers for rock crushing plant	Included in Project Construction costs	-	Contractor	X	
	Drainage (including oil and grease interceptors)	Included in Project Construction costs	-	Contractor	X	

Activity	**Item**	**Number of Units / Unit cost /US$**	**Cost estimate / US$**	**Responsibility**	**Source: JICA**	**Source: RD**
	Vehicle washing bay	Included in Project Construction costs	-	Contractor	X	
	Fire safety	Included in Project Construction costs	-	Contractor	X	
	PPE	Included in Project Construction costs	-	Contractor	X	
	Impervious hardstanding (for maintenance yards, bitumen storage, etc)	Included in Project Construction costs	-	Contractor	X	
	First aid facilities	Included in Project Construction costs	-	Contractor	X	
	Animal Crossings	Included in Project Construction costs	-	Contractor	X	
	Fencing around borrow pits	8 / $,2000	$16,000	Contractor	X	
	Fencing around PCR	2 / $1,000	$2,000	Contractor	X	
	Water bowsers	Included in Project Construction costs	-	Contractor	X	
	Water sprinklers (rock crushing plant)	Included in Project Construction costs	-	Contractor	X	
	Dust control measures (rock crushing and batching plants)	Included in Project Construction costs	-	Contractor	X	
	Tarpaulins	Included in Project Construction costs	-	Contractor	X	
SFF Tree Cutting and tree removal	Labour	Included in Project Construction costs	-	Contractor	X	
Fencing around red-list species (over 8cm in diameter)	Fencing	Approximately 200 / $50	10,000	Contractor	X	
Re-planting of red-list species	Seedlings	615 / $10	6,150	Contractor	X	
Tunnel Excavation	Pre-condition surveys	Approximately 200 / $100	20,000	Contractor	X	
Tree / Vegetation maintenance	Labour and water	Included in Project Construction costs	-	Contractor	X	
Embankment vegetation and soil erosion measures	Vegetation, Labor and maintenance	Included in Project Budget	-	Contractor	X	
Potentially Contaminated Soil	Disposal of soil.	TBD	TBD	Contractor	X	

Activity	**Item**	**Number of Units / Unit cost /US$**	**Cost estimate / US$**	**Responsibility**	**Source: JICA**	**Source: RD**
Training & Awareness Programs	Safety Training	Included in Project Budget	-	Contractor	X	
	HIV/AIDS Training	4 / US$1,000	4,000	Contractor	X	
	Toolbox Training	Included in Project Budget	-	Contractor	X	
	Construction orientation meetings	Included in Project Budget	-	Contractor	X	
	Periodic meetings with stakeholders	Included in Project Budget	-	Contractor	X	
Clean-up of construction sites.	Labor, waste disposal	Included in Project Budget	-	Contractor	X	
Environmental Staff	EO	30 / US$ 2,000	60,000	Contractor	X	
	IES	5 / US$ 20,000	100,000	Engineer	X	
	NES	30 / US$ 1,500	45,000	Engineer	X	
Total Construction Costs	US$267,150					
Operation						
Noise	Noise Barriers[22]	5,950 m / $1,352 m	8,044,440	Contractor	X	
	Noise Barrier foundations	4,822 m / $200 m	964,400	Contractor	X	
	Resettlement	Maximum 120	See RAP for costs	RD		X
	Other noise mitigation (noise proof windows, etc)	Maximum 120 receptors / US$2,000	240,000	Contractor	X	
Operation Costs	**US$9,248,840**					
Total Cost	**US$9,520,190**					

Table G-7: Construction Phase Instrumental Monitoring Costs

Activity / Item	**Frequency / Responsibility**	**Unit Cost**	**Cost /USD**
Air Quality Monitoring	Monthly (six sites) / Engineer to hire certified laboratory.	200 per site	36,000
Soil Sampling	Ten samples from each of the eight stockpiles (2,500m^3) / Engineer to hire certified laboratory.	400 per sample	32,000
Noise Monitoring	Monthly (six sites) / Engineer to hire certified laboratory.	200 per site	36,000
Surface Water Quality Monitoring	Weekly during construction period at the bridge sites crossing rivers (three sites) / Engineer to hire certified laboratory.	200 per site	28,800
Groundwater levels	Weekly during construction period of each tunnel / Engineer to hire	20 per site	2,880

[22] Cost estimate is provided by **Appendix H**.

	certified laboratory.		
Tunnel dewatering	Weekly during construction period of each tunnel / Engineer to hire certified laboratory.	200 per site	41,600
Vibration Monitoring	Continuous during blasting in the vicinity of tunnels. One sensor for each cluster of house within the risk zones. At least 5 sensors within 100 m and 5 beyond. 10 sensors in total / Contractor	800	8,000
Total			**185,280**

Table G-8: Operational Phase Instrumental Monitoring Costs

Activity / Item	Frequency / Responsibility	Unit Cost	Annual Cost /USD
1. Air Quality Monitoring to JICA	Bi-annually (six locations) for two years / Engineer (during DLP)	200 per site	2,400
2. Noise Monitoring for Noise Mitigation.	Twice per year (all affected receptors) / Engineer	200 per site	Maximum 80,000
Total			**82,400**

*Final noise barrier monitoring costs to be included in the general construction costs for the noise barriers

G.5 Site Specific EMP (SSEMP)

675. The SSEMP is the documents that the Contractor shall prepare outlining how he intends to implement the EMP and ensure that all of the mitigation and monitoring is completed according to the implementation arrangements specified in this EMP and the EIA as a whole.

676. The SSEMP will describe the precise location of the required mitigation / monitoring, the persons responsible for the mitigation / monitoring, the schedule and reporting methodology. The SSEMP will also include:

- Waste Management Plan.
- Traffic Management Plan.
- Occupational Health and Safety Plan.
- Emergency Response Plan.
- Borrow Pit Management Plan.
- Air Quality Plan.
- Spill Response Plan.
- Vibration Monitoring Plan.
- Clearance, Re-vegetation and Restoration Management Plan.
- Groundwater Management Plan.
- Tunnel Blasting Plan.

677. The SSEMP will be submitted to the Engineer and RD for approval at least 10 days before taking possession of any work site. No access to the site will be allowed until the SSEMPs are approved by the Engineer and RD.

G.6 Bid Documents

678. The Bid Documents for the potential Contractor will contain two sections relating to environmental issues, firstly a basic clause indicating that the Contractor

will be responsible for following the requirements of the EMP and that he should prepare his own SSEMP for the Project. Secondly, the EMP shall be repeated in its entirety as an Annex to the Bid Documents so as the bidder is aware of his environmental requirements under the Project and help him put environmental costs to his proposal.

G.7 Contract Documents

679. The Contract Documents will follow a broadly similar pattern to the Bid Documents. It is not considered necessary to repeat the mitigation measures verbatim in a list of environmental contract provisions, rather the Contract will specify that the Contractor is responsible for implementation of the EMP via his SSEMP. Again, the EMP will be included as an Annex to the Contract so the Contractor will be liable for any non-conformance with the EMP, and thereby this EIA.

G.8 Contractor Requirements

680. As stated above, the Contractor will be responsible for the preparation of the SSEMP. The SSEMP will need to be fully compliant with the EMP and this EIA as a whole and will need to be prepared within 30 days of Contract award and approved 10 days prior to access to the site.

681. During construction the Contractor must retain the expertise of an Environmental Officer (EO) to implement and continually update the SSEMP and to oversee and report on the operation throughout the contract period. The EO should be full-time member of staff on the Contractors roster and should be on site at least five days per week.

682. The required qualifications of the EO are as follows:
- Degree in environmental sciences and related expertise.
- Fluent in Georgian and English.
- Experience of at least one construction project of a similar size and scale.

678. The EO will be responsible for the preparation of weekly environmental checklists and an environmental section of the Contractor's monthly progress reports that shall be submitted to the Engineer for review.

683. The monthly reports, which will include the weekly environmental checklists, shall contain sections relating to:
(1) General Progress of the Project.
(2) Environmental Incidents; e.g. spills of liquids, accidents, etc.
(3) Progress of any environmental initiatives, e.g. energy savings, recycling, etc.
(4) Records of any environmental monitoring, both observational and instrumental.
(5) Conclusions and Recommendations.

684. The EO shall provide daily toolbox training at the construction camp and also at construction sites. The EO shall keep a record of all monthly training and toolbox training undertaken.

G.9 Engineer Requirements

685. As noted in the mitigation plans below, the Engineer is tasked with specific responsibility to review designs and ensure safeguard compliance of civil works – with particular emphasis on the monitoring of implementation of EMP through the

Contractors SSEMP and related aspects of the project. The Engineer will also be responsible for reviewing and approving the monthly reports prepared by the Contractor, especially the first monthly report, to ensure that it contains all of the required reporting elements, such as instrumental monitoring results. The Engineer will also be responsible for regular review and attendance of the Contractors environmental, health and safety training.

686. The Engineer is also responsible for engaging external services from a certified laboratory for instrumental monitoring of air quality, noise and water during the construction phase.

687. The Engineer should retain the use of Environmental Specialist, both national (NES) and international (IES), to ensure that the Contractor is compliant with his environmental obligations. Terms of reference for both specialists is provided below.

Engineers National Environmental Specialist

688. Scope of Services: He/she will (i) review all documents and reports regarding the integration of environmental including contractor's environmental action plan, (ii) supervise the contractors' compliance to EMP, and (iii) prepare monthly compliance reports.

689. Qualification: Degree in environmental sciences or equivalent. Preferably five years' experience in conducting environmental impact assessments and implementation of environment mitigation plans and/or monitoring implementation of environmental mitigation measures during implementation of projects including highway projects funded by developing partners.

690. Time Period – The NES shall be employed permanently over the duration of the construction period.

Engineers International Environmental Specialist

691. Scope of Services: The IES will prepare a detailed action plan including environmental monitoring checklists to be completed by the NES. He/she will conduct environmental training and briefings to provide environmental awareness on JICA and the government environmental safeguards policies, requirements and standard operating procedures in conformity with the government's regulations and international practice for project and RD Safeguards staff; ensure baseline monitoring and reporting of Contractor's compliance with contractual environmental mitigation measures during the construction phase.

692. Qualification: Degree or diploma in environmental sciences or equivalent. Preferably fifteen years' experience in conducting environmental impact assessments and implementation of environment mitigation plans and/or monitoring implementation of environmental mitigation measures and health and safety plans during implementation of projects including road projects funded by developing partners, including twelve years' international experience. Working knowledge of Georgia is preferred.

693. Time Period: The IES shall be engaged on a part-time basis for a period of five months spread over the duration of the construction period (two months per year). The specific on-site inputs will be determined by the Engineers Team Leader and the RD.

G.10 PMU Requirements

694. A review of the capacity of the RD was undertake as part of this EIA. The review indicates that the existing RD has sufficient expertise to adequately manage the Contractors environmental performance. The RDs safeguard department has extensive experience of implementing road projects for a range of donors, including ADB and JICA. As such no further capacity building is recommended within the RD.

G.11 EMP Implementation Summary

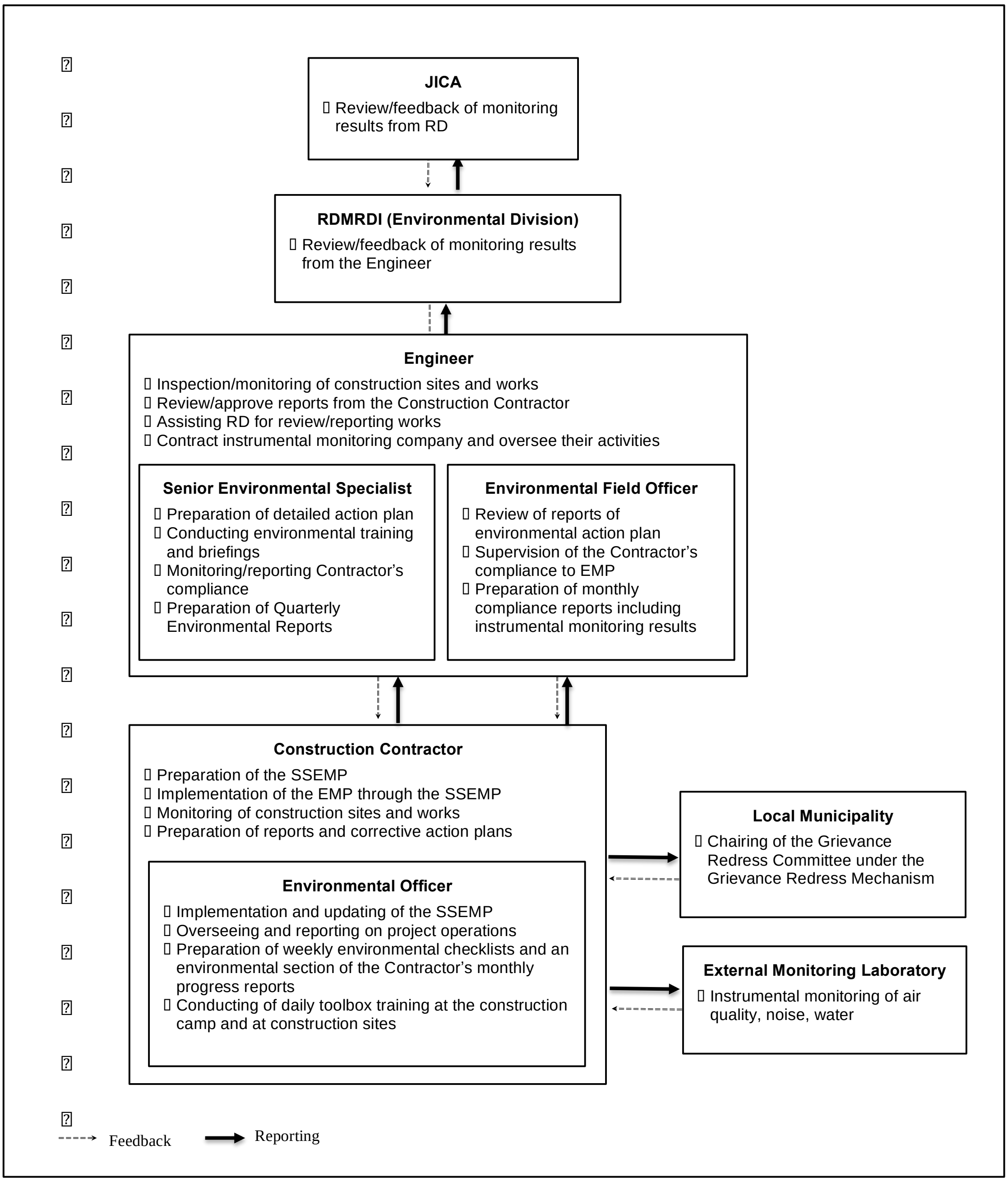
695. The following Table (**Table G-7**) summarizes the various institutional responsibilities for the implementation of the environmental management plan at various stages of the Project Road rehabilitation.

Table G-7: EMP Implementation

Project Stage	Responsible Institution	Responsibilities
Detailed Design	RD with the Detailed Design Consultant and EIA Team.	• Incorporate EMP mitigation measures into engineering design.
	RD	• Ensure EMP is incorporated into the works Contracts.
	RD	• Review Contractors proposals to ensure that they are aware of the EMP requirements and that line items for environmental management as per the EMP are included in the BOQ.
Pre-construction	Contractor	• Prepare SSEMP
	Engineer, JICA and PMU	• Review and approve SSEMP
	Contractor and Engineer	• Site Induction
Construction	Contractor (through its EM)	• Daily monitoring of environmental issues • Preparation of weekly environmental checklists • Preparation of Monthly environmental reports • Preparing Corrective action plans
	PMU	• Routine site visits to monitor Contractors performance.
	Engineer	• Weekly monitoring of the Contractors compliance with EMP / SSEMP by the NES. • Issuing the Contractor with Non-compliance Notices • Monthly reporting to RD of Contractors performance based on the review of Contractors weekly checklists and weekly site visits. • Quarterly Environmental Reports prepared by the IES and submitted to PMU and JICA.

696. **Figure G-1** illustrates the EMP implementation activities during the construction phase.

Figure G-1: Construction Phase EMP Implementation



H. Public Consultation, Information Disclosure & Grievance Mechanism

H.1 Public Consultations

697. According to the ADB Safeguard Policy Statement (2009):

"*The borrower/client will carry out meaningful consultation with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation. Meaningful consultation is a process that:*
1. *Begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle;*
2. *Provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people;*
3. *Is undertaken in an atmosphere free of intimidation or coercion;*
4. *Is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and*
5. *Enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues.*

Consultation will be carried out in a manner commensurate with the impacts on affected communities. The consultation process and its results are to be documented and reflected in the environmental assessment report."

698. Category A EIA require two rounds of consultations which were undertaken in June 2017 and November 2017.

H.1.1 Scoping Consultations

699. Scoping consultations were held in June, 2017 in Zestafoni. The consultations were arranged by the RD. Information about the date, time and venue of the meeting was published in a newspaper. Communication with local municipal authorities was also undertaken to inform them of the meeting. 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. A copy of the presentation made can be found as **Appendix A**. The following provides an overview of the consultations (names of all attendees can be found in **Appendix B**).

Table H-1: Zestafoni Scoping Consultation

Date: 7th June, 2017
Location: Zestafoni Town Hall

Panel Members:
Mr. Nick Skinner – International Environmental Specialist
Mr. Giansante Bonin – Team Leader
Ms. Maka Stamateli – National Environmental Specialist
Ms Lika Bubashvili – Environmental Specialist, Road Department of Georgia
Mr. Gia Sopadze – Head of Environmental Division, Road Department of Georgia

List of Participants:
40 Participants (see **Appendix B** for list)

#	Question / Comment	Answer	EIA Status

1	In previous road projects in the region we have had 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.	We will ensure that adequate space is made available for spoil disposal. If additional areas are required for spoil material their locations will require approval by the Engineer and the RD.	Calculations of spoil material have been made and discussions have been held with the RD regarding the re-use of the material (See **Section F.7.3**). If other sites are to be chosen the Contractor will be responsible for following the procedures for spoil disposal also outlined in **Section F.7.3**.
2	Where will the borrow pits be located?	The locations have not been finalized at this stage.	The final locations of the borrow pits will be determined by the Contractor and will be based on a number of decisions including the quality and availability of materials as well as the costs to transport the materials. Notwithstanding the above, **Section F.7.5** contains specific provisions for the operating of new, or use of existing borrow pits, including specific provisions required by the GoG.
3	Landslides are a problem in this region, the project must carefully manage this issue.	We are aware of this issue and will make sure that the detailed design takes landslide issues into account.	As noted in **Section E.1.4**, several landslide areas have been identified. They are not anticipated to significantly impact on the Project, but further survey will be conducted. The Project is not anticipated to increase the chances of landslides occurring.
4	For every tree cut, at least three must be replanted as part of the project.	The exact tree-replanting requirements will be confirmed during the EIA preparation.	As noted in **Section F.6.1**, all trees within State Forest Fund locations that will be cut shall be replaced.
5	How will issues be resolved during the construction phase?	There will be a grievance mechanism for complaints to be aired and regular consultations throughout the construction phase with affected villages.	**Section H.3** provides the Grievance Redress Mechanism (GRM) for the Project. In addition, **Section F.8.2** provides requirements for the Contractor to undertake monthly community meetings in villages along the alignment in order to discuss specific issues before reaching the GRM level.
6	We are concerned about access to our property, both during the construction phase and the operational phase of the project.	This issue is noted and we will try to ensure that access is maintained as far as is practical throughout the construction phase.	Careful consideration has been given to the issue of access in this section. Only a small section of the new road will affect the existing road, and in this location two interchanges will be constructed that will provide access to this area during the operational phase of the Project. In addition, **Section F.7.1** states that the Contractor will ensure access to land and properties remains at all times during construction, through diversions, or temporary roads.

7	Will the Contractors repair access roads after construction works are completed?	We will include specific mitigation measures to ensure that access roads are left in the same condition as before the project.	**Section F.7.1** makes recommendations for a condition survey of the roads and for any roads to be repaired by the Contractor if the Engineer deems it necessary.
8	Will we be able to review your documents?	Yes, and we will hold a second round of consultations based on your review of the findings of this report.	As per **Section H.3.2**, this report and a Georgian EIA will be published on the JICA and RD websites. In addition a second round of consultations was held to discuss the draft EIA,
9	There are lots of cultural heritage sites along the corridor. How will they be protected?	We will identify all cultural heritage sites within the corridor and prepare mitigation measures to protect these resources.	Surveys of cultural heritage within the Project corridor have been undertaken (**Section E.4.4)** and none have been identified directly within the RoW with the exception of a small natural spring north of the GAA plant. Provisions have been outlined to protect this area, as well as a cemetery close to the Project alignment (see **Section F.9.5**). The Contractor will be responsible for following GoG procedures for chance finds as per Section.

Figure H-1: Scoping Consultation in Zestafoni, 7th June, 2017

H.1.2 Public Consultations

700. A second round of consultations were held in Zestafoni in January 2018. Participants in the consultations were presented with the initial findings of the EIA (see **Appendix C** for the presentation). The following provides an overview of the consultations (names of all attendees can be found in **Appendix D**).

Table H-3: Zestafoni Public Consultation

Date: 17th January, 2018 **Location:** Zestafoni

Panel Members: Mr. Nick Skinner – International Environmental Specialist Zura Mgaloblishvili - Director of Gamma Consulting Ltd (LCF) Elene Mgaloblishvili, Social Specialist of Gamma Consulting Ltd (LCF) **List of Participants:** 30 Participants (see **Appendix D** for list)			
#	**Question / Comment**	**Answer**	**EIA Status**
1	Is there a risk that construction of the highway results in loss of water in the wells around?	Impact on ground water is may be possible in the sections of the road where tunnels are planned. Prior to construction water wells in the boundaries of potential impact zone of tunneling works will be identified. Measures have been provided in the EIA to monitor groundwater and provide temporary/alternative source of potable water if impacts occur.	Impacts of groundwater from tunneling activities are addressed in **Section F.7.6** - Tunnels.
2	Construction of the highway is planned in the mineral water spring behind the GAA. Will it be affected?	During the construction works the spring will be fenced from the northern side to prevent impact of construction works. Close to the area of interest, excavation works capable to affect the flow are not planned. Impact on the spring is not expected.	Protection of the spring behind GAA is addressed in **Section F.8.5** - Physical and Cultural Resources
3	The lighting along the road will affect migratory birds. Has this risk been considered?	Illumination does have impact on wildlife, including birds (migratory and nocturnal). The impact cannot be fully avoided. However, modern Lower wattage flat lens lamps widely used on highways, direct light down and reduce glare. This enables to reduce light pollution effect to some extend.	Street lighting impacts and mitigation are addressed in **Section F.6.2** – Flora.
4	It is advisable to arrange additional access near Shorapani to make access to the highway for local population easier. Is this possible?	The design team has considered the aspect of access in considerable detail. However, in some instance not all of the access roads will be as convenient as they were with the existing road.	Access impacts are considered as part of the Detailed Design.

701. The meeting was also attended by Representative of MoENRP Irakli Pirckhaleishvili, Environmental Impact Permits Department, Senior Specialist in the Second category of the Permits Division. Other questions and comments raised by the participants, which are not related to environmental issues, are not included in the table above.

Figure H-2: Consultation in Zestafoni, January 17th, 2018

H.2 Planned Information Disclosure

702. It is anticipated that in compliance with JICA's requirements for EIAs (Category A environmental analyses), the document will be provided for disclosure on the JICA website and the RD Website (in local language).

703. The RD PMU will be responsible to notify and inform the public of construction operations prior to construction works, publish an emergency response plan disclosing his intentions to deal with accidents and emergencies, including environmental/public health emergencies associated with hazardous material spills and similar events, etc.

H.3 Grievance Mechanism

H.3.1 Introduction

704. Grievance redress mechanisms (GRMs) are institutions, instruments, methods, and processes by which a resolution to a grievance is sought and provided. GRM is seen by ADB as a pre-litigation mechanism for conciliation of disagreements and addressing concerns of project affected persons (PAPs) at early stages of dispute. GRM is aimed on smooth and creative resolution of disputes, minimizing time and resources waste and reputational risk to the project. The experience gained in ADB and other donor funded projects demonstrates that the efficient GRM enables to avoid time-consuming and complex legal procedures in majority cases of claims.

705. The GRM is an integral part of the ADB Accountability Mechanism (AM) that complements the problem solving (OSPF) and compliance review (CRP) functions of the ADB AM Policy 2012.

706. The GRM should be established and operated in compliance with the Georgian Regulations and ADB Policy requirements.

707. According to the ADB requirements, the GRM should be arranged to address

the resettlement related issues (SPS 2009 – Safeguard Requirements 2: Involuntary Resettlement, Requirement 7. Grievance Redress Mechanism) and the environmental concerns of the affected communities and other stakeholders (SPS 2009 - Safeguard Requirements 1: Environment, Requirement 5. Grievance Redress Mechanism).

H.3.2 Georgian Regulations

708. The Administrative Code of Georgia is the legal document defining the rules and procedures for the grievance review and resolution.

709. According to the law, the Administrative body receiving officially lodged claims is obliged to review the claims and engage the claimant in the grievance review and resolution process, and issue final decision in that regard.

710. Clause 181. defines the content and the grievance submission forms. In particular, the grievance package should include: a) Name of the administrative body to whom the complaints are addressed; b) Name, address and contact details of the claimant; c) Name of the administrative body, who's decisions or administrative acts are the subject of complain; d) Name of the administrative act or decision, which is subject of complain; e) Content of the claim; f) The context and facts, based on which the complaint is substantiated; g) list of attachments;

711. Clauses 194 and 198 define the rules and procedures ensuring participation of the claimants in the grievance review process.

712. According to the clause 202, the decision issued by the Administrative Body in relation with the reviewed claim has a status of individual administrative legal act.

713. The standard period given for the issuance of the decision in relation with the grievance is 1 month.

H.3.3 ADB Policy (SPS, 2009) Requirements

714. The borrower/client will establish a mechanism to receive and facilitate the resolution of affected persons' concerns and grievances about physical and economic displacement and other project impacts, paying particular attention to the impacts on vulnerable groups.

715. The grievance redress mechanism should be scaled to the risks and adverse impacts of the project.

716. It should address affected persons' concerns and complaints promptly, using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to the affected persons at no costs and without retribution.

717. The mechanism should not impede access to the country's judicial or administrative remedies. The borrower/client will inform affected persons about the mechanism.

H.3.4 Grievance Redress Process

718. At the LARP/EIA preparation stage, during the consultation meetings and

negotiations the PAPs shall be fully informed of the grievance redress mechanism, its functions, procedures, contact persons and rules of making complaints.

719. Grievance resolution is viewed as a two-stage process, first involving local resources for the grievance resolution and only in case of failure engaging top management and entire capacity of the central offices of RD/PIUs.

720. Grievance redress procedures of Stage 1 represent an informal tool of dispute resolution allowing the PAPs and the project implementation team to resolve the disagreement without any formal procedures, procrastination and impediments. Such informal grievance redress mechanism helps to solve most of the complaints without formal procedures (i.e. without using the procedures specified in the Administrative Code or litigation). This mechanism enables unimpeded implementation of the Project and timely satisfaction of complaints.

721. Care will always be taken to prevent grievances rather than going through official procedures of Stage 2. The achievement of this goal can be ensured through careful planning and preparation of EIA and LARP, active participation of PAPs, effective consultations, proper communication and coordination among local communities, IAs and local authorities.

722. In case of failure of the grievance resolution attempts at the stage 1, the process of grievance review and resolution enters Stage 2. Stage 2 is a process formalized in accordance with the Administrative Code of Georgia. The claimant submits official claim in a written form to the RD and the RD as an administrative body is conducting the grievance review and response process following requirements of the law, regarding time frames, involvement of claimant, etc. The stage 2 process may require involvement of different departments and specialists of the RD, its consultants, local authorities and other stakeholders.

723. If the grievance is not resolved at the stage 2, the claimant has right and possibility to apply to court and the GRM helps the claimant to prepare application package.

H.3.5 Grievance Redress Mechanism

724. The GRM consists of temporary, project-specific units established at the municipal level in project affected municipality and regular system established at the RD level:

- ***Grievance Redress Committee (GRCE)*** established at municipal level as a project-specific instrument, which is functional only for the period of the project implementation.
- ***Grievance Redress Commission (GRCN)*** is formed as permanently functional informal structure within the RD to ensure grievance review, resolution and record.

H.3.6 Grievance Redress Commission for Stage 1

725. A Grievance Redress Committee (GRCE) is an informal, project-specific grievance redress mechanism, established to administer the grievances at Stage 1. This informal body will be established at community level in both the affected Municipality. The representative of Zestafoni Municipality will be a Chairman of the GRCE. The RD representative(s) of Environmental and Resettlement Unit in GRCE shall coordinate the GRCE formation. The Contact Person will then be responsible for the coordination of GRC activities and organizing meetings. In addition, GRCE

shall comprise representative of Shorapani (Secretary), representatives of PAPs, women PAPs (if any), and appropriate local NGOs to allow voices of the affected communities to be heard and ensure a participatory decision-making process.

726. GRCEs will be established at the community level (office of the official Representative of Zestafoni Municipality). The establishment of GRCE will be formalized by the protocol of the first meeting, as a part of binding agreement of the Government and JICA. For the GRCE following composition is proposed (**Table H-4**). There shall be at least one female member of the GRCE.

Table H-4: GRCE Composition

1	Representative(s) of Environmental and Resettlement Safeguards Unit of RD	Member
2	Representatives of Zestafoni Municipality	Chairman
3	Representative of Shorapani	Member
4	Representative of PAPs	Member
5	Representative of NGO	Member
6	Representative of Contractor	Member
7	Environmental and Resettlement Specialists of Engineer	Member

727. The representative(s) of the Environmental and Resettlement Unit of RD shall coordinate the work of the Committee and at the same time they will be the contact person for collecting the grievances and handling grievance log. The local authorities at the municipal level (Zestafoni), Contractor, Engineer, as well as PAPs (through informal meetings) will be informed about the contact person.

728. The PAPs should be informed about the available GRM. This shall be achieved through the public consultation process and routine community meetings throughout the construction phase.

H.3.7 Grievance Redress Commission for Stage 2

729. Grievance Redress Commission (GRCN) is formed by the order of the Head of the RD as a permanently functional informal structure, engaging personnel of RD from all departments having regard to the environmental and LARP issues and complaint resolution. This includes top management, Environmental and Social Safeguards Units, Legal Departments, PR department and other relevant departments (depending on specific structure of the RD). The GRCN is involved at the Stage 2 of grievance resolution process. The Order shall also state that if necessary representative of local authorities, NGOs, auditors, representatives of PAPs and any other persons or entities can be engaged in a work of GRCN. For the GRCN the following composition is proposed in **Table H-5**. There shall be at least one female member of the GRCE.

Table H-5: GRCN Composition

1	RD Management	Member
2	Head of Environmental and Social Safeguards Unit at RD	Member
3	Legal Department of RD	Member
4	PR Department of RD	Member

H.3.8 Grievance Redress Procedures

Stage 1 – informal review of the AP's complaint (whether written or oral)

730. **Grievance Collection and registration.** The representative(s) of the Environmental and Resettlement Unit of the RD is the person responsible for collecting the grievances received from different entry points and for recording them. Through the consultations conducted at the early stages of the project development and throughout construction, the PAPs will be informed that grievances should be addressed directly to the Contact Person. However, it is expected that some portion of grievances will be addressed to the local authorities at the Municipal level, to the Contractor and Engineer. All these stakeholders will arrange entry points and recording systems for grievances and will readdress the grievances to the Contact Person. Further, the Contact Person will register the grievances and will coordinate the grievance resolution process, engaging the required members of GRCE.

Step 1: Informal negotiations

731. The Representative of the RD will review the grievance, and based on that will:

- Define the list;
- Agree with the claimant the date and site for the informal meeting;
- Conduct meetings, site visits and negotiations with the PAP with participation of relevant members of the GRCE; and
- Will document all site-visits, meetings and discussions with the involved parties (minutes of meetings, photos, etc.)

732. In case of amicable resolution of the dispute, a Protocol of Agreement (Protocol 1: Action Plan) will be prepared by the RD describing agreed actions, dates, other conditions. The protocol will be signed by the claimant and Contact Person. The Action Plan should define:

- Clear timeline for each action; and
- Parties responsible for undertaking and completing each action, budget.

733. After implementation of the agreed action another protocol is prepared by the RD (Protocol of Grievance Closure), which confirms the fact that the parties have finally resolved the dispute. The protocol will be signed by RD as a representative of GRCE and by the claimant.

Step 2.: Formal Review of the Grievance by GRCE:

730. If informal negotiations conducted as step 1 of the stage 1 process fails to resolve the issue, the official procedure of the grievance review by the GRCE is triggered.

734. The Contact Person of Environmental and Resettlement Safeguards Unit of RD assists the claimant to prepare the official written claim addressed to the GRCE

and supplements this by his information notes.

735. The written claim will contain the following information:

- Name and contact details of the claimant;
- Date of submitting claim;
- The brief description of the essence of claim; and
- Documents prepared (photos, maps, other documents) confirming the information presented in a claim.

736. The RD and all members of the GRCE regarding the need of execution of the formal GRCE procedure. The RD will agree the date of formal meeting with the chairman and Secretary of the GRCE and inform the claimant and all members of the GRCE regarding the meeting site and date. The meeting should be held not later than two weeks after the notification issued by the RD. The RD will distribute the claim supplementary documents among the GRCE members.

737. The GRCE will engage all required specialists in reviewing the claim and, in case of need, will invite them on a planned meeting. During 1 week after the meeting the GRCE will issue its Conclusion and the Contact Person will inform the claimant about the decision.

738. In case of amicable resolution of the dispute, a Protocol of Agreement is prepared by the RD describing agreed actions, dates, other conditions. The protocol is signed by the claimant and Chairman of the GRCE.

739. After implementation of the agreed action the Protocol of Grievance Closure is prepared by the RD. The protocol will be signed by the Chairman of GRCE and by the claimant.

737. If informal negotiations conducted as stage 1 process fails to resolve the issue, the grievance resolution by GRCE at the local level is considered as not sufficient and the claim resolution process by GRCN at the central level is triggered.

738. The RD assists the claimant to prepare the official written claim addressed to the GRCE and supplements this by his information notes.

740. The written claim will contain following information:

- Name and contact details of the claimant;
- Date of submitting claim;
- The brief description of the essence of claim; and
- Documents prepared (photos, maps, other documents) confirming the information presented in a claim.

Stage 2 – Official Review of the Grievances by GRCN

741. The Stage 2 process is triggered by notice from the RD sent to the GRCN with the attached claim and the supplementary package of documents prepared with the assistance of the RD. The notice sent by the RD contains brief description of the grievance review and resolution attempts made at the Stage 1, including explanation of the reasons of disagreement and attachments (minutes of meetings, protocols, photos etc.).

742. Upon receiving the grievance and supplementary documents, the secretary of the GRCN will register the claim in a grievance log and initiate the formal grievance

review and resolution process in accordance with the requirements of the Administrative Code. The GRCN members will discuss the issue and engage relevant departments and specialists of the RD, in order to find solutions for the grievance resolution. In case of need the specialists from other governmental institutions or expert groups could be also engaged.

743. Not later than two weeks from receiving the claim, the GRCN will conduct a formal hearing participation of the claimant at a date fixed by the GRCN member secretary. On the date of hearing, the aggrieved PAP will appear before the GRCN at the RD office for consideration of grievance. The member secretary will note down the statements of the complainant and document all details of the claim, proposed solutions and final agreement.

744. In case of amicable resolution of the dispute, a Protocol of Agreement (protocol 1) is prepared by the Secretary of GRCN, describing agreed actions, deadlines and other conditions. The protocol is signed by the claimant and Chairman of the GRCN.

745. After implementation of the agreed action the Protocol of Grievance Closure is prepared by the Secretary of GRCN. The protocol will be signed by the Chairman of GRCE and by the claimant.

746. If the RD decision fails to satisfy the aggrieved PAPs, they can pursue further action by submitting their case to the appropriate court of law (Rayon Court). GRCN (secretary) will help the claimant to prepare the documents for submission to the Rayon (municipal) court.

747. A brief description of all stages of Grievance Resolution Process are given in the **Table H-6** below.

Table H-6: Grievance Resolution Process

Steps	Action Level	Process
Stage 1 (GRCE Level)	Step 1: Informal negotiations with PAPs	The complaint is informally reviewed by the GRCE Contact Person – Representative of Environmental and Resettlement Unit of RD, which takes all necessary measures to resolve the dispute amicably. At this stage, RD Contact Person engages in discussions with PAP only those members of the GRCE, who have direct relation to the issue.
	Step 2: Formal negotiations with PAPs GRCE level resolution of grievance	If the oral grievance is not solved during the negotiations, the GRCE will assist the aggrieved PAPs to formally lodge the grievances to the GRCE. The aggrieved PAPs shall submit their complaints to the GRCE within 1 week after completion of the negotiations at the village level or later, as he wishes. The aggrieved PAP shall produce documents supporting his/her claim. The GRCE RD Contact Person will review the complaint and prepare a Case File for GRCE hearing and resolution. A formal hearing will be held with the GRCE at a date fixed by the GRCE RD Contact Person. On the date of hearing, the aggrieved PAP will

		appear before the GRCE at the Municipality office for consideration of grievance. The member secretary will note down the statements of the complainant and document all details of the claim. The decisions from majority of the members will be considered final from the GRCE at Stage 1 and will be issued by the RD Contact Person and signed by other members of the GRCE. The case record will be updated and the decision will be communicated to the complainant PAP. After implementation of the agreed action the Protocol of Grievance Closure is prepared by the RD Contact Person. The protocol will be signed by the Chairman of GRCE and by the claimant.
Stage 2	Step 3 Decision from central RD GRCN	If any aggrieved PAP is unsatisfied with the GRCE decision, the next option will be to lodge grievances to the RD at the national level. GRCE should assist the plaintiff in lodging an official complaint to GRCN (the plaintiff should be informed of his/her rights and obligations, rules and procedures of making a complaint, format of complaint, terms of complaint submission, etc.). The aggrieved PAP shall produce documents supporting his/her claim, in accordance with the legal requirements (Administrative Code of Georgia). The GRCN of the RD shall review the complaint in compliance with the procedures specified in the Administrative Code of Georgia. If needed, a formal hearing will be held with the GRCN at a date fixed by the GRCN member secretary. On the date of hearing, the aggrieved PAP will appear before the GRCN at the RD office for consideration of grievance. The Contact person will note down the statements of the complainant and document all details of the claim. The plaintiff shall be informed of the decision.
Stage 3	Step 4 Court decision	If the RD decision fails to satisfy the aggrieved PAPs, they can pursue further action by submitting their case to the appropriate court of law (Rayon Court). The aggrieved PAP can take a legal action not only about the amount of compensation but also any other issues, e.g. occupation of their land by the contractor without their consent, damage or loss of their property, restrictions on the use of land/assets, etc.

H.3.9 Grievance Log

748. The Grievance Logs will be developed at GRCE level.

Grievance Log in GRCE

749. The GRCE Grievance Logs will be developed and maintained at the Municipal level.

750. The Grievance Logs will be developed and managed by the RD representative at site. The logs will be kept on Excel files and shared copies will be available at the RD and at site in the Engineers office. The records in Grievance logs include the following information:

- Name and contact details of the claimant;
- Date of receiving claim;
- Form of claim – (oral or written);
- To whom the claim has been addressed initially (entry point);
- The brief description of the essence of claim;
- The stages, dates and participants of negotiations with the PAP with GRCE (stage 1);
- Minutes of meetings;
- Final decision of the GRCE (in case of the dispute is resolved, the decision is about closure of the issue. In case if the dispute remains unresolved, the decision is about passing to the stage 2 of the grievance redress process);
- Date of decision of GRCE; and
- Documents prepared by PAP with the help of GRCE for passing to GRCN.

751. The copies of the records/documents may be also kept in the municipal office.

ADB Accountability Mechanism Policy, 2012

752. In addition to the GRM, the ADB has also developed its Accountability Mechanism (AM) Policy. The AM provides a forum where people adversely affected by ADB-assisted projects can voice and seek solutions to their problems and report alleged noncompliance with ADB's operational policies and procedures. It consists of two separate but complementary functions: problem solving function and compliance review function. The objective of the Accountability Mechanism Policy 2012 is to be accountable to people for ADB-assisted projects as a last resort mechanism.

H.3.10 Disclosure of the Grievance Process

753. The complaints resolution process was presented formally during the public consultations. The grievance redress mechanism will also be presented during routine community meetings in the Project area during the construction phase of the Project.

I. Conclusions and Recommendations

I.1 Conclusions

754. This EIA has established that there are no significant environmental issues that cannot be either totally prevented or adequately mitigated to levels acceptable GoG and international standards for all Project activities. However, further detailed assessment is required to determine the exact nature and extent of noise impacts within the Project corridor so that suitable and cost effective mitigation measures can be provided.

755. The total estimate costs of the environmental mitigation and management to be funded by JICA has been calculated at approximately US$9,787,870, or approximately 3% of the total project cost of $328m. This figure does not include costs of resettlement of people affected by noise (which will be included in the Project LARP).

I.2 Recommendations

756. The EMP, its mitigation and monitoring programs, contained herewith will be included within the Bidding documents for project works for all Project components. The Bid documents state that the Contractor will be responsible for the implementation of the requirements of the EMP through his own 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 borrow pit locations. This ensures that all potential bidders are aware of the environmental requirements of the Project and its associated environmental costs.

757. The EMP and all its requirements will then 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 note any non-conformance with the SSEMP (and the EMP) the Contractor can be held liable for breach of the contractual obligations of the EMP. To ensure compliance with the SSEMP the Contractor should employ an Environmental Manager to monitor and report Project activities throughout the Project Construction phase.

APPENDIX A

List of Consultation Attendees, June 2017

NAME	SIGNATURE	TEL. No
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible] 577111580
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APPENDIX B

Consultation Presentation, June, 2017

Project Overview

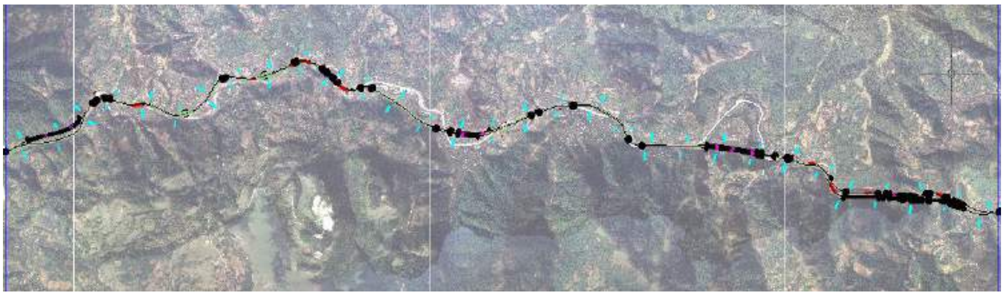
The Project is construction of a new road requiring new tunnels, bridges and other structures in order to allow traffic capacity expansion. Construction will be undertaken in difficult topographic and geological conditions without interrupting the traffic flow.

Item	Description
Road Length	41.665 km
Road Width / Number of Lanes	27m/4 lanes
Design Speed	100/80 km/h
Number of Bridges	77
Number of Tunnels	40
Construction Period	3 years

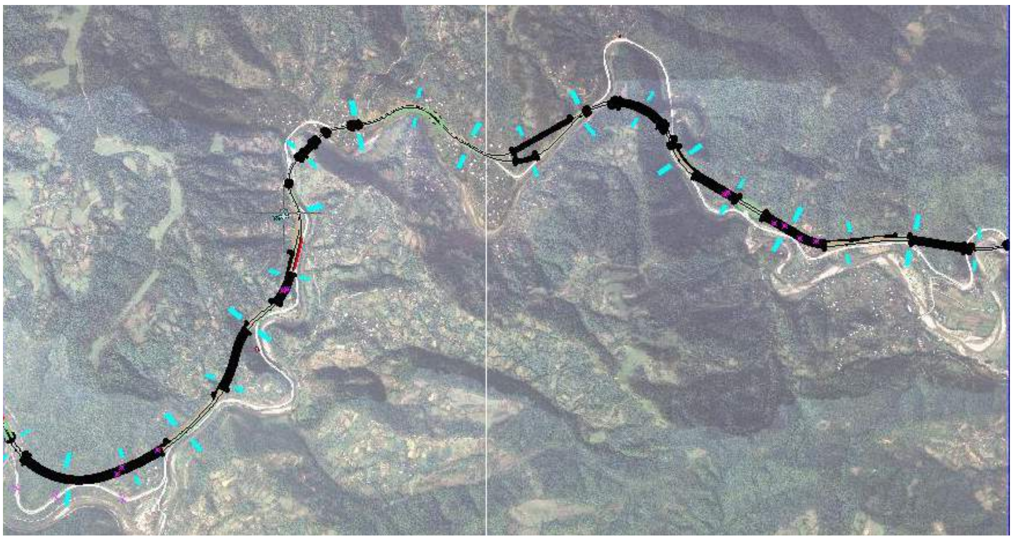
Project Location

Khevi-Argveta section of E60 Highway starts at the 9th km west from the existing Rikoti tunnel and ends near village Argveta. The entire section is divided in 3 Lots: F2-F3-F4

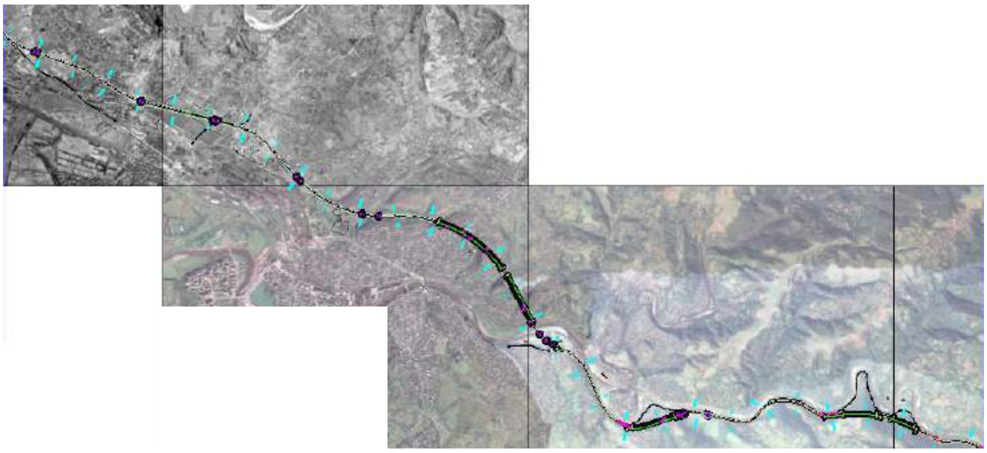
1st Lot: F2 (from km 8+880 to km 24+266 – Tot Length = 15.4 km)



3rd Lot: F4 (from km 34+695 to km 50+545 – Tot Length = 10.4 km)



2nd Lot: F3 (from km 24+266 to km 34+695 – Tot Length – 10.4 km)



Need for the Project

Transport sector development in Georgia is essential for the achievement of sustainable economic growth, alleviation of poverty and promotion of tourism.

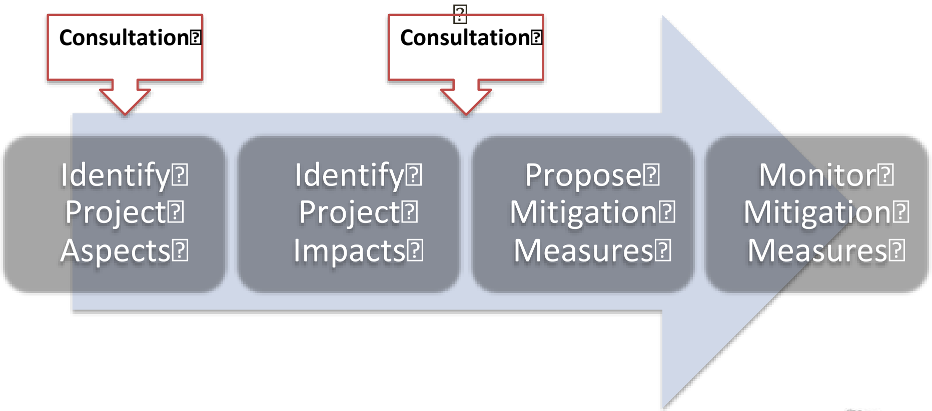
Deterioration of transport infrastructure increases the cost of doing business, deters foreign investment, hampers transit traffic growth, and leaves segments of the population out of mainstream economic activities.

Georgia's geographical location is at the center of East-West (Black Sea and Caspian Sea) and North-South (between Russia and Turkey) transit routes.

Trade with neighboring countries is therefore an important driver of Georgia's economy.

What is EIA?

"A process for predicting and assessing the potential environmental and social impacts of a proposed project, evaluating alternatives and designing appropriate mitigation, management and monitoring measures."



Need for Consultations

EIA of the Project is required by both Government of Georgia and the Asian Development Bank (ADB)

ADB specifically state:

"The borrower/client will carry out meaningful consultation with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation."

For environment category A projects, such consultations will include consultations at the early stage of EIA field work and when the draft EIA report is available during project preparation, and before project appraisal by ADB.

Type of Consultations

Second round – review draft EIA and comment on the findings of the report

First Round – initial discussions regarding the scope of the EIA and potential impacts

Other EIA Activities

1. Collection of Baseline Data, including surveys of flora, fauna & rivers.
2. Instrumental monitoring of existing air quality, noise and water quality.
3. Review regulatory requirements.
4. Examine potential alternatives.
5. Assess impacts using tools such as impact matrices and models (air and noise).
6. Prepare of Environmental Mitigation and Monitoring Plans

Potential Physical Impacts

Aspect	Potential Impact
Air quality	• Dust during construction – from vehicle movement, batching plants, blasting, tunneling, etc. • Vehicle and machinery emissions both during construction and operational phases of the project.
Soils	• Spills and leaks of hazardous liquids. • Poor management of borrow pits. • Soil Erosion during the operational phase.
Water Quality	• Spills and leaks of hazardous liquids into rivers. • Sedimentation of water ways. • Poor disposal of waste water from camp sites.
Climate Change	• Increased levels of GHGs from vehicle emissions. • Impacts of climate change to the Project, e.g. flooding.

ADB

Potential Biological Impacts

Aspect	Potential Impact
Flora	• Clearance of vegetation for road widening, borrow pits, construction camps and access roads. • Illegal cutting of trees. • Damage to trees and vegetation during construction.
Fauna	• Destruction of habitat for road widening, borrow pits, construction camps and access roads. • Blocking migration routes. • Degradation of river habitat and associated impacts to fish and other aquatic fauna.
Protected Areas / Forests	• Degradation of forests for road widening, borrow pits, construction camps and access roads.

ADB

Potential Socio-economic Impacts

Aspect	Potential Impact
Access	• Construction works impeding access to properties and shops / businesses.
Noise	• Elevated noise levels during both construction and operational phases of the project.
Traffic and Safety	• Construction traffic accidents. • Blasting during tunnel excavation and embankment works. • Accidents to workers. • Accidents involving the public at work sites.
Waste	• Illegal dumping of solid and liquid waste • Poor management of hazardous waste leading to pollution of soil, groundwater and health impacts
Cultural Heritage	• Road encroaching on cemeteries and sites of cultural value

APPENDIX C

List of Consultation Attendees, January 2018

DETAILED DESIGN FOR THE CONSTRUCTION OF KHEVI–UBISA–SHORAPANI–ARGVETA ROAD (E60 HIGHWAY), DEVELOPMENT OF BIDDING DOCUMENTS, ENVIRONMENTAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN

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APPENDIX D

Consultation Presentation, January, 2018

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პროექტის მიზანი

- საქართველოს მთავრობა ახორციელებს ქვეყნის ძირითადი საგზაო მაგისტრალების მოდერნიზაციას.
- პროგრამის ფარგლებში, ევროპის იაპონიის საერთაშორისო განვითარების სააგენტოს (JICA) დაფინანსებით, იგეგმება ქვ.წევა-არგვეთას გზის მონაკვეთის მშენებლობა.

3

პროექტის გზშ - ს საფუძველი - საქართველოს კანონმდებლობა და საერთაშორისო მოთხოვნები

- საქართველოს კანონმდებლობით - საერთაშორისო და შიდასახელმწიფოებრივი მნიშვნელობის საავტომობილო გზის, რკინიგზის და მათზე განთავსებული ხიდის, გზაგამტარის, გვირაბის საჭიროებს გარემოზე ზემოქმედების შეფასებას.
- საერთაშორისო საფინანსო ინსტიტუტების მოთხოვნების შესაბამისად - პროექტი მიეკუთვნება ე.წ. A კატეგორიას და საჭიროებს გარემოზე ზემოქმედების შეფასებას

4

მონაწილე მხარეები

- ✓ პროექტი ხორციელდება რეგიონალური განვითარების და ინფრასტრუქტურის სამინისტროს საავტომობილო გზების დეპარტამენტის ხელმძღვანელობით;
- ✓ პროექტი მუშავდება იტალიური კომპანიების „აი არ დი“-ს და „სპეა“-ს (IRD- SPEA) კონსორციუმის მიერ;
- ✓ გარემოზე ზემოქმედების შეფასება და განსახლების სამოქმედო მომზადებაზე პასუხისმგებელია “გამა კონსალტინგი” **IRD- SPEA-**ს ექსპერტებთან თანამშრომლობით.

5

ალტერნატივები

უპირატესი ვარიანტის შესარჩევად განხილული ალტერნატივები:

- ნულოვანი (არაქმედების) ალტერნატივა
- ტექნიკურ-ეკონომიკური შეფასების ეტაპზე განხილული 3 ოპტიმიზებული ალტერნატივა
- ახალი მარშრუტი (ტექნიკურ-ეკონომიკური შეფასებისას განხილული დერეფნის ფარგლებში)
- გზის საფარის ალტერნატივები (მყარი/ხისტი)

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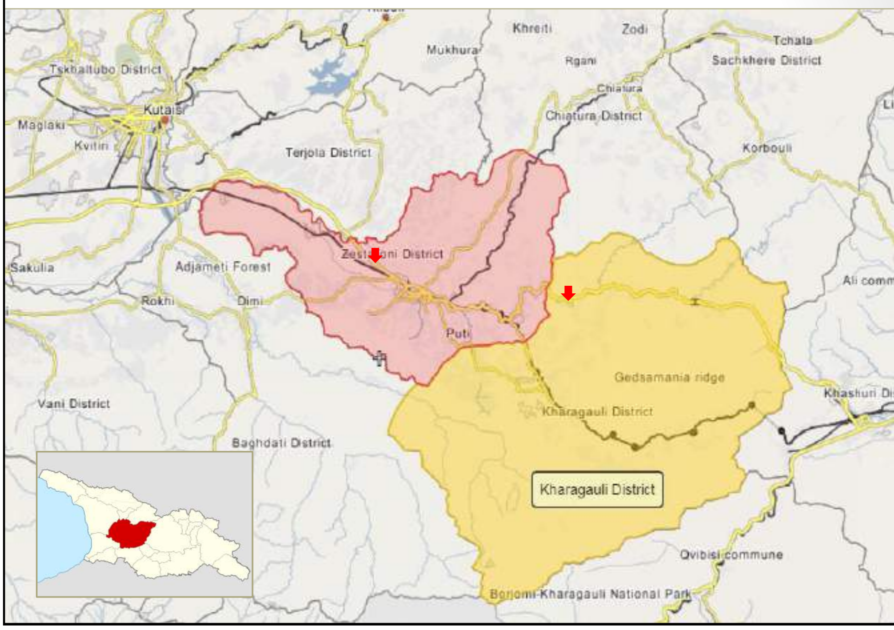

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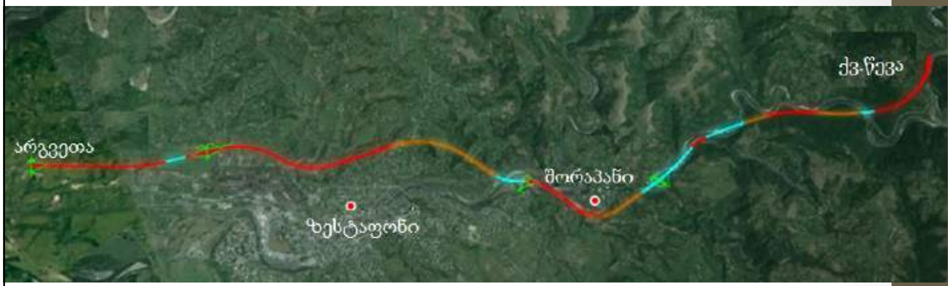
პროექტის აღწერა



წითელი - გზა;
ცისფერი - ხიდი;
ყავისფერი - გვირაბი

გზის სიგრძე:
- თბილისი არგვეთას მიმართულება - 14.778 კმ;
- არგვეთა - თბილისის მიმართულება - 14.726 კმ.

9

პროექტის აღწერა

- საპროექტო მონაკვეთის სიგრძე 14.7 კმ
- საპროექტო მონაკვეთი იწყება თბილისი-სენაკი-ლესელიძეს საავტომობილო გზის 185-ე კმ-ზე და სრულდება ამავე გზის 200 კმ-ზე სოფ. არგვეთასთან.
- პროექტით გათვალისწინებულია ხიდების (ჯამური რაოდენობა **10**) და გვირაბების (გვირაბები **6** ორმაგი გვირაბი, სიგრძით 399-დან 1166 მ-მდე) მშენებლობა.
- პროექტის ფარგლებში ასევე მოეწყობა:
  - გადასასვლელები სოფლის გზებისთვის;
  - გასასვლელბი პირუტყვისთვის;
  - კულვერტები

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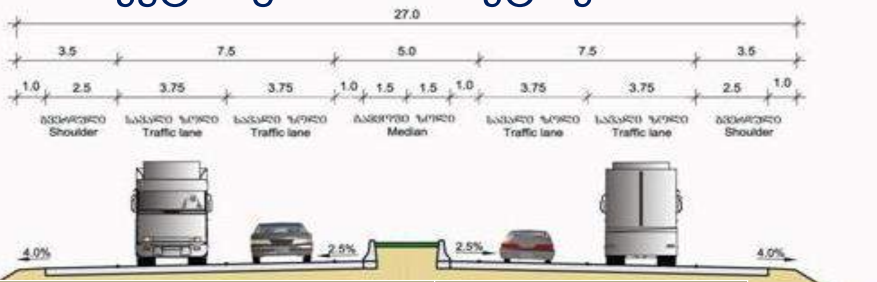
საპროექტო გზის პარამეტრები



საპროექტო სიჩქარე	**100** კმ/სთ
გზის ჯამური სიგანე	27 მ
სავალი ნაწილის ჯამური სიგანე:	2x7.5 მ
ზოლების რაოდენობა:	4
ზოლის სიგანე:	3.75 მ
ცენტრალური სარეზერვო სიგანე:	5.0 მ
გვერდულის სიგანე:	2.5 მ
გზისპირის სიგანე:	1 მ

11

ხიდები

ხიდი #	დასაწყ. პკ (მ)	ბოლოო პკ (მ)	მდინარე	ხიდის სიგრძე (მ)	მალის სიგრძე, მ
1-AT	1,256	1,846	ძირულა	589	42, 48, 54 და 60
1-TA	1,250	1,890	ძირულა	640	
2-AT	2,039	2,980	ძირულა	941	
2-TA	2,050	2,930	ძირულა	880	
3-AT	3,230	3,485	ბორიმელა	255	34
3-TA	3,210	3,470	ბორიმელა	260	
4-AT	5,862	6,317	ყვირილა	455	48, 54, 60 და 72
4-TA	5,853	6,273	ყვირილა	420	
5-AT	9,044	9,240	-	196	34
5-TA	9,018	9,214	-	196	
6-AT	7,061	7,101	-	40	
6-TA	7,031	7,071	-	40	
ჯამი				4,912	

#3,5 - სხმული ბეტონის; # 1,2,4 - ფოლად-ბეტონის

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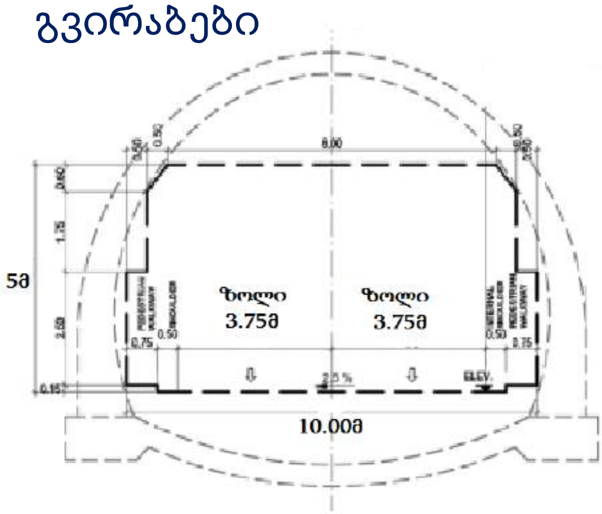
გვირაბები



გვირაბების ვერტიკალური ცენტრალურ ღერძებს შორის მანძილი =30მ

გვირაბი აღჭურვილი იქნება ვენტილაციით, ხანძრ-საწინააღმდეგო, ავარიული სატელეფონო სისტემებით, საავარიო გასასვლელებით.

13

გვირაბები

გვირაბი #	სიგრძე (მ)	პიკეტაჟი		ლითოლოგია
		დასაწყ.(მ)	ბოლო (მ)	
01-AT	560	165	725	საშუალო ხარისხის ქანები
01-TA	399	226	625	
02-AT	510	725	1,235	
02-TA	445	725	1,220	
03-AT	1,165	3,472	4,637	
03-TA	804	3,490	4,294	
04-AT	715	6,330	7,045	ზომიერად სუსტიდან საშ. ხარისხის ქანებამდე
04-TA	723	6,300	7,023	
05-AT	1,193	7,137	8,330	
05-TA	1,152	7,107	8,259	
06-AT	450	9,277	9,727	
06-TA	444	9,265	9,709	

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გასასვლელები და გადასასვლელები

- **6** გასასვლელები ადგილობრივი გზებისთვის - 6.0x4.5 მ
- **4** ნაჩირსარეკი - 4.0x2.5 მ
- **17** კულვერტი - 2.0x2.5 მ
- **2** კულვერტი (წყალსატარი) - 4.0x2.5 მ

- 1 გადასასვლელი (km 11+854-ზე) - სიგრძე =40 მ.

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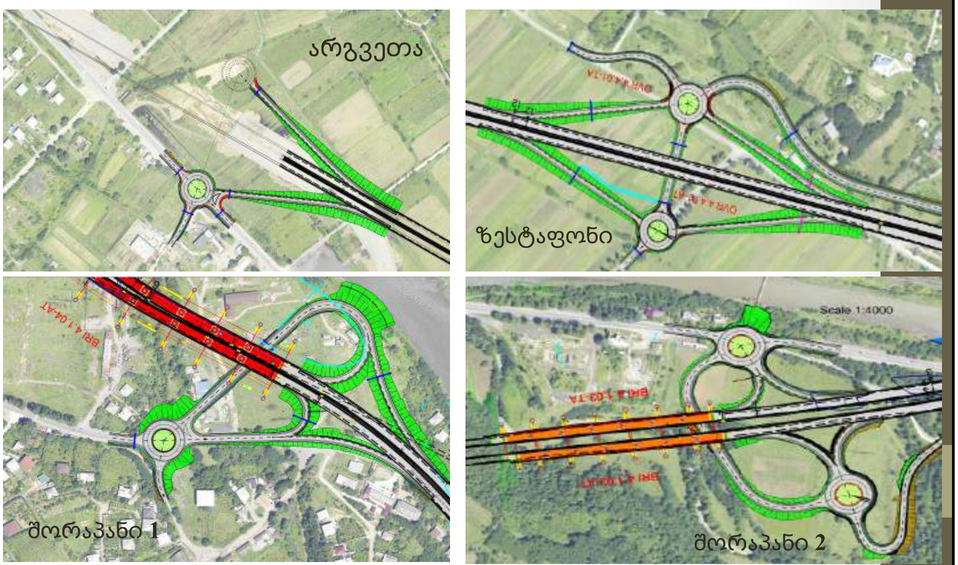
კვანძები

დაგეგმილია 4 კვანძის მოწყობა



' "%, &0 7 , 7 , &0 5&, 4 , . ! (/ , 8 " (, . ! (1%0 ; , (! ,
7 , &0 5&, 4 , . ! ((" +, , . ! ;) " 1, . ! (&! +, 4 $! 2

17

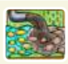
%" (' - * ! (+&0 . (' 7 / 1%0 ; , (!


' "%, &0 ("%(, . - * ! &4 ' 0 &"%, 0 . ! (4 "+" (! "2 , . "


8 ! 7 ! 3- % ' "%, &0 7 , - B', %7 , , #! "4 "' 7 , , 6="* 7 ,
7 , &0 5&, 4 , . ! (/ , 8 " (, . "


. ! 0 * 0 ' ! - % ' "%, &0 7 , - &; , #"%, - * ("8 "%7 , ,
; +0 $, * 2 " ("&="%0 7 , 7 , &0 5&, 4 , . ! (/ , 8 " (, . "


(0 ; ! "* -, 30 #0 &! 3- % ' "%, &0 7 , -4 " ("5&, . ",
3- *) - %- * ! &, &3$! 4 %, 0 . ! (: , ' * , . ! , (+$.
7 , &0 5&, 4 , . "


- "%=0 8 ! 2 ! 7 , &0 5&, 4 , . ! (/ , &; ! %, . ! (' 7 , . ! (
' "#("7 9 $%"


/ , &"%. ! * , . , * ! 9 0 #! (: ! , . , . ! (' ") "%, . ! (/ , &4 , ' , .6
#"%?, #! 7 , &0 5&, 4 , . ! (' "#("7 9 $%"


' "%, &0 (4 "; $! 2 ! &, #, @&, #) ! 4 " &0 #!) 0 %! #' ! (
4 "' , ' &$"

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ეტაპები

- ფონური მდგომარეობის შესწავლა - კამერალური და საველე სამუშაოები;
- რეცეპტორების განსაზღვრა, ზემოქმედების და მისი მნიშვნელოვნების შეფასება;
- ალტერნატივების შედარება პოტენციური ზემოქმედების; შერბილების შესაძლებლობის; საჭირო ხარჯების; ნარჩენი ზემოქმედების მნიშვნელოვნების თვალსაზრისით.
- უპირატესი ალტერნატივის შერჩევა;
- პროექტის ეტაპებისთვის ზემოქმედების მართვის და მონიტორინგის გეგმის მომზადება.

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შეფასების "საზღვრები"

ხმელეთის ბიომრავალფეროვნება	200 მ საპროექტო გზის ორივე მხარეს. 5 მ მოსასვლელი გზიდან.
წყლის ბიონრავალფეროვნება	მდინარის გადაკვეთის უბანზე - 50 მ დინების ზედა და 250მ დინების ქვედა მიმართულებით.
ჰაერი	გზის ღერძულა ხაზიდან 200 მ.
ხმაური	გზის ღერძულა ხაზიდან 250 მ,

ზემოქმედება მოსამზადებელი (წინა-სამშენებლო) ეტაპზე

დაგეგმილი სამუშაო/ქმედება	ზემოქმედება
• ნებართვების აღება პროექტთან დაკავშირებით; • გეგმების (როგორიცაა: ნარჩენების მართვის. სატრანსპორტო მოძრაობის მართვის. ეროზიის მართვის) შემუშავება და დამტკიცება; • მასალების წყაროს/ მიმწოდებლების იდენტიფიცირება; • დროებითი ბანაკებისათვის. მასალის. ნიადაგის ნაყოფიერი ფენის. გრუნტისა და ნარჩენების (დროებითი. ხანმოკლე) განთავსების ადგილების შერჩევა გარემოსდაცვის და უსაფრთხოების მოთხოვნების გათვალისწინებით;	გ ა რ ე მ ო ზ ე ზ ე მ ო ქ მ ე დ ე ბ ა მოსალოდნელი არ არის

დაგეგმილი სამუშაო/ ქმედება	ზემოქმედება
• ტერიტორიის მომზადება - მცენარეული საფერის მოხსნა, ნაყოფიერი ნიადაგის მოხსნა და დროებით დასაწყობებას. სამუშაო ტერიტორიის პროფილირება; • ტერიტორიაზე და მის გარეთ წარმოებული სამუშაოები.	• მტვრის და წვის პროდუქტების ემისია; • ხმაური და ვიბრაცია; • ნარჩენების წარმოქმნა; • საწვავის/ზეთების შემთხვევითი დაღვრა - ნიადაგისა და წყლის დაბინძურება; • ნიადაგის ეროზია/დატკეპნა; • ზემოქმედება ფლორასა და ფაუნაზე; • საგზაო მოძრაობის ზრდა - ზემოქმედება ინფრასტრუქტურაზე; • განსახლების/მიწის შეძენის (დროებით სარგებლობაში აღების) საჭიროება; • უსაფრთხოების რისკები - პერსონალის და მოსახლეობის უსაფრთხოება; • დროებითი დასაქმება (შენიშვნა: დადებითი ზემოქმედება).

ზემოქმედება მშენებლობის ეტაპზე

დაგეგმილი სამუშაო/ქმედება	ზემოქმედება
• ინერტული მასალების შემოტანა გზის ვაკისის მოსაწყობად; • მასალის დასაწყობება სპეციალურად გამოყოფილ ადგილას; • გვირაბის გაყვანა; • ვაკისის მოწყობა - ფორმირება. დატკეპნა; • დრენაჟის სისტემის მოწყობა; • შპუნტური კედლების მოწყობა მდინარის კალაპოტში ხიდის მშენებლობისას; • ხიდის მშენებლობა - მიწის. ბეტონის, სამონტაჟო	• ემისიები – მტვერი. გამონაბოლქვი, შედუღების აეროზოლები; • ხმაური და ვიბრაცია; • წყლის ხარისხის შესაძლო გაუარესება მდინარის კალაპოტში ან მის უშუალო სიახლოვეს მუშაობისას; • კალაპოტის ჩახერგვის რისკი; • ნავთობპროდუქტების ავარიული დაღვრის შემთხვევაში - ნიადაგის დაბინძურების შესაძლებლობა; • ნიადაგის ეროზია/დატკეპნა;

დაგეგმილი სამუშაო/ქმედება	ზემოქმედება
• ხიდის და სავალი ნაწილის საფარის მოწყობა. გვერდულების ჩათვლით; • გზის მონიშვნა და საგზაო ნიშნების დადგმა; • ტერიტორიაზე და მის გარეთ წარმოებული სამუშაოები.	• ნარჩენების წარმოქმნა; • ზემოქმედება ფაუნაზე; • ზემოქმედების რისკი მცენარეულობაზე; • სატრანსპორტო ნაკადის ზრდა; • ზემოქმედება საგზაო ინფრასტრუქტურაზე; • კერძო საკუთრების შემთხვევითი დაბინძურების რისკი; • დროებითი დასაქმება მშენებლობის დროს (დადებითი ზემოქმედება); • შესაძლო უსაფრთხოების რისკები - პერსონალის და მოსახლეობის უსაფრთხოება; • სატელიტური ბიზნესის ხელშეწყობა (დადებითი

ზემოქმედება ექსპლოატაციის ეტაპზე

დაგეგმილი სამუშაო/ქმედება	ზემოქმედება
• სატრანსპორტო მოძრაობა ახალი მარშრუტზე; • ხიდებისა და გზების ტექმომსახურება/მოვლა	• ემისია - მტვერი. გამონაბოლქვი; • ხმაური და ვიბრაცია; • უსაფრთხოების რისკები; • ზემოქმედება ტექმომსახურების/შეკეთების დროს - ზემოქმედების სახეები და რისკები მსგავსია მშენებლობის დროს მოსალოდნელის. თუმცა ნაკლები სიდიდის და უფრო ლოკალური.

გარემოზე ზემოქმედების შეფასების ჯგუფის მიერ ჩატარებული საველე კვლევები

- პროექტის ზემოქმედების ზონაში მცენარეული საფარის/ფლორის და ცხოველთა სამყაროს შესწავლა
- ზედაპირული, გრუნტის წყლის და ნიადაგის ფონური ხარისხის განსაზღვრა;
- ხმაურის და ჰაერის ხარისხის ფონური დონე;
- ვიბრაციის გაზომვა;
- სოციალურ-ეკონომიკური ინფორმაციის შეგროვება.

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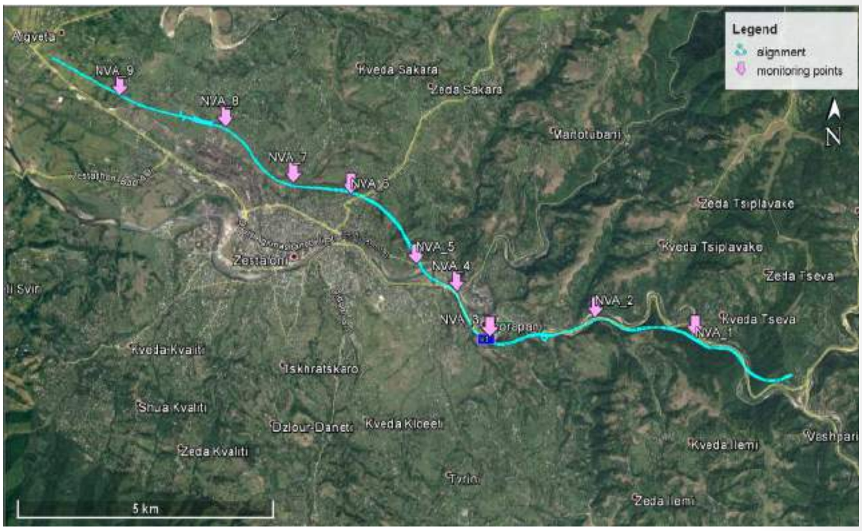
ხმაურის ფონური დონე



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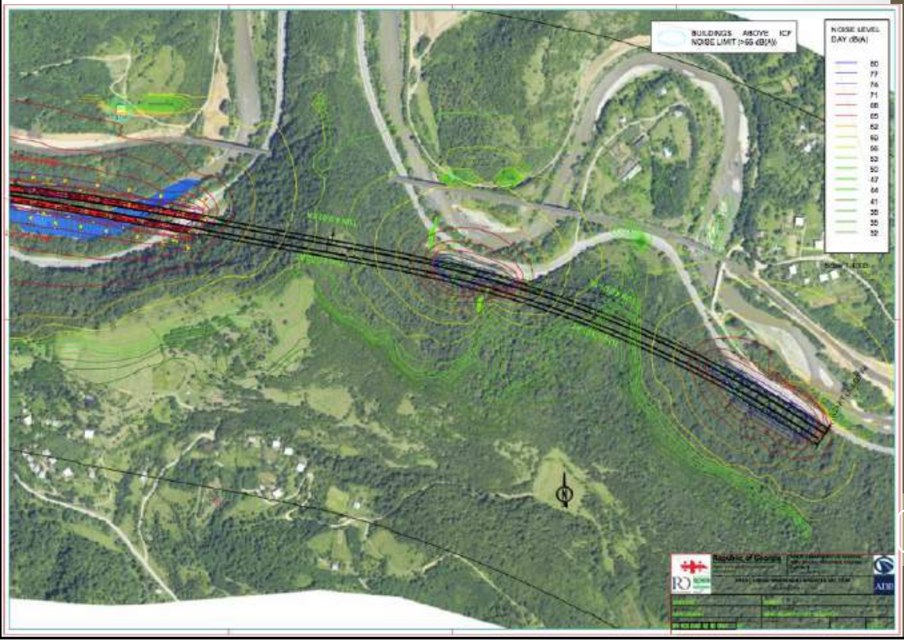
ხმაურის მოდელირება

- მშენებლობის დროს 25-50მ ხმაურის დონე დღის და ღამის საათებისთვის დაწესებულ ნორმას გადააჭარბებს. 100მ დაშორებით ხმაური დღის ნორმის ფარგლებში იქნება. 250მ-ზე - დღის და ღამის საათებში ხმაურის დონე დასაშვებს არ აღემატება.
- ხმაურის მოდელირება გზის ექსპლოატაციისას SOUND PLAN VER. 7.2 პროგრამის გამოყენებით - სატრანსპორტო ნაკადის პროგნოზული (30 წელი) ნაკადის გათვალისწინებით.

28

+&"- %! 4 9 ! ((" " 2 , . / !



29

+&"- %4 " &; " $! . " %! , %!

- - +, / ! &! " +* 0 , . ! 2 +&"- %! (' " # 4 " ("; " $" 4 (" >! %0 ! 5#, . " @"&/ ! &! " +* 0 , . ! 2 11.8&. " %! , %! (&0 6=0 . ".
- +&"- %! (4 " , &! (! , . ! (' " # 4 " ("; " $" 4 " (, $, / , (" : * , . , * ! " 10&(! ' " #! (&6$" #, . " %! , %, . ! (/ , 5&#" .
- ("3! 2 +! 4 " 7 - ( ) 4 , . " &0 #!) 0 %! #' ! ((" 8 - : $, * 7 , .

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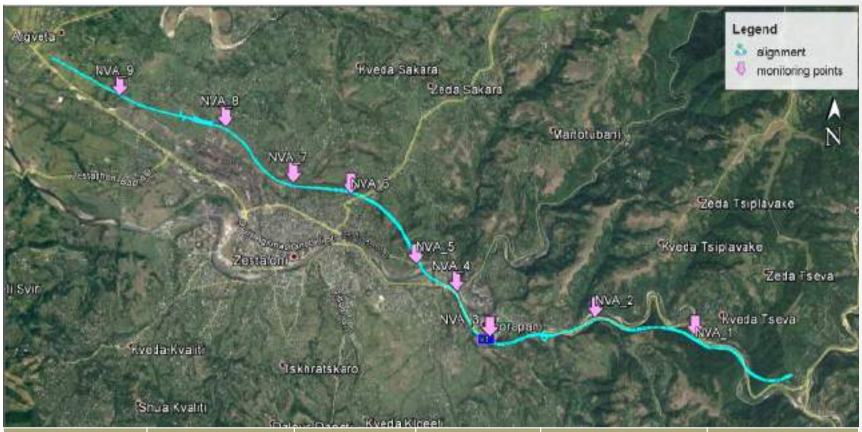
ჰაერის ფონური ხარისხი



CO. მკგ/მ3	NO_2. მკგ/მ3	SO_2. მკგ/მ3	PM10. მკგ/მ3	PM 2.5. მკგ/მ3	TSP. მკგ/მ3

საკონტროლო წერტილებში გაზომილი მახასიათებლები არ აღემატება დასაშვებს. NO2 და მტვრის მომატებული კონცენტრაცია დაფიქსირდა გზის მახლობლად .

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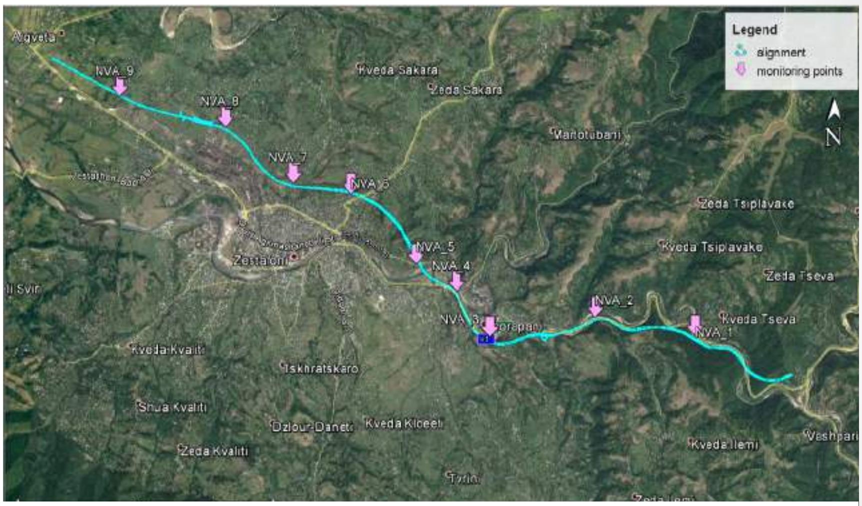
ფონური ვიბრაცია



მშენებლობის დროს ვიბრაციის წყაროების - სამშენებლო ტექნიკა, პნევმატური ჩაქუჩი, კომპაქტორი, გენერატორი (საჭიროების შემთხვევაში), აფეთქებითი სამუშაოები გვირაბში.

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ვიბრაცია

- ვიბრაცია მშენებლობისას წყაროდან 25მ დაშორებით არ გადააჭარბებს 10მმ/წმ.

ვიბრაციის შედეგად სტრუქტურული დაზიანების შესაძლებლობის კრიტერიუმები

ზიანი მოსალოდნელი არ არის	**PPV < 5 mm/s**
კოსმეტიკური დაზიანების რისკი	PPV 5 to 15 mm/s
კონსტრუქციული დაზიანების რისკი	PPV > 15 mm/s

- სამუშაოების დაწყებამდე (გვირაბის მოწყობის მონაკვეთი ზესტაფონთან) საჭირო იქნება ახლომდებარე შენობების ტექნიკური მდგომარეობის შემოწმება.

- ექპლოატაციის დროს კონსტრუქციული დაზიანების შესაძლებლობის მქონე ვიბრაციის ონე მოსალოდნელი არ არის

33

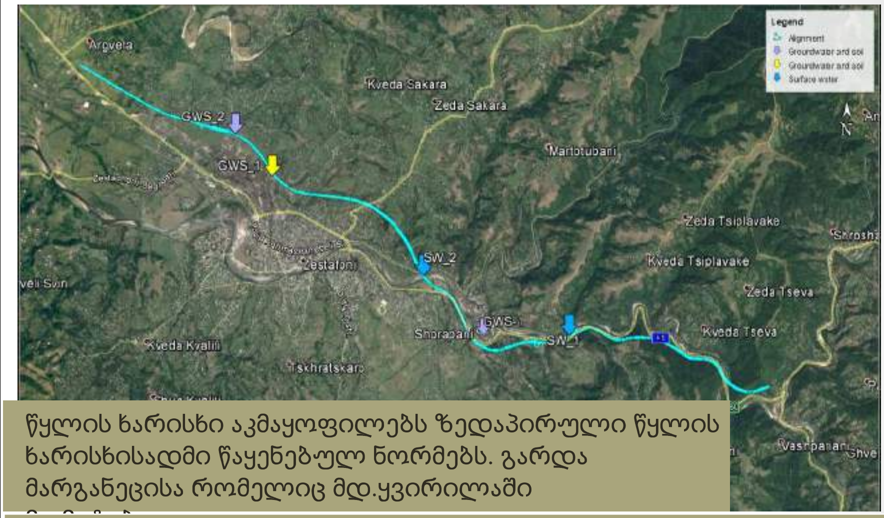
ნიადაგის ხარისხი

სპილენძი
თუთია
ნიკელი
ქრომი
ტყვია
დარიშხანი
კადმიუმი
ვერცხლისწყალი
პოლიქლორირებული ბიფენილები
ასბესტი

ზესტაფონის მიმდებარედ დაფიქსირდა ტყვიის და დარიშხანის ოდნავ მომატებული დონე.

34

ზედაპირული წყლის ხარისხი



წყლის ხარისხი აკმაყოფილებს ზედაპირული წყლის ხარისხისადმი წაყენებულ ნორმებს. გარდა მარგანეცისა რომელიც მდ.ყვირილაში

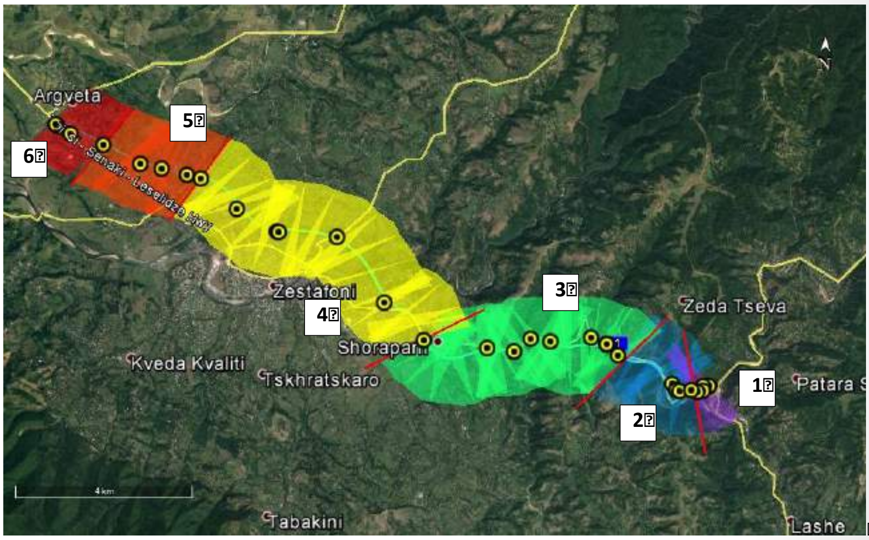
ზედაპირული წყალი: **pH**, ელგამტარობა **(EC)**, სიმღვრივე, ჟბმ$_5$, ჟქმ, გახსნილი ჟანგბადი **(DO)**, **TSS**, ჯამური ფოსფორი, ჯამური აზოტი, ჯამური ამონიუმი, ჯამური თუთია, გახსნილი სპილენძი, მარგანეცი, სიმღვრივე, **TPH**, ტოტალური კოლიფორმები

გრუნტის წყლის ხარისხი

pH
გახსნილი ჟანგბადი
ელგამტარობა
ტუტიანობა
სიხისტე
ჯამური შეტივნარებული ნაწილაკები
დარიშხანი
ქლორიდები
რკინა
ნიტრატები
ნატრიუმი
კალიუმი
კალციუმი
მაგნიუმი
მარგანეცი
ტყვია
სულფატები

წყლის ხარისხი აკმაყოფილებს საქართველოში მოქმედ მოთხოვნებს.

. ! 0 &%"$"* 8 , %0 $#, . "

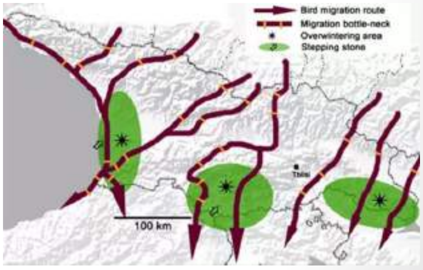


B'. !) ") , . ! (("30 #(, %$"; ! 0 9 ! %, . - * , . "

- . "#!	&0 3* , 4 "+"(! ", . "	
1	6! 2 , * ! #- (+! (("+, 0 . ! 4 "# 4 "8 ! 5(! %4 " 3"3* ! (+, (2 : ! %! , "+"* ' "7 %4 "), %0 &, * ! ; / , &0 9 0 . ! * &! 6! (#"3$, 2 7, "4 ' ! * 0 . %! $, . (+, * 0 $#- %"4 "5$2 ?"%' - * ! .	4 ". "* !
2	7 0 &! , %"4 ("+, / , ; $* ! * ! B'. !) ") ! ; "4 "&! "#! (7 , ' "$* , #" ("/ - "* 0 "; 4 "; - * ! ("+, 0 . , . ! 4 "# 4 "8 ! 5(! %4 " ?$. 6". * ! ("+"* ' "7 %4 ")4 " 2 : ! %! - %2 +0 $"%!	("/ - "* 0
3	7 0 &! , %"4 ("+, / , ; $* ! * ! B'. !) ") ! ". "4 "&! "#! (7 , ' "$* , #" ' "&0 ! +") , . " ("50 #* ! (: 0 $, . "(" 4 ") =! (?, +$"/ ! ; "% 4 "8 ! 5(! %4 " &, #"%! ("%; , %2 ! 4 "; - * ! ("+, 0 . ".	4 ". "* !
	&(' "$(!) ! 1! (B'. !) ") ! ' "#$! 2 "%, . - * ! " &4 ! #"%! (1! %" >"* , . / ! 4 "("+* , . , . ! (&'+* 0 . * "4 .	4 ". "* !
5	4 "; - * ! ("+, 0 . , . ! 4 "# ' $+$4 , . " 3"3"* ! (&0 &6! 8 "%!). ' "$%; , * , . - * ! " ! #$"7 ! - %! . "* "+0 $"#! &, #"%, =$"$! * 6$%! * ".	4 ". "* !
6	(! &! #4 ! (="#, . ! , $, #"+! , +, +! * ! (. "9 , . ! . 2 "$! (- 8 "*	&'9 "* !

ცხოველთა სამყარო - დაცული სახეობები

სახეობა	წით. ნუსხა	IUCN	სხვა	Section N
კავკასიური ციყვი	VU	LC	EU ჰაბიტატების დირექტივა (92/43) IV 21/05/92; ბერნის კონვენცია 01/03/02,	1/2/3
წავი	VU	NT	CITES დანართი I, ბერნის კონვენცია დანართი II, ჰაბიტატების დირექტივა დანართი II და IV	4
ხმელთაშუა აზღვის კუ	VU	VU	-	1/4/



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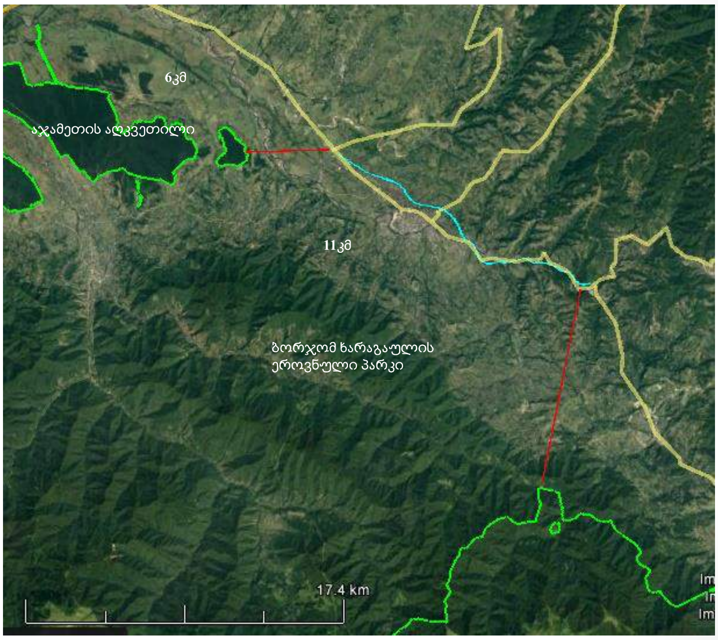
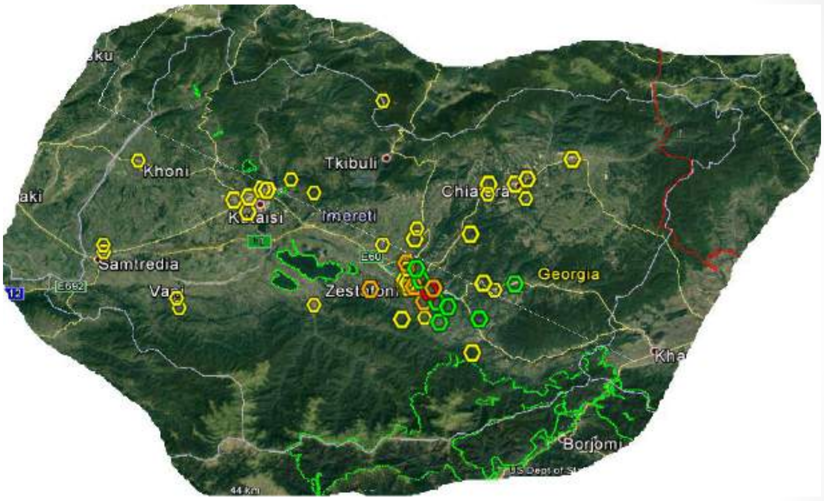
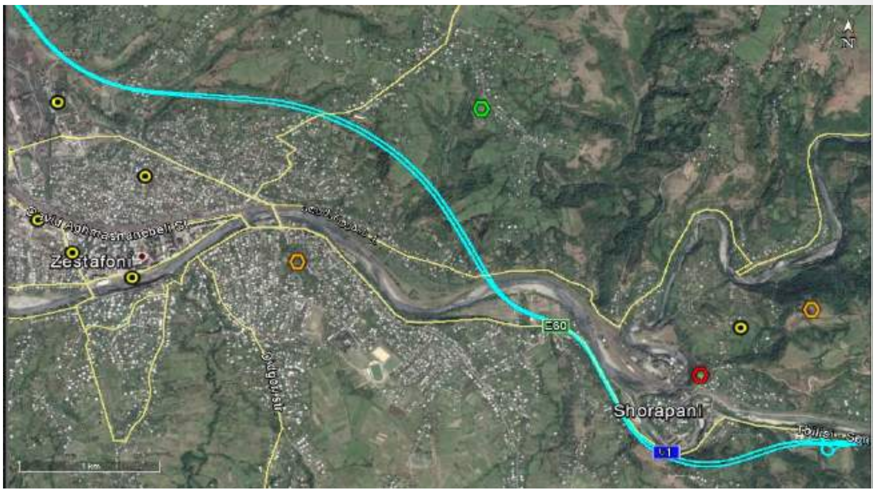
დაცული ტერიტორიები



კულტურული მემკვიდრეობა



კულტურული მემკვიდრეობა



ყვითელი ექსლკუთხედი - ეკლესია; მწვანე ექვსკუთხედი - ეკლესია და სასაფლაო; ნარინჯისფერი ექვსკუთხედი - სასაფლაო;

1წმ,ნინოს წკლესია,მიახლოებითი მანძილი 260m; 2 – წმ.ნიკოლოზის ეკლესია - მიახლ.მანძილი 650m. 3 – სასაფლაო - მიახლ მანძილი 630m; 4 – შორპნის ციხე - მიახლ. მანძილი 590მ

კულტურული მემკვიდრეობა - არქეოლოგია

ზემოქმედება	რანგირება
მშენებლობა	
ჰაერის ხარისხის გაუარესება	L-M, S, R, ადგილობრივი.
ხმაური და ვიბრაცია	L-M.S, R, ადგილობრივი
წყლის ხარისხი	L-M, S. R, ადგილობრივი
ნიადაგის ხარისხის გაუარესება	L-M, S, R, ადგილობრივი
ზემოქმედება ფლორაზე/ მცენარეულობაზე	L-M, ადგილობრივი, ტერიტორიებზე, რომელიც გასხვისება არ ხდება მუდმივად - საშუალოდან ხანმოკლე (დროებითი), შექცევადი.
ზემოქმედება ფაუნაზე	L-M, დამოკიდებულია სამარშრუტო მონაკვეთზე, S, R, ადგილობრივი. ეს იქნება - დარჩენილი ხმაურის გავრცელება, გამონაბოლქვი ემისიები, ზემოქმედების გარკვეული რისკი წყალქვეშა ცხოველებზე, დროებითი ზემოქმედება წყლის ხარისხზე(ძირითადად სიმღვრივის მომატება), შეჯახება
ლანდშაფტის და ვიზუალური ცვლილება	L-VL (დამოკიდებულია ადგილმდებარეობაზე), S, R, ადგილობრივი

ფუნქციონირება	
ჰაერის ხარისხის გაუარესება	დაბალიდან საშუალომდე, მოდელირების მონაცემების მიხედვით, ზემოქმედება არ არის მაღალი, შემამსუბუქებელი ზომები არ არის საჭირო
ხმაური და ვიბრაცია	დაბალიდან საშუალომდე .
წყლის ხარისხი	უმნიშვნელო - დაბინძურება ზედაპირული ჩამონარეცხით
ნიადაგის ხარისხის გაუარესება	დაბალიდან უმნიშვნელომდე - დაბინძურება ჩამონარეცხით
გეოლოგიური საშიშროებების განვითარება	უმნიშვნელო.
ზემოქმედება ფლორაზე/ მცენარეულობაზე	უმნიშვნელო.
ზემოქმედება ფაუნაზე	დაბალი. ხმაურის გავრცელება, გამონაბოლქვი ემისიები, ზემოქმედების გარკვეული რისკი წყლის ცხოველებზე წყლის ხარისხის გაუარესების გამო და კოლიზიის რისკი
ლანდშაფტის და ვიზუალური ცვლილება	მნიშვნელოვანი ცვლილება გზისა და ხიდების გამო

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- / 0 %"1"#! (3&4.0-6.0)
- 7 , ( ) "8 0 #! (3&6.0-11.0)
- 5$.("5"%" (3&11.0-12.0)
- "%' $, 2 " (3&13.0-15.0)

' "("($* , * , . !

#	ვკ (მ)	#	ვკ (მ)
01-AT	10,293	03-AT	13,222
01-TA	10,269	03-TA	13,200
02-AT	12,770	04-AT	13,636
02-TA	12,749	04-TA	13,614

კულვერტები

#	პკ (მ)	#	პკ (მ)	#	პკ (მ)	#	პკ (მ)
01-AT	50	14-AT	5,408	28-TA	11,223	40-AT	13,259
01-TA	50	16-TA	8,333	28-AT	11,245	42-TA	13,405
04-AT	190	16-AT	8,344	30-TA	11,567	42-AT	13,427
04-TA	190	18-TA	8,683	30-AT	11,579	44-TA	13,568
06-TA	620	18-AT	8,694	32-TA	12,183	44-AT	13,591
08-AT	755	20-TA	9,923	32-AT	12,204	46-TA	13,818
08-TA	760	20-AT	9,954	34-TA	12,428	46-AT	13,842
06-AT	615	22-TA	10,172	34-AT	12,449	48-TA	13,955
10-TA	4,639	22-AT	10,197	36-TA	12,489	48-AT	13,979
10-AT	4,661	24-TA	10,534	36-AT	12,510	50-TA	14,188
12-TA	5,021	24-AT	10,558	38-TA	12,975	50-AT	14,213
12-AT	5,049	26-TA	10,794	38-AT	12,997	52-TA	14,349
14-TA	5,391	26-AT	10,817	40-TA	13,236	52-AT	14,274

დამცავი კედლები

- კმ 0.00 to კმ 0.25
- კმ 4.36 to კმ 4.43 (შორაპანთან)
- კმ 8.63 to კმ 8.71
- კმ 8.84 to კმ 8.94

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APPENDIX E

Chance Find Procedure

Purpose of the chance find procedure

The chance find procedure is a project-specific procedure that outlines actions required if previously unknown heritage resources, particularly archaeological resources, are encountered during project construction or operation. A Chance Find Procedure, as described in IFC Performance Standard 8 and EBRD Performance Requirement 8 and law on Cultural Heritage of Georgia, is a process that prevents chance finds from being disturbed until an assessment by a competent specialist is made and actions consistent with the requirements are implemented.

Scope of the chance find procedure

This procedure is applicable to all activities conducted by the personnel, including contractors, that have the potential to uncover a heritage item/site. The procedure details the actions to be taken when a previously unidentified and potential heritage item/site is found during construction activities. Procedure outlines the roles and responsibilities and the response times required from both project staff, and any relevant heritage authority.

Induction/Training

All personnel, especially those working on earth movements and excavations, are to be inducted on the identification of potential heritage items/sites and the relevant actions for them with regards to this procedure during the Project induction and regular toolbox talks.

Chance find procedure

If any person discovers a physical cultural resource, such as (but not limited to) archaeological sites, historical sites, remains and objects, or a cemetery and/or individual graves during excavation or construction, the following steps shall be taken:

1. Stop all works in the vicinity of the find, until a solution is found for the preservation of these artefacts, or advice from the relevant authorities is obtained;
2. Immediately notify a foreman. The foreman will then notify the Construction Manager and the Environment Officer (EO)/Environmental Manager (EM);
3. Record details in Incident Report and take photos of the find;
4. Delineate the discovered site or area; secure the site to prevent any damage or loss of removable objects. In cases of removable antiquities or sensitive remains, a night guard shall be arranged until the responsible local authorities take over;
5. Preliminary evaluation of the findings by archaeologists. The archaeologist must make a rapid assessment of the site or find to determine its importance. Based on this assessment the appropriate strategy can be implemented. The significance and importance of the findings should be assessed according to the various criteria relevant to cultural heritage such as aesthetic, historic, scientific or research, social and economic values of the find;
6. Sites of minor significance (such as isolated or unclear features, and isolated finds) should be recorded immediately by the archaeologist, thus causing a minimum disruption to the work schedule of the Contractor. The results of all archaeological work must be reported to the Ministry/Agency, once completed.
7. In case of significant find the Agency/Ministry (Agency for Protection of National Heritage or Archaeological Research Centre, hereinafter referred to as Heritage

team) should be informed immediately and in writing within 7 days from the find (ref.law on heritage protection).

8. The onsite archaeologist provides the Heritage team with photos, other information as relevant for identification and assessment of the significance of heritage items.
9. The Ministry must investigate the fact within 2 weeks from the date of notification and provide response in writing.
10. Decisions on how to handle the finding shall be taken by the responsible authorities. This could include changes in the layout (such as when finding an irremovable remain of cultural or archaeological importance) conservation, preservation, restoration and salvage;
11. Construction works could resume only after permission is granted from the responsible authorities.
12. In case no response received within the 2 weeks period mentioned above, this is considered as authorisation to proceed with suspended construction works.

One of the main requirements of the procedure is record keeping. All finds must be registered. Photolog, copies of communication with decision making authorities, conclusions and recommendations/guidance, implementation reports – kept.

Additional information
Management options for archaeological site

- **Site avoidance.** If the boundaries of the site have been delineated attempt must be made to redesign the proposed development to avoid the site. (The fastest and most cost-effective management option)
- **Mitigation.** If it is not feasible to avoid the site through redesign, it will be necessary to sample it using data collection program prior to its loss. This could include surface collection and/or excavation. (The most expensive and time-consuming management option.)
- **Site Protection.** It may be possible to protect the site through the installation of barriers during the time of the development and/or possibly for a longer term. This could include the erection of high visibility fencing around the site or covering the site area with a geotextile and then capping it with fill. The exact prescription would be site- specific.

Management of replicable and non-replicable heritage
Different approaches for the finds apply to replicable and non-replicable heritage.

Replicable heritage
Where tangible cultural heritage that is replicable[23] and not critical is encountered, mitigation measures will be applied.
The mitigation hierarchy is as follows:

- Avoidance;
- Minimization of adverse impacts and implementation of restoration measures, in situ;
- Restoration of the functionality of the cultural heritage, in a different location;

[23] Replicable cultural heritage is defined as tangible forms of cultural heritage that can themselves be moved to another location or that can be replaced by a similar structure or natural features to which the cultural values can be transferred by appropriate measures. Archaeological or historical sites may be considered replicable where the particular eras and cultural values they represent are well represented by other sites and/or structures.

- Permanent removal of historical and archaeological artefacts and structures ;
- Compensation of loss - where minimization of adverse impacts and restoration not feasible.

Non-replicable heritage
Most cultural heritage is best protected by in situ preservation, since removal is likely to result in irreparable damage or even destruction of the cultural heritage.

Nonreplicable cultural heritage[24] must not be removed unless all of the following conditions are met:

- There are no technically or financially feasible alternatives to removal;
- The overall benefits of the project conclusively outweigh the anticipated cultural heritage loss from removal; and

Any removal of cultural heritage must be conducted using the best available technique advised by relevant authority and supervised by archaeologist.

Human Remains Management Options
The handling of human remains believed to be archaeological in nature requires communication according to the same procedure described above.

There are two possible courses of action:

- **Avoid.** The development project is redesigned to completely avoid the found remains. An assessment should be made as to whether the remains may be affected by residual or accumulative impacts associated with the development, and properly addressed by a comprehensive management plan.
- **Exhumate.** Exhumation of the remains in a manner considered appropriate by decision makers. This will involve the predetermination of a site suitable for the reburial of the remains. Certain ceremonies or procedures may need to be followed before development activities can recommence in the area of the discovery.

EMERGENCY CONTACTS
Ministry of Culture and Monument Protection
Address: 4 Sanapiro Street, 0105, Tbilisi, Georgia; Fax: 995 32 2999966, 2932235;
E-Mail: culturegovge@gmail.com

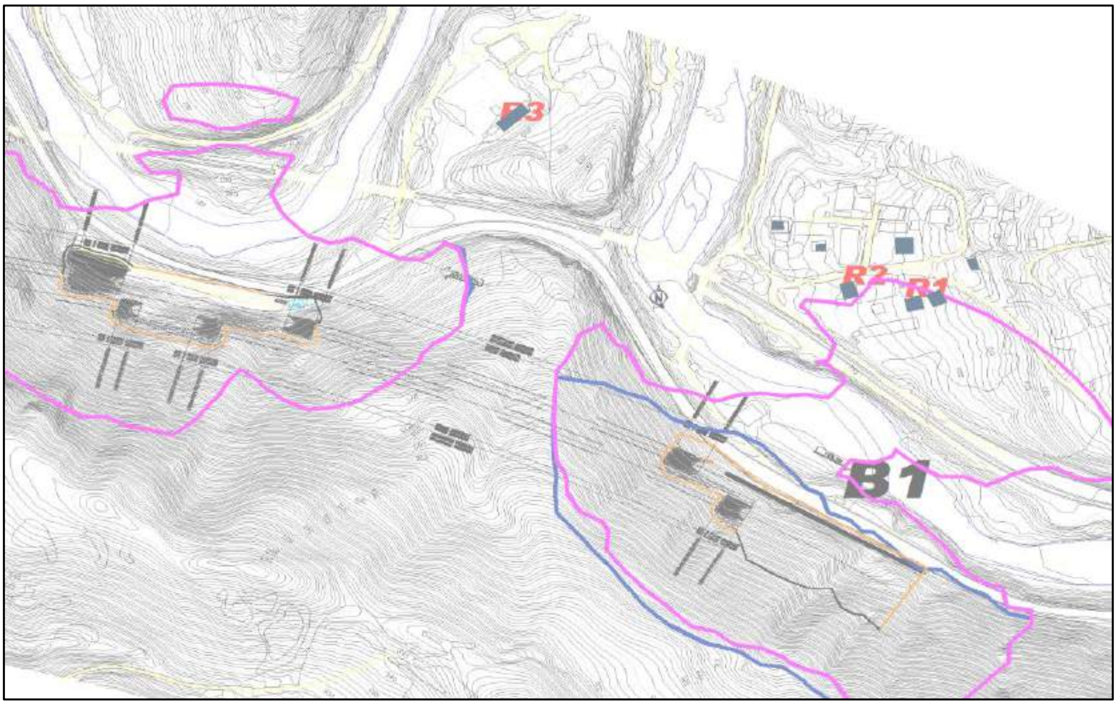
National Agency for Cultural Heritage of Georgia
27 Atoneli street, 0105 Tbilisi, Georgia: tel/fax: +(99532) 2932411
E mail: info@heritagesites.ge

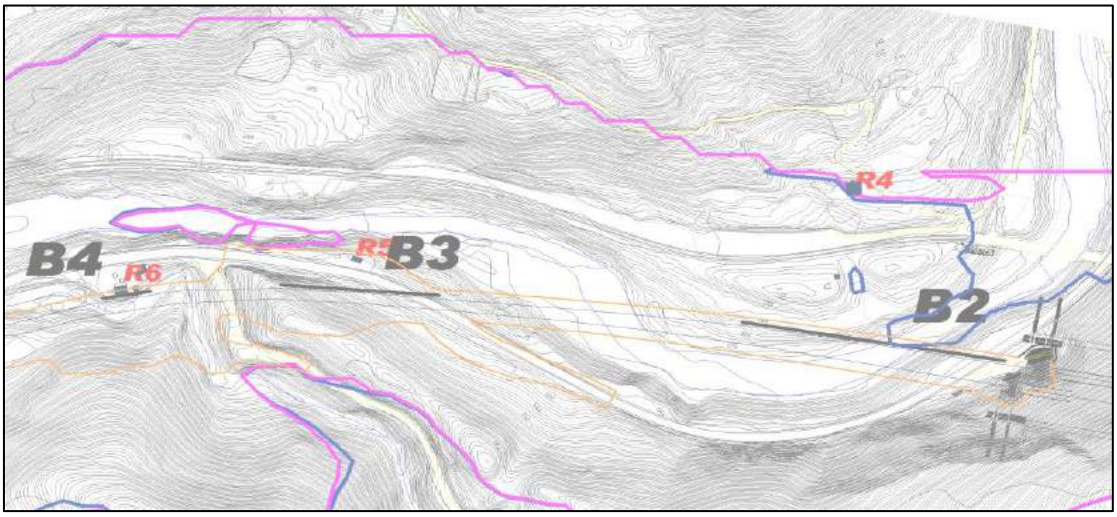
Archaeological Research Centre under the Georgian National Museum
3, Rustaveli Avenue0105 Tbilisi, Georgia
Tel: +(995 32) 2998022; Fax: +(995 32) 2982133
E-Mail: info@museum.ge

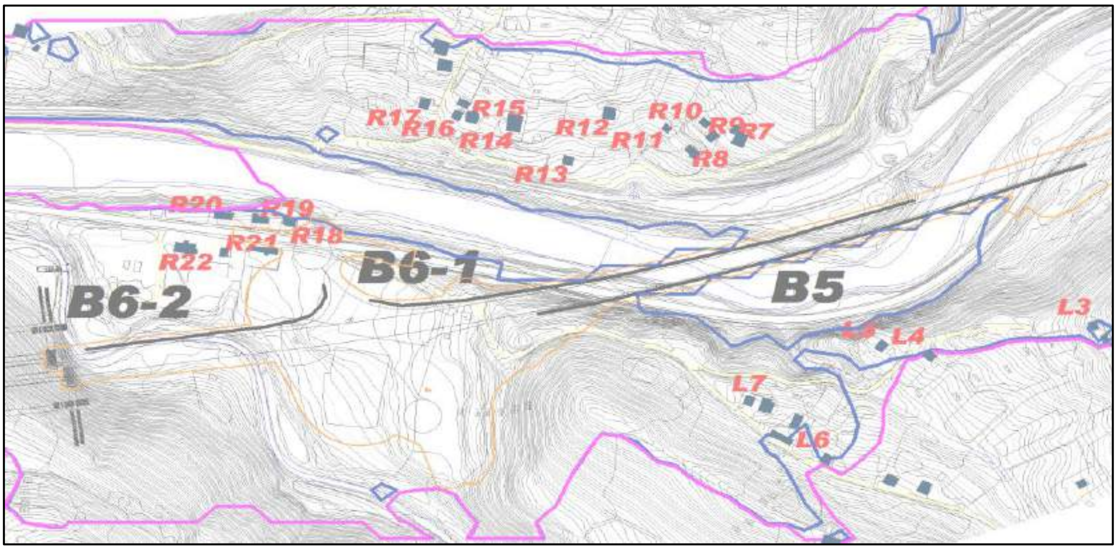
[24] Nonreplicable cultural heritage may relate to the social, economic, cultural, environmental, and climatic conditions of past peoples, their evolving ecologies, adaptive strategies, and early forms of environmental management, where the (i) cultural heritage is unique or relatively unique for the period it represents, or (ii) cultural heritage is unique or relatively unique in linking several periods in the same site. Examples of non-replicable cultural heritage may include an ancient city or temple, or a site unique in the period that it represents.

APPENDIX F

Noise Barrier Locations



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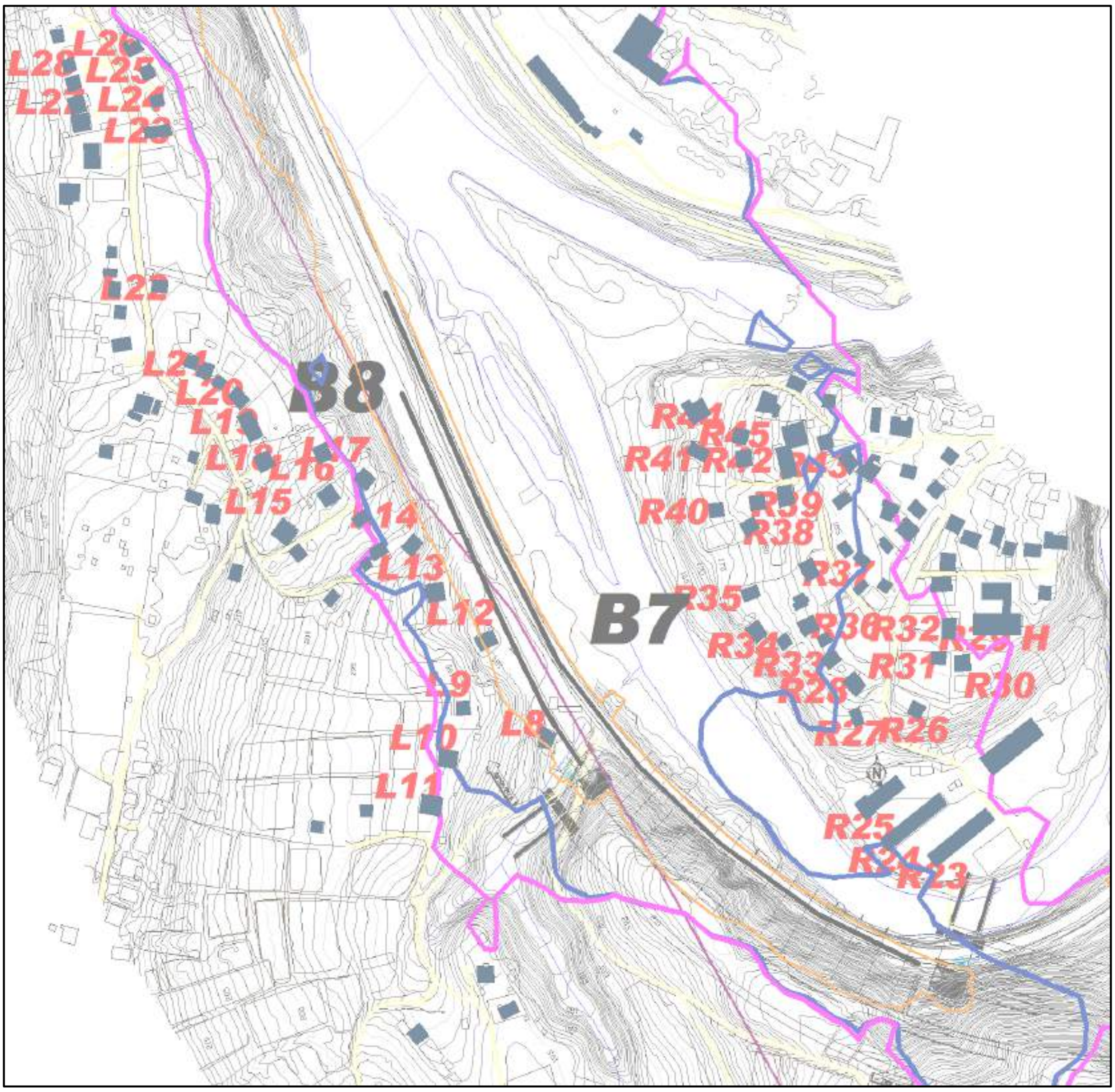
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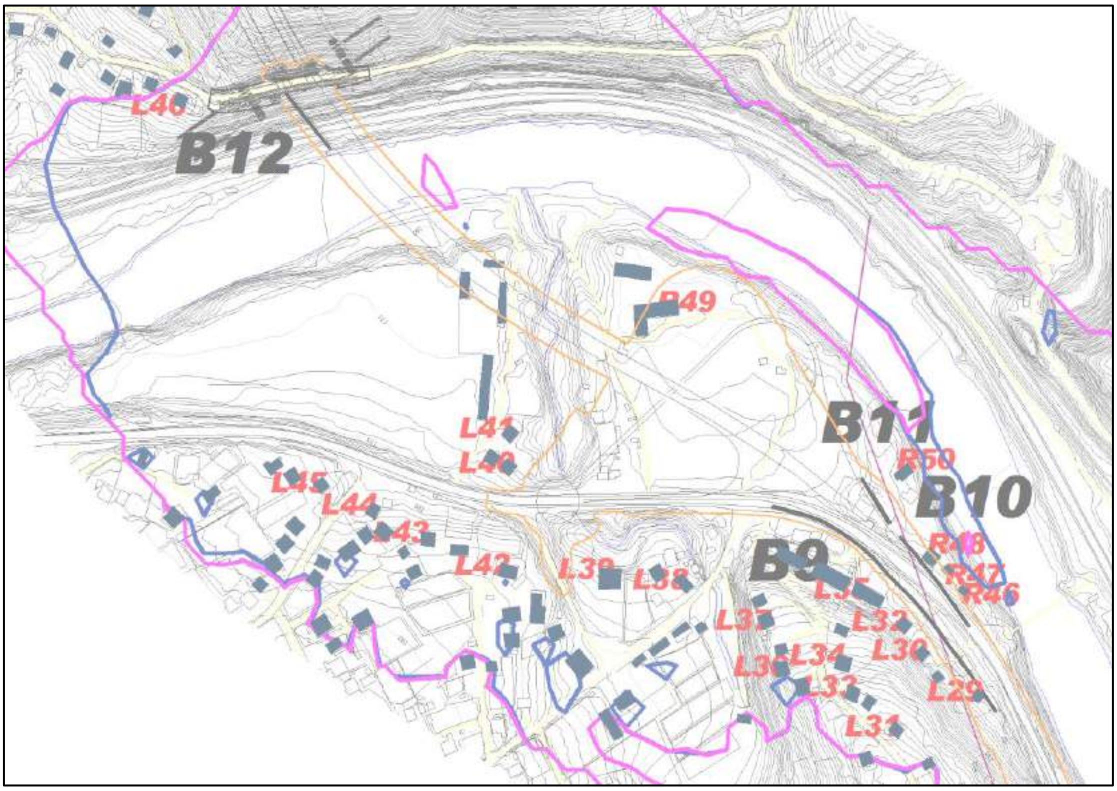
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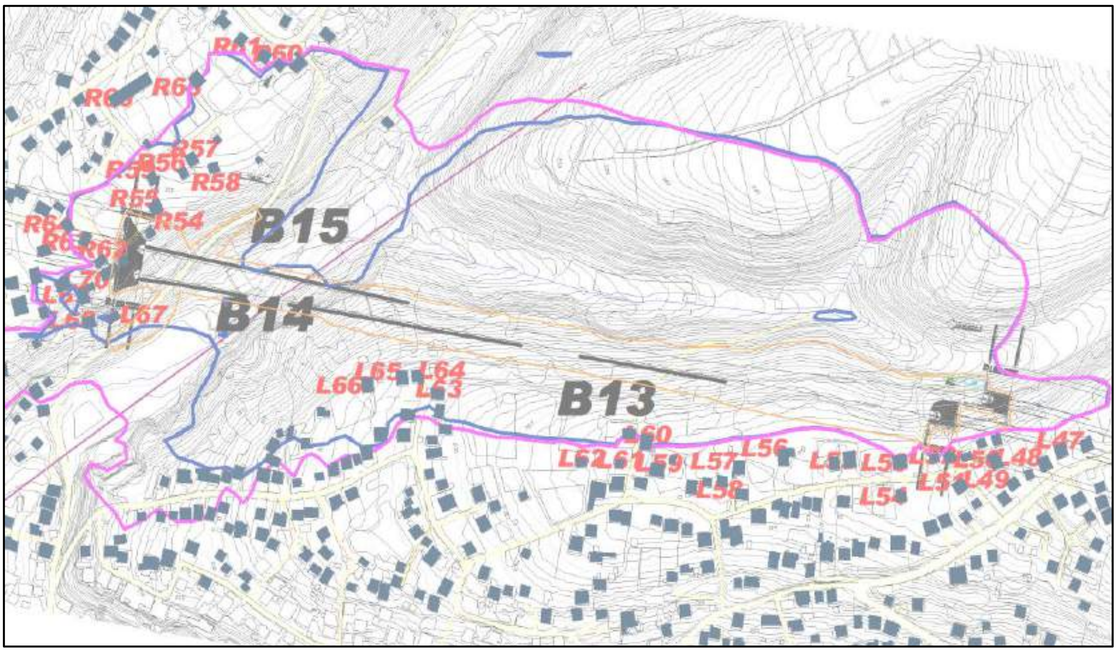
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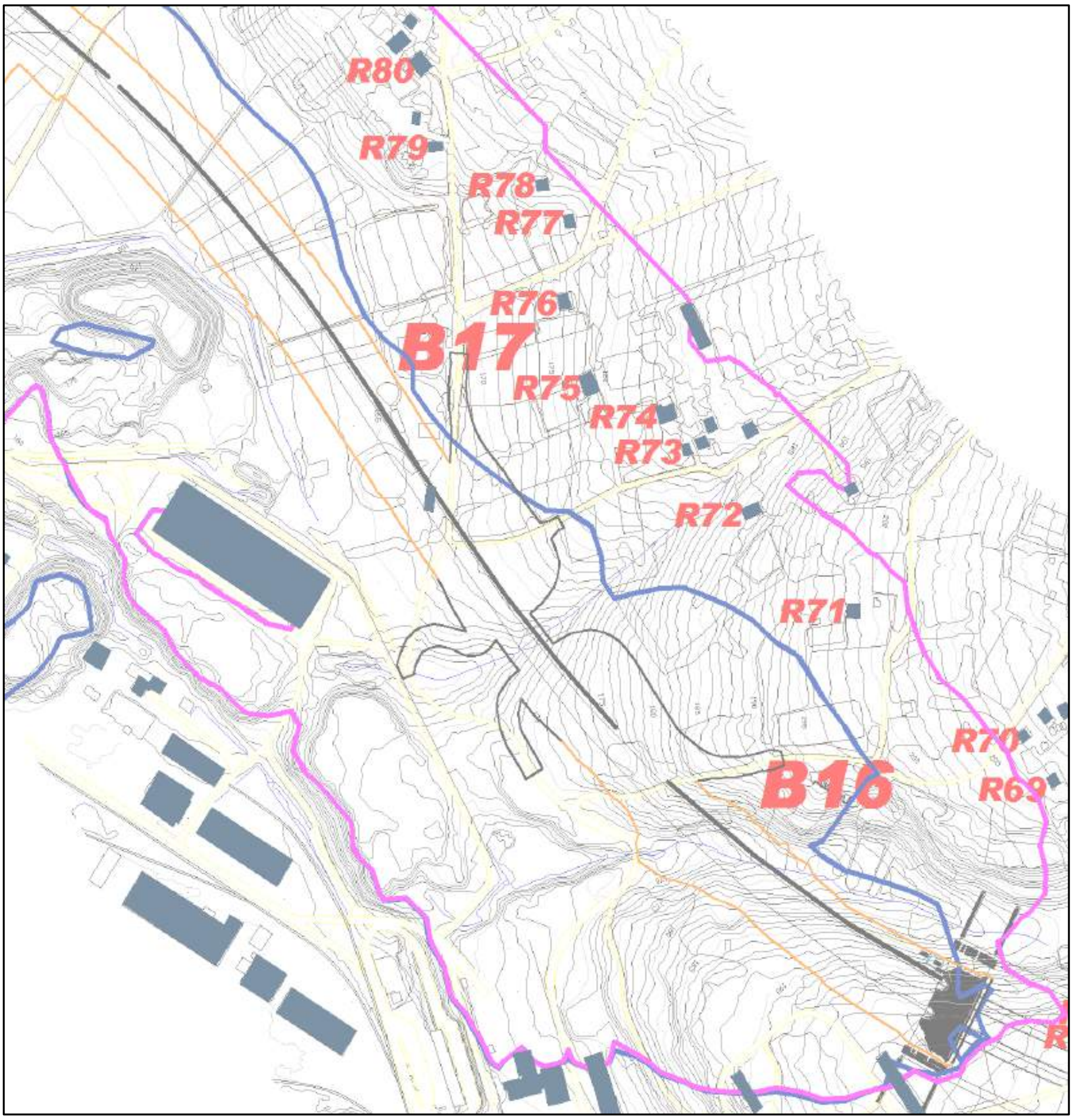
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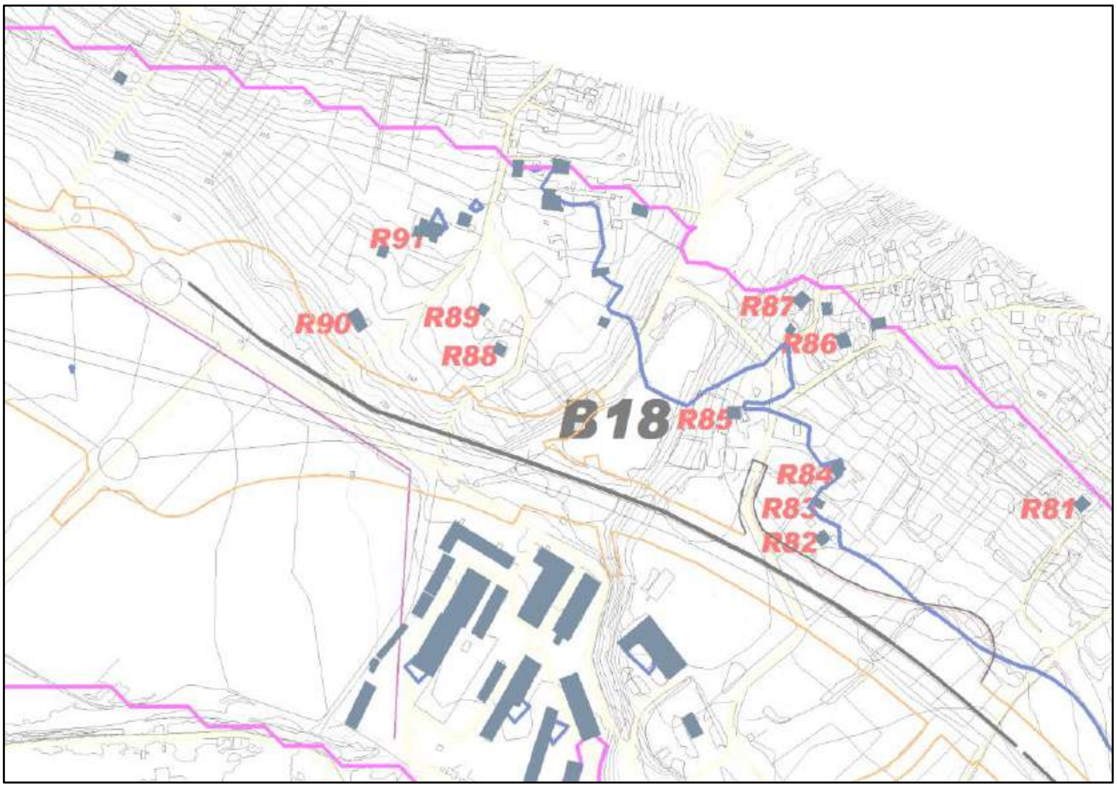
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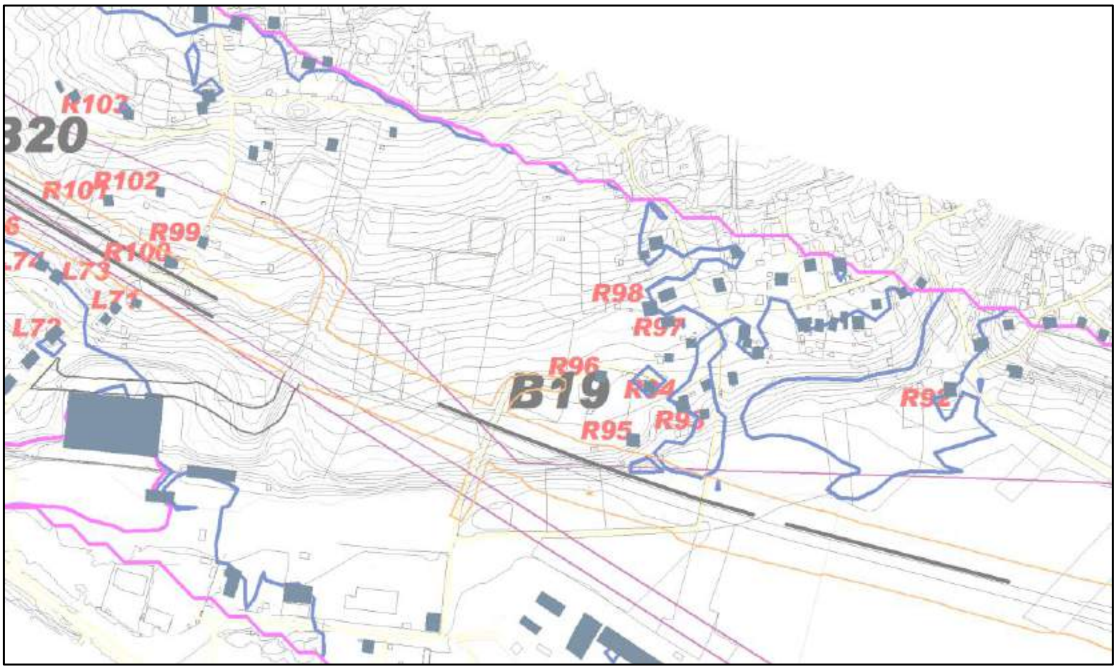
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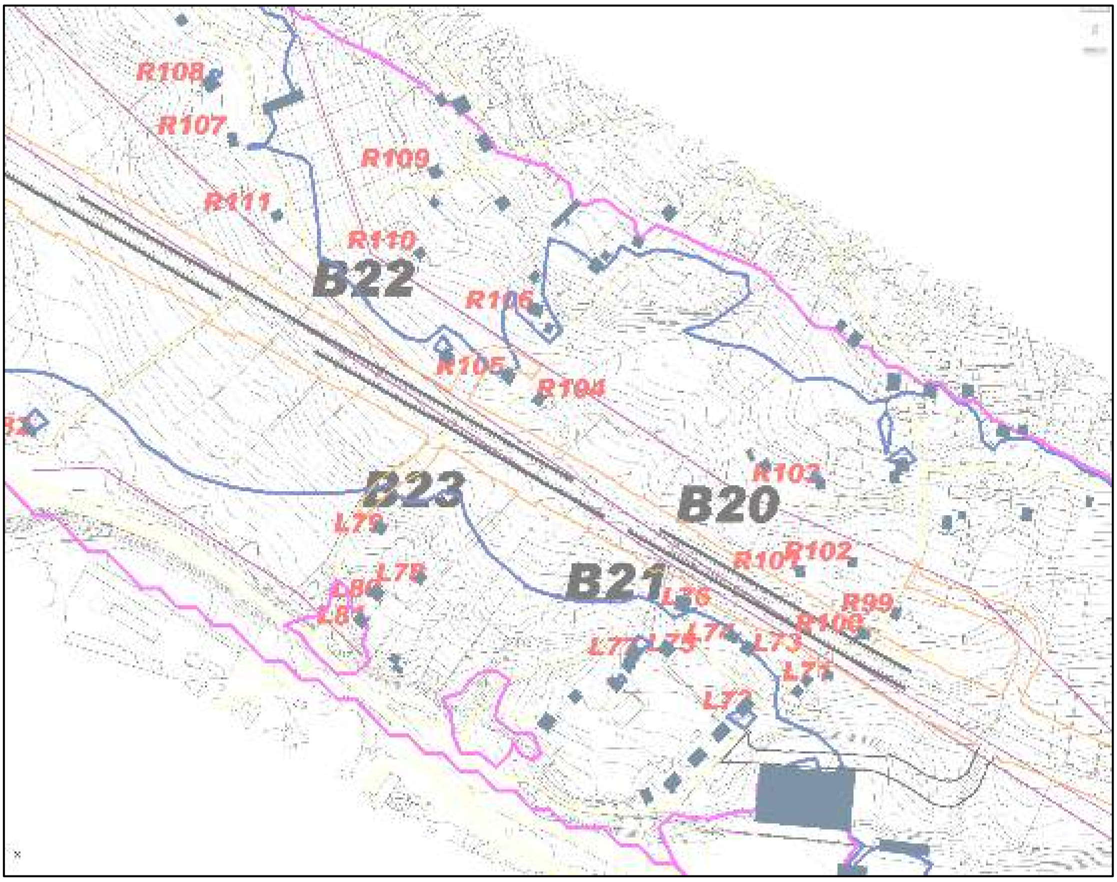
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APPENDIX G

State Forest Fund

Wood Resource Listing

Forest Fund Territorial Authority with the right of management - LEPL Imereti Forestry Service of National Forestry Agency

Forest district - Zestaponi - Kharagauli , forest district- Satsable

Quarter_31, district - former Sak.forest; area _5086m2,

Slope inclination (degree)-15.

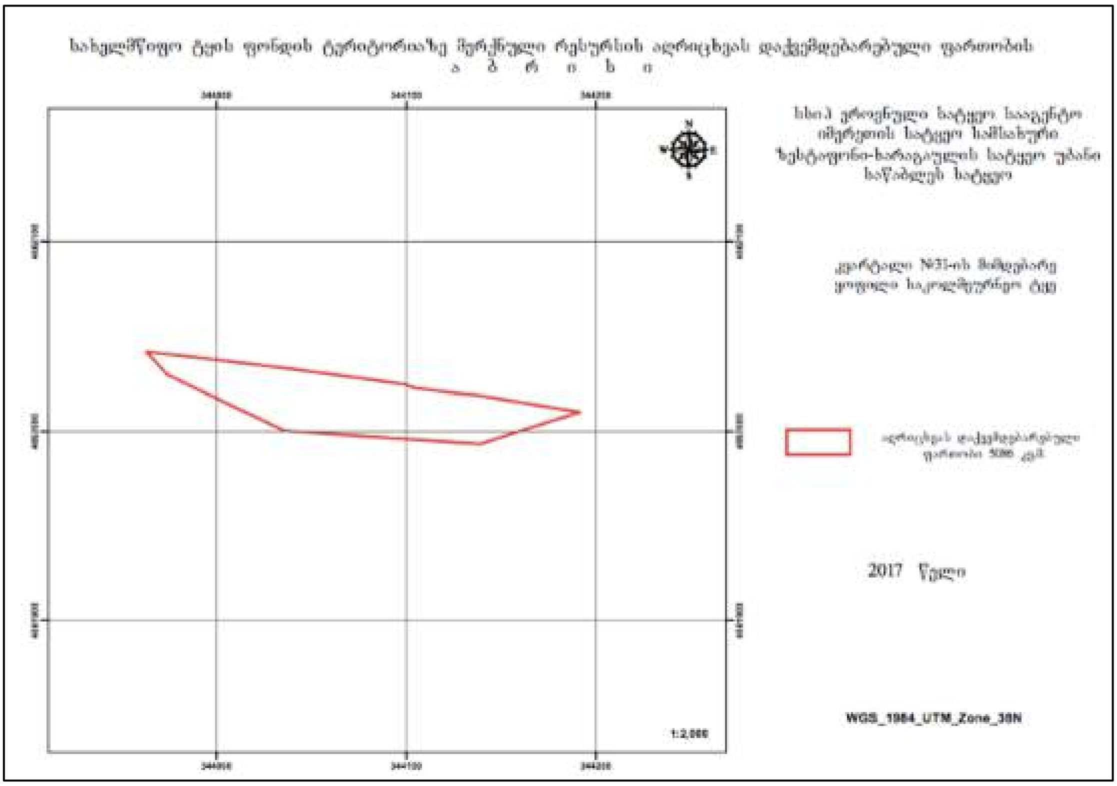
Quantity of the wood resources of 8 cm and more taxation diamter subject to recording (in pieces), volume (m3), according to the diameters and varieties of wood resources

#	Species (variety)	species (Latin)	Diameter (D)	Number of trees	Volume (v)	Note
1	**2**	**3**	**4**	**5**	**6**	**7**
1	zelkova	**Zelkova carpinifolia**	8	9	0.135	**VI-rank**
			10	6	0.21	**(Red list)**
			12	14	0.714	
			14	13	0.975	
			16	12	1.188	
			18	2	0.27	
			20	5	0.85	
			24	3	0.78	
			32	1	0.5	
Total zelkova:				**65**	**5.622**	
2	Acacia	**Acacia dealbata**	8	16	0.336	**IV-rank**
			10	9	0.369	
			12	15	0.96	
			16	1	0.123	
			20	1	0.21	

Total Acacia:				**42**	**1.998**	
3	ashtree	**Fraxinus excelsior**	8	2	0.024	**IV-rank**
			10	3	0.114	
			12	1	0.056	
Total ashtree:				**6**	**0.194**	
4	alder	**Alnus barbata**	8	1	0.019	**V-rank**
			10	1	0.038	
			12	1	0.058	
			14	1	0.088	
			16	3	0.36	
			20	2	0.4	
Total alder:				**9**	**0.963**	
5	willow	**Salix magnifica**	12	3	0.153	**VI-rank**
			14	2	0.15	
			16	2	0.198	
			18	2	0.27	
			20	12	2.04	
			24	5	1.3	
			28	1	0.37	
			32	1	0.5	
			36	1	0.67	
Total willow:				**29**	**5.651**	
6	oriental hornbeam	**Carpinus orientalis**	8	14	0.238	**VIII-rank**
			10	10	0.3	
			12	12	0.516	
			14	10	0.62	
			16	3	0.246	
			18	2	0.222	
			20	2	0.288	
Total oriental hornbeam:				**53**	**2.43**	
Grand total:				**204**	**16.858**	
In addition to the above, the wood resource of less than 8 cm diamter						**Note**

was also recorded with the following quantity:					
zelkova	150	unit	0.01	m3	**Red list**
Acacia	110	unit	0.008	m3	
oriental hornbeam	80	unit	0.01	m3	
oak Geo.	15	unit	0.001	m3	
hawthorn	40	unit	0.002	m3	
holly	22	unit	0.001	m3	
total	**417**	**unit**	**0.032**	**m3**	
grand total	**621**	**unit**	**16.89**	**m3**	

Date of preparation of listing: 20.12.2017.



Wood Resource Listing

Forest Fund Territorial Authority with the right of management - LEPL Imereti Forestry Service of National Forestry Agency

Forest district - Zestaponi - Kharagauli , forest district- Satsable

Quarter_34, district - former Sak.forest; area _34869 m2,

Slope inclination (degree) -15-25.

Quantity of the wood resources of 8 cm and more taxation diamter subject to recording (in pieces), volume (m3),according to the diamters and varieties of wood resources

#	Species (variety)	Species (variety)	Diameter (D)	Number of trees	Volume (v)	Note
1	**2**	**3**	**4**	**5**	**6**	**7**
1	hornbeam	**Carpinus caucasica**	8	18	0.27	**VI-rank**
			10	7	0.231	
			12	24	1.224	
			14	6	0.45	
			16	16	1.584	
			18	16	2.16	
			20	31	5.27	
			24	8	2.08	
			28	6	2.22	
			32	2	1	
			36	2	1.34	
			40	1	0.84	
Total hornbeam:				**137**	**18.669**	
2	Oak Geo.	**Quercus iberica**	12	2	0.09	**VI-rank**
			14	1	0.068	
			16	1	0.09	
			20	1	0.157	
			24	1	0.256	
			28	1	0.356	

			32	2	1	
			40	1	0.78	
			44	1	0.97	
Total oak:				**11**	**3.767**	
3	crab apple	**Malus sylvestris**	16	1	0.099	**VI-rank**
			20	1	0.17	
Total wild apple:				**2**	**0.269**	
4	alder	**Alnus barbata**	8	13	0.247	**V-rank**
			10	2	0.076	
			12	14	0.812	
			16	4	0.48	
			18	13	2.08	
			20	16	3.2	
			24	1	0.3	
			28	5	2.05	
			32	1	0.55	
			36	1	0.73	
Total alder:				**70**	**10.525**	
5	hazel	**Corylus avellana**	8	20	0.3	**VI-rank**
			10	14	0.462	
			12	14	0.714	
			20	2	0.34	
Total hazel:				**50**	**1.816**	
6	common pear	**Pyrus communis**	12	1	0.051	**VI-rank**
			20	2	0.34	
			28	1	0.37	
			32	1	0.5	
			36	1	0.67	
Total common pear:				**6**	**1.931**	
7	oriental hornbeam	**Carpinus orientalis**	8	31	0.527	**VIII-rank**

			10	17	0.51	
			12	8	0.344	
			14	4	0.248	
			16	1	0.082	
Total oriental hornbeam:				**61**	**1.711**	
8	chestnut	**Castanea sativa**	8	13	0.156	**VI-rank**
			10	8	0.184	**(red list)**
			12	3	0.135	
			14	2	0.136	
			16	6	0.54	
			18	8	0.992	
			20	11	1.727	
			24	7	1.792	
			28	6	2.136	
			32	2	1	
			36	3	1.869	
			40	8	6.24	
			48	4	4.76	
			52	2	2.84	
			56	2	3.34	
Total chestnut:				**85**	**27.847**	
9	Lime tree	**Tilia caucasica**	8	1	0.012	**V-rank**
			10	1	0.034	
			12	7	0.392	
			14	2	0.168	
			16	2	0.224	
			18	3	0.45	
			20	7	1.323	
			28	1	0.412	
			32	1	0.556	
			36	1	0.723	
			40	3	2.736	
			44	1	1.134	
			56	1	1.93	
			60	1	2.26	
Total lime tree:				**32**	**12.354**	

10	maple	**Acer campestre**	8	1	0.012	**VI-rank**
			20	3	0.471	
			24	1	0.256	
			32	1	0.5	
			36	2	1.246	
			52	1	1.42	
Total maple:				**9**	**3.905**	
11	taller ash	**Fraxinus excelsior**	8	9	0.108	**V-rank**
			12	4	0.224	
			14	4	0.336	
			16	5	0.56	
			18	3	0.45	
			24	1	0.279	
			36	1	0.723	
			40	3	2.736	
			52	1	1.64	
total taller ash:				**31**	**7.056**	
12	bladder nut	**Staphylea colchica**	8	7	0.126	**VII-rank**
			10	8	0.248	**(red list)**
			12	18	0.846	
			14	5	0.335	
Total bladder nut:				**38**	**1.555**	
13	yew-tree	**Taxus baccata**	10	1	0.031	**VII-rank**
						(red list)
Total yew-tree:				**1**	**0.031**	
14	zelkova	**Zelkova carpinifolia**	8	4	0.072	**VII-rank**
			10	4	0.124	**(red list)**
			12	2	0.094	
			16	2	0.18	
Total zelkova:				**12**	**0.47**	

15	Wild plum	**Prunus insititia**	8	2	0.03	**VI-rank**
			10	4	0.132	
			12	1	0.051	
			16	2	0.198	
			32	1	0.5	
total wild plum:				**10**	**0.911**	
16	hawthorn	**Crataegus microphylla**	8	2	0.036	**VII-rank**
			10	4	0.124	
			12	1	0.047	
			16	2	0.18	
			32	1	0.466	
Total hawthorn:				**10**	**0.853**	
17	cedar	**Cedrus deodara**	16	5	0.35	**VI-rank**
			20	19	4.56	
			24	15	11.55	
			28	22	13.64	
			32	29	25.81	
			36	15	12.45	
			40	5	5.35	
			44	6	8.04	
			48	4	6.6	
			52	1	1.99	
Total cedar:				**121**	**90.34**	
18	Acacia	**Acacia dealbata**	8	37	0.777	**IV-rank**
			10	16	0.656	
			12	41	2.624	
			14	11	1.034	
			16	22	2.706	
			18	25	4.25	
			20	84	17.64	
			24	83	25.73	
			28	47	20.21	
			32	19	10.83	
			36	8	6	
			40	2	1.84	

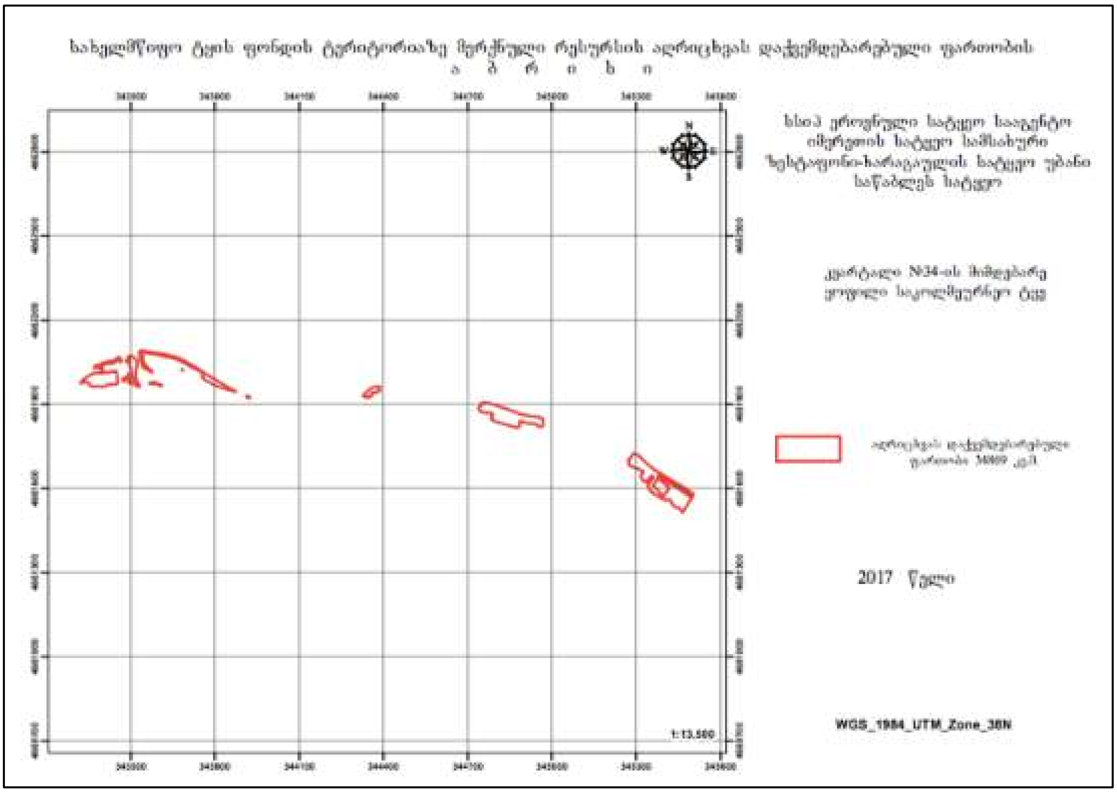
			44	2	2.22	
			56	1	1.84	
total Acacia:				**398**	**98.357**	
19	tree of heaven	**ailanthus altissima**	8	11	0.242	**V-rank**
			12	14	0.798	
			16	11	1.21	
			18	4	0.56	
			20	10	1.8	
			24	3	0.84	
			28	1	0.4	
Total tree of heaven:				**54**	**5.85**	
20	Elm	**Ulmus foliacea**	8	2	0.036	**VII-rank**
			12	1	0.047	
			20	5	0.725	
			24	2	0.466	
			28	2	0.666	
			32	1	0.466	
Total elm:				**13**	**2.406**	
21	Circassian walnut	**juglans regia**	8	1	0.015	**VI-rank**
			20	1	0.17	**(red list)**
			40	1	0.84	
Total Circassian walnut:				**3**	**1.025**	
22	Fig-tree	**Ficus carica**	12	2	0.094	**VII-rank**
			16	2	0.198	
Total fig-tree:				**4**	**0.292**	
23	honey-locust	**gleditschia caspica**	12	1	0.047	**VI-rank**
			20	1	0.17	
Total honey-locust:				**2**	**0.217**	

24	mulberry tree	**morus alba**	8	6	0.108	**VII-rank**
			16	3	0.27	
			24	3	0.699	
			28	1	0.333	
Total mulberry tree:				**13**	**1.41**	
25	asp	**Populus alba**	56	1	2.02	**V-rank**
Total asp:				**1**	**2.02**	
26	willow	**Salix magnifica**	20	1	0.145	**VII-rank**
Total willow:				**1**	**0.145**	
27	persimmon	**Diospyros kaki**	8	13	0.234	**VII-rank**
			10	4	0.124	
			12	9	0.423	
			14	5	0.335	
			16	4	0.36	
			18	4	0.48	
			20	8	1.16	
			24	1	0.233	
			28	1	0.333	
Total persimmon:				**49**	**3.682**	
Grand total:				**1224**	**299.414**	

In addition to the above, the wood resource of less than 8 cm diamter was also recorded with the following quantity:				**Note**	
hornbeam	25	unit	0.001	m 3	

Oak Geo.	5	unit	0.001	m3	
hazel	1550	unit	0.4	m3	
blackberry	900	unit	0.002	m3	
persimmon	13	unit	0.001	m3	
bladder nut	250	unit	0.005	m3	
Fig-tree	7	unit	0.001	m3	
elm	51	unit	0.002	m3	
tree of heaven	80	unit	0.005	m3	
mulberry tree	41	unit	0.002	m3	
maple	12	unit	0.001	m3	
oriental hornbeam	550	unit	0.03	m3	
pine-tree.	2	unit	0.001	m3	
crab apple	5	unit	0.001	m3	
wild plum	10	unit	0.002	m3	
ash-tree	15	unit	0.001	m3	
wild cherry	5	unit	0.001	m3	
hawthorn	335	unit	0.05	m3	
cornel	135	unit	0.005	m3	
laurel cherry	50	unit	0.004	m3	
winterberry	55	unit	0.001	m3	
greenbrier	1160	unit	0.03	m3	
Acacia	100	unit	0.02	m3	
zelkova	9	unit	0.001	m3	**red list**
chestnut tree	22	unit	0.002	m3	**red list**
Total	**5387**	**unit**	**0.57**	**m3**	
Grand total:	**6611**	**unit**	**299.984**	**m3**	

Date of preparation of the listing: 20.12.2017.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APPENDIX H

Noise Barrier Cost Estimate

description of works		Unit price	quantity for meter					cost/m
	UNIT	$	L	l	h	n.	q.ty	
"B A R R IE R AND ANTI-NOISE BARRIERS ANTIRUMOR BARRIER COMPOSED BY ALUMINUM PANELS-SUPPLY AND INSTALLATION OF THE COMPLETE BARRIER "	mq	$ 338,02			4		4	$1.352,08
WORKS OF ART FOUNDATIONS - DIAPHRAGMS - PALI MEDIEPALI TRIVELLATI IN CEMENTITIOUS CONGLOMERATE - WITH TUBE SHAPE OF 600 MM EXTERNAL DIAMETER	mc	$ 78,32	10	0,2826		0,25	0,7065	$ 55,33
"WORKS OF ART MURATURES - CONGLOMERATES CEMENT - STRUCTURAL CONCRETE FOR FONDAZIONE WORKS IN C.A. O C.A.P. - C28 / 35 RESISTANCE CLASS (RCK> = 35 N / mmq) "	mc	$ 136,18	10	0,2826		0,25	0,7065	$ 96,21
"ARTWORK STEELS AND STEEL STRUCTURES STEEL IN ROUND BARS B450C IMPROVED BARS "	kg	$ 1,18			56,52	0,25	14,13	$ 16,74
"ARTWORK FORMWORK - ARMORIES - CENTI NATURE HORIZONTAL OR VERTICAL PLAN COREBOXES FOR CEMENTIZED CONGLOMERATES "	mq	$ 24,43	0,8		4	0,25	0,8	$ 19,54
"WORKS OF ART MURATURES - CONGLOMERATES CEMENT - STRUCTURAL CONCRETE FOR FONDAZIONE WORKS IN C.A. O C.A.P. - C28 / 35 RESISTANCE CLASS (RCK> = 35 N / mmq) "	mc	$ 136,18	0,8	0,8	0,5	0,25	0,08	$ 10,89
"ARTWORK STEELS AND STEEL STRUCTURES STEEL IN ROUND BARS B450C IMPROVED BARS "	kg	$ 1,18			6,4	0,25	1,6	$ 1,90
			total cost for 1m noise barrier for funfation considering one pile each 4 meters					$ 200,61

APPENDIX I

Modeling of Vibration generated by tunneling activities in the calcarenitic formations along the tunnel TUN-4006 of F4 section

1. GENERAL APPROACH IN ANALYSIS

This report refers to the study carried out in order to estimate and evaluate the critical environmental issues, in terms of vibration, which will be generated by the construction of the new highway and the related tunneling activities in the carbonatic and volcanic formation formations.

The goal is to estimate of vibration levels during Road construction generated by those processes involving the use of all the categories of machinery (Bull Dozers, Motor Graders, Wheel Excavator, Wheel Loader, Vibro Roller, Tandem Roller, Roller Tire, Pneumatic Hammer, Dump Truck) necessary to complete the work. In particular, the analysis to evaluate the level of vibrations in nearby houses has been carried out by the following steps:

- Estimating/determining the vibration levels expected in the buildings as a result of the construction works of the new road, using a forecasting model based reference data sets;
- Verifying the reliability of simulated values by comparison with the permissible limits posed by international reference standards;
- Identification of monitoring during construction and post-operam and mitigation measures (if necessary).

2. FRAMEWORK OF IMPACT PROBLEMS AND PROVIDED ACTIVITIES

Vibration problems during the construction phase are the result of the direct emission of vibrations generated by the working activities and by the emission of low frequency noise, as represented in term of cause-effect in Table 1.

Problems	Principal causal factors	Potential effects
Vibration	Demolition of rock banks with jackhammers, sledgehammers Excavations by mechanical means Carryovers by mechanical means Compaction embankment substrates made with vibro-rollers or rollers Transit of heavy vehicles (Dump Truck, Concrete Mixer Truck,…)	Vibrations transmitted from the ground to the structural elements of buildings, with the emission of noise through solids
Low frequency noise emission	Machines in the construction site	Vibrations structural elements (windows and furniture's) with emission of noise in correspondence of the resonance frequencies

Table 1 - Causal factors and potential impacts

In general, the aspects influencing the level of vibro-acoustic noise in receptor buildings are mainly the following (see Table 2):

Factor	Mode of influence
Nature and characteristics of the soil	vibrations are more expected in the presence of rigid subsoil and rock
Distance between plano-altitude of construction sites and building foundations	vibrations tend to decay by the distance from their source according to an exponential curve
Features of the foundations of buildings	The loss of energy of vibration due to the coupling with foundation is greater in case of high-bearing foundations,– i.e. bigger is the bearing capacity of foundation more vibration energy of can be absorbed. The coupling losses also depend on the type of foundation
Structural characteristics of the buildings	vibrations inside the building are lower with the increasing mass of the building

Table 2: Factors and Modes of Influence in Vibration Transmission

3. ANALYSIS OF POTENTIAL ADVERSE EFFECTS

To produce a significant effect, the sources of vibration must be in proximity of to the buildings and according to the scientific literature no more than a few tens of meters.The effects of vibrations in buildings can range from a nuisance to exposed people, to architectural or structural damage.

Vibration sources such as construction activities can cause discomfort to the residents of buildings and in some cases could be of possible of potential damage to structures, especially in the presence of particularly critical structural conformation and/or use).

In general structural damage to the building caused by vibration phenomena are extremely rare and almost generally generated by the contribution of other factors. Other forms of damage, defined “threshold level", is the one that without compromising the structural safety of the buildings, can cause a reduction of the value or the use. The damage threshold takes the form of cracks in the plaster, enhancements of existing cracks, damage of architectural elements.

4. REFERENCE STANDARDS

There are several technical standards, which constitute a useful reference for the evaluation of the disturbance and damages caused by vibration phenomena.

For the disturbance to people, the main references are:

- ISO 2631 / Part 2 "Evaluation of human exposure to whole-body vibration ",
- UNI 9614 regulation "Measurement of vibrations in buildings and evaluation criteria of the disorder."

For damage to the buildings the main references are:

- UNI 9916 "Criteria for measuring and assessing the effects of vibration on buildings",
- DIN 4150 and BS 7385.

The above standards provides a guide for the selection of appropriate methods of measurement, data processing and evaluation of the vibratory phenomena for the evaluation of the effects of vibration on buildings (risk of structural damage), with reference to their structural response and architectural integrity.

The physical quantities used to quantify the effects of vibration on humans and on building structures are described below.
Induced Vibratory phenomena are the motions of structures (in this case building and constructions) at frequencies ranging from 1 to and 80 Hz. The characterization is carried out in terms of effective average value (RMS) of the speed (in mm/s) or the acceleration (in mm/s2). Speed is usually used to evaluate the effects of vibrations on buildings, and acceleration (weighted) to assess the human perception.
Measurement, are normally done by accelerometers, providing the level of acceleration, or "geophones", providing a signal proportional to the speed.
Converting the acceleration values “a” to the corresponding values of speed “v”, can be done , having the frequency, “f”, by the relation: v = a / 2 π f .
According to the noise analysis, both speed values and acceleration are evaluated on the scale of dB, by the relations:

$$L_{acc} = 20\log\frac{a}{a_0} \qquad \textbf{where} \quad a_0 = 0.001\, mm/s^2 \quad \mathbf{= 10^{-6}\ m/s^2}$$

$$L_{vel} = 20\log\frac{v}{v_0} \qquad \textbf{where} \quad v_0 = 1\cdot 10^{-6}\, mm/s$$

DESTINATION OF USE	LEVEL (dBpa)		ACCELERATION (mm/s²)		VELOCITY (mm/s)	
	Z Axis	XY Axes	Long.	Crossing	Long.	Crossing

Critical areas	74	71	5.0	3.6	0,10	0,28
Residential buildings (night)	77	74	7.0	5.0	0,14	0,40
Residential buildings (day)	80	77	10.0	7.2	0,20	0,56
Offices	85	83	20.0	14.4	0,40	1,10
Factories	92	89	40.0	28.8	0,80	2,20

Table 3: Values and limit levels of acceleration in weight of vibration disturbance (UNI 9614 – DIN 4150-2).

Category	Types of constructions	Velocity of vibration in mm/s *			
		Measurement at the foundation			Measurement at the last floor
		Frequency ranges (Hz)			Various frequencies
		< 10	10 ÷ 50	50 ÷ 100 **	
1	Buildings used for commercial purposes, industrial buildings and similar	20	20 ÷ 40	40 ÷ 50	40
2	Residential buildings and similar	5	5 ÷ 15	15 ÷ 20	15
3	Buildings very sensitive to vibrations, not included in the previous categories and of great intrinsic value	3	3 ÷ 8	8 ÷ 10	8
* Is the maximum of the three componentes of the velocity at the point of measurement ** Frequencies greater of 100 Hz should be referred to this column					

Table 4: Reference values for the speed of vibration to evaluate the action of short duration vibrations on buildings (UNI 9916 – DIN 4150-3)

5. POTENTIAL IMPACT ON BUILDINGS

The present study has the goal to estimate the induced vibrations in the buildings during the construction phase and the evaluation in terms of disturbance to people (UNI 9614, DIN 4150-2) and damage to buildings (UNI 9916, DIN 4150-3). The following lists the procedural steps followed:

1. Identification of the potentially impacted buildings and evaluation of their distance from the construction sites of the new Road.
2. Analysis of the highway project in correspondence of settlements and buildings Analysis of the geotechnical characteristics of the foundation soils and bedrock
3. List of construction machines used in the construction of the highway in correspondence areas of interest. Analysis of about the vibrations spectra generated by the used construction machines.
4. Estimation of surface vibration levels using, in order to evaluate the attenuation due to the propagation of waves in the ground, the formulations proposed in the literature (for example Dong-Soo Kim, Jin-Sun Lee and GP Wilson).
5. Analysis literature data concerning the propagation of vibrations to the interior of buildings, in order to obtain transfer relationships of acceleration levels between exterior and interior building for various types of buildings.
6. Estimate of inside buildings vibration by application of the transfer function evaluation of vibration levels inside buildings by comparison with the limits set by the regulations.
7. Identification of critical points and possible mitigation actions.

6. EMISSION SPECTRA OF THE WORKSITE MACHINERY AND EQUIPMENTS

The vibration emissions in the construction phase are widely variable in relation to the type of equipment/operating machinery employed, to the context of use and to the operator. In this study we were used both data source bibliographic either data directly acquired through measures carried out in construction of large works in Italy.

As regards the bibliographic data, it was in particular used the volume LH Watkins - "Environmental impact of roads and traffic" - Appl. Science Publ., which represents a set of experimental data on the emission of vibrations by various types of construction machines, used in road construction.

On Table below is shown the acceleration levels in dB at various frequencies of certain construction machinery that have greatest impact (Hydraulic Hammer and Roller Compactor), measured at 5m and 2m away from the source of vibration.

Other machinery type Dozer, Motor Grader, Wheel Excavator, Wheel Loader, Dump Truck have lower levels of acceleration and therefore are not able to create vibrations that can exceed the limits set by the standard.

The frequency of vibration produced by equipment is expressed in Hz, and level of vibration is expressed in dB.

Hz	1	1.25	1.6	2	2.5	3.15	4	5	6.3	8	10	12.5	16	20	25	31.5	40	50	63	80
Pneumatic hammer – reference distance: 5 m																				
dB	70	68	70	71	72	76	77	81	87	98	88	85	98	95	97	100	101	103	102	101
Roller Compactor – reference distance: 2 m																				
dB	74.9	77.5	75.8	75.0	76.2	77.8	76.3	76.7	77.7	79.2	81.9	96.2	91.0	82.6	96.1	90.6	104.0	97.4	97.6	96.1
Heavy Truck – reference distance: 10 m																				
dB	0	0	0	40	40	41	41	42	47	52	54	56	62	69.5	79	73	71.6	72	80	78
Wheel Loader – reference distance: 10 m																				
dB	0	0	0	52	52	52	53.6	55	54	57.6	61	62	66	69.5	84.6	84.6	78	83.5	83	78
Tracked Machines – reference distance: 10 m																				
dB	0	0	0	69	69	69	69	71	68	79.5	78.5	75.5	92	91.6	96	96	96	96	97	96

Table 5: Levels of vibration of various machinery on respect of the frequency.

Notice that max amplitude of vibration occurs at frequencies range from 25 to 50 Hz. This frequencies range was considered in the analysis.

In Picture below are shown acceleration spectrums, of some machinery measured at 5m distance from the source of vibration in which it can be noted that the Hydraulic Hammer and the Drum Roller are machinery greatest impact, with acceleration levels emitted around 100dB for good part of the spectrum.

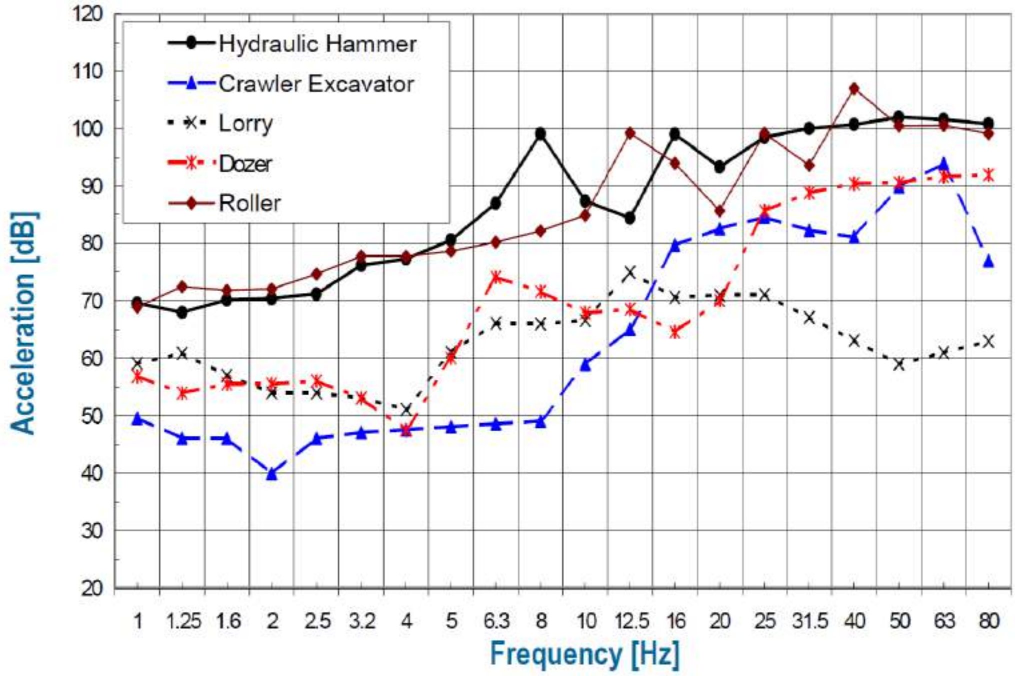

Figure 1: Acceleration spectrum of different machinery.

7. DYNAMIC CHARACTERISTICS OF SUBSOIL

Due to vertical in homogeneity of the subsoil, carbonatic and volcanic formations covered by a weathered/alterated material and alluvial soil, it can be assumed that important attenuations and modification of spectrum –toward lower frequencies- with will occur at the transition between the competent (hard) formation and the alterated layer/alluvia-vegetal soil where the shallow foundations of buildings are inserted.

The situation of the uppermost part of the subsoil – arable, alterated and alluvial- can be represented by the average values shown below, obtained by the geotechnical investigations and geophysical measurements.

It is also important to consider the below formula and table showing the formula of attenuation and some typical damping parameters attenuation due to the absorption of the ground

$$A_t = 20\log\left[e^{\frac{\omega\eta(x-x_0)}{2c}}\right]$$

Where: $\omega = 2\pi f$ is the pulsation wave (with f = frequency in Hz)

c is the speed of wave propagation in the soil in m / s

η is the absorption factor of the soil

Soil type	η
Rock	0.01
Sand, gravel	0.1
Silt, Clay	0.2 – 0.5

Table 7: Values of the damping parameter as a function of the soil type

In the above expression the exponential term represents dissipation phenomena of mechanical energy, which is dependent on the frequency, on the propagation velocity and on the loss mean factor. This means that the high frequencies are extinguished after a short distance, while lower frequencies propagate at greater distances.

In particular for the overburden soil above the calcarenitic formation the level of acceleration at the distance “r” from a point source of energy is given by:

□(□) = □$_0$ + 10 □□□ (□$_0$ / □) – 8,69 □ (□ − □$_0$) □□

Where:

- L_0 is the reference level;
- d_0 is the reference distance for L_0;

- r is the distance from the source;
- α is the attenuation constant of the terrain.

The term relating to the dissipation of mechanical energy is obtained by the relationship e−α(r−d0).

The values of "α" given from Rudder are the following:

TYPE OF TERRAIN	SHEAR-WAVE VELOCITY (m/s)	α x m
Moist clay	152	0,025-0,25
Alluvial deposit of clay	152	0,019-0,43
Wet clay	152	0,31-0,50
Deposits to ambient humidity	259	0,04-0,13
Dry sand	152-396	0,007-0,07
Compact sand with gravel	250	0,015-0,045
Gravel and deposit sand	250	0,023-0,053
Gritty sand saturated with water	110	0,09-0,3
Gritty sand saturated with ice water	110	0,05-0,17

Table 7: Values of the attenuation constant "α" for different kinds of soil and for the frequency of 15 Hz

The above values were obtained for the frequency f=15 Hz and for α = 2□□η / where "η" is the loss factor of the terrain and "c" is the speed of propagation by the transverse propagation mode.

8. TYPE OF EQUIPMENTS USED IN CONSTRUCTION AND TYPICAL EMISSION SPECTRA/ATTENUATION OF MACHINERIES AND BLASTING CHARGE

In the case of evaluation of the impact of vibration sources realized, simple analytical formulas allow an approximate calculation of the attenuation of the vibrations as a result of propagation in the soil.

In the scientific literature there are tables and diagrams allowing estimating the attenuation or amplification caused by the various structural components of buildings. By combining this information, it is possible, with some approximation (typically +/- 5 dB) to estimate the levels of vibration that will develop in potentially impacted buildings. Taking into account uncertainty above, it can still evaluate whether the planned source of vibration is potentially impacting, or if the same is certainly acceptable.

The vibration level at a receiver at a distance "x" from the point at which it is generated is equal to the level at the reference distance "x_0", minus the sum of the attenuations that occurring in the soil between "x_0" and "x":

$$\mathbf{L(x) = L(x_0) - \Sigma iAi}$$

The basic level $L(x_0)$ is generally derived from experimental measurements at distances between 2m and 25m. The components of attenuation and amplification of vibrations in the ground and on the building, introduced in the calculation model as average values, are:

- geometric attenuation, in relation to the type of source and wave;
- attenuation for internal dissipation of the soil;
- Attenuation due to obstacles or discontinuity of the ground.

The below table shows the decay diagram of the vibration velocity for certain types of machineries.

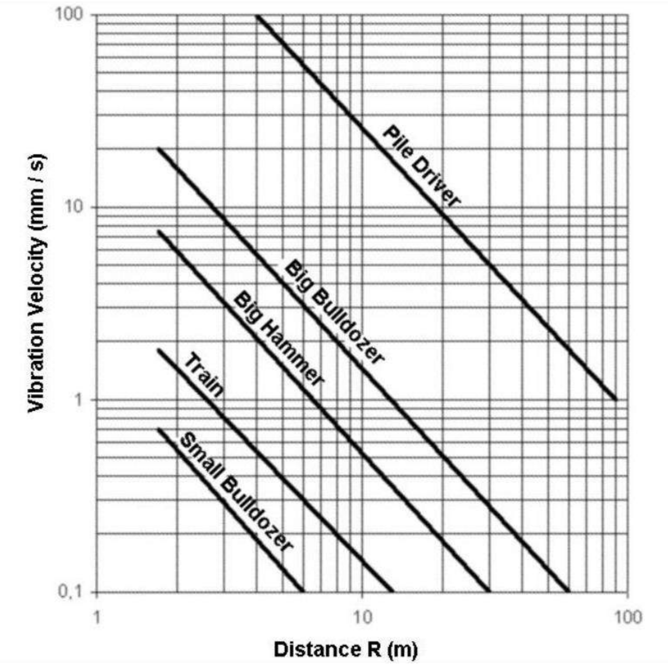

Figure 2: Decay curves of the vibration velocity

Source location	Source type	Induced wave	*n*
Surface	Point	Body wave	2.0
		Surface wave	0.5
	Infinite line	Body wave	1
		Surface wave	0
In-depth	Point	Body wave	1.0
	Infinite line		0.5

Table 8: Values of attenuation due to radiation damping for various combinations of source location and type

Considering that, for a conservative estimation a concentrated source has to be estimated, the exponent "n" should be 0.5 for the surface waves (prevailing in the case of source placed on the surface), and "n" equal to 1 for the volume waves which are prevailing in the case of deep source such as in tunnels.
The assessment of attenuation or the amplification in the buildings structure must also be considered.

Various types of foundation systems can determine attenuations or amplifications, inside buildings compared to the levels on the ground.

In particular for the type of buildings which are prevalent in the area of the tunnels, it should be considered that these shallow and small foundations should determine a certain attenuation of the acceleration levels in the buildings for the fact that the interface soil-structure is not perfectly coupled and also small. For that the system soil-foundation will generate s dissipative phenomena. The attenuation caused by bad ground-foundation coupling is illustrated in Figure 3 for different categories of buildings. The category of large reinforced concrete buildings with continuous foundations can be associated to large buildings in masonry with continuous foundations which curve suggests an attenuation of 2 dB.

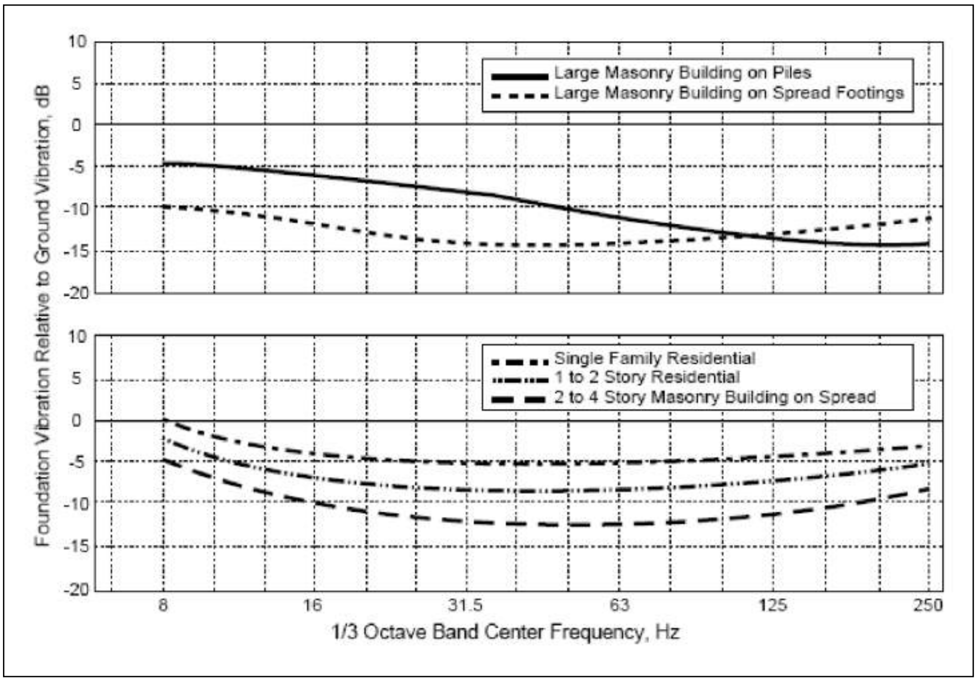

Figure 3 - Coupling losses for various types of buildings

The Table below shows the results at various frequencies of such interaction effects with the structures. In particular these are the standard parameters used in modeling and similar analysis.

Band (Hz)	1	1.25	1.6	2	2.5	3.15	4	5	6.3	8	10	12.5	16	20	25	31.5	40	50	63	80
Loss by coupling the soil-foundation (masonry building)	4.8	4.8	4.8	4.8	4.8	4.8	4.9	5.0	5.1	10	11	12	13	13	14	15	15	15	14	14
Loss by coupling the soil-foundation (concrete building)	3	3	3	3	3	3	3	3	3	8	9	10	11	11	12	13	13	13	12	12
Attenuation by propagation from floor to floor	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	3.0
Amplification of the horizontal elements	4.5	4.5	4.4	4.4	4.3	4.2	4.0	3.8	3.6	3.3	3.0	1	4.4	16.5	4	0.0	0.0	0.0	0.0	0.0

(dimension 4-5m)																					

Table 9: Reference parameters for the calculation of the interaction with structures

9. CALCULATION OF VIBRATIONS DURING EXCAVATION OF TUNNEL TUN-4006

Based the above considerations, and given the fact that the vibrations transmission to the ground is a side effect difficult to reduce, mostly during tunneling activities; the best approach is to consider the risk/disturbance for the population and buildings and to enforce the actions required for the mitigation of these effects.

In the studied case, the modeling does not point out levels of risk for standard buildings due to the excavation techniques and the attenuation provided by the cushion of alterated/weathered rock and arable/vegetal soil. in addition the type of foundations of the buildings, shallow and small, will determine an additional damping factor.

According to the recorded geomechanical parameters and stratigraphy for the computation of attenuation the following model should be considered:

- Tunneling technique: Roadheader from 7 to 10 m below the surface (as a conservative approach a TBM computation has been applied)
- Medium of propagation:

Calcarenites (N_1^2)at the source followed by:

2 meters of weathered calcarenites followed by

4 meters of alluvial soil (eQ) and 1 m of topsoil

For simplicity the topmost soil and the Alluvial deposits can be modelized as a single layer having a thickness of about 5 meters.

The sequence is characterized by an inversion of the VP and VS waves, suggesting a poor propagation of the energy in the upward direction

Layer n.	Lithology	Bed depth	Thickness	Waves velocity		Dynamic density	Poisson Modulus	Dynamic Elastic Modulus	Dynamic Shear Modulus	Dynamic Compressibility Volumetric Modulus	Dynamic Compressibility Edometric Modulus	Vp/Vs
				Vp	Vs	γ	ν	E_d	G_d	K_{dv}	K_{de}	
		(m)	(m)	(m/s)	(m/s)	(t/m^3)	(-)	(kg/cm^2)	(kg/cm^2)	(kg/cm^2)	(kg/cm^2)	(-)
1	Soil	1	1	300	130	1,51	0,38	705	255	1017	1357	2,3
2	eQ	5	4	500	230	1,66	0,37	2400	879	2981	4153	2,2
3	Weathered N_1^2	7	2	1240	720	1,97	0,25	25493	10233	16707	30350	1,7
4	N_1^2	-	-	2340	1320	2,23	0,27	98299	38803	70204	121942	1,8

Table 10: Stratigraphy of the terrain starting for surface for tunnel TUN-4006 and relevant parameters

In a very conservative assumption it can be assumed that:

- The vibrations generated at the source will propagate with velocity of 10 mm/s (conservative source: big hammer and bulldozer);
- After travelling 2 meters into the weathered calcarenites, vibration at the boundary weathered calcarenite-alluvial soil are estimated at 7-8 mm/s. A strong backscattering is expected at this boundary due to the strong inversion of Vp and Vs velocity.
- After this points vibrations will be strongly attenuated by the travel into 5 meters of alluvial soil with poor geomechanical parameters. (Vs velocity decreased by 70%, Vp velocity decreased by 50%),
- The expected value at the surface will be 5-4 mm/s .
- At this point the coupling with the foundations will generate a further dumping effect whose amount depends on the type of foundation.

The results of calculations fit with the results provided in the scientific literature for tunnels done by TBM, which represents a stronger source of noise.

<u>For the above consideration an area of influence has to be considered with a distance from the source of 20 meters (total width about 75 meters) also in consideration of the poor quality of the building.</u>

For that it is recommended to proceed with photo-documentation of the state of the buildings, to avoid conflicts with the population and to set up a couple of monitoring stations to have reference data to provide in case of controversy (see figure 4).

Figure 4 – Area of influence and buildings potentially affected