Executive Summary

1. Introduction

1. This Environmental Impact Assessment (EIA) is part of the process of compliance with the ADB Safeguard Policy Statement (2009) in relation to the construction of Section F2 of the new Khevi-Ubisa-Shorapani-Argveta section of the E60 Highway, or more simply, the "Project".

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:

(i) Describes the existing socio-environmental conditions within the Project area;
(ii) Describes the project design, construction activities and operational parameters;
(iii) Describes the extent, duration and severity of potential impacts;
(iv) Analyzes all significant impacts; and
(v) 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 as the project is considered to have significant diverse impacts over a wide area, such as noise impacts, significant quantities of spoil disposal, road safety impacts, and vibration.

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 (which is resulting in high accident rates), 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 and F4 has been completed and selection of the construction Contractor is on-going. Detailed design of sections F2 and F3 is now on-going and this report forms the EIA for detailed design phase of section 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 (Figure 1). Section F3 forms the Khevi - Boriti portion of the Khevi-Ubisa-Shorapani-Argveta section of the E-60. The length of the Project road is as follows:

(i) Right lane **(TA** – meaning Tbilisi – Argveta direction**)** – 12.197 km;
(ii) Left lane **(AT** – meaning Argveta – Tbilisi direction**)** – 12.193 km.

Figure 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:

(i) Design speed – 100 km/h (speed limit 80 km/h);
(ii) Number of traffic lanes – 4;
(iii) Width of traffic lane – 3.75 m;
(iv) Width of each carriageway – 7.5 m;
(v) Width of paved shoulder (emergency lane) – 2.5 m;
(vi) Width of verge – 1.0 m;
(vii) Width of central reserve – 5.0 m;
(viii) Width of paved shoulder at the central reserve – 1.0 m;
(ix) Total width of each paved platform – 11.0 m

(x) Width of road bed – 27.0 m;
(xi) Carriageway cross-fall on straight sections – 2.5%;
(xii) Minimum radius of horizontal curve – 400 m;
(xiii) Maximum longitudinal gradient – 4%;
(xiv) Minimum convex curve – 15 000 m;
(xv) Minimum concaved curve – 15 000 m.

10. Thirty five bridges will be constructed during the project works – 18 on the TA axis and 17 on the AT axis. The total length of the bridges is 8,297 meters, the longest of which is 1,362 meters. The bridges will be constructed from either composite steel-concrete or pre-cast steel-concrete

11. Twenty tunnels are proposed in Section F2:
(i) Two existing tunnels to be upgraded (TUN-2001-TA and TUN-2003-TA) of about
100-130 m;
(ii) Two new tunnels parallel and adjacent to the existing (TUN-2001-AT and TUN-2003-AT) on the carriageway AT of about the same length;
(iii) Two single tunnels on the carriageway AT (TUN-2002-AT and TUN-2004-AT) of about 200 and 400 m
(iv) Seven tunnels with double tube with length from 300 m to about 1300 m. In this Section, the rock is generally good, even if there are some faults, generally the soil cover are not very thick.

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.

13. Two interchanges are planned in F2 Section, the first (interchange I1) at approximately KM5.3 has only ramps to and from Tbilisi; the second (interchange I2) at approximately KM9.3 is instead complete. Another interchange is exactly at the endpoint and it is split in two between F2 and F3. Most of this interchange will be included in F3. Only the ramps from and to Tbilisi will be included in F2 (interchange I3).

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

15. Two different pavement structures will be used:
(i) Concrete pavement structure for the motorway and interchanges; and
(ii) Asphalt pavement structure for all Slip Roads and all Minor Roads and bridges.

4. Alternatives

16. 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.

17. 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.

18. As noted above, the Project forms part of a program upgrading the E-60. The Khevi – Argveta section of the E-60 (including section F2) is 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.

19. 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.

20. 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.

21. Several locations were identified for the disposal of 1.9 million cubic meters of spoil material from cuts and tunnels. Four locations have been considered as potential location for of spoil material. The location originally proposed, Kutaisi bypass, has been eliminated due to a lack of space for all of the material and the costs of transporting the waste to the site as well as environmental considerations of a huge amount of truck journeys through Zestaphoni. Three other potential locations closer to section F3 were screened to determine the potential environmental impacts of these areas. Two of these areas have been eliminated based on the fact a large number of trees would need to be felled in these areas. The remaining site, close to Boriti, is considered a possible option for the disposal material given the large volumes of spoil to be generated by the Project. **Section C.6 – Alterative Spoil Disposal Locations** discusses this issue further.

5. Description of the Environment

22. 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, and rolling hills. The existing road is located within the bottom of the river valley and elevations vary from around 480 above sea level at the start of the road to 305 meters above sea level at the end of the road section in Boriti.

23. Annual precipitation in Zestafoni (the nearest weather station) is around 800 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 0 °C in the winter months to around 28 °C in the summer. The dominant wind direction is from the east. However, strong winds from the west are also experienced quite frequently.

24. A climate risk and vulnerability assessment was prepared by ADB as part of the Project. The assessment concluded that the number of hot days (above 25ºC) is anticipated to increase and mean precipitation will decrease by 4.5% by 2050. The number of days with heavy rainfall will also increase while annual river run-off is anticipated to decrease by 13%. The assessment also indicated that the Project area is in a high-risk range for landslides.

25. 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).

26. Within the Project area the main sources of air emissions are from transport, including vehicles on the existing Project road. Air quality monitoring was carried out at six different locations during March 2018 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, World Bank Group (WBG) standards.

27. The main rivers in the Project area include the Dzirula, Riktola and the Dumala. The Project road flows parallel with the Rikotula from KM0.0 until it merges with the Dzirula adjacent to KM1.3 beneath bridge BRI 2.1.04 TA/AT. The Dzirula is the main river flowing through the valley in which the Project road is located. The Dumala is a major tributary of the Dzirula, but is located more than 300 m north of the new alignment in Boriti, almost at the end point of the Project road.

28. The project road crosses natural forest areas, agricultural land plots, hilly forest slopes, residential areas and riparian ecosystems. Due to anthropogenic impact in the Project area natural vegetation has been lost to agricultural and other urban development and these areas can be described as modified habitat. In these areas arable lands and pastures have developed. Over the time the fauna of the region has changed significantly, however, large portions of the Project area can still be classified as natural habitat.

29. According to available information there are three species considered as vulnerable in Georgia (Georgian Red List) that may be found within the Project area, the Otter (Lutra lutra) and the Caucasian squirrel (Sciurus anomalus) and the Mediterranean turtle (*Testudo graeca* Linnaeus). Site surveys did not reveal the presence of squirrels or turtles in the Project area. In addition, the review of the habitat along the alignment indicates that it is not optimum for existence of the Caucasian squirrel. Site surveys undertaken by local ecologists did not reveal evidence of otters in the Project area, such as otter holts or spraints, however, the ecologists did identify a number of locations within the Project area that are suitable habitat for otters. Anecdotal and photographic evidence provided by the ADB did however show that otters are present within the Project area, notably at the confluence of the Rikotula and Dzirula rivers.

30. The nearest protected area is the Borjomi Nature Reserve which is located more than 15 kilometers south of the Project road. The nearest Important Bird Area (IBA) to the Project road is the Adjara-Imereti Ridge more than twenty kilometers south of the Project road.

31. 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, Zestaphoni, 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. The Project road is located within Kharagauli Municipality. 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 Kharagauli was 19,473 the majority of which is classified as rural and only 1,965 as 'urban'

32. Of the total area of Kharagauli municipality 1.5% is used for agricultural purposes. 70.9% of this territory is occupied by pastures and 29.1% is used for ploughing and sowing, annual crops grow over 22.5% of the area, permanent plantings grow over 11,5% and perennial plants grow over 6,6% of the area. Out of agricultural branches, cattle-breeding and bee-keeping are most developed. During the Soviet times, industry was well-developed in Kharagauli municipality, with food enterprises, mining industry and timber plants, wine, milk and furniture complexes of enterprises. However, industrial activity has declined in the area since then and few large scale industrial activities remain. Folk trade is highly developed in the municipality.

33. The road network in the Project area is dominated by the existing E-60 which links Tbilisi with Batumi. Numerous local roads feed directly onto the existing E-60 in the Project area, and these roads vary in condition from good to very poor. There are no rail networks or airports within the Project area.

34. During the period 2012 – 2016 there were 2,713 collisions, 471 persons killed and 4,913 persons injured within 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 F2 section 106 collisions occurred, with 25 persons killed and 204 persons injured.

35. Kharagauli Municipality previously used Boriti landfill located in Boriti Village. The landfill was put into operation in 2005 but is currently closed. As such there appears to be no landfill within the Project area for hazardous and non-hazardous waste.

36. Within the Project corridor the following key physical cultural resources have been identified; 1) Church – A small church is located within 20 meters of the existing alignment at KM10.0. The new alignment will be located approximately 25 meters further south of the existing alignment at KM10.0; and 2) Cemetery – The cemetery is located around 20 meters east of the existing alignment. The new alignment will pass approximately 125 meters north of the cemetery at KM8.6.

37. Dostakari-Beriti Emergency Medical Care Clinic in Boriti is located adjacent to the existing road. The new alignment will pass more than 300 meters south of the hospital with a tunnel (TUN 2011 AT/TA) at KM11.5. Three educational facilities are located within the Project area. Two are located within 50m of the new alignment (Public school of village Vashlevi and Khunevi School).

38. Noise levels within the Project area are predominantly a result of vehicle traffic on the existing road. Very little commercial or industrial activities can be observed in these areas that would give rise to significant noise levels. 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 undertaken at thirteen residential locations in the Project area showed that noise levels at the building facade varied according to their distance from the existing road. Properties located between 50 and 100 meters of the existing road had daytime noise levels ranging from the low 50's to the high 50's and nighttime noise levels of very similar values.

Even further than 100 meters from the road, some of the monitored locations registered values above IFC nighttime limits of 45 dBA.

39. A noise model was also prepared for the existing road. Out of the 89 receptors modeled, only five had noise levels below the IFC daytime and night time standards indicating that the current road produces levels of noise that are not consistent with a health environment.

6. Impact Identification

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

Design / Preconstruction Phase

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

42. Soils – Productive soils can also be impacted without due consideration of their value when locating 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.

43. Natural Hazards - 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. The Consultants have also assessed all issues relating to landslides, which are considered relatively minor, and prepared designs to take these issues into account.

44. 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 most residential areas and the construction of numerous tunnels reduces the level of resettlement and compensation that would otherwise be expected if the existing alignment was being upgraded.

45. Hydrology - 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. Accordingly, failure of structures is not anticipated.

46. 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

47. 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 haul roads, unpaved roads, exposed soils, material stock-piles, etc. This can lead to health impacts to locals and impacts to ecology and crops.

48. 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.

49. 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 Rikotula rivers. The required amounts, potentially 200 m^3 per day (0.002 m^3/s) are insignificant given the flow rates of this river.

50. 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).

51. 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.

52. 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 4,896 trees have been identified in State Forest Fund areas. Of these, 18 are Georgian Red-listed species greater 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.

53. Biodiversity – A range of Project related activities may have negative impacts upon fauna in the Project area, including site clearance, pollution and waste generation, light pollution and a lack of regulation. These activities may degrade habitat and impact significantly upon wildlife in the Project area. Site clearance carried out for the Project will result in loss of habitat that is presently being used by wildlife. Impacts to habitat were unavoidable given the constraints of the Project corridor and the need to design a safe road to a modern standard. It is estimated that approximately 33 hectares can be classified as natural habitat within the Project buffer – all of the land in this area will be cleared for construction works. Almost all of these areas comprise the afore mentioned State Forest Fund areas.

54. Protected Areas - The nearest protected area, Borjomi Nature Reserve, is located more than 15 kilometers south of the road and will not be impacted by Project works.

55. 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. Use of local roads may also be damaged by large trucks transporting materials to and from the various work sites along the alignment.

56. 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.

57. 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.

58. Tunnel & Embankment Spoil Material - A large volume of spoil material will be generated from the tunneling works. Estimates provided by the Detailed Design Consultant indicate that as around 935,000 m^3 of spoil material will be generated from the tunnels, 161,000 m^3 from tunnel portals, 135,000 m^3 from local roads / interchanges and 1,010,000 m^3 from cut in side slopes. Where practical the spoil will be re-used as embankment material at the Project site. Estimates indicate that approximately 327,950 m^3 can be re-used as embankment material, which would leave approximately 1,913,050 m^3 as static balance.

59. The average journey distance to transport the spoil material from tunnels to the embankment areas may be around 5 kilometers. To transport material to the embankment areas approximately 27,000 return truck journeys will be required (based on 12m^3 of material in each truck), or an average of 29 a day over the 30 month construction period.

60. 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.

61. 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.

62. 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.

63. Landscape - The Project Area largely consists of valleys with large trees and bushes of heights greater than 2 m. The hilly landscape greatly restricts visibility to a less than one km at receptor locations. The construction phase visual impact will be local and temporary. The activities during construction that will affect the aesthetics of the area include excavation, and storing of material in stockpiles and dumping at the waste disposal areas. The elevated interchanges and retaining walls in some sections may also have an aesthetic impact.

64. 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.

65. 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 except for a small church at KM10.0 and a Cemetery at KM8.6. It is possible, given the rich cultural heritage of Georgia, that chance finds could occur during excavation works.

66. 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.

67. Vibration – A vibration model prepared for the Project shows that, for tunnels TUN-2001 to TUN-2006 and TUN-2008, there will be no receptors affected by structural damage (due to their absence or expropriation). In these locations blasting is acceptable. In the remaining tunnels, blasting has the potential to cause structural damage to as many as 42 properties, this is reduced to 16 when using mechanical excavation. The conclusions for cosmetic damage are very similar, with no impacts to TUN-2002 - TUN-2006 and TUN-2008 and only one receptor impacted next to TUN-2001. The number of receptors potentially subject to cosmetic damage is 64 with the use of blasting, reducing to 20 with the use of mechanical excavation technique. For bridge construction the model, both blasting and piling were modeled. However, only piling is considered relevant to the Project. Only 5 potential receptors have been identified that may suffer structural damage from piling, but all five receptors are very close to the bridge and are being considered for expropriation. A total of eleven receptors may suffer potential cosmetic damage, but this will reduce to six if the properties mentioned above are expropriated.

68. Cumulative Impacts – Cumulative impacts during the construction phase include:

(i) Construction Traffic – Most construction vehicles will be operating within their specific section (and even the Contractors individual 'Lot'), however, there will also be numerous daily vehicle movements across all three sections for the delivery of materials and the movement of spoil material to Kutaisi bypass. These combined vehicle movements will have impacts to noise and air quality along the road, in addition to the potential safety aspects that come with the movement of as many as 1,000 construction vehicles per day along the combined F2, F3 and F4 section.

(ii) Construction Camps – There are, potentially six construction 'Lots' for the all three sections. This means that there could be six different contractors as well as at least three supervision engineers. Each one will need their own construction camps and offices. As noted above, the valley is rather constrained in terms of land availability and six construction camps could place a strain on the local population and the ecology of the area.

Operational Phase

69. 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 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.

70. Climate Change – The climate risk and vulnerability assessment classified portions of the Project according to the risk of them being affected by climate change. Bridges, tunnels, cut sections and drainage structures were deemed to be at high and moderate risk from climate change. Road surface, road embankments, road base and interchanges were deemed to be at low risk from climate change. All of the items identified have been assessed by the Detailed Design Consultant and none of the issues identified are considered to represent a significant risk given the design measures already included as part of the Project.

71. Hydrology – In rare circumstances there could be a major spill of oil / fuel from tanker trucks. Such spills could impact significantly on the Dzirula and Rikotula rivers given the proximity of the road to these surface water courses in many locations along the alignment. 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.

72. Noise – A noise model was developed for the EIA to determine the noise levels on the Project road in the year 2037. Using the current traffic levels a model was also prepared for the existing road. A comparison of the result of the 'ambient' noise levels against the forecast levels was then made to determine if the forecast noise was more than 3 dBA above the ambient. The results show that 21 of the 66 identified receptors are within 3 dBA of the modeled ambient. In addition, it is noted that a further four receptors will be below IFC guidelines for daytime and nighttime noise (45 and 55 DBA), meaning that a total of 25 receptors would be within IFC guideline limits in the predicted future scenario and 41 would be above the limits.

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

74. 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.

75. Employment and Business - Although the existing road will remain open for almost its entire extent and interchanges will be constructed to access the existing road from the new alignment, it is likely that a number of roadside market traders will be impacted by the reduced traffic levels on the existing road, including the pottery and ceramics traders around Shrosha.

76. After the Project construction phase many local workers may be without employment. However, the Project will have provided them, in many instances, with additional skills and experience to work on similar projects in other locations.

77. Visual Impact - Cut slopes, embankments, concrete bridges and tunnels will have an impact on the landscape within the valley throughout the Project lifecycle. The mitigation measures outlined above may go someway to enhancing the aesthetic value of the Project especially as vegetation grows back around construction zones, and in all likelihood any negative opinion of the new road in terms of visual impact will decrease over time as people get used to the altered landscape.

78. Induced Impacts – It is possible that construction of the new road could induce development along the corridor to some extent, but in general the purpose of the Project is to improve the existing E-60 corridor to provide safer and quicker journey times which will help facilitate the movement of people and goods locally and regionally. It is considered unlikely that significant new commercial, industrial or residential developments would arise along this portion of the corridor as a result of the Project that in turn may lead to; a) conversion of agricultural land, b) 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. It is also noted that the Project does not increase accessibility to forests.

7. Mitigation and Management Actions

79. The summary mitigation and management measures for the potential impacts identified above for the Roads include:

Design / Preconstruction Phase

80. Specific Environmental Management Plan (SEMP) - The SEMP will describe the precise location of the required mitigation / monitoring, the persons responsible for the mitigation / monitoring, the schedule and reporting methodology. The SEMP will also include the following plans:

(i) Topic Specific Plans:
- Waste Management Plan.
- Spoil Disposal Plan for Arrangement of Spoil Disposal Area.
- Re-cultivation Plan.
- Traffic Management Plan.
- Occupational Health and Safety Plan.
- Emergency Response Plan.
- Air Quality Plan.
- Spill Response Plan.
- Vibration Monitoring Plan.
- Clearance, Re-vegetation and Restoration Management Plan.
- Groundwater Management Plan.
- Tunnel Blasting Plan.
- Noise Management Plan.
- Biodiversity Management Plan.

(ii) Site Specific Plans:
- Construction Camp Plan.
- Asphalt Plant Plan.
- Rock Crushing Plant Plan.
- Concrete Batching Plant Plan.
- Bridge Construction Plan (for each bridge construction site)

81. The SEMP 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 SEMPs are approved by the Engineer and RD. New topic specific or site specific EMPs may also need to be developed by the Contractor during the construction phase. These new plans will also need to be approved by the Engineer and the RD.

82. 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.

83. Siting of Facilities – Locations for rock crushing facilities, concrete batching yards and asphalt plants will require approval from the Engineer, MoEPA 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).

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

85. Bridge Design - The bridge designs considered where possible, to avoid placing bridge piers in rivers. However, it is important to point out that the Project road is located in a complicated orography (a narrow valley with a central river) and that the geometric standards of the route have imposed strong constraints that oblige to pass over the river, to have no greater environmental impact on forests or populated areas. Bridge designs will ensure that drainage from bridge decks over 50 meters do not discharge directly to the watercourses beneath the bridges. Discharge waters will 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.

86. Drainage Design - Consideration in the design phase has to 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. It is also strongly recommended that the RD considers including the use of oil separators within the road drainage system to capture any spills of oil / fuel and also to filter hydrocarbon run-off from the road in general.

87. Natural Hazards - No significant issues have been identified relating to landslides that cannot be managed by incorporation of the design measures

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:

(i) Private Land – Compensation shall be paid to all affected tree owners as per the Project LARP.

(ii) State Forest Fund – An inventory of the species to be de-listed is being prepared as part of this EIA and updates to this document will be made when the final information is received. 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 MoEPA in writing regarding the identified Red-List species in the project area so that they may also be de-listed from the SFF. Compensation payments for the tree cutting in SFF areas will paid to the Government by the RD according to GoG regulations prior to any tree cutting. No compensation in the form of re-planting is required under this resolution unless specified by the MoEPA in the Conclusion of Ecological Expertise.

90. Biodiversity – Prior to any land clearing activities, bridge works, or works in tunnels, site surveys shall be undertaken by national specialists to determine the presence of any species that may be impacted in these areas including bats, birds, otters, squirrels, herpetofauna and turtles. Management plans for identified species noted in the area will be prepared by the Contractors specialists and implemented prior to the start of any land clearing/ construction works.

91. 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. The Contractor will also submit a Traffic Management Plan to local traffic authorities prior to mobilization and include the plan as part of his SEMP.

92. 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.

93. Spoil Disposal – The responsibility for identifying the final disposal areas for tunnel and embankment spoil material lies with the Contractor. However, initial assessment of this issue has been undertaken for this EIA and environmental screening of three potential spoil disposal sites have been undertaken. One site, close to Boriti has the least environmental and social impacts and it is possible that the spoil material could be placed in this location. If the Contractor chooses to use this location, or another, he will be responsible firstly, for preparing a detailed assessment of this site to be approved by the ADB and the RD. Upon approval of this assessment, the Contractor shall then prepare a Spoil Disposal Plan for Arrangement of Spoil Disposal Area and a Re-cultivation Plan. 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. The Contractor will also complete an EIA for this location to satisfy the national EIA regulations. All relevant permits will be needed before any spoil can be placed in the identified area. The Plans 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. 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 Contractor within the vicinity of each tunnel he is excavating.

95. 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.

96. Loss of Land and Property - Under the terms of the Loan of the ADB, before the commencement of the construction works at any part of the site, the ***Employer*** must prepare the Land Acquisition and Resettlement Plan (the LARP), obtain the approval of ADB and then implement the plan and acquire the land.

97. 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 500 meters downwind of sensitive receptors will limit potential noise impacts. In addition to the above, prior to the start of construction, and as part of his SEMP, the Contractor will develop a noise management plan.

98. 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 pre-construction surveys undertaken.

Construction Phase

99. 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.

100. 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.

101. 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.

102. 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.

103. Biodiversity – Specific mitigation measures have been prepared for International Union for Conservation of Nature (IUCN) and Georgian Re-list species identified as part of this report. In addition, a range of general mitigation measures have been prepared to limit impacts to fauna, including for example, prohibiting hunting and poaching.

104. The Project will clear approximately 33 hectares of natural habitat. The EIA has identified the different habitats affected and the size of each habitat to be cleared. To mitigate this impact the Project shall undertake a three phase approach. Firstly, the Contractor, as part of his Clearance, Re-vegetation and Restoration Management Plan, shall prepare an action plan for the restoration of habitat within the Project corridor. This is of particular importance in the riparian environments where bridge construction occurs. The plan should be prepared by qualified national biodiversity specialists. Secondly, the Contractor shall prepare, as part of his Clearance, Re-vegetation and Restoration Management Plan, a plan to restore habitat at his spoil disposal sites, including, if practical the spoil site identified close to Boriti. Third and finally, the Contractor will consult with MoEPA to determine if there are any areas within the vicinity of the Project area where habitat restoration programs would be beneficial to the local environment or community. Plant maintenance as part of such programs will be carried out for at least two years in the plantation areas. The Contractor will be responsible for the maintenance of these areas. 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. Protected Areas - No construction activities, including camps, haul routes, etc. will be allowed within, or through protected areas, or reserves.

106. Landscape – The following mitigation measures are proposed to reduce the visual impact of the Project; a) minimize disturbance to, or movement of, soil and vegetation; b) undertake landscaping after the completion of the activities to match in with surrounding landscape; and c) Reinstate vegetation.

107. Infrastructure - The Contractor will continually 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.

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

111. Bridge Construction – In the first instance all feasible efforts will be made to minimize the construction footprint in the river as much as possible. In addition, A range of measures are provided in the EIA to prevent impacts occurring at bridge construction site 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 MoEPA to confirm 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.

112. Tunnels - Routine monitoring of the groundwater levels in wells in the Project area will be undertaken on a weekly basis by the Contractor within the vicinity of each tunnel under excavation. 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, or alternative sources of water supply will be provided for the affected persons.

113. 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.

114. 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.

115. 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.

116. Physical and Cultural Resources - The cemetery identified close to the Project road is unlikely to be significantly impacted by construction works, however, it is required that during the construction phase the boundary of the cemetery be fenced off to ensure that there is no encroachment into this area by construction workers or equipment. During the construction phase works shall be schedule that no works occur within 250 meters of the Church at KM8.6 on Sundays, or during religious holidays. In the event of any chance finds during the construction works procedures shall apply that are governed by GoG legislation and guidelines.

117. Noise – 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.

118. Vibration - The Detailed Design team has been made aware of the areas potentially subject to structural damage from tunnel blasting and the recommendation that all tunneling activities in these areas has to be done by Roadheader excavation (which is the less invasive mean of excavation) has been included in the Design Report. The use of Roadheader will also limit the potential for cosmetic damage in these locations. In addition, during the construction phase a number of activities will be followed relating to vibration, including building surveys, real time monitoring, etc.

Operational Phase

119. Noise – The noise models prepared indicate that noise barriers, in certain locations, will reduce noise levels to comply with IFC standards. These noise barriers should be constructed as part of the Project. However, some receptors have been identified that will still be subjected to noise levels above IFC standards during the operational phase. Several options have been provided that should be followed up in order to mitigate the impacts to the identified receptors. In this first instance this involves refined mitigation measures, including redesign of several noise barriers, including their height, and potential location. Other refined mitigation options include the use of noise proof windows, low noise asphalt on the identified bridges and speed limits in Khevi and Khunevi. If these refined measures still cannot meet the IFC standards two remaining options will be left, firstly relocation of the home owner, or signing of legally binding agreements stating the owners want to stay in their homes despite the potentially high noise levels.

120. Climate Change – Although no significant risks have been identified, the Detailed Design Consultant shall ensure the recommendations made in this EIA are included in the "Recommendations for the management of the highway" document.

121. Hydrology - During the operational phase of the Project, the RD will be responsible for monitoring drainage along the road to ensure that it does result in increased run-off and flooding. The RD will be responsible for rectifying this issue if it occurs.

122. Groundwater - The Contractor shall continue to monitor the water levels in any affected ground water wells for a period of 12 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 alternative water supply will be provided to the affected parties, this may include for example, increasing the depth of their wells, or piped water from another location, which, as noted above, appears to be a fairly effective option.

8. Monitoring Actions

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

124. Instrumental Monitoring – This shall be completed by independent specialists and will include; a) Routine air quality, water quality soil sampling and noise monitoring during the construction phase; and b) 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 SEMP 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, firstly in Boriti in 2017 and secondly in Kharagauli in 2018. 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 I** of the Report provides details of the consultation procedures and the main comments received. Consultations are also still on-

going as part of the LARP procedure. As information from these consultations will be added to this EIA as they are received.

10 Conclusions

129. This EIA has established that in general there are no significant environmental issues that cannot be either totally prevented or adequately mitigated to levels acceptable GoG and international standards for Project activities.

130. However, several residual impacts have been identified in botht the construction and operational phases of the Project, including:

Construction Phase

(i) Fauna - Site clearance will impact upon fauna in the Project corridor, including, for instance Otters. Residual impacts will be **MINOR/MODERATE.** Further surveys of fauna prior to the start of construction to identify potentially affected species and action plans to manage these issues will help reduce the residual impacts.

(ii) Aquatic Flora and Fauna – A number of bridge piers will be constructed within the Dzirula and Rikotula rivers. In addition bridge abutments will also encroach into the river in some locations. Even though mitigation measures outlined above will help reduce the significance of the impact, residual impacts will be **MODERATE** as aquatic flora and fauna are disturbed by the Project works.

(iii) Land Use - No residual impacts are anticipated if the LARP is implemented correctly. However, there will still be disruption to the local community during the LARP implementation process. A GRM has been prepared to manage complaints received during this process. Residual impacts will be **MINOR/MODERATE.**

(iv) Waste Management - In general, if the mitigation measures suggested are implemented residual impacts will be minor. However, restoration of any spoil disposal area will take a number of years and as such the residual impacts for the spoil disposal areas are considered **MINOR/MODERATE**.

(v) Noise and Vibration – Despite the fact that comprehensive mitigation measures have been set to manage construction noise and vibration there may still be instances where construction works may result in unanticipated elevated levels of noise and vibration. However, these will only be temporary and localized. Good oversight from the Contractors HSE team and the Engineers environmental manager should limit the impact of these types of incidents. Residual impacts will be **MINOR**.

Operational Phase

(i) Surface Water Drainage - It is noted that the Project requires interceptor tanks for bridge run-off and this should also be considered for the road drainage network in general, if not **LOW/MEDIUM** residual impacts will occur during the operational phase as polluted road water run-off drains directly into surface water courses.

(ii) Greenhouse Gases - Residual impacts from the generation of GHGs will remain throughout the lifecycle of the Project. This is an unavoidable

consequence of the Project, but as noted in other sections of this report, the growth of the electric car market and more fuel efficient cars may, in the future lead to a decrease in the emissions generated on the Project road. Residual impacts will be **LOW/MEDIUM.**

(iii) Employment - After the Project construction phase many local workers may be without employment. However, the Project will have provided them, in many instances, with additional skills and experience to work on similar projects in other locations. Local businesses supplying the Contractors and their staff may also see a fall in trade, this is an unavoidable consequence of the Project. Residual impacts will be **LOW/MEDIUM.**

(iv) Habitat - In the short term the residual impacts will be **MEDIUM/HIGH** as the habitat is cleared. It will take a number of years for the habitat to be restored and for re-planted areas to develop into something similar to the habitats they are replacing. However, in the longer term, the significance of the impacts will reduce as these areas mature.

(v) Aquatic Flora and Fauna – The actual area in the river to be lost from bridge piers or retaining walls will be minimal compared to the wider aquatic habitat available in the Dzirula River, well below 1% of the habitat available. While habitat loss will cause local impacts to aquatic flora /fauna as rivers are dynamic systems it is expected that the river will make a full recovery following construction. Residual impacts will be **LOW/MEDIUM.**

(vi) Visual Impacts - Cut slopes, embankments, concrete bridges and tunnels will have an impact on the landscape within the valley throughout the Project lifecycle. The mitigation measures outlined above may go someway to enhancing the aesthetic value of the Project especially as vegetation grows back around construction zones, and in all likelihood any negative opinion of the new road in terms of visual impact will decrease over time as people get used to the altered landscape. Residual impacts will be **LOW/MEDIUM.**

(vii) Noise - Residual impacts to a number of receptors will remain even after the construction of the noise barriers listed above. Several options have been provided that should be followed up in order to mitigate the impacts to the identified receptors. In this first instance this involves refined mitigation measures, including redesign of several noise barriers, including their height, and potential location. Other refined mitigation options include the use of noise proof windows, low noise asphalt on the identified bridges and speed limits in Khevi and Khunevi. If these refined measures still cannot meet the IFC standards two remaining options will be left, firstly relocation of the home owner, or signing of legally binding agreements stating the owners want to stay in their homes despite the potentially high noise levels. Residual impacts will be **MEDIUM/HIGH**, but will only remain if the measure outlined above are not implemented.

11. Implementation

131. 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.

132. The Bid documents state that the Contractor will be responsible for the implementation of the requirements of the EMP through his own Specific Environmental Management Plan (SEMP) which will adopt all of the conditions of the EMP and add site specific elements that are not currently known, such as the Contractors construction camp locations.

133. 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 SEMP 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 SEMP the Contractor can be held liable for breach of the contractual obligations of the EMP. To ensure compliance with the SEMP the Contractor will employ a national environmental specialist to monitor and report Project activities throughout the Project Construction phase.

134. 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

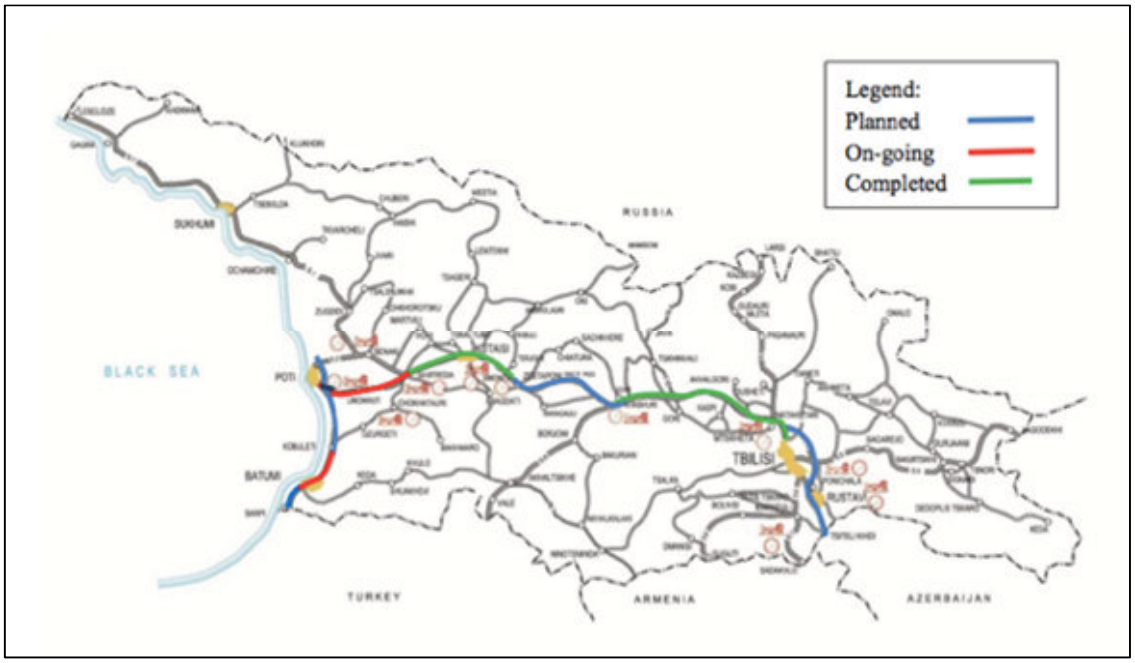
A.1 General

1. This section of the report; a) outlines the purpose of the EIA; b) provides a summary of the project, and c) identifies the project proponent.

A.2 Overview

2. 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. Georgia became part of the Central Asia Regional Economic Cooperation (CAREC) program in 2016, and 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 2 illustrates the current status of road construction and rehabilitation projects in Georgia.

Figure 2: Status of Road Construction / Rehabilitation Projects in Georgia



3. In light of the traffic growth on EWH, the high percentage of truck traffic, and the difficult terrain and resulting geometric profiles (which is resulting in high accident rates), 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.

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

Table 1: Chumateleti – Argveta Road Sections

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

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

A.3 Purpose of the EIA Report

6. This Environmental Impact Assessment (EIA) is part of the process of compliance with the ADB Safeguard Policy Statement (2009) in relation to the construction of Section F2 of the new Khevi-Ubisa-Shorapani-Argveta section of the E60 Highway, or more simply, the "Project".

7. 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.

8. More specifically, the EIA:

(i) Describes the existing socio-environmental conditions within the Project area;
(ii) Describes the project design, construction activities and operational parameters;
(iii) Describes the extent, duration and severity of potential impacts;
(iv) Analyzes all significant impacts; and
(v) Formulates the mitigation actions and presents it all in the form of an Environmental Management Plan (EMP).

A.4 Category of Project

9. Based on the existing ADB Environmental Safeguards Policy (2009), this Project falls under ADB's project Category A as the project is considered to have significant diverse impacts over a wide area, such as noise impacts, significant quantities of spoil disposal, road safety impacts, and vibration.[1]

[1] According to ADB "*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.*"

A.5 Scope of the EIA

10. 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 / EU environmental law. The following section provides further details of each of these aspects.

A.5.1 Scoping Consultations

11. Scoping consultations were held in June, 2017 in Boriti. 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:

- How will you dispose of spoil material from tunnels?
- Roadside businesses should be protected from construction impacts, e.g. dust, restricted access.
- Cattle underpasses should be considered.
- Will all three construction lots be undertaken at the same time, or will they be phased? This could cause a lot of traffic disruption.
- Will access to properties be disrupted during construction?
- There are periods of very high flow in the river, this should be carefully considered during the detailed design to ensure that flooding does not occur.

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

A.5.2 ADB Requirements

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

i. 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 MoEPA.

ii. 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.5.3 Best Practice

14. The World Bank Group (WBG) 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 WBG guidelines to ensure that the Project meets international best practice.

A.5.4 Structure of the Report

15. Given the findings of the scoping consultations, the recommendations of the ToR, best practices guidelines and the defined Project area the following structure will be followed:

Section A: Introduction – The section in hand provides the introductory information.

Section B: Description of the Project – Section B describes the Project need and its environmental setting. A scope of works is also provided indicating the type of engineering works required.

Section C: Analysis of Alternatives – This portion of the report provides an analysis of alternatives, including the 'no project' option.

Section D: Legal, Policy and Administrative Framework - This section presents an overview of the policy/legislative framework as well as the environmental assessment guidelines of Georgia that apply to the proposed project. The overview is based on recent EIA reports prepared for the previous East West Highway Improvement Projects (EWHIPs).

Section E: Methodology – This portion of the report provides the methodology for completion of the EIA, including the procedures followed for monitoring, surveys, modeling, etc.

Section F: 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:

(i) Physical: geology; topography; soils; climate; air quality; noise; surface water; groundwater; seismicity and natural hazards.
(ii) 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.
(iii) 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 have been 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.

Section G: Environmental Impacts and Mitigation Measures – Section G outlines the potential environmental impacts and proposes mitigation measures to manage the impacts. This has included numerical modeling of noise, vibration and air quality to assist in predicting impacts and planning mitigation in these fields.

Section H: Environmental Management Plan – This section comprises an Environmental Mitigation Plan and an Environmental Monitoring Plan.

The Environmental Mitigation Plan:

(i) Clearly identifies what specific potential impacts various types of works may have on the sensitive receptors;
(ii) Provides concrete actions prescribed for managing these impacts, including location and timing of these actions;
(iii) Provides 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); and
(iv) Specifies responsibility for the implementation of each mitigation activity.

The Environmental Monitoring Plan:

(i) Lists all prescribed mitigation measures by types of construction activities;
(ii) Provides selected criteria of monitoring implementation of mitigation measures;
(iii) Specifies methods for measuring outcomes of applied mitigation measures (visual, instrumental, survey, etc.);
(iv) Identifies location and timing/frequency of monitoring mitigation measures by the prescribed criteria;
(v) Gives cost estimates of monitoring mitigation measures by the prescribed criteria; and
(vi) Specifies responsibility for tracking each monitoring criterion.

Section I: Public Consultation, Information Disclosure & Grievance Mechanism – Section I provides a summary of all of the stakeholder consultation activities undertaken. The section also describes the grievance redress mechanism, setting out the mechanisms for resolving complaints about environmental performance.

Section J: Conclusions and Recommendations – The final section of the report provides the report conclusions and recommendations, including a description of any residual impacts.

B. Project Description

B.1 Section Layout

16. This section of the EIA provides the Project description. More specifically it provides; a) Summary of the type and location of the Project, including detailed site location maps, b) Road standards and profiles, c) Description of various Project components, including bridges, tunnels, interchanges, etc., d) Summary of the construction process and the sources of materials, e) An overview of construction facilities, and f) Summary of traffic safety measures.

B.2 Type and Location of project

17. The Project is a road construction project located in Imereti Region of central Georgia. The Project road comprises Section F2 (Khevi - Boriti) of the Khevi-Ubisa-Shorapani-Argveta Road (E-60). The length of Project road is:

(i) Right lane (TA)[2] – 12,197 km;
(ii) Left lane (AT) – 12,193 km.

18. Figure 3 indicates the location of the Project within the context of Georgia. Figure 4 provides a map of the entire Project road and Figure 6 to Figure 25 provides a set of fifteen detailed maps of the site including locations of tunnels and bridges.

Figure 3: Road Location Map

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

Figure 4: Project Road Overview

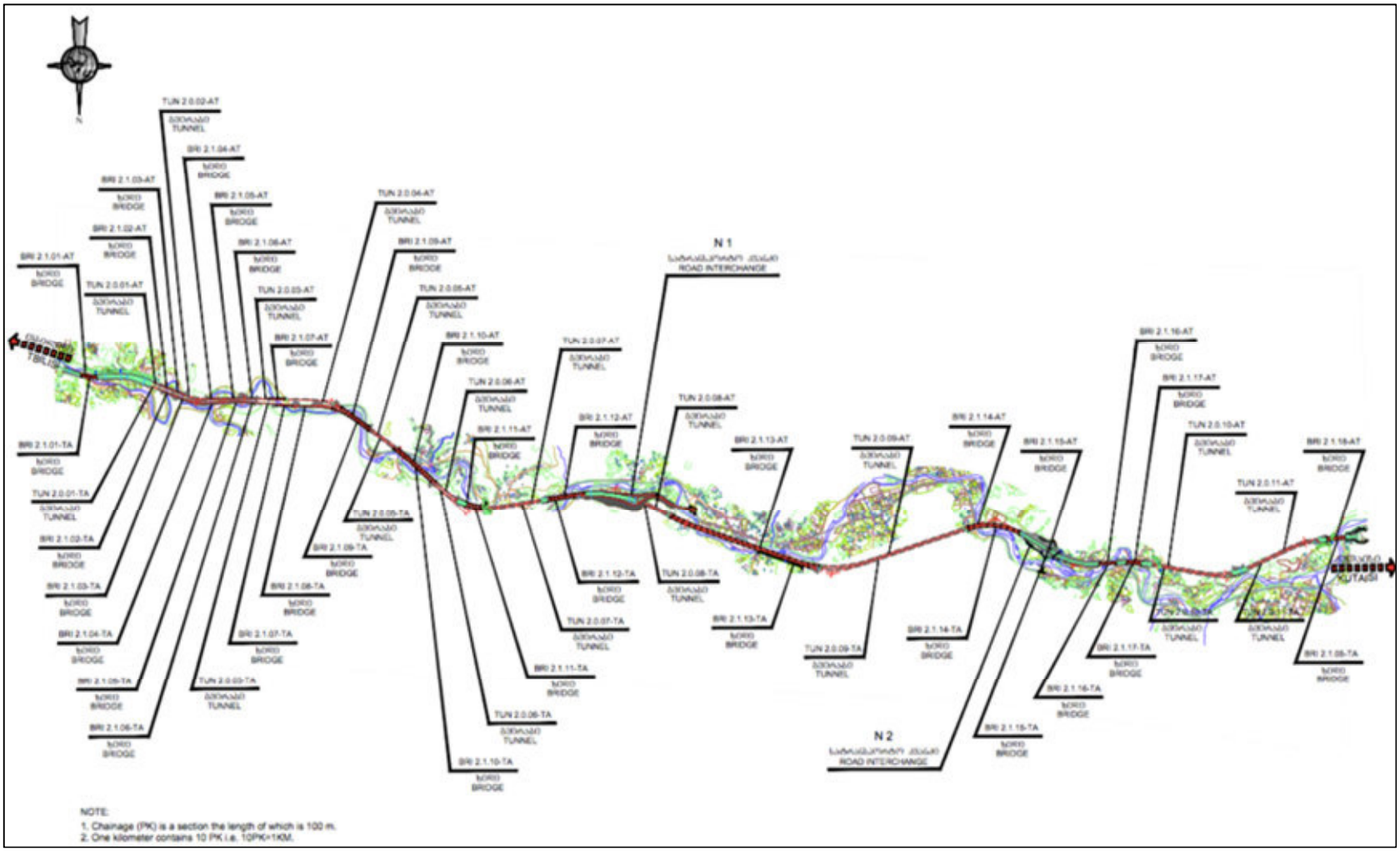


Figure 5: Map Overview

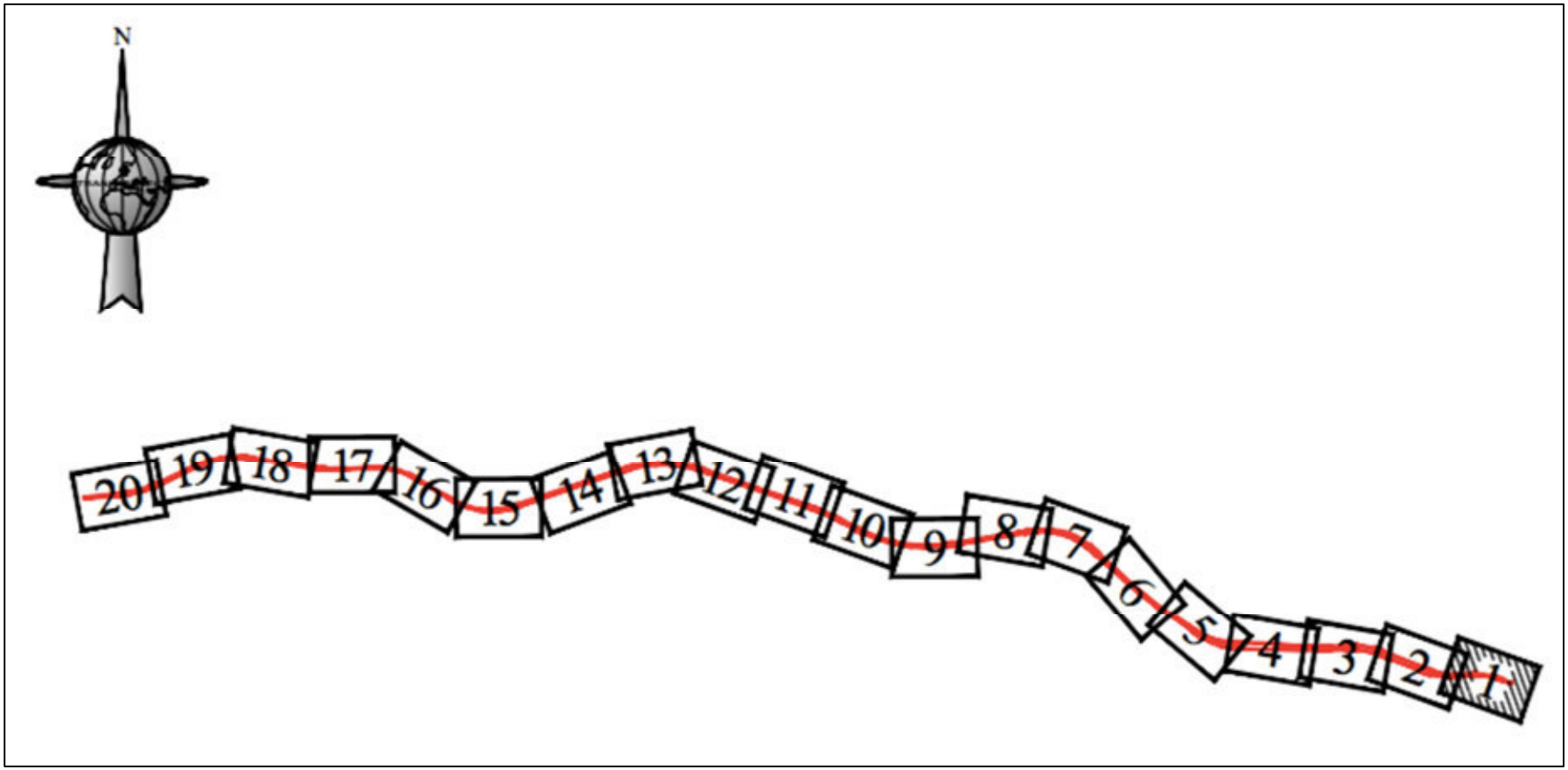


Figure 6: Map 1 - Project Road (KM0.0 – KM0.6)

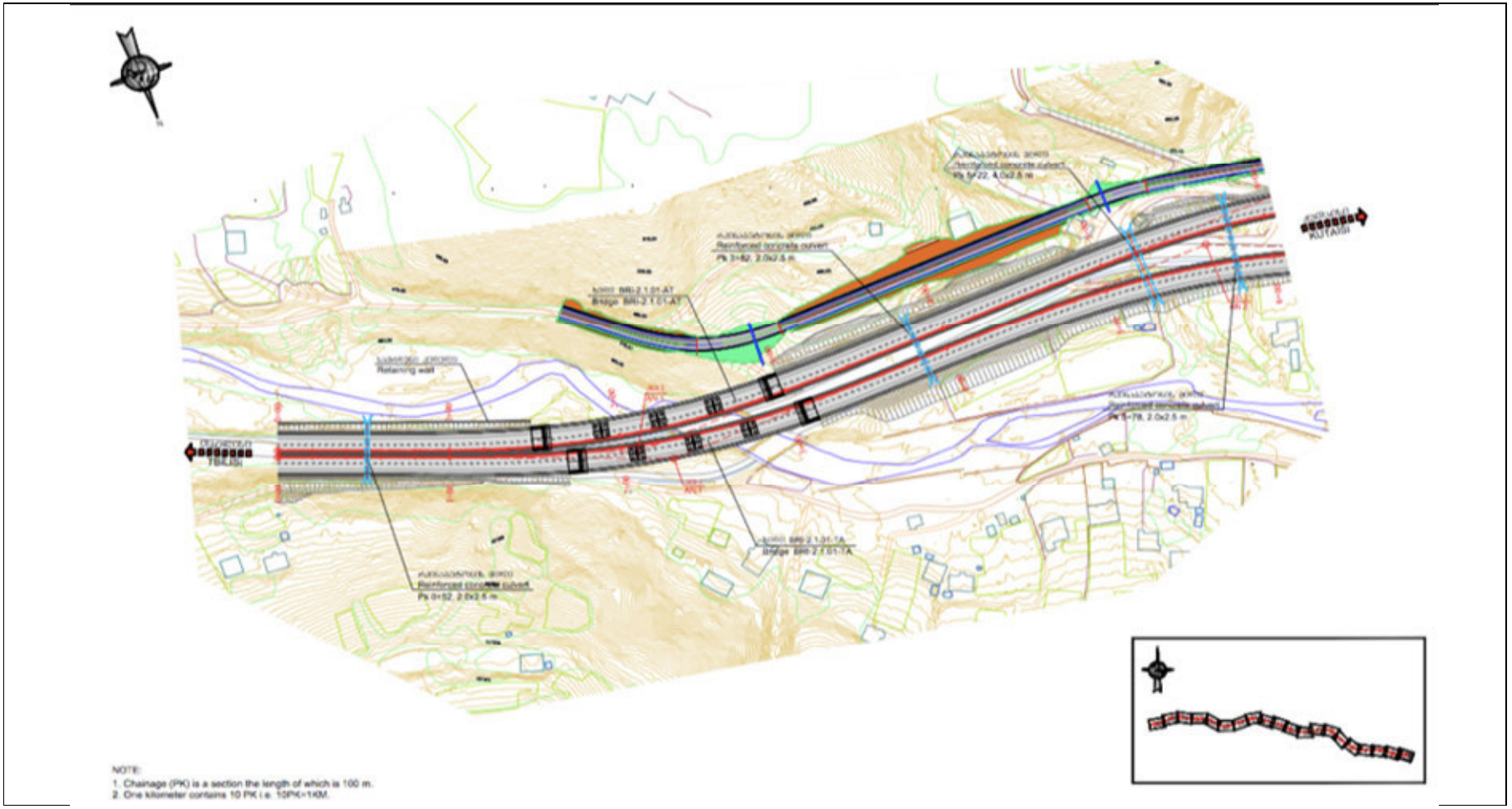


Figure 7: Map 2 - Project Road (KM0.6 – KM1.2)

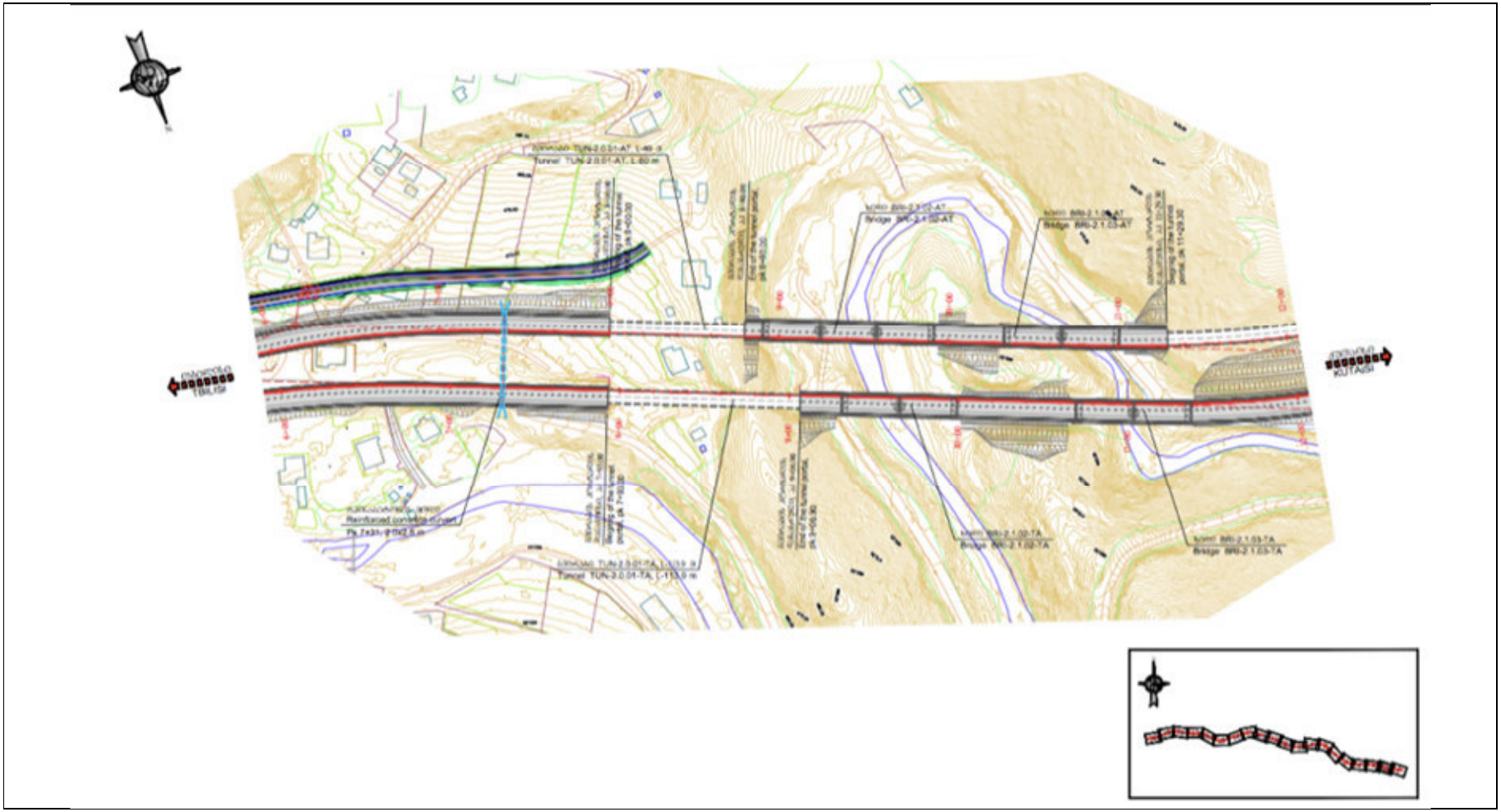


Figure 8: Map 3 - Project Road (KM1.2 – KM1.8)

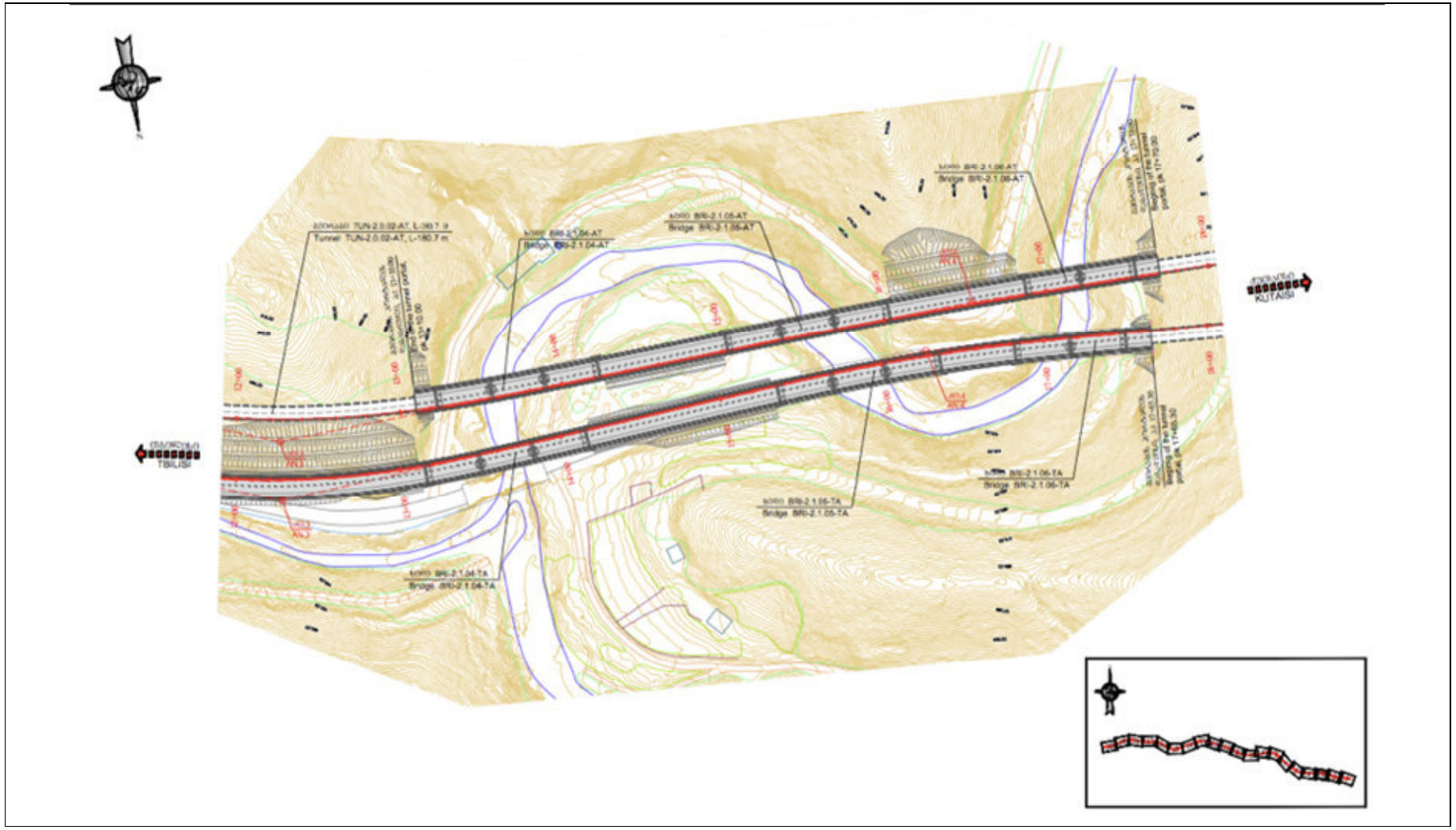


Figure 9: Map 4 - Project Road (KM1.8 – KM2.4)

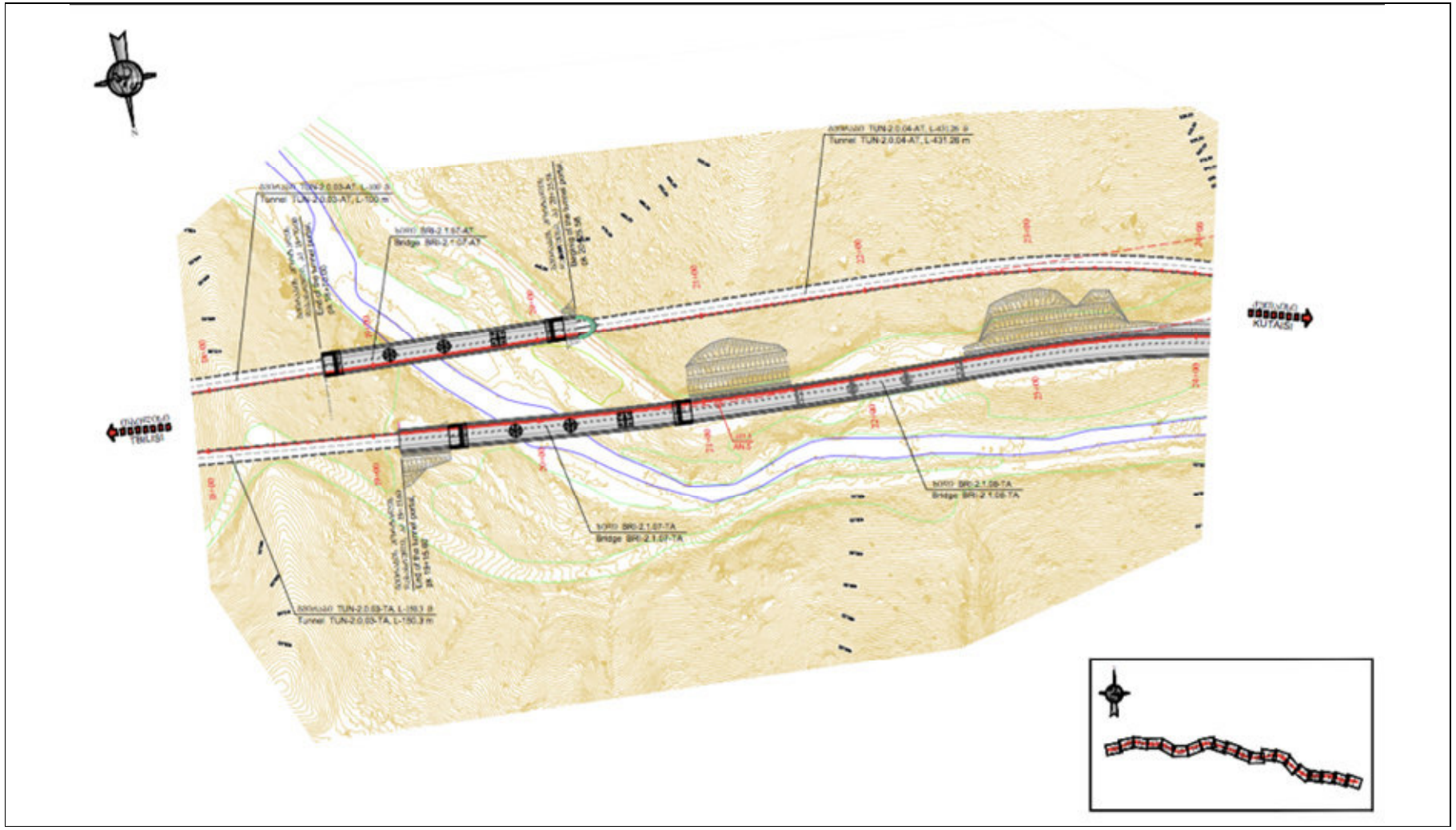


Figure 10: Map 5 - Project Road (KM2.4 – KM3.0)

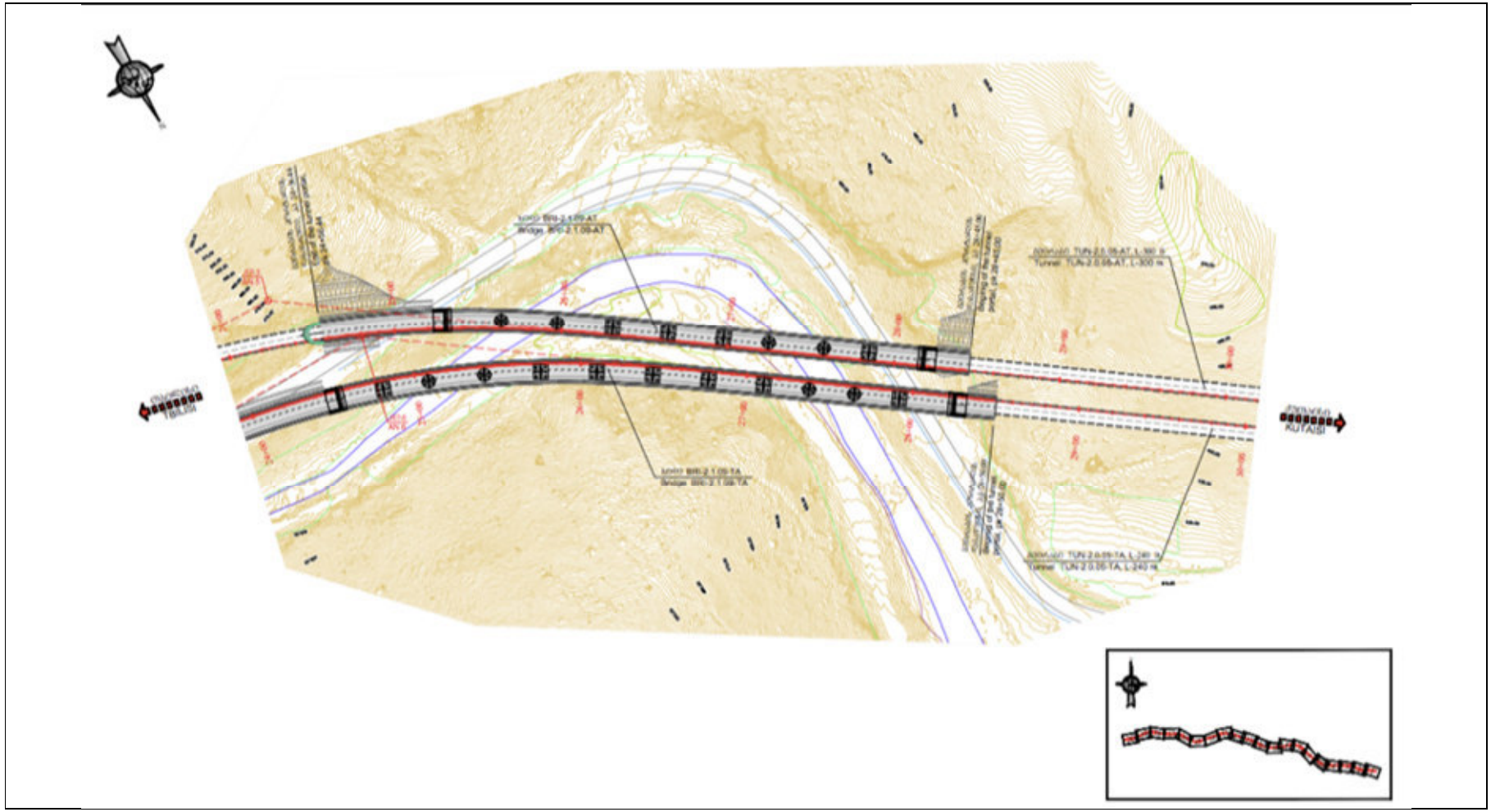


Figure 11: Map 6 - Project Road (KM3.0 – KM3.6)

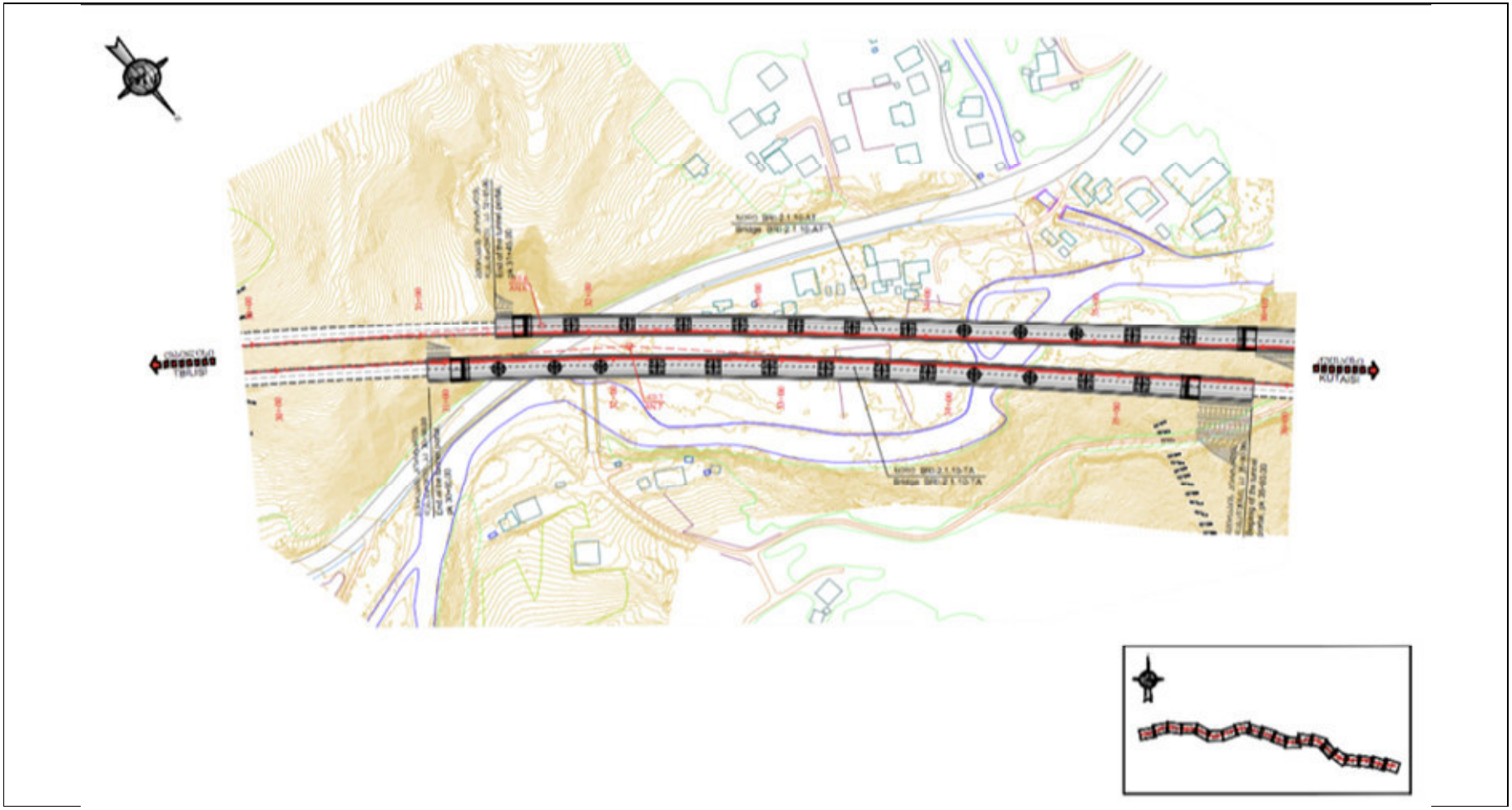


Figure 12: Map 7 - Project Road (KM3.6 – KM4.2)

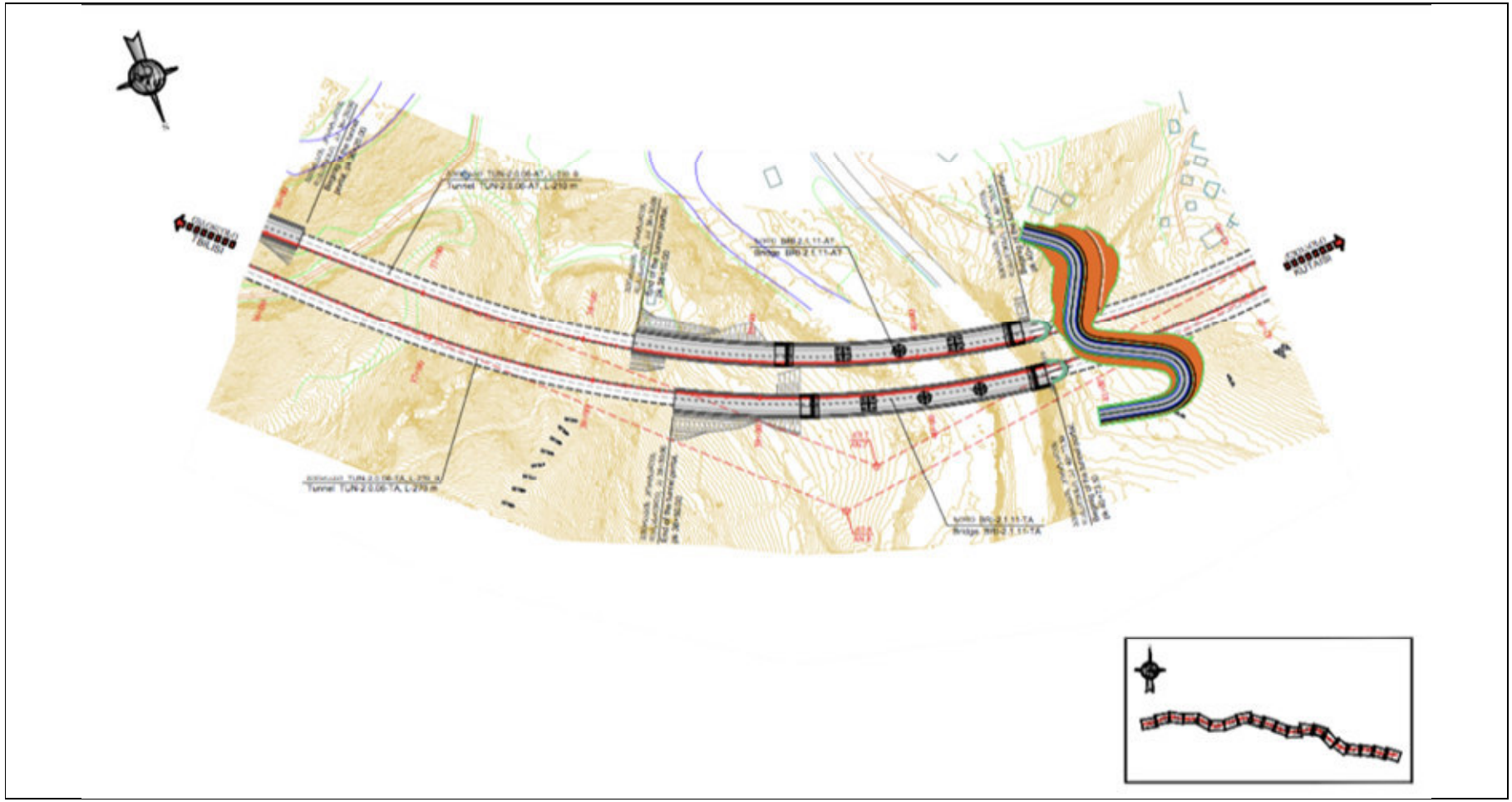


Figure 13: Map 8 - Project Road (KM4.2 – KM4.8)

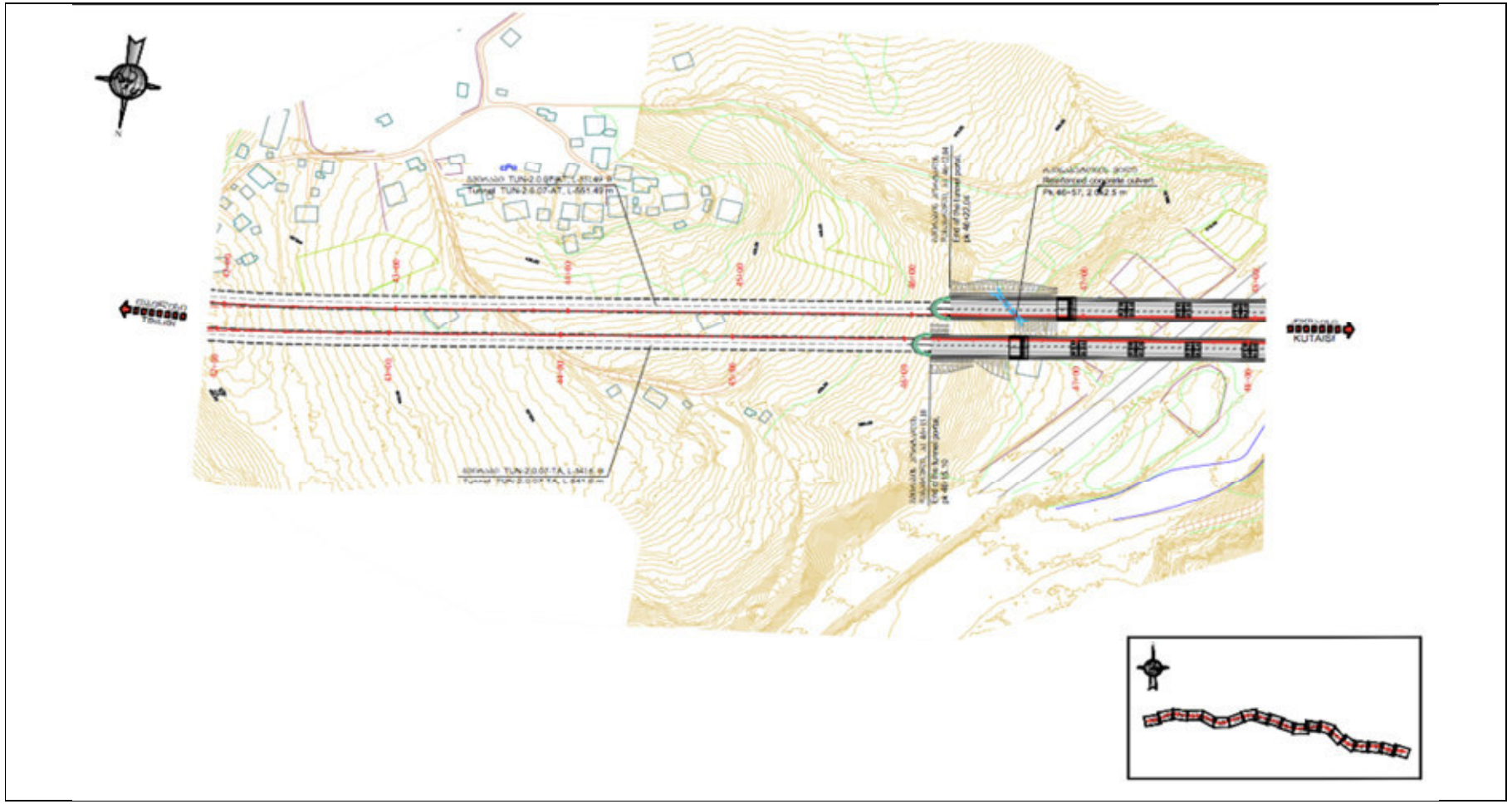


Figure 14: Map 9 - Project Road (KM4.8 – KM5.4)

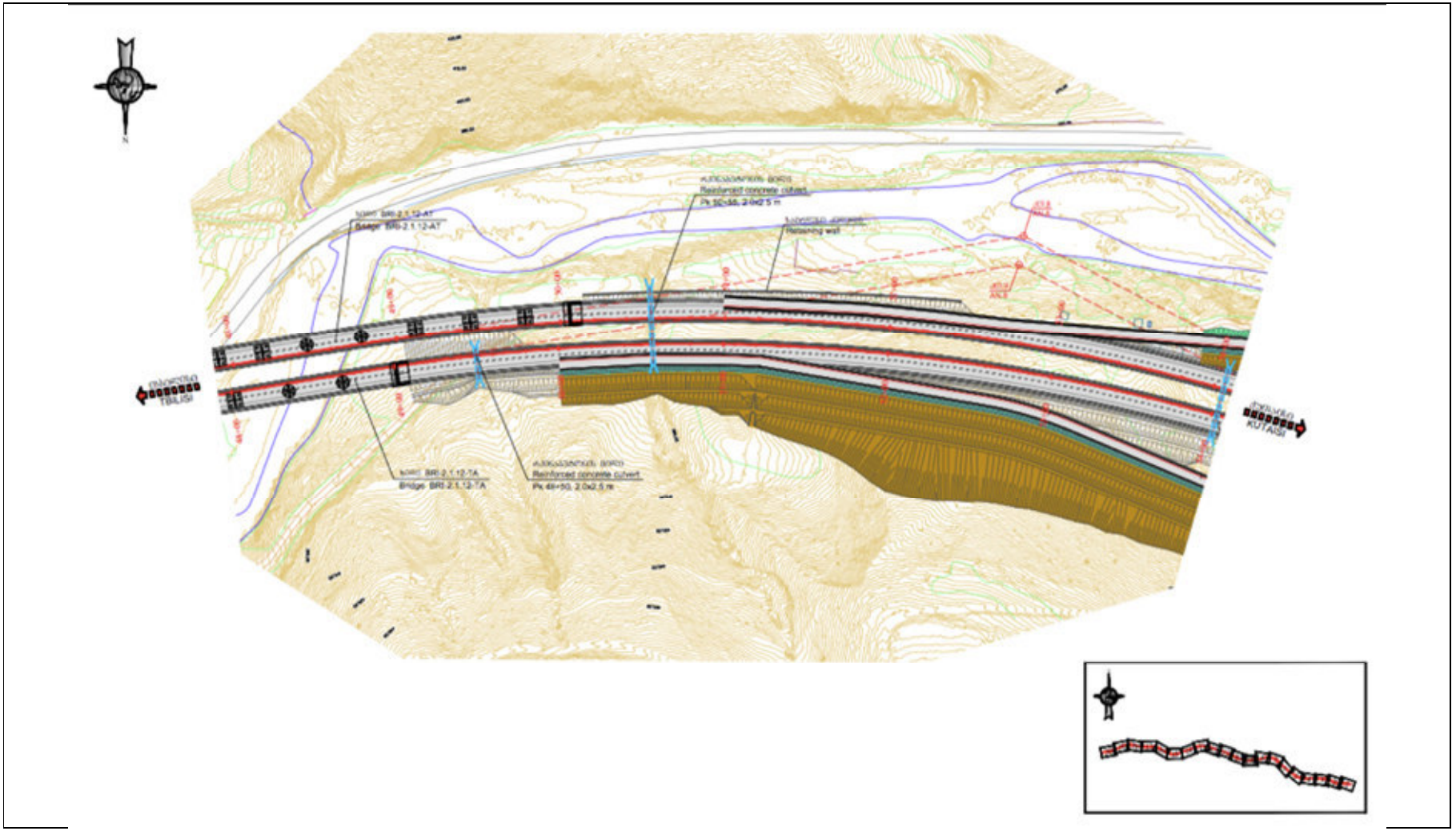


Figure 15: Map 10 - Project Road (KM5.4 – KM6.0)

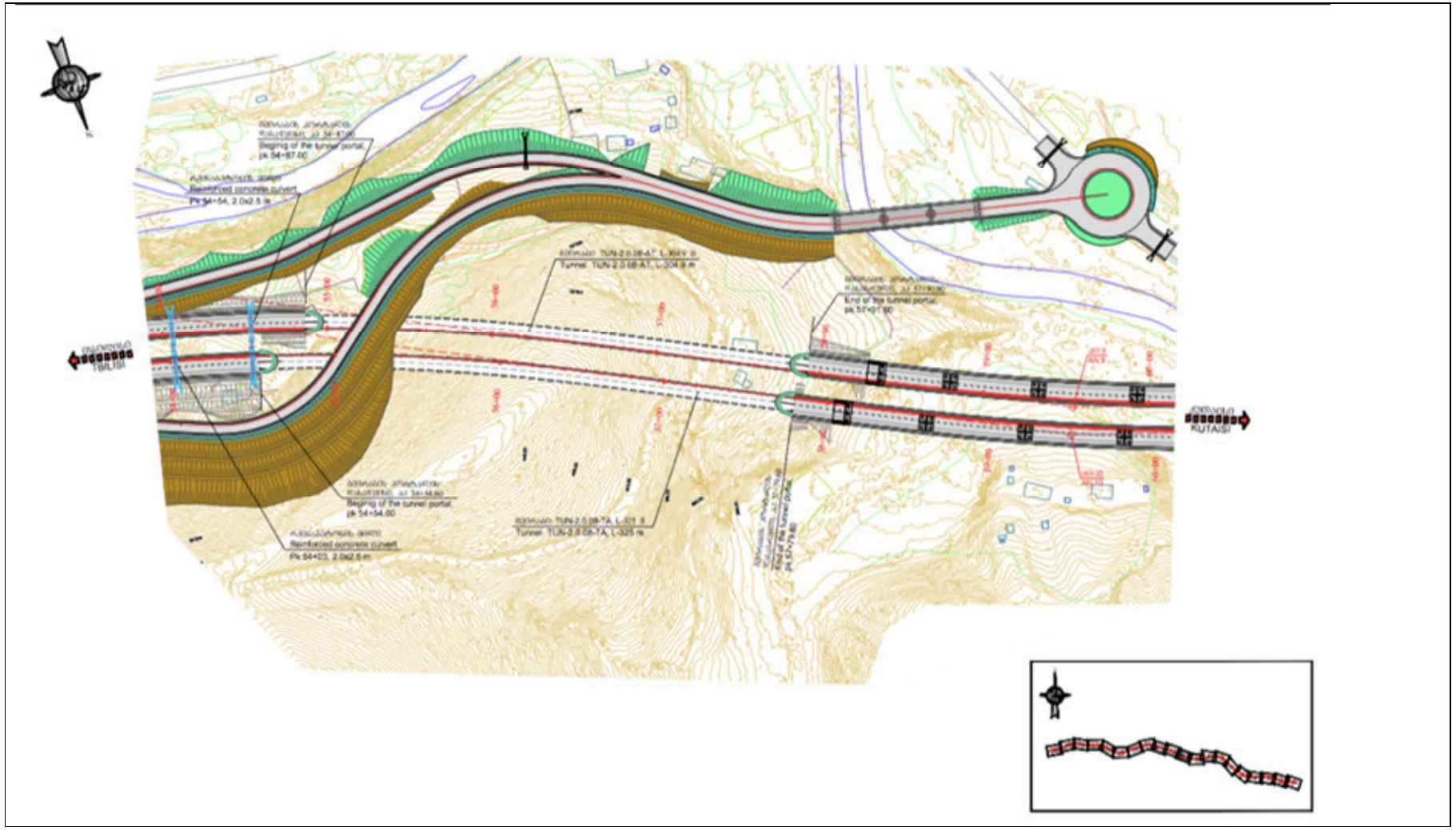


Figure 16: Map 11 - Project Road (KM6.0 – KM6.6)

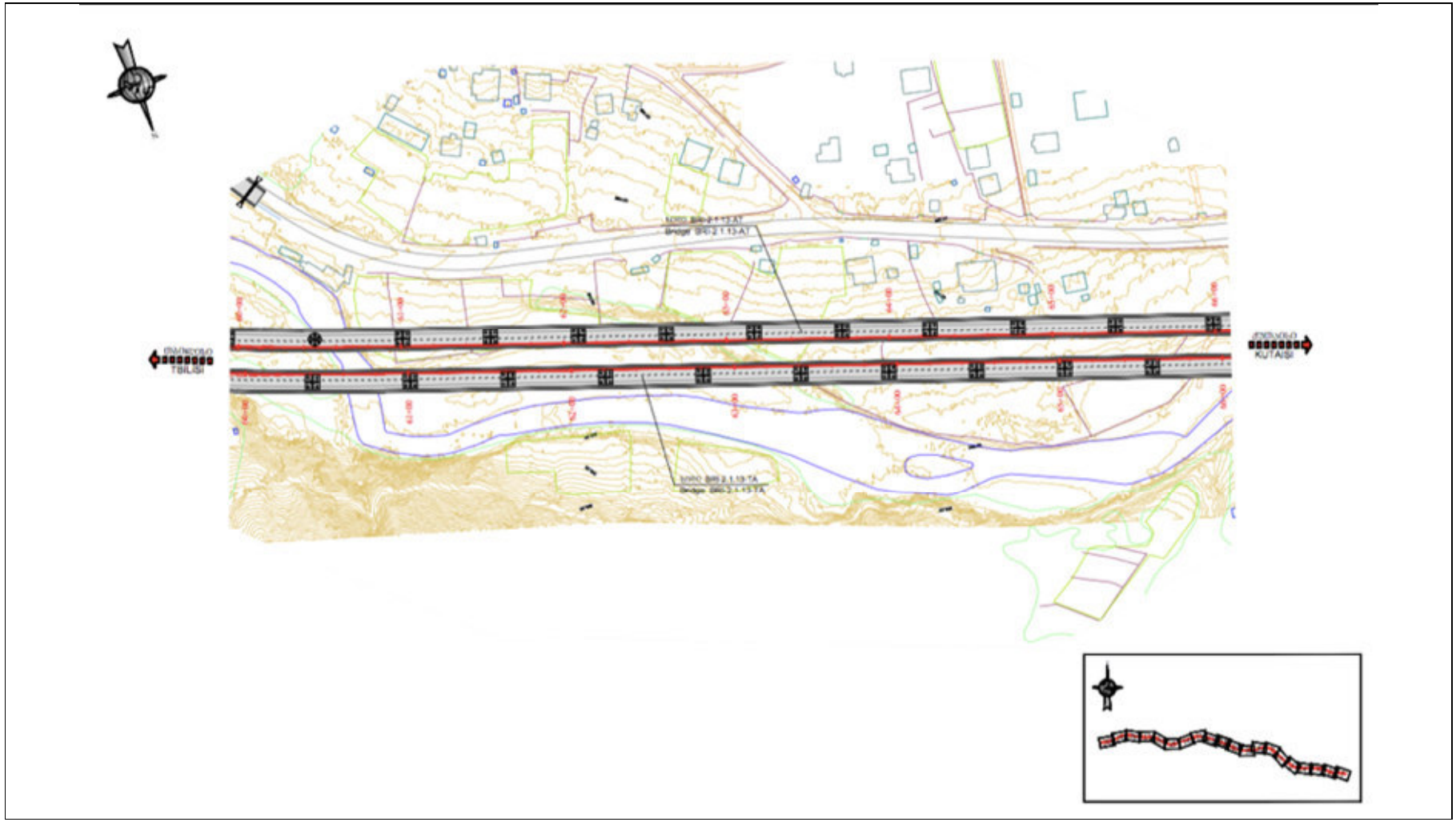


Figure 17: Map 12 - Project Road (KM6.6 – KM7.2)

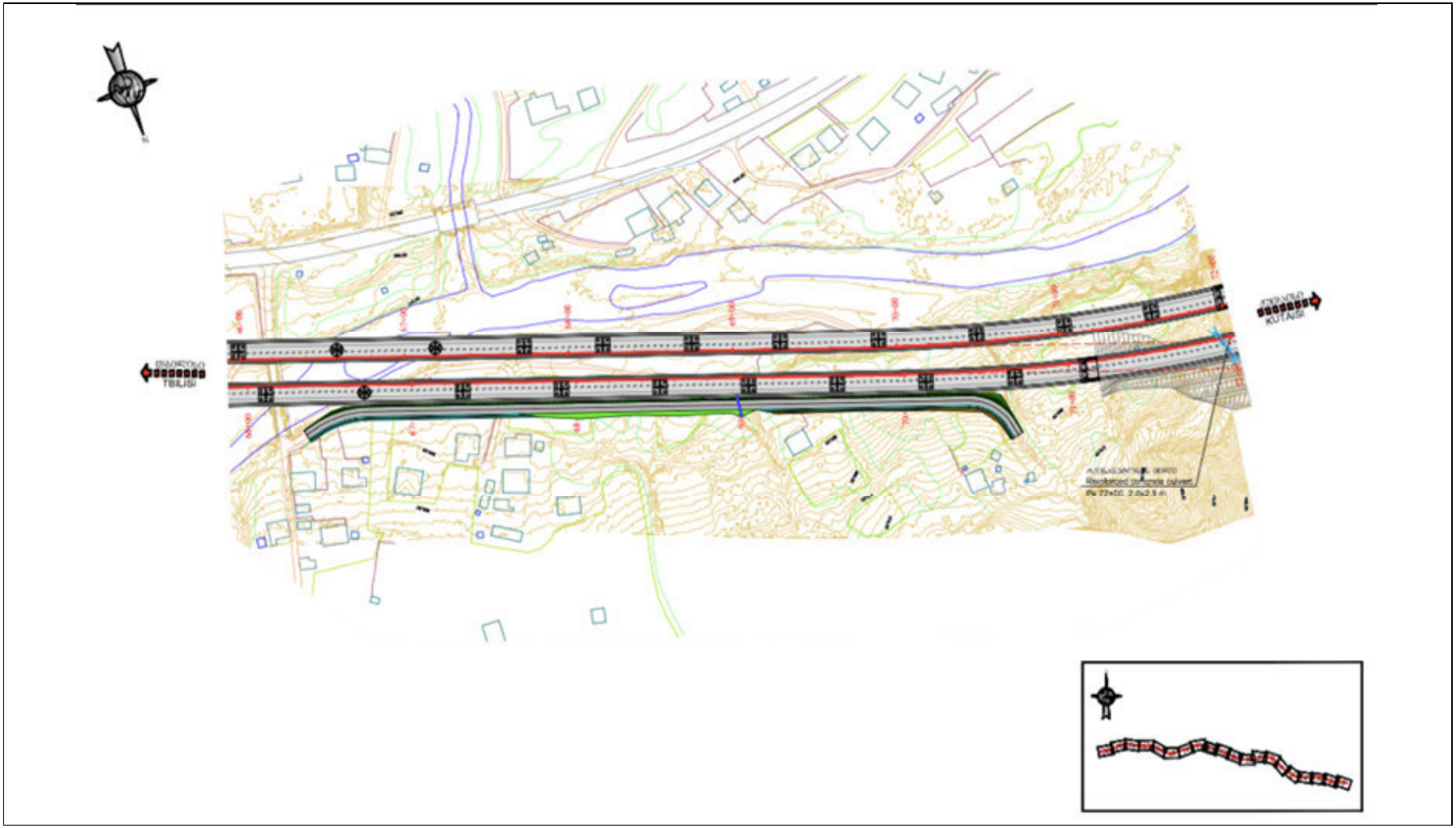


Figure 18: Map 13 - Project Road (KM7.2 – KM7.8)

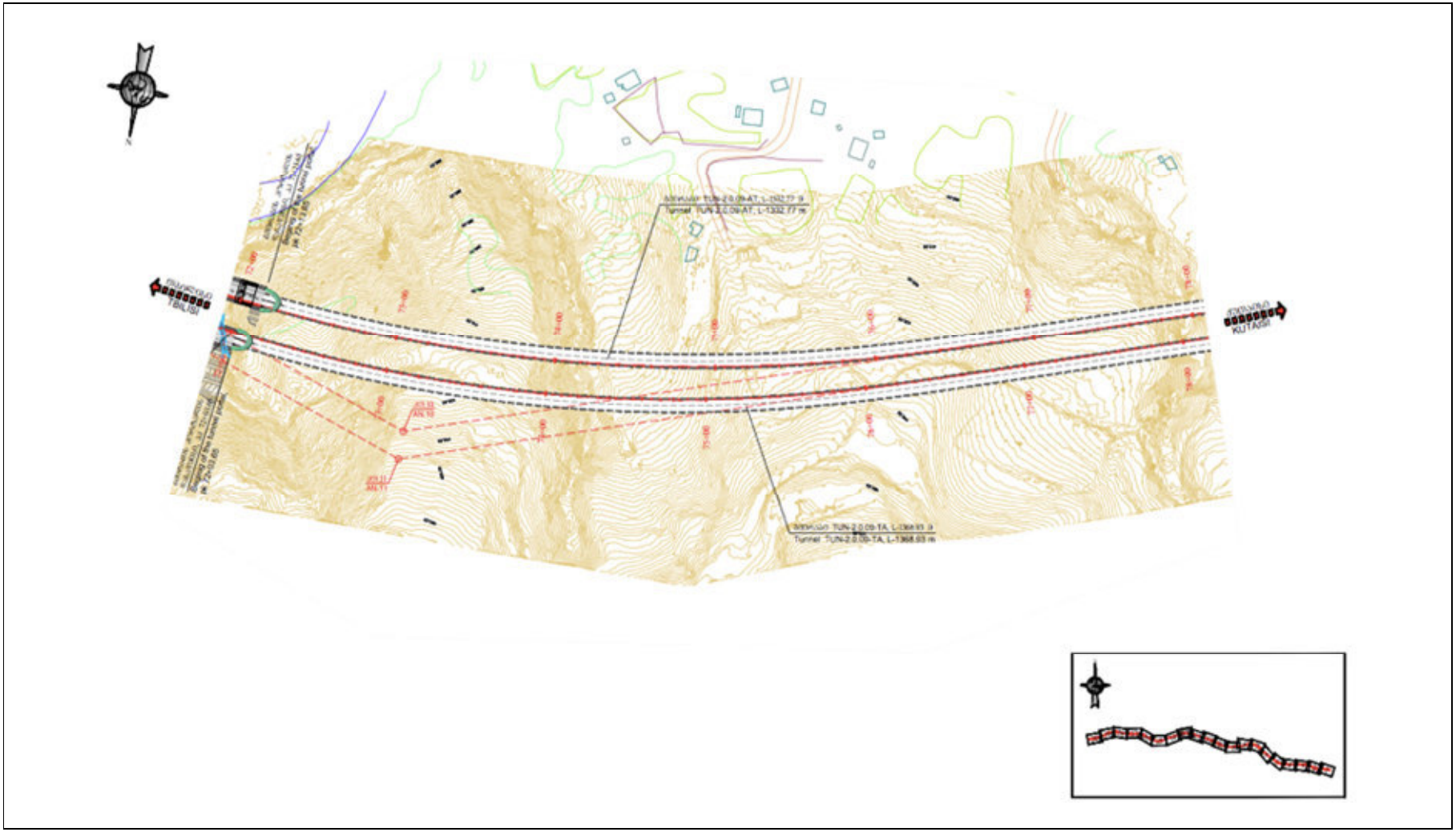


Figure 19: Map 14 - Project Road (KM7.8 – KM8.4)

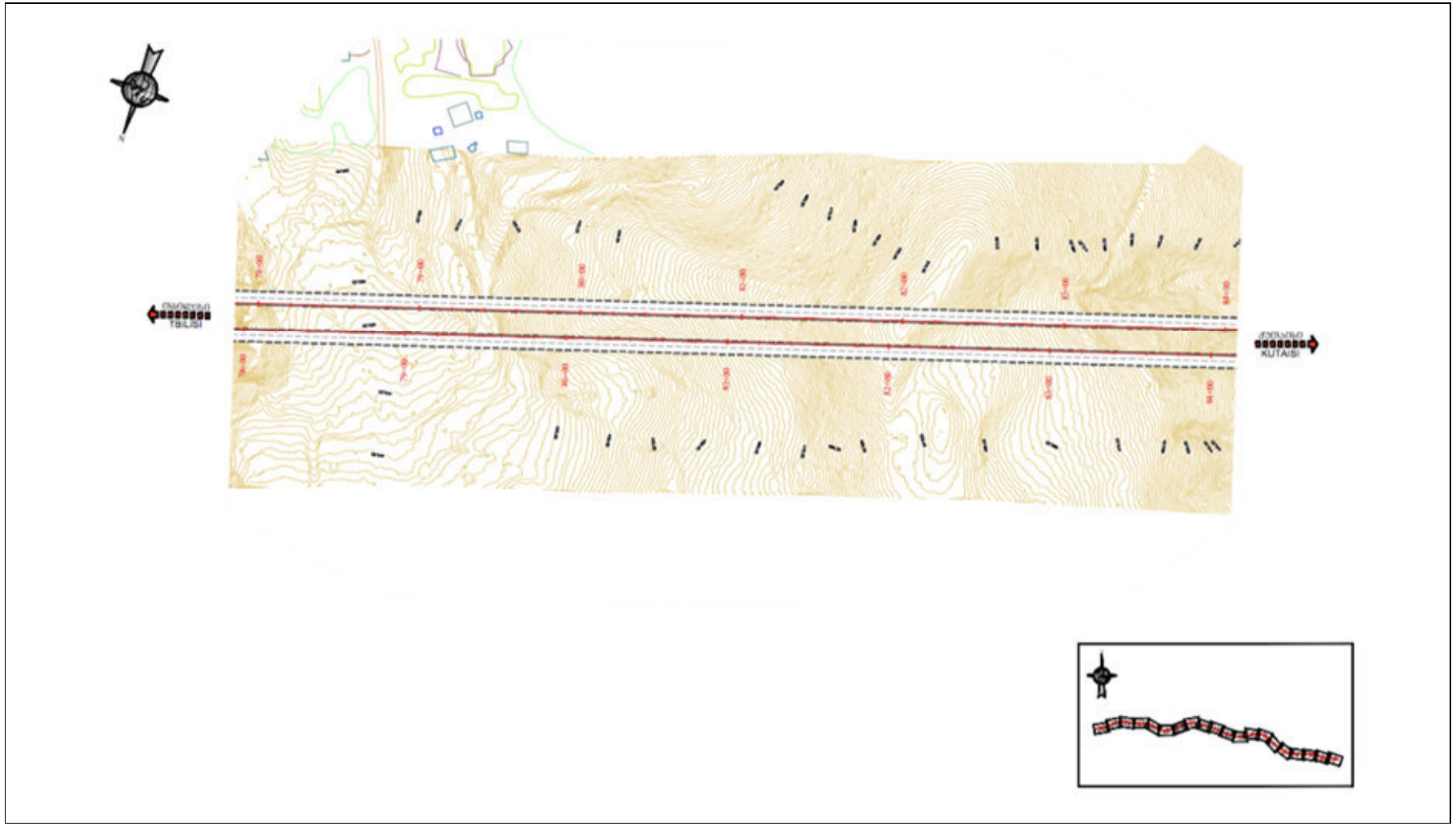


Figure 20: Map 15 - Project Road (KM8.4 – KM9.0)

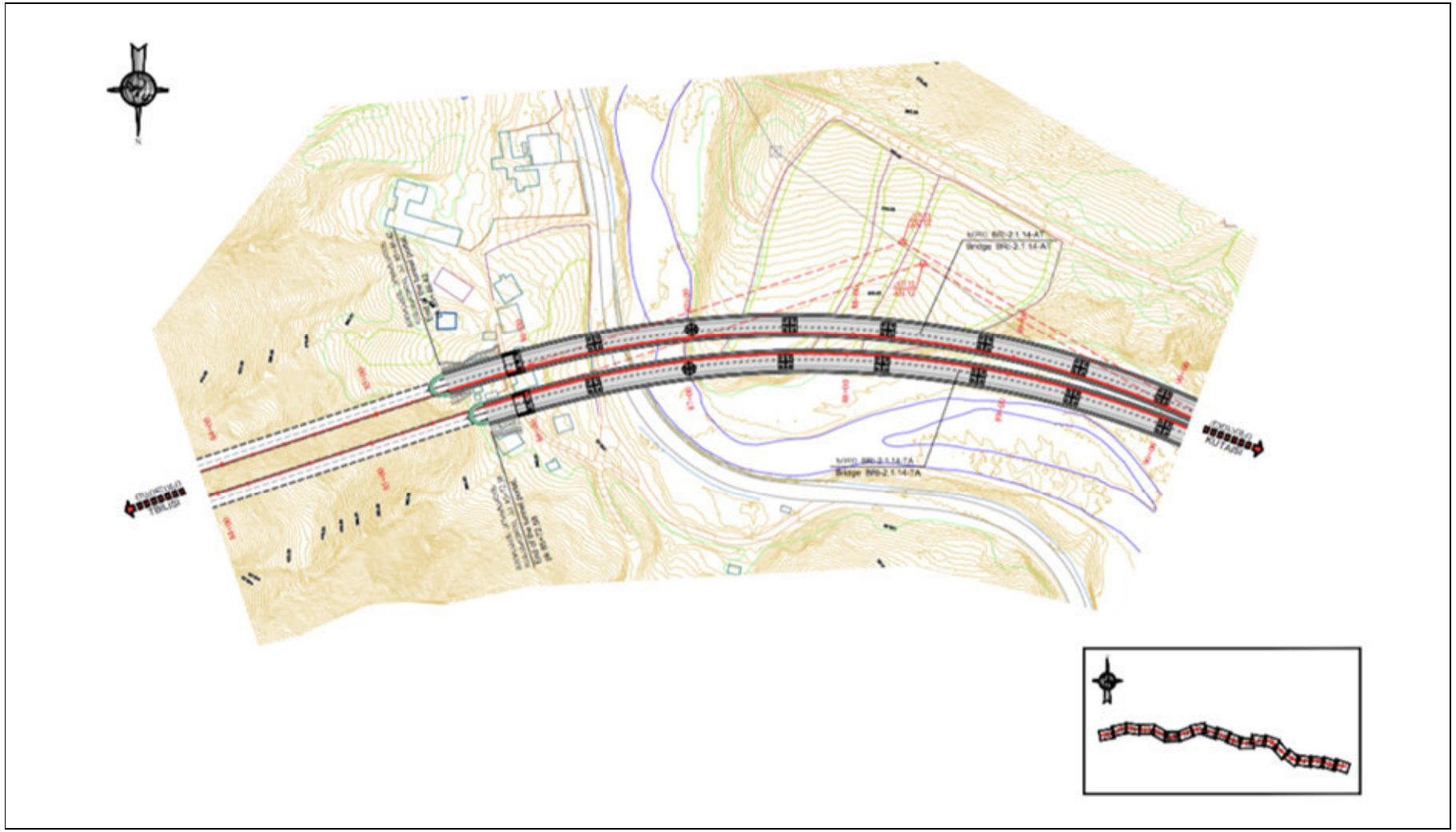


Figure 21: Map 16 - Project Road (KM9.0 – KM9.6)

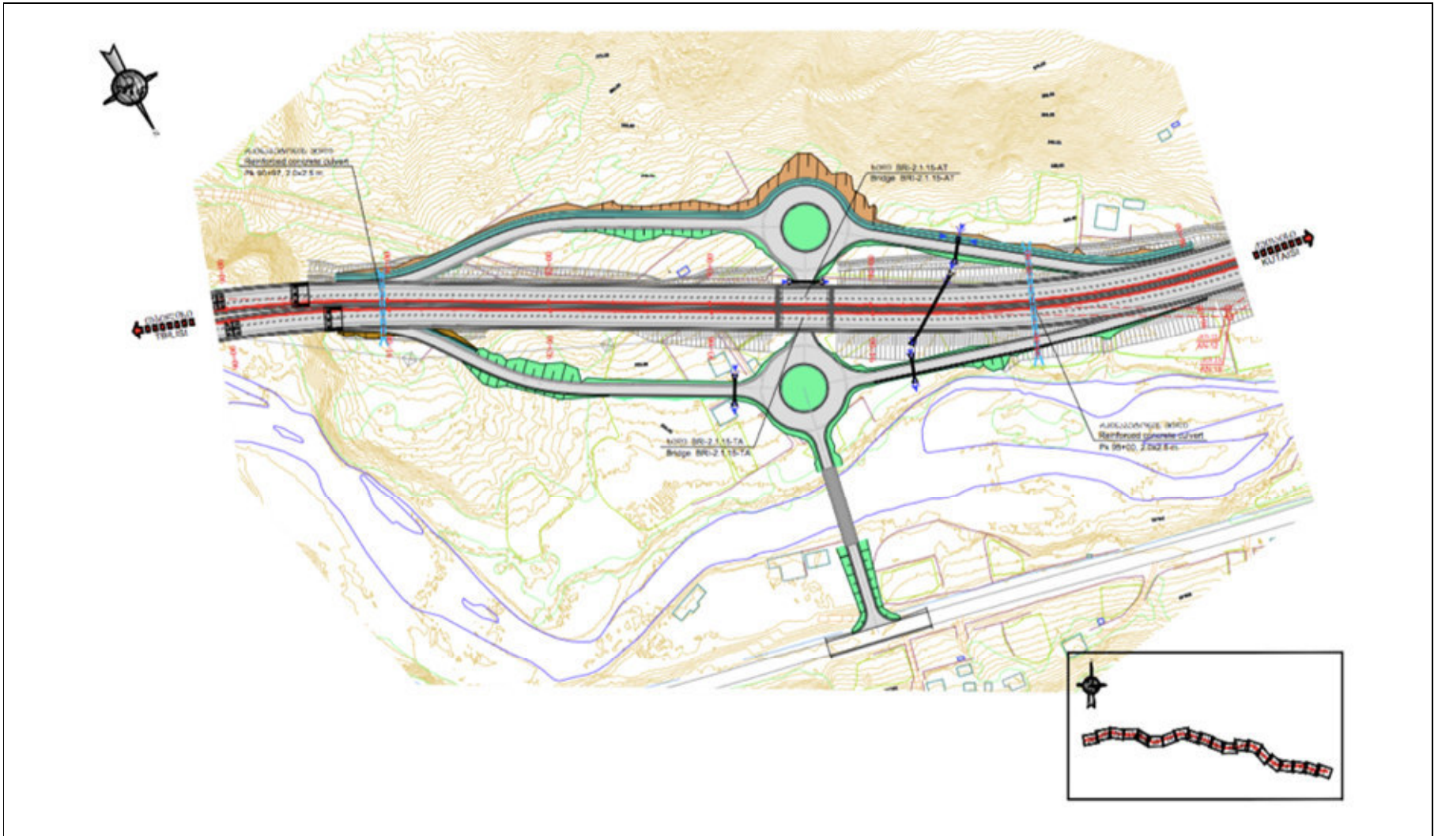


Figure 22: Map 17 - Project Road (KM9.6 – KM10.2)

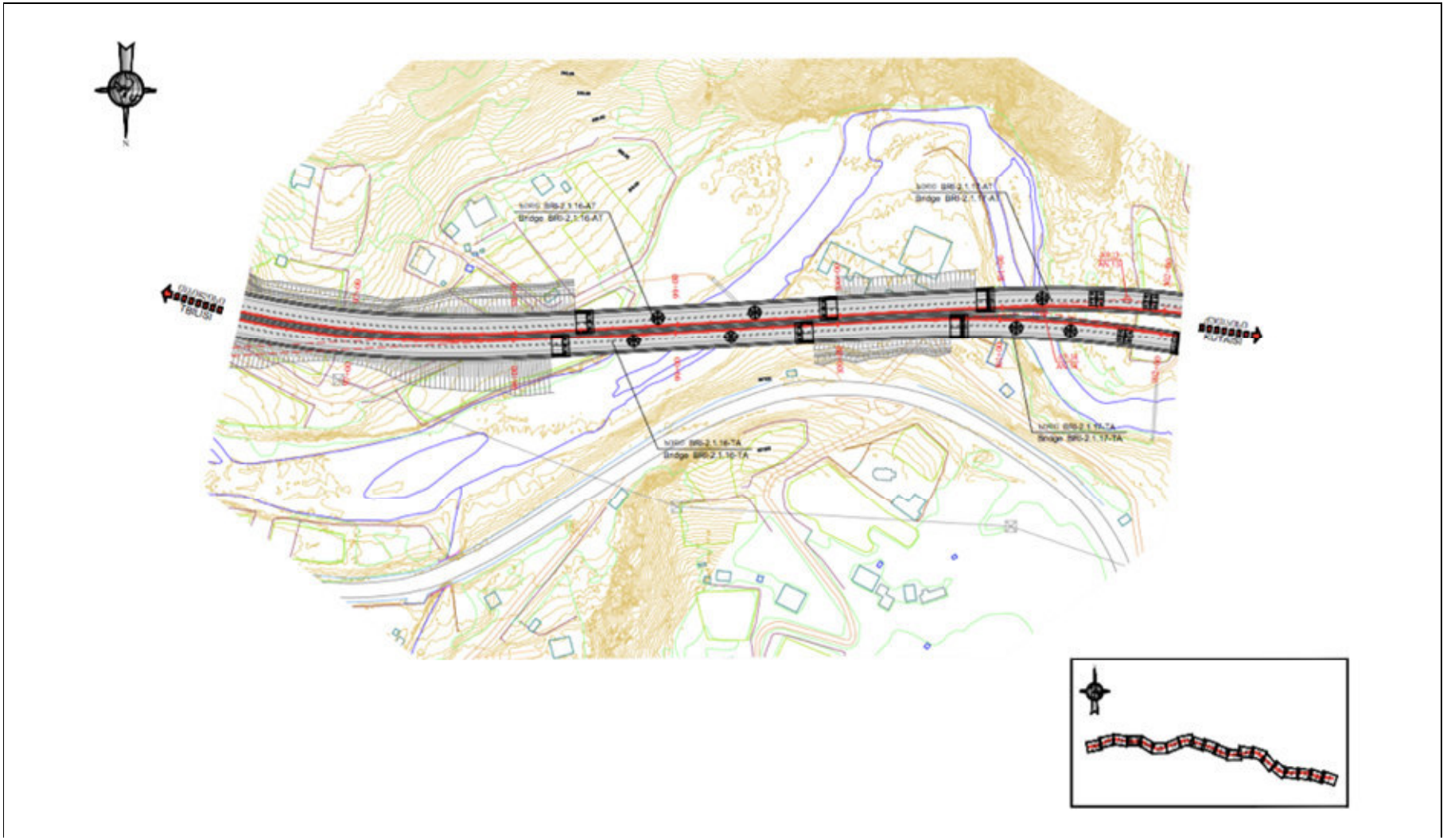


Figure 23: Map 18 - Project Road (KM10.2 – KM10.8)

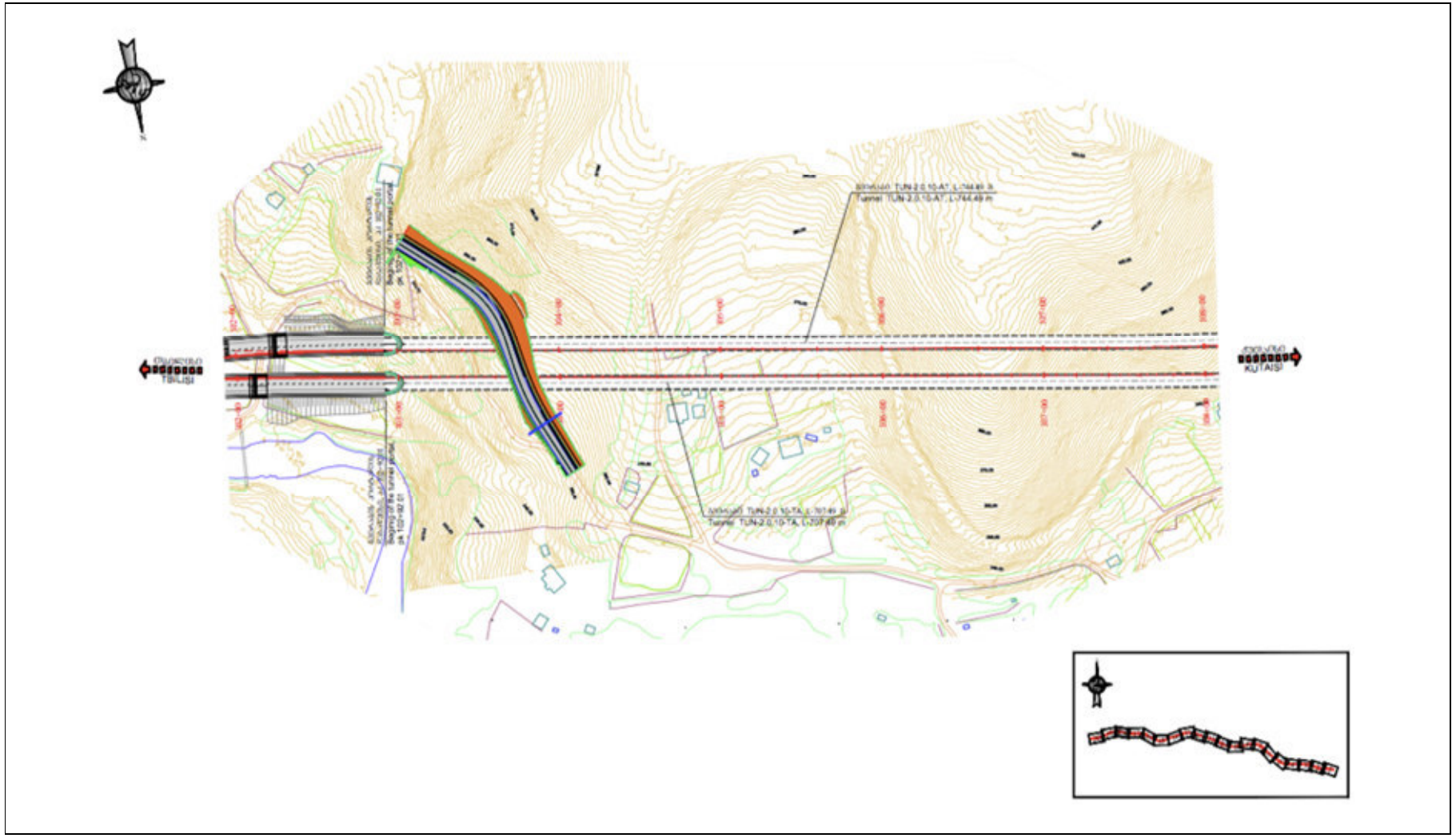


Figure 24: Map 19 - Project Road (KM10.8 – KM11.5)

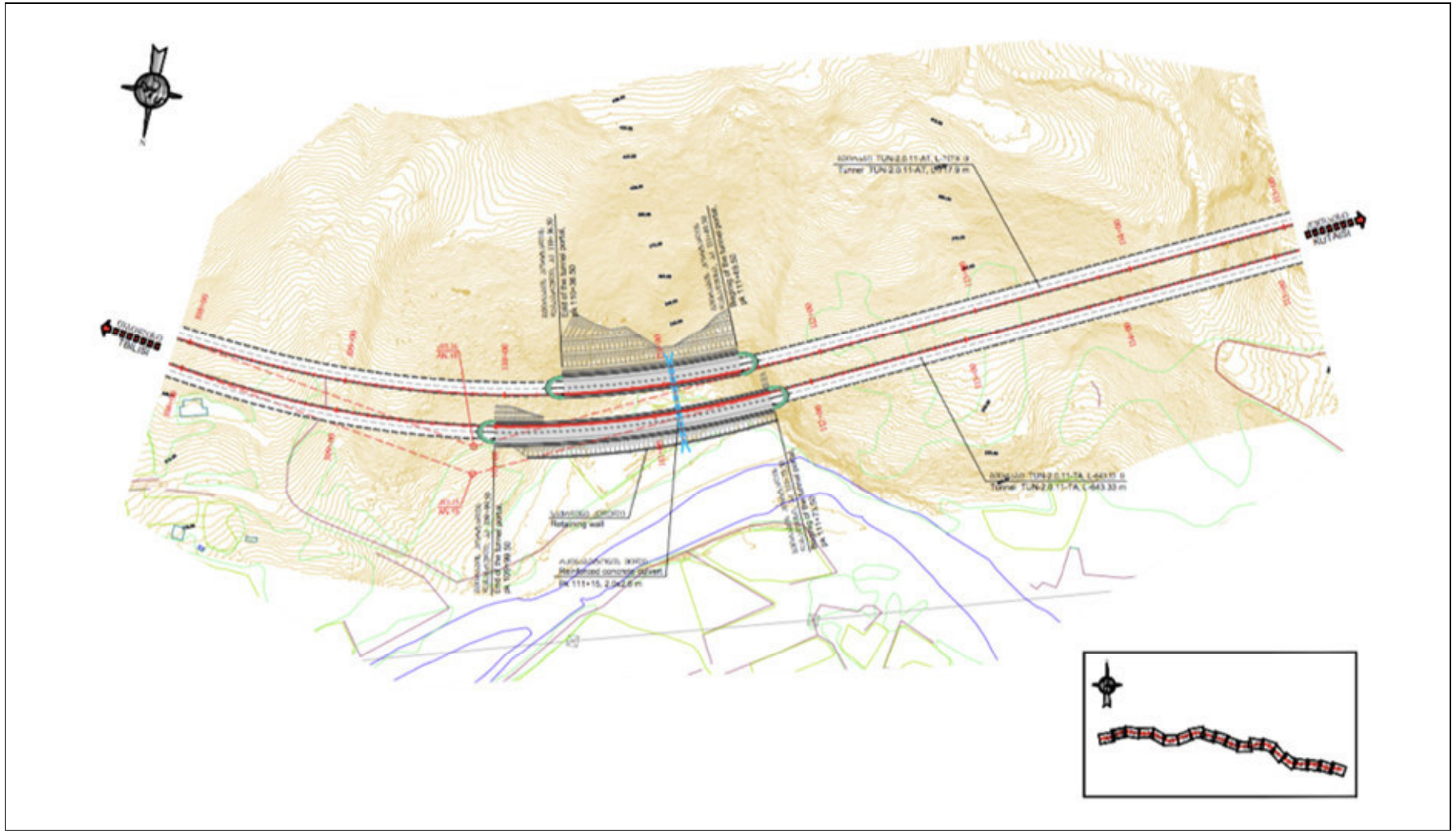
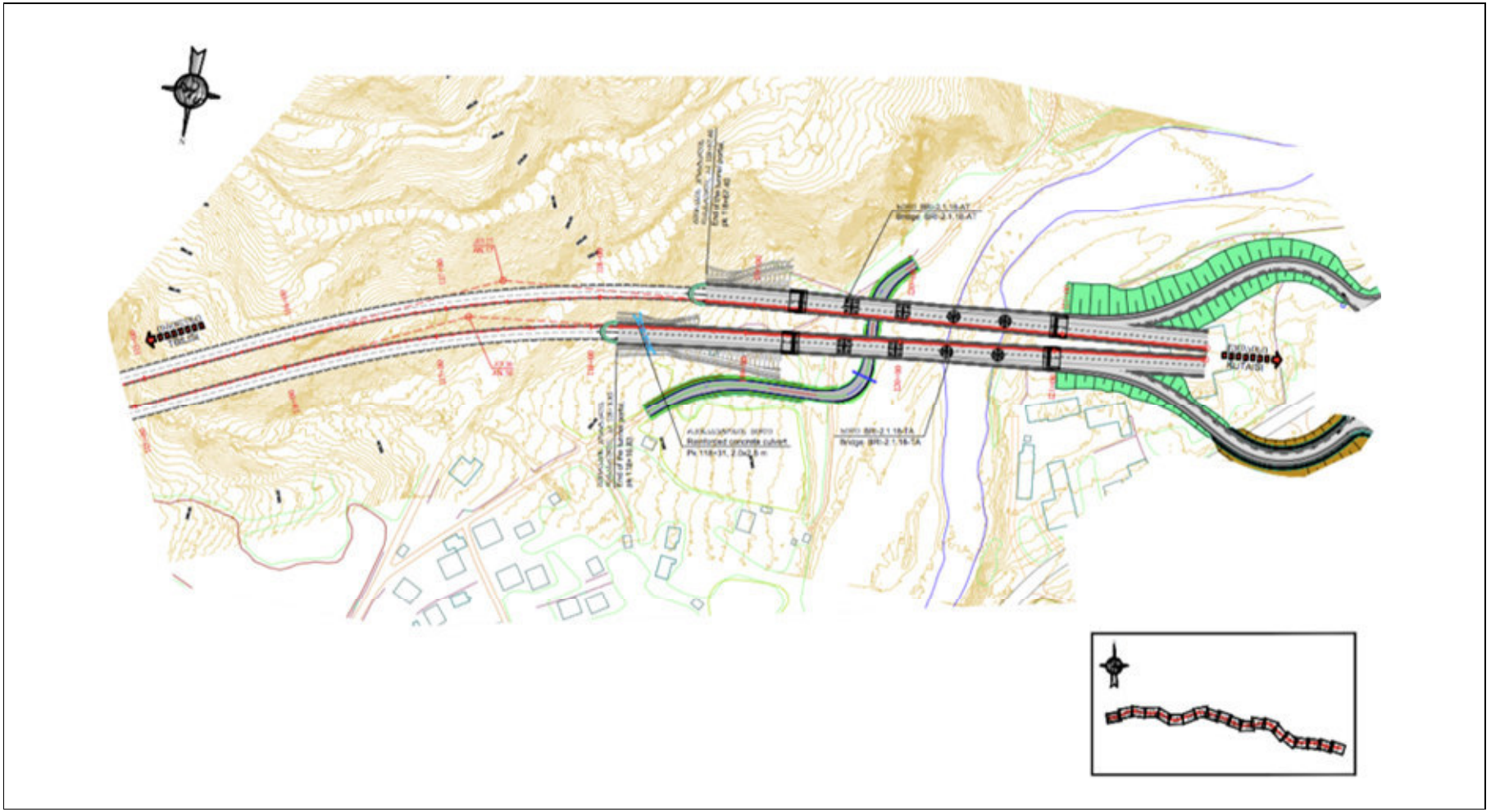


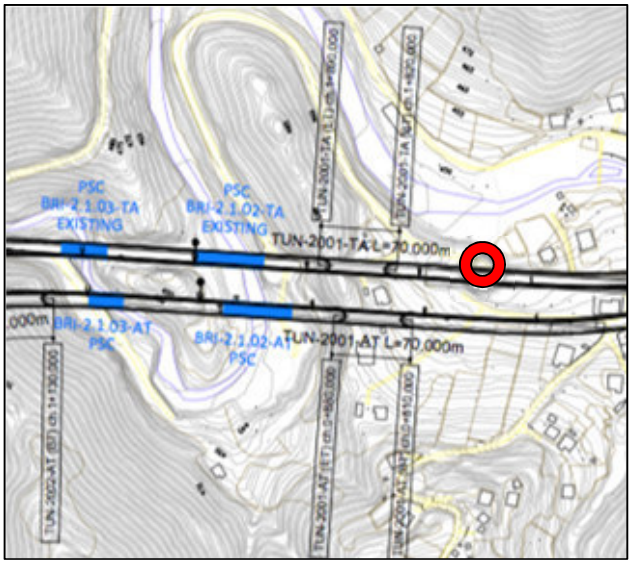
Figure 25: Map 20 - Project Road (KM10.8 – KM12.19)



B.3 Environmental Setting

19. Figure 26 provides an overview of the F2 Section environmental setting.

Figure 26: F2 Environmental Setting

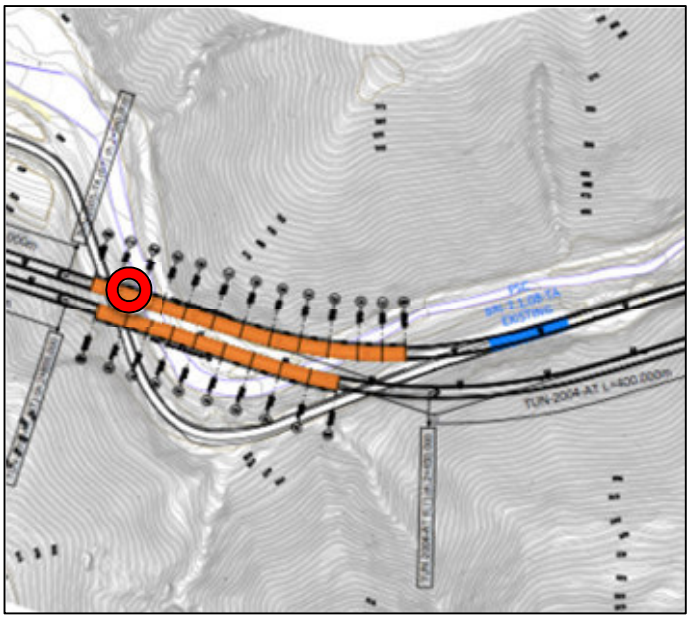


KM 0.7

The Project road starts on the alignment of the existing E-60 in Khevi heading west. Khevi is a small village situated in the valley of the Rikotula river. The photo opposite is taken looking east back towards the start of the Project road from KM0.7.

Land uses in this area are dominated by agricultural activities.

The TA section of the road will follow the existing alignment, the AT section will follow parallel to the existing alignment.



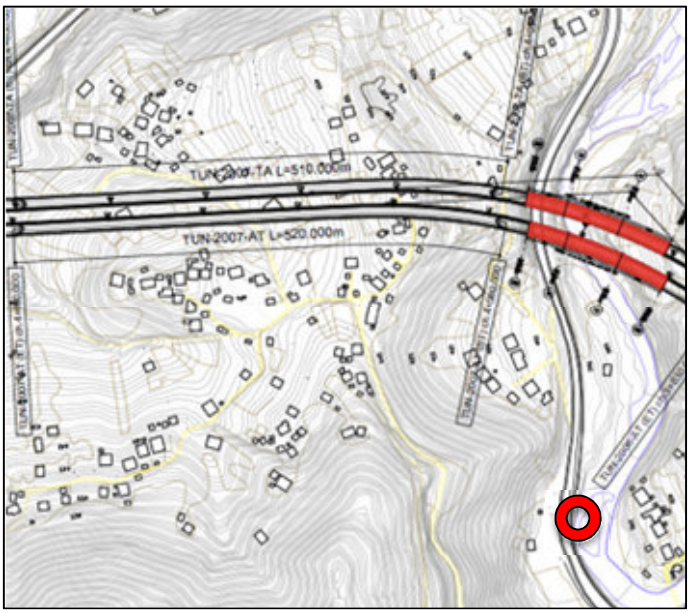
KM 2.8

The existing road passes through a couple of tunnels and over several bridges which will be used by the TA alignment before the alignment starts to meander through the valley, following the Dzirula river.

The new alignment takes a more direct approach, cutting across the river, as shown opposite, and passing through tunnels.

The landscape in this area is a mix of small agricultural plots adjacent to the river and forests higher up the valley slopes. Population density is in this area is very low.

The photo opposite is taken looking south towards the area where the Bridge BRI-2.0.09 AT/TA will cross the Dzirula via a new bridge.



KM 4.0

The Project road continues east through a series of tunnels and bridges before reaching the small village of Khunevi where a small school is located close to the new alignment.

A bridge will be constructed straddling a portion of the village in the valley bottom which will require resettlement and compensation for a few properties in the village.

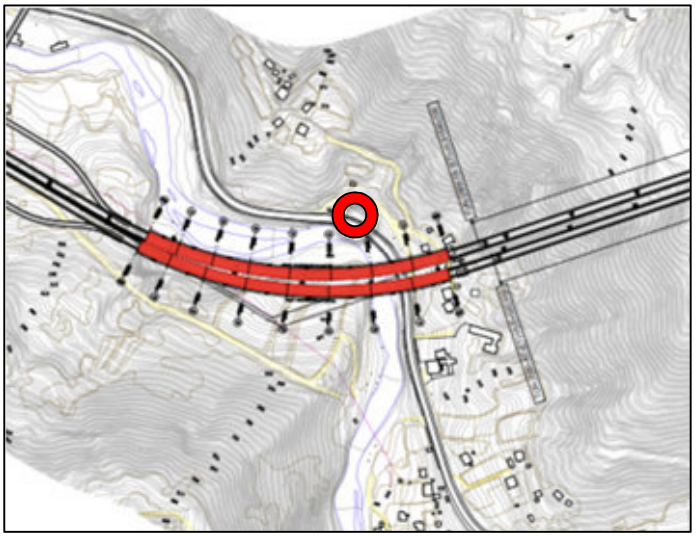
The photo opposite is taken looking north along the existing alignment which runs parallel with the Dzirula. The new alignment will pass above the river and the existing road via a bridge. The existing road will remain open throughout the construction and operational phases of the Project in this location.

KM 8.8

After leaving Khunevi the existing road follows the southern river bank while the new alignment is located in a tunnel on the north side of the river. Construction of tunnel portals in these areas will require a number of trees to be cut, and possibly some small access roads will need to be constructed to reach the tunnel portal areas.

At around KM5.0 the road reaches the village of Vertkvichala. The new alignment will run almost parallel to the existing road through the village, but it will be located on a bridge which will run straight east-west through the bottom of the valley for more than 1km.

This activity will result in a number of social and environmental issues, including, elevated noise levels, resettlement and compensation for loss of land.



Immediately after crossing the bridge the new alignment heads into a 1.3km long tunnel located north of the existing alignment. The tunnel exits at the point of the photo opposite crossing directly over the Dzirula. Just to the south of this point a school and cemetery can be found.

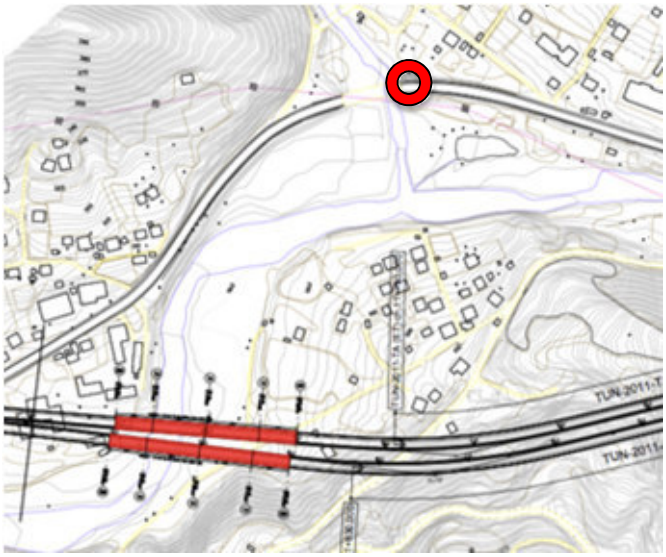
The roads only intersection follows directly after the bridge shown on the plan opposite.

KM 10.1

After the intersection, which will provide access to the existing alignment (the existing alignment is generally unaffected by the new alignment from KM4.5 onwards), the new alignment runs generally to the south of the Dzirula with the existing alignment located on the north bank of the river.

This area is dominated by agricultural activity in the valley.

The photo opposite looks south towards the area where the road will be located on a bridge. A small church is located immediately to the north of the point where the photo opposite is taken.



KM 11.8

The Project road then disappears into two tunnels, both around 600 meters in length, before emerging to the south of the village of Boriti. It then crosses the Dzirula one last time before it reaches its end point at an intersection signaling the start of section F3.

Bypassing the village to the South has significant environmental benefits, such as reduced noise, improved air quality, and public safety.

The photo opposite is taken looking south from the conflux of the Dumala and Dzirula rivers. The new alignment crosses the river at the location of the arrow.

B.4 Road Standards and Profiles

20. 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:

(i) Design speed – 100 km/h (speed limit 80 km/h);
(ii) Number of traffic lanes – 4;
(iii) Width of traffic lane – 3.75 m;
(iv) Width of each carriageway – 7.5 m;
(v) Width of paved shoulder (emergency lane) – 2.5 m;
(vi) Width of verge – 1.0 m;
(vii) Width of central reserve – 5.0 m;
(viii) Width of paved shoulder at the central reserve – 1.0 m;
(ix) Total width of each paved platform – 11.0 m□
(x) Width of road bed – 27.0 m;
(xi) Carriageway cross-fall on straight sections – 2.5%;
(xii) Minimum radius of horizontal curve – 400 m;
(xiii) Maximum longitudinal gradient – 4%;
(xiv) Minimum convex curve – 15 000 m;
(xv) Minimum concaved curve – 15 000 m.

21. A minimum radius of horizontal curve 400 m for the design speed 100 km/h is adopted based on Austrian standards (considered best practice for mountainous environments given the required speed levels and minimum radius) 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.4.1 Cross Sections

22. 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.

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

(i) 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;
(ii) 1.00m verge on the outmost of the external shoulders, where external safety barrier may be located according to needs;
(iii) 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).

24. 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 27: Typical Cross Section of Road Pavement

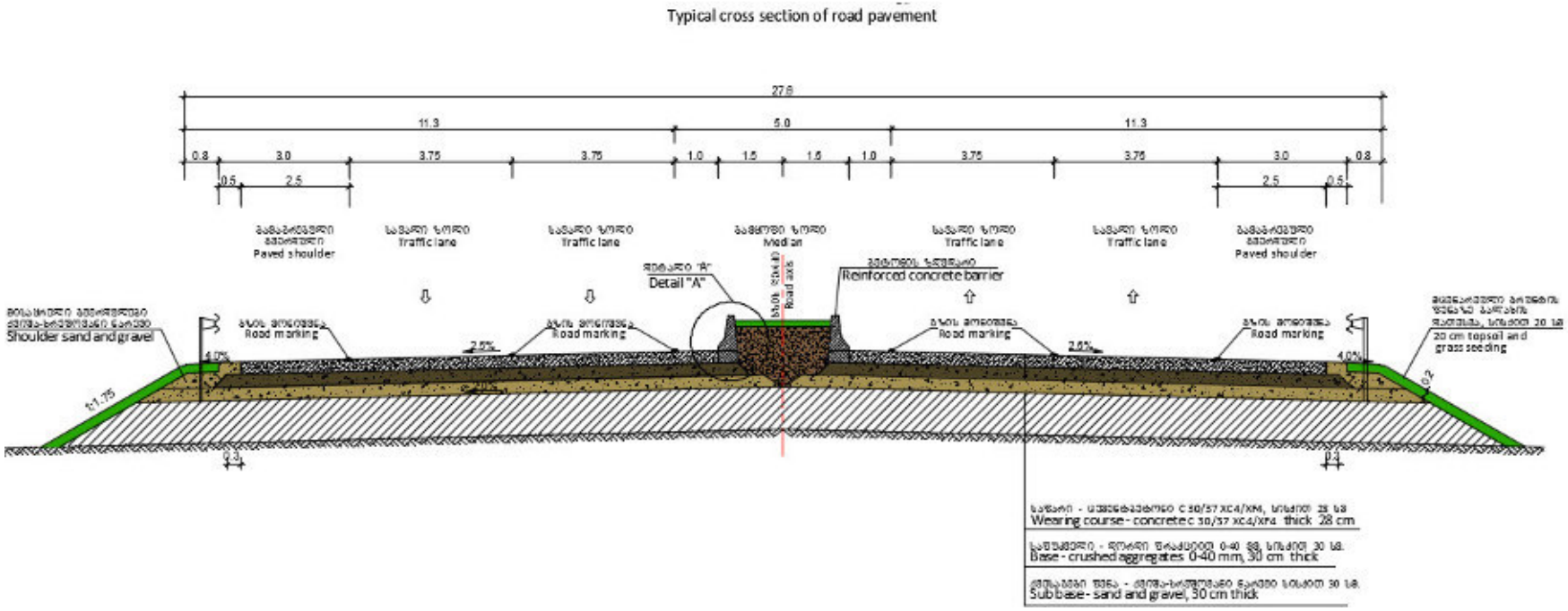


Figure 28: Other Types of Cross Section of Road Pavement

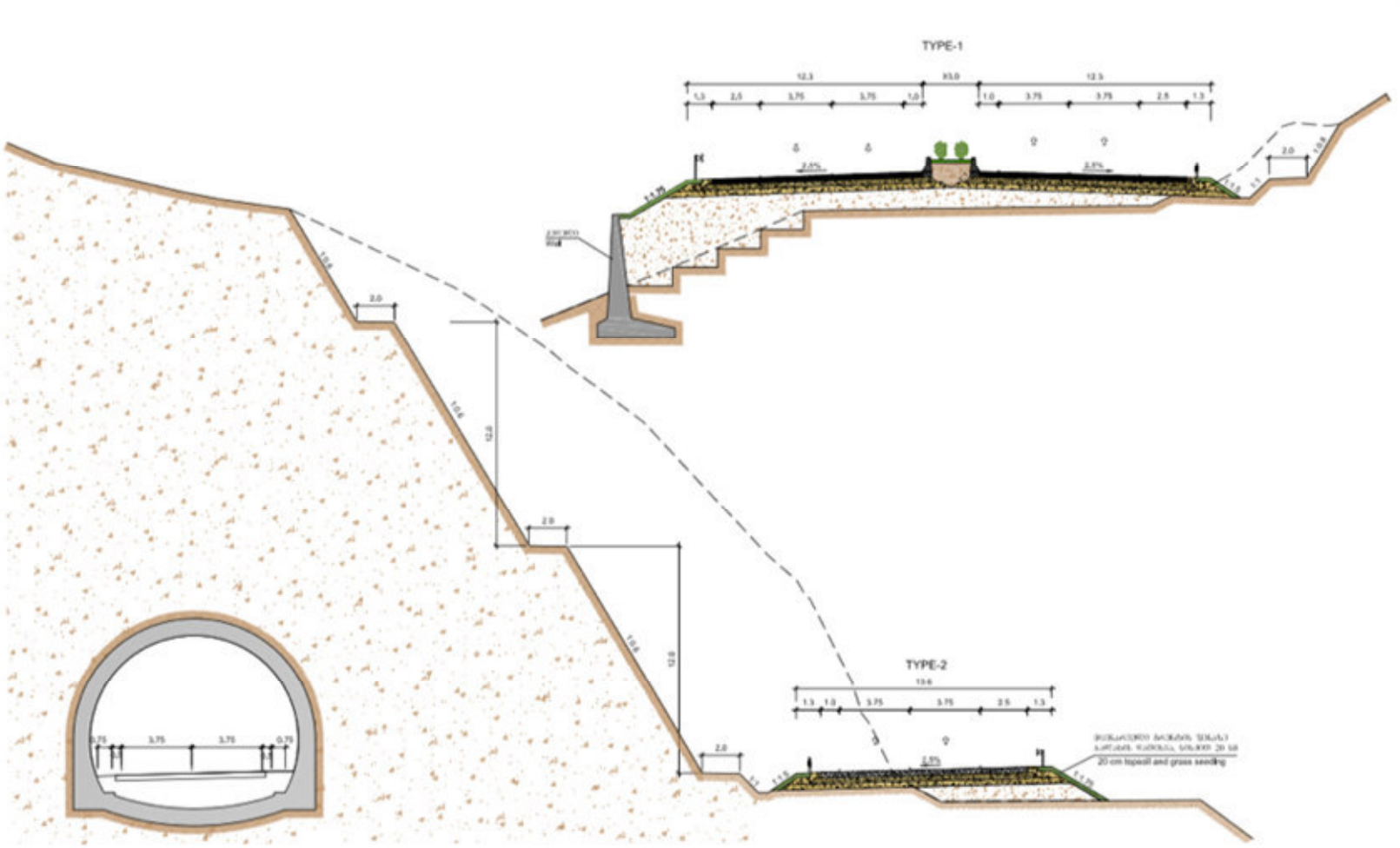


Figure 29: Other Types of Cross Section of Road Pavement

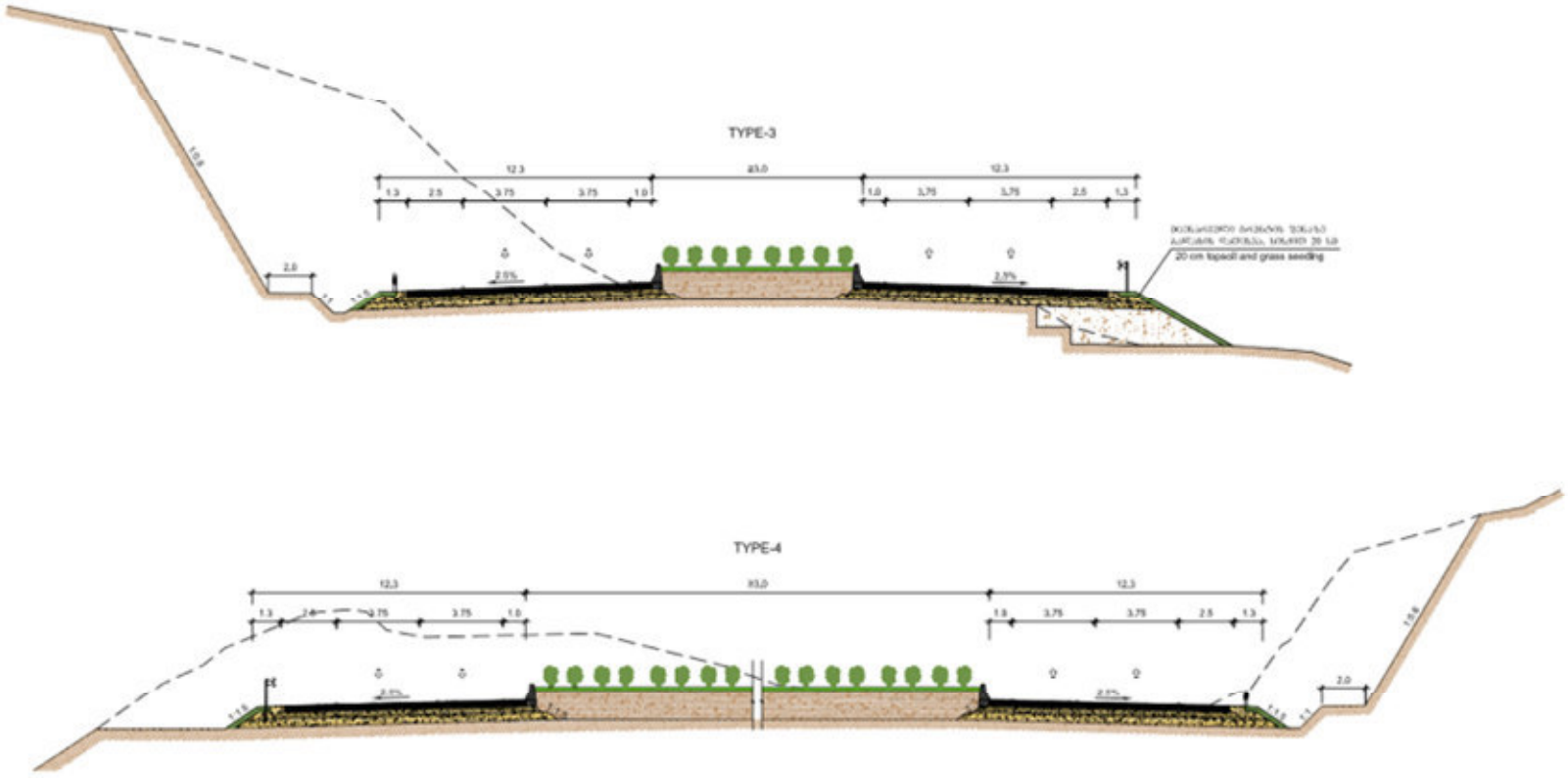


Figure 30: Cross Section on PSC Bridges

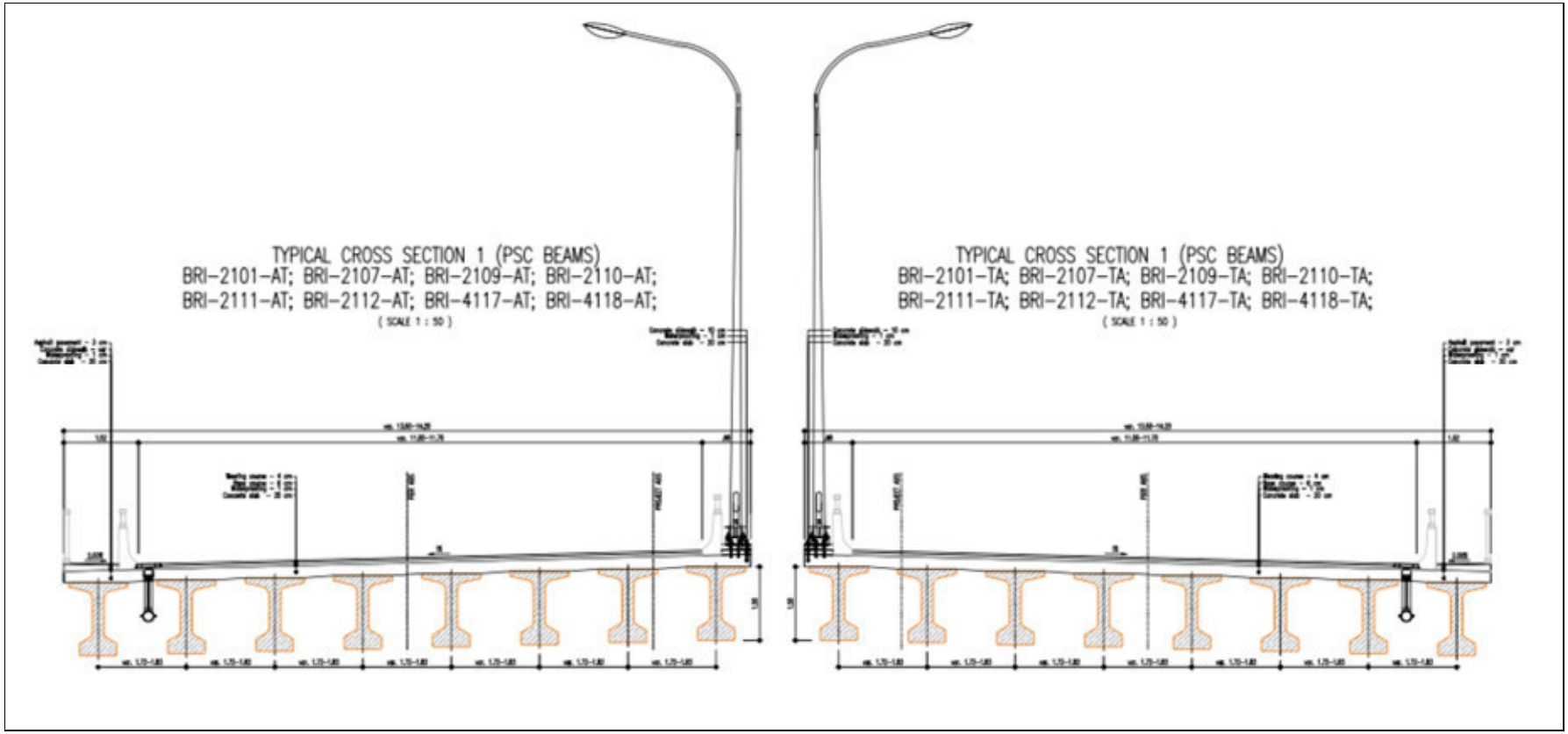


Figure 31: Cross Section on Steel-concrete Bridges

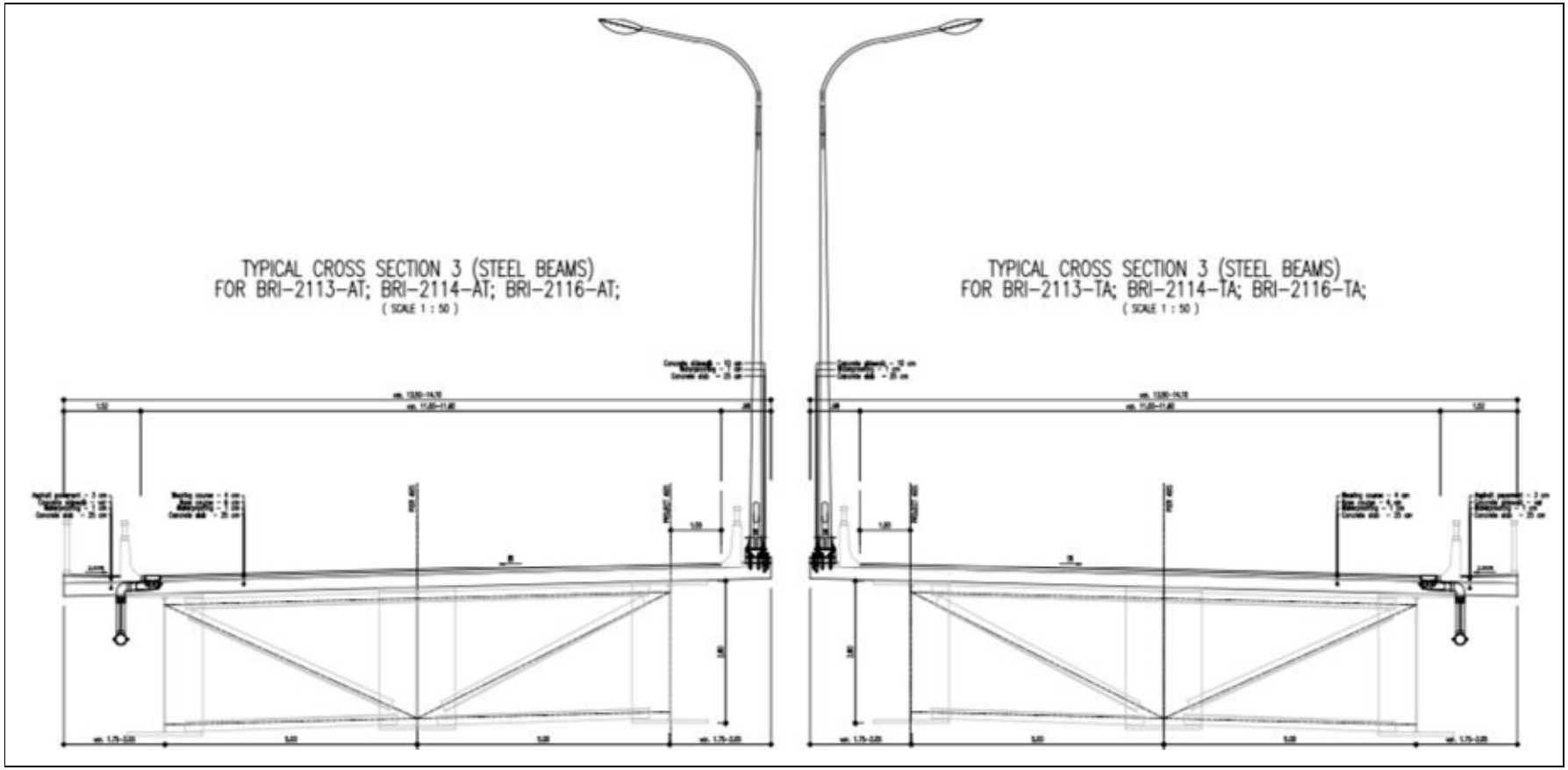
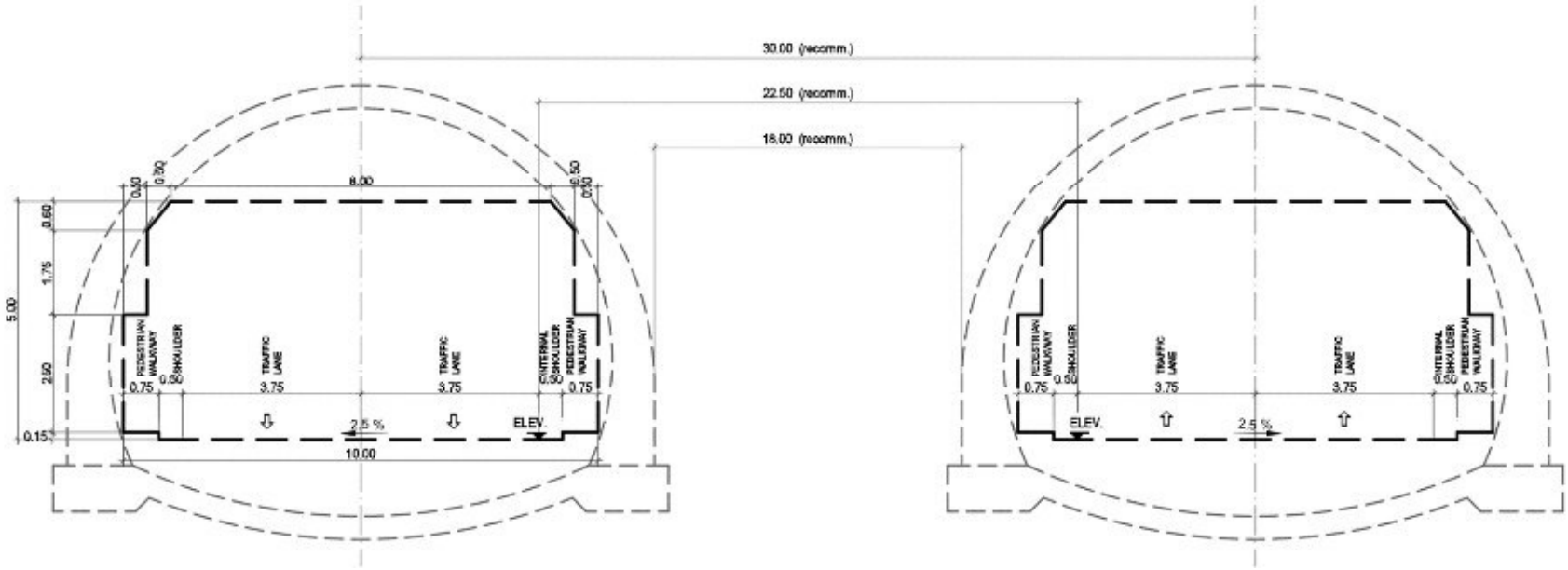


Figure 32: Cross Section in Tunnels



25. **Cross Section on Bridges** - 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.

26. **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.5 Bridges

27. Thirty five bridges will be constructed during the project works, 18 on the TA axis and 17 on the TA axis. 17 of the bridges are located adjacent to each other and can be considered one bridge, but are not joined so constitute 'two' bridges. Table 2 and Table 3 below provides summary details of the bridges and their locations.

Table 2: F2 Bridges - TA Axis

#	Type	Length (m)	Number of Piers / in River	Start	End	Crossing
BRI-2.1.01	PSC	132.08	3/1	0+176.00	0+308.08	River
BRI-2.1.02	PSC	66.00	1/0	0+932.58	0+997.84	River
BRI-2.1.03	PSC	66.00	1/0	1+070.75	1+136.01	River
BRI-2.1.04	PSC	99.00	2/0	1+316.50	1+414.82	River
BRI-2.1.05	PSC	99.00	2/0	1+536.40	1+634.72	River
BRI-2.1.06	PSC	66.00	1/1	1+683.30	1+748.56	River
BRI-2.1.07	PSC	131.65	3/2	1+953.00	2+084.65	River
BRI-2.1.08	PSC	99.00	2/0	2+157.50	2+255.82	Dry Ravine
BRI-2.1.09	PSC	372.00	11/2	2+453.00	2+825.00	River
BRI-2.1.10	PSC	429.70	14/2	3+111.05	3+540.75	River
BRI-2.1.11	PSC	132.00	3/2	3+931.61	4+063.61	River
BRI-2.1.12	PSC	231.80	7/2	4+668.70	4+900.50	River
BRI-2.1.13	STEEL	1296.00	20/1	5+813.00	7+109.00	River
BRI-2.1.14	STEEL	462.00	8/1	8+600.00	9+062.00	River
BRI-2.1.15	PSC	33.00	0/0	9+341.30	9+374.30	Interchange
BRI-2.1.16	STEEL	144.00	2/2	9+832.00	9+976.00	River
BRI-2.1.17	PSC	133.70	3/2	10+077.00	10+210.70	River
BRI-2.1.18	PSC	165.00	4/2	11+931.50	12+096.50	River
	Total	**4157.93**				
	PSC	2255.93				
	STEEL	1902.00				

*PSC - Pre-cast Steel-concrete / STEEL - Composite steel-concrete

Table 3: F2 Bridges - AT Axis

#	Type	Length (m)	Number of Piers / in River	Start	End	Crossing
BRI-2.1.01	PSC	134.90	3/1	0+156.00	0+290.90	River
BRI-2.1.02	PSC	99.00	2/0	0+891.80	0+990.12	River
BRI-2.1.03	PSC	66.00	1/0	1+034.17	1+009.43	River
BRI-2.1.04	PSC	99.00	2/1	1+324.04	1+422.36	River
BRI-2.1.05	PSC	99.00	2/1	1+504.13	1+602.45	River
BRI-2.1.06	PSC	66.00	1/1	1+689.33	1+754.59	River
BRI-2.1.07	PSC	131.55	2/0	1+878.00	2+009.55	River
BRI-2.1.09	PSC	286.35	8/2	2+531.00	2+817.35	River
BRI-2.1.10	PSC	425.35	13/1	3+162.85	3+588.20	River
BRI-2.1.11	PSC	134.35	3/2	3+922.43	4+056.78	River
BRI-2.1.12	PSC	313.45	9/1	4+692.20	5+005.65	River
BRI-2.1.13	STEEL	1362.00	22/3	5+837.00	7+199.00	River
BRI-2.1.14	STEEL	450.00	8/0	8+593.00	9+043.00	River
BRI-2.1.15	PSC	33.00	0/0	9+342.54	9+375.54	Interchange
BRI-2.1.16	STEEL	144.00	2/2	9+846.00	9+990.00	River
BRI-2.1.17	PSC	132.00	3/1	10+092.00	10+224.00	River
BRI-2.1.18	PSC	165.00	4/2	11+929.80	12+094.80	River
	Total	**4140.95**				
	PSC	2184.95				
	Steel	1956.00				

28. The following presents a short description of the main bridges:

Pre-cast Steel-concrete (PSC) beams bridges (all spans in isostatic scheme):

(i) Bridge BRI-2001: both carriageways are composed by 4 spans of about 33 m.
(ii) Bridge BRI-2007: both carriageways are composed by 4 spans of about 33 m.
(iii) Bridge BRI-2009-TA: the bridge is composed by 12 spans, 7 of about 33 m and 5 of about 27 m.
(iv) Bridge BRI-2009-AT: the bridge is composed by 9 spans, 7 of about 33 m and 2 of about 27 m.
(v) Bridge BRI-2011: both carriageways are composed by 4 spans of about 33 m.
(vi) Bridge BRI-2012-TA: the bridge is composed by 7 spans of about 33 m.
(vii) Bridge BRI-2012-AT: the bridge is composed by 10 spans, 7 of about 33 m and 3 of about 27 m.
(viii) Bridge BRI-2017: both carriageways are composed by 4 spans of about 33 m.
(ix) Bridge BRI-2018: both carriageways are composed by 5 spans of about 33 m.

Composite steel-concrete deck bridges (all continuous deck):

(i) Bridge BRI-2014-TA: the bridge is composed by 23 spans with length 42 m, 48 m, 54 m and 60 m.
(ii) Bridge BRI-2014-AT: the bridge is composed by 25 spans with length 42 m, 48 m, 54 m and 60 m.
(iii) Bridge BRI-2015-TA: the bridge is composed by 8 spans with length 42 m and 60 m.
(iv) Bridge BRI-2015-AT: the bridge is composed by 8 span with length 42 m, 48 m and 60 m.
(v) Bridge BRI-2016: both carriageways are composed by 3 spans of 42+60+42 m.

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

(i) Precast steel-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

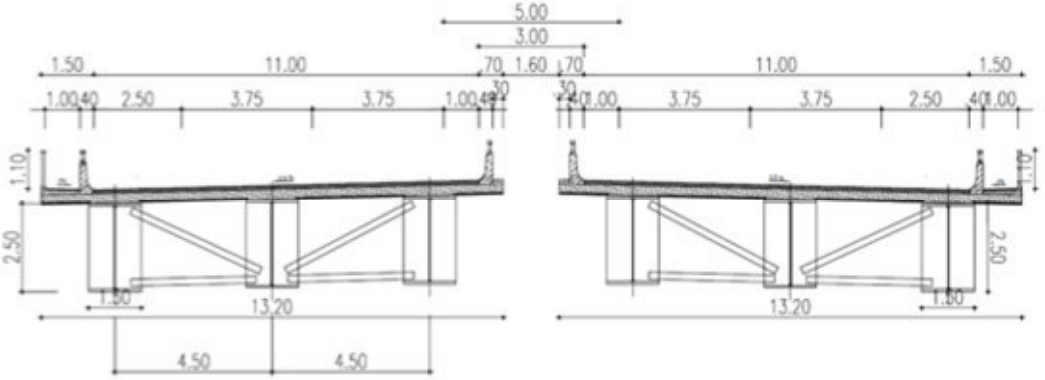
and difficulty of span arrangement over 40 m in a span length, but the strength is short construction period due to using crane method and economic efficiency.

(ii) Composite 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.

30. There are two types of pier geometry in elevation (see **Appendix I**).

31. The bridge decks will be composed by three main beams connected by diagonal and transversal bracings and with the slab cast on situ on a thin concrete plate thin slab ("predalle"), more or less as is shown in Figure 33 below.

Figure 33: Bridge Cross Section



32. For foundation of substructures, installation of piles will be done through boring using cast-in-place bored piles with reinforced concrete which was adopted due to local field condition, environment effect, and supply of materials. This construction method has less noise and vibration impacts compared to precast driving methods. The foundations on the riverbed will have a circular plinth, so to minimize the disturb to the flow of water.

B.6 Tunnels

33. Twenty tunnels are included in Section F2:

(i) Two existing tunnels to be qualify (TUN-2001-TA and TUN-2003-TA) of about 100-130 m;
(ii) Two new tunnels parallel and adjacent to the existing (TUN-2001-AT and TUN-2003-AT) on the carriageway AT of about the same length;
(iii) Two single tunnels on the carriageway AT (TUN-2002-AT and TUN-2004-AT) of about 200 and 400 m
(iv) Seven tunnels with double tube with length from 300 m to about 1300 m. In this Section, the rock is generally good, even if there are some faults, and generally the soils covers are not very thick.

Table 4: Tunnels in Section F2

Tunnel	Carr.	Length	Length Underground	CHAINAGES			
				Start of Tunnel	Start Underground	End Underground	End of Tunnel
TUN 2001	AT	100.4	52.6	800.00	829.00	88.,60	900.40
	TA	113.9	113.9	793.00	793.00	906.90	906.90
TUN 2002	AT	186.5	173.5	1.129.30	1.135.80	1,309.30	1,315.80
TUN 2003	AT	126.2	99.5	1.756.70	1.771.40	1,870.90	1,882.90
	TA	150.3	150.3	1.765.30	1.765.30	1,915.60	1,915.60
TUN 2004	AT	423.3	400	2,025.58	2.050.00	2,450.00	2,456.44
TUN 2005	AT	311.1	279.2	2,829.90	2,854.00	3,133.20	3,156.00
	TA	266	234.4	2,831.10	2,854.00	3,088.40	3,112.10
TUN 2006	AT	227.4	206.4	3,610.50	3,617.00	3,823.40	3,845.40
	TA	277.7	254,7	3,575.00	3,581.50	3,836.20	3,860.20
TUN 2007	AT	583.9	573	4,070.55	4,077.00	4,650.00	4,662.04
	TA	534.1	510	4,073.50	4,080.00	4,590.00	4,615.10
TUN 2008	AT	274.9	242.7	5,502.00	5,526.20	5,768.90	5,791.90
	TA	310	279	5,454.60	5,476.90	5,755.90	5,779.60
TUN 2009	AT	1325.3	1300	7,213.55	7,220.00	8,520.00	8,546.42
	TA	136.5	1335	7,203.55	7,210.00	8,545.00	8,572.58
TUN 2010	AT	736.9	710	10,292.01	10,320.00	11,030.00	11,036.45
	TA	694.4	663	10,297.53	10,330.00	10,993.00	10,999.50
TUN 2011	AT	710.4	679	11,149.50	11,156.00	11,835.00	11,867.40
	TA	635.8	610	11,173.50	11,180.00	11,790.00	11,816.83

*Existing tunnel

34. A study of the two existing tunnels is currently on-going. The proposed works, which has been preceded by some survey on the concrete lining (which showed more of 80 cm of thickness, no reinforcement and bad conditions due to water infiltrations) is the following:

(i) Remove 20-30 cm of existing concrete;
(ii) Install waterproofing membrane; and
(iii) Install new reinforcement bars.

Table 5: 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	10.0

35. Ventilation - The primary ventilation for the tunnels having length >1000m 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.

36. 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.

37. 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).

38. 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.

39. In the absence of electric current, safety systems of the tunnel shall be supplied by a diesel generator which has to ensure the backup power and the continue functioning of the above services. Considering that the starter of the generator (even if it's automatic) needs several seconds (0,5 ÷ 15 sec.) and certain services like: safety lighting system, monitoring system, etc., can never be interrupted, it will be installed an UPS to intervene before the starter of the generator, in order to ensure the continuity without interruption of the safety and emergency services can never be interrupted.

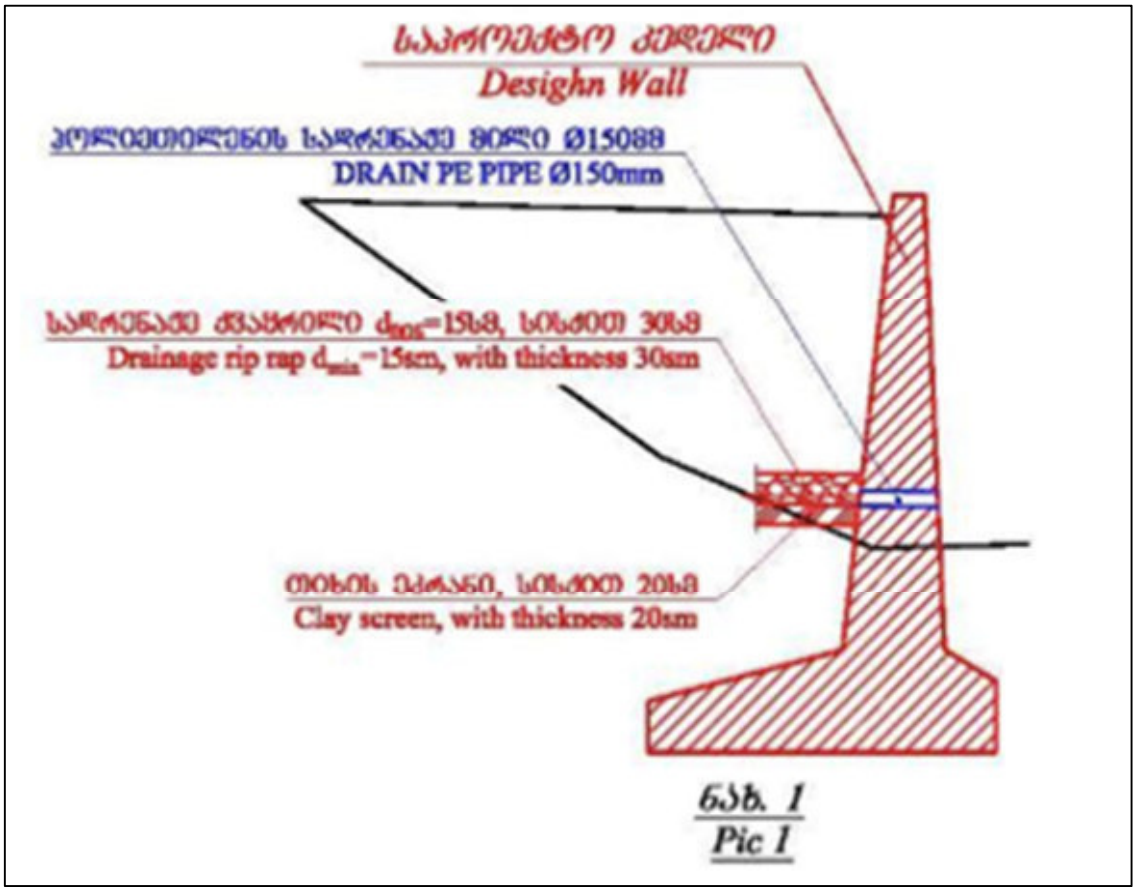
B.7 Retaining Walls

40. 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 all along the alignment and in particular in correspondence of the abutments of the bridges. The following three retaining walls have been included in the design:

(i) KM0.00 – KM0.15
(ii) KM5.00 – KM5.25
(iii) KM11.00 – KM11.20

41. The retaining walls are in reinforced concrete and may be founded directly on the rock, or by mean of concrete piles In the figure, the cross section of a wall. Figure 34 illustrates a typical retaining wall structure to be used.

Figure 34: Typical Retaining Wall



Note: Drain Pipe 150mm / Drainage Rip-rap thickness 30cm / Clay Screen thickness 20cm

B.8 Interchanges & Access Roads

42. Two interchanges are planned in the F2 Section:

(i) I1 - INTERCHANGE 1 - It has been envisaged to place the first interchange in the area of Sakasria village, at the left side of the river, around KM5.7. There will be designed a new bridge crossing Dzirula river to connect the existing traffic with the Interchange. This bridge is needed because of the position of the Interchange. The interchange is not complete, due to the lack of space. So the only ramps are the one coming from and going to Tbilisi.

(ii) I2 - INTERCHANGE 2 - The second Interchange will be around KM9.3. The type of this Interchange followed the previous sections and is designed like Diamond shape with small roundabouts.

43. Another interchange (interchange I3) is exactly at the endpoint and it is split in two between Section F2 and Section F3. Most of this last interchange will be included in the Section F3 and only the ramps from and to Tbilisi will be included in F2 section.

44. Figure 35 illustrates the location of the interchange I1 at KM5.7, Figure 36 illustrates the interchange at KM9.3 and Figure 37, the interchange at the end of the lot (I3).

Figure 35: Interchange I1 at KM5.7

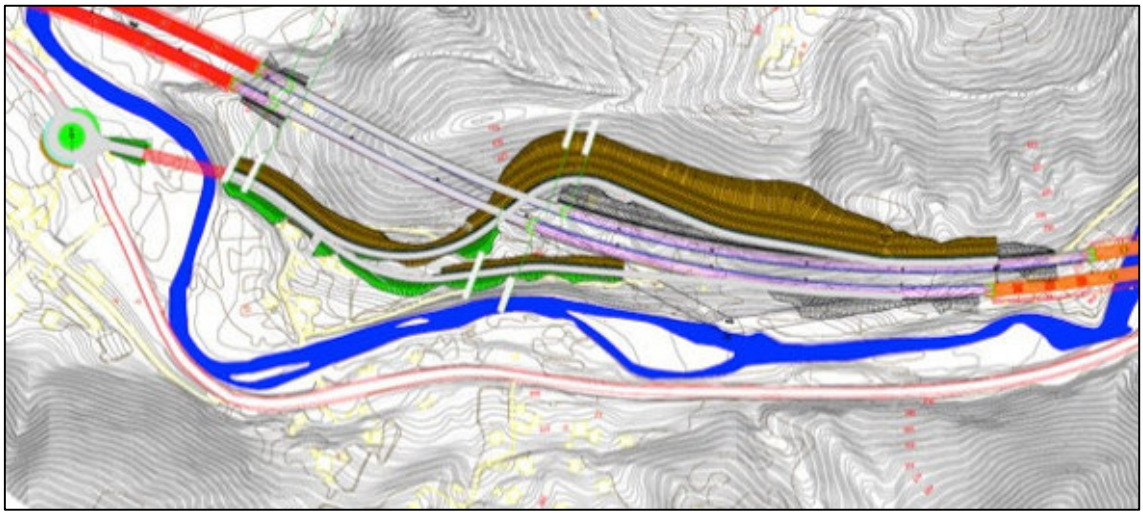


Figure 36: Interchange I2 at KM9.3

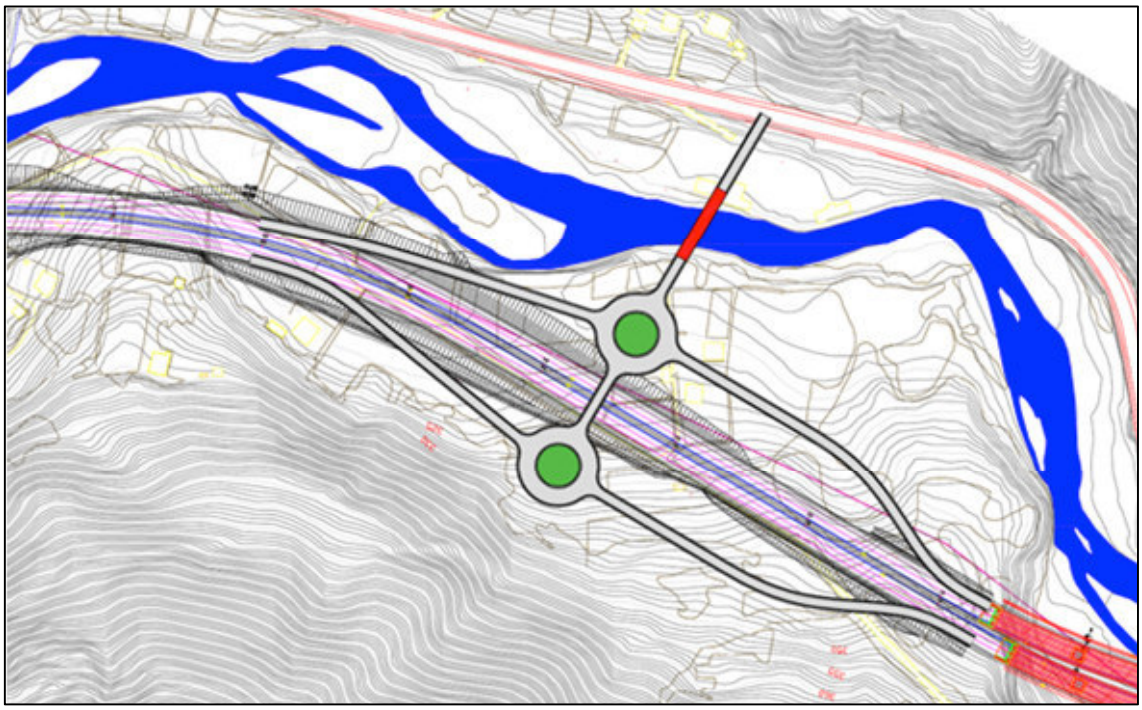
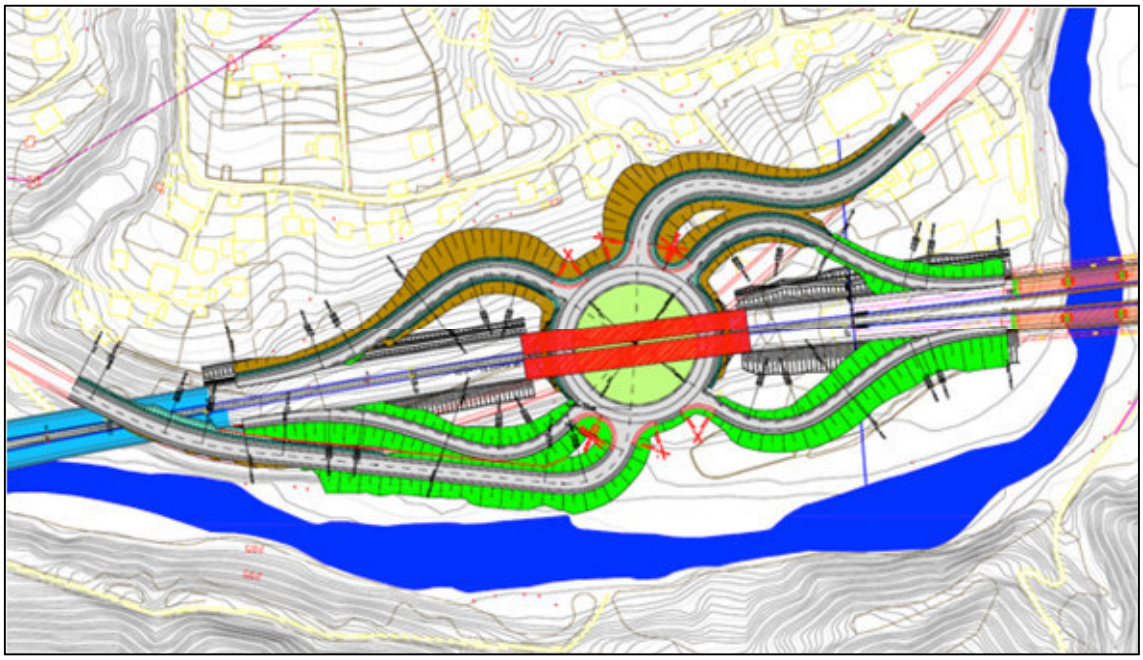


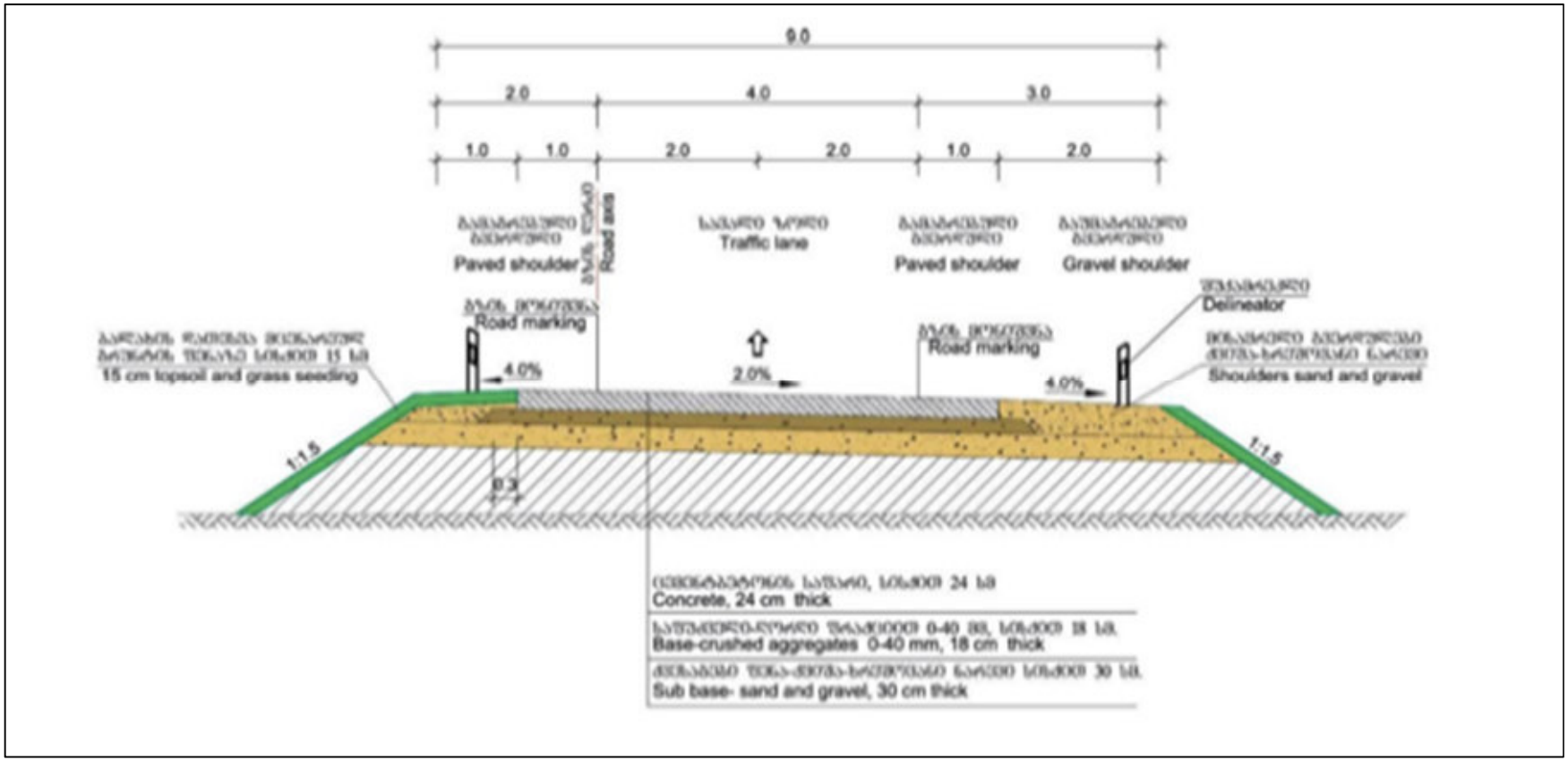
Figure 37: Interchange I3 at end of Lot



45. The pavement structure for interchanges includes:

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

Figure 38: Road Pavement Structure for Interchanges



46. In addition five access roads will be constructed in areas where the new alignment cuts into existing local roads, either blocking access to properties or to the existing alignment. **Appendix F** illustrates the locations of these access roads. All access roads have been designed to ensure that local residents have access to the existing road which thereby links them to the new road via the interchanges mentioned above. This may, in some instances result in slight increases in journey times to the existing alignment.

B.9 Culverts and Underpasses

47. Culverts, cattle underpasses and rural road 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 cattle underpasses and rural road underpasses allow for the movement of cattle and wildlife, while pedestrians and vehicles can pass via the rural road underpasses.

48. The following types of culverts will be constructed.

(i) Underpasses for rural roads – cast in situ reinforced concrete structures – 6.0x4.5 m – 2 Units (KM5.13 / KM9.35).
(ii) Cattle underpasses – cast in situ reinforced concrete structures – 4.0x2.5 m – 1 Unit (KM5.22).
(iii) Cross drains – cast in situ reinforced concrete culverts – 2.0x2.5 m – 14 Units.
(iv) Cross drains – cast in situ reinforced concrete culverts – 1.0x1.5 m – I Unit.

B.10 Construction Process

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

(i) **Land Acquisition -** Under the terms of the Loan of the Asian Development Bank (ADB), before the commencement of the construction works at any part of the site, the *Employer* must prepare the Land Acquisition and Resettlement Plan (the LARP), obtain the approval of ADB and then implement the plan and acquire the land.
(ii) **Specific Environmental Management Plan (SEMP)** - Ensure that the SEMP 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 SEMP is reviewed by the Engineer and approved by the RD / PIU.
(iii) **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:
  (a) Clearing and grubbing.
  (b) Removal and disposal of traffic signs, sign posts and their foundations.
  (c) Demolition, removal and disposal of existing bridges including foundations, abutments, piers, retaining walls, riverbank and waterway protection works.
  (d) Demolition, removal and disposal of existing culverts, inlet and outlet structures, headwalls, concrete drains, channel lining, and erosion protection works.
  (e) Removal of and any other natural or artificial objects within the RoW.
  (f) Removal and disposal of all vegetation and debris within the designated limits of the Right-of-Way.
(iv) **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:

(a) water mains
(b) overhead electric supply lines
(c) gas pipelines
(d) underground telephone cables
(e) sewer mains

(v) **Construction Activities –** The main construction phase aspects are described in detail below.

B.10.1 Bridges

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

(i) Foundations.
(ii) Substructure including bridge bearings.
(iii) Superstructure, including construction of expansion and deformation joints and footpaths.
(iv) Deck pavement including hydro isolation, drainage, hand railing, and conduits for services.
(v) Approach slabs.
(vi) Slope treatments in front and around the abutments.
(vii) Construction and maintenance of traffic detours.
(viii) 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.
(ix) All necessary and incidental items required for a complete bridge.
(x) All new and widened bridges will be designed for the life expectancy of 100 years.
(xi) Oil and grease interceptor tanks.

B.10.2 Tunnels

51. The actual development of the tunnel design follows the principles of ADECO RS[3] method and is summarized in the following table.

Table 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.

[3] ADECO is a method of calculation of the tunnels developed in Italy by prof. Lunardi and in the latest years widely spread in Italy and also in Europe. The main principles are described in the general report and the method consists in letting the tunnel develop deformations and thus decrease the stress on the structures (DE.CO.means Deformations Controlled). There is a prevision of utilization of sections of intervention and a system of monitoring of the deformations (topographic, generally) which give informations on the tunnel behaviour. Then there is a report called Guide Lines which for each behavior gives instructions of which section to apply.

Phase	ADECO RS
	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.10.3 Culverts

52. 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:

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

B.10.4 Other Drainage Structures

53. 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.10.5 Earthworks

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

(i) Removal of topsoil.
(ii) Construction of embankments.
(iii) Construction of subgrade.
(iv) Excavation and removal of the existing pavement materials and the existing road embankment.
(v) Removal and replacement of unsuitable materials.
(vi) Structural excavation.
(vii) Excavation for the construction of side drainage and cross-drainage works.
(viii) Excavation for the removal and relocation of the existing utilities.
(ix) 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.

(x) Preparation of beddings and filters for all structural, cross drainage, side drains or pavement works.
(xi) Excavation, filling or backfilling necessary for the execution of any other incidental works.

55. Table 7 indicates the approximate earthworks and pavement quantities for the Project Road.

Table 7: Estimated Earthworks for Section F2

Description	Unit	Quantity
Stripping of topsoil	m^3	**26,000**
Road bed excavation and excavation in cut	m^3	**1,010,000**
Excavation in tunnel	m^3	**935,000**
Embankment Construction for roads and associated works up to bridge pay lines	m^3	**327,950**
Subgrade Preparation	m^3	**57,000**
Preparation of the underlying granular pavement layer	m^3	**127,000**
Dismantling of existing concrete structures	m^3	**4,000**
Removal and transportation of existing bituminous pavement	m^3	**4,400**
Asphalt pavement	m^3	**12,000**
Concrete pavement	m^3	**118.000**

B.10.6 Pavement

56. Two different pavement structures will be used:

(i) Concrete pavement structure for the motorway and interchanges; and
(ii) Asphalt pavement structure for all Slip Roads and all Minor Roads and bridges.

57. The following shall apply to the motorway, concrete pavement structure, construction category I:

(i) 28 cm Concrete;
(ii) 30 cm Crushed Aggregate Course;
(iii) 27 cm Granular Base Course;
(iv) 85 cm Total Pavement Construction.

58. The following shall apply to slip roads and minor roads, asphalt pavement structure, construction category III:

(i) 4cm Asphalt Wearing Course;
(ii) 4cm Asphalt Binding Course;
(iii) 14 cm Asphalt Bearing Course;
(iv) 58 cm Granular Base Course;
(v) 80 cm Total Pavement Construction.

59. 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.

60. 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 which, given the extensive use of concrete pavement in Germany, is considered best practice.

61. 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.10.7 Removal of Asphalt

62. There are some small section of the existing pavement which will need to be removed to make way for the new alignment. The Contractor shall remove the existing bituminous pavement layers in these areas 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, and if not suitable will be re-used for shoulder material.

B.10.8 Construction Equipment

63. Table 8 provides indicative lists of the key equipment required in the construction phase (not including tunneling equipment).

Table 8: Key Equipment Section F2

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
14	Crane (100 tons)	4
15	Crane (250 tons)	2

16	Rotary drilling Machine	8
17	Roadheader	2
18	Excavator Hammer	8
19	Jack Hammer	8
20	Pusher Leg	4
21	Truck mixer concrete pump	10

B.10.9 Personnel

64. The construction phase will last approximately 30 months and it is expected that approximately 600 direct employment opportunities will be available during the peak of construction. This maybe divided between two construction 'Lots'. The breakdown of skills required during the construction phase will be as follows:

(i) Skilled labour: 58%;
(ii) Semi-skilled labour: 20%; and
(iii) Unskilled labour: 22%.

B.11 Source of Materials

B.11.1 Borrow Material

65. An assessment of the volumes of cut and fill are provided in **Section F.7.3** which discusses the management of spoil material. No additional quarries or borrow pits will be needed under this Project.

B.11.2 Concrete Batching and Asphalt

66. 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.

67. Cement is produced locally by companies such as Saqcementi and Kartuli Cementi in Kaspi (approximately 70 km east of the Project area), other sources of cement may also be found closer to the site.

68. In case Contractor decides to run asphalt production facility the issues must be agreed with MoEPA. Asphalt production belongs to activities listed in Annex II to Environmental Assessment Code. MoEPA will make a decision in the need of EIA for this activity based on the screening procedure (ref. Environmental Assessment Code (document code: 360160000.05.001.018492).

69. The Contractor will be responsible for ensuring the concrete batching facilities and asphalt plant comply with the conditions outlined in **Section G.7.4** and that all necessary permits to operate are obtained from the MoEPA. The Contractor will source concrete and asphalt from existing batching plants or from his own dedicated plant. **Section G.7.4** provides explicit conditions for operating batching plants and asphalt plants and the conditions for sourcing concrete and asphalt from existing plants.

B.11.3 Technical and Potable water

70. 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 reusable bottles – no single use bottles will be permitted. 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.12 Camps and Storage Areas

B.12.1 Construction Camps

71. 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 RD and supervision engineer will have to coordinate between contractors for F1, F2 and F3 to ensure that locations for each contractors camps are located appropriately and cumulative impacts are not made more significant. In addition, where practical, camp sites and ancillary facilities, such as batching plants, rock crushing, etc, should be kept separate (distance of more than 500 meters) to avoid noise and air quality impacts to accommodation areas and offices within camps.

72. 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.

73. The Contractor will provide the following basic facilities in the construction camps:

(i) Safe and reliable water supply.
(ii) Hygienic sanitary facilities and sewerage system.
(iii) Facilities for sewerage of toilet and domestic wastes.
(iv) Storm water drainage facilities.
(v) Sickbay and first aid facilities.

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

B.12.2 Storage Areas

75. 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.13 Temporary Roads

76. The project included temporary road forecasts for access to construction sites, in particular to the main intervention sites, i.e. to tunnel portals and areas where bridges are envisaged. These temporary roads allow to access the construction sites from the existing roads. In general, such roads must be removed at the end of their use, unless otherwise notified by the Employer.

77. These forecast roads have been represented in the project for the sole purpose of indicating possible access routes and to evaluate the cost of construction within the BoQ. These schemes of design are indicative and not mandatory, although suggested: the Contractors, according to their working methods, available machinery and experience, can change them and must in any case submit to the Employer, or his Engineer, a detailed plan for such access roads and will also have to provide for the temporary acquisition of the relevant areas.

78. Such plan must be complete with detailed drawings of the elements that make up the road, the areas and the properties affected by possible occupation outside the areas owned by the administration, calculation reports if necessary. In addition, in this plan the existing traffic affected by the passage of construction vehicles must be shown and the Contractor will be responsible for requesting authorization from the Authority managing the use of the same infrastructure.

79. The Contractor shall install tanks for washing the truck wheels at the access points to the work site in order to guarantee the cleanness of the existing roads used for transport. The Contractor must also provide for the restoration of the existing roads if the Employer ascertains that the passage of construction vehicles has deteriorated the level of service. This assessment will be done in contradiction, to the presence of the Contractor, the Engineer and the Employer. Once ascertained, the costs for the restoration of such roads are totally on charge of the Contractor.

B.14 Road Safety

80. Besides a signage and markings plan in line with the best international motorway standards, the design has particularly focused on road restraint systems.

81. Safety barriers will be installed at the edges of the carriageways to prevent out-of-control vehicles from leaving the motorway or encroaching the opposite carriageway. In particular, as well as along the median, the barriers will be installed on the bridges and sections in embankments, where the expected consequences following a run-off are greater than a possible crash with the barrier. Both rigid and semi-rigid barriers will be implemented.

82. **Rigid barriers** - A rigid concrete barrier in line with current Georgian standards will be installed along the median. The barrier is anchored to the road infrastructure and has a profile that is similar to a New-Jersey type, so that vehicles can be redirected in the event of an impact. Similar barriers will be used on bridges.

83. **Semi-rigid barriers** - Guardrails have to comply with the European Standard EN-1317 “Road Restraint Systems” or comparable standards. In particular the roadside barriers shall be tested to properly retain heavy vehicles (13 tons) impacting at 70 km/h, i.e. containment level **H2** according to EN-1317 standard. This containment class takes into account the high percentage of heavy vehicles expected on the highway (about 15%).

84. Moreover, in order to limit the width of the verge behind the barrier to 80 cm, the working width of the barrier shall be consistent with this distance, i.e. class W2 according to EN-1317 standard.

85. Finally, in order to assure an adequate anchoring of the posts to the ground and avoid a soil collapse in case of crash, the planting depth shall be at least of 115 cm, thus assuring a correct plastic bending of the steel post (“plastic hinge”). This measure has been assessed through soil modeling with FLAC3D software.

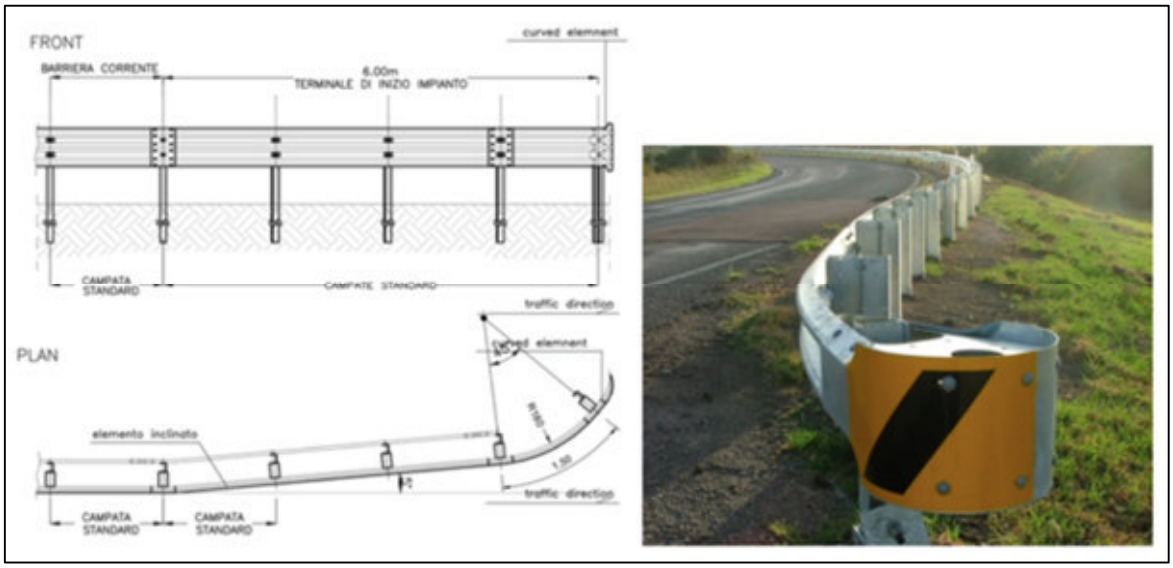
86. In order to assure a smooth transition between semi-rigid and rigid barriers (e.g. approaching to the bridges), the guardrail is gradually stiffened by doubling the number of posts in the ten spans preceding the rigid barrier.

87. Finally, special attention is given to the barrier terminals, which are curved outwards with respect to the mainline and terminated at full height. There is ample evidence, in fact, that this layout is safer than the ramped terminals that can cause vehicles to be launched and rolled. It is also recommended, if available on the local market, to install a Modified Eccentric Loader Terminal (MELT), which ensures even higher performance.

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

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

Figure 39: Barrier terminal layout (left) and an example of MELT (right)



B.15 Traffic Projections

89. Traffic forecasts for Dzirula are presented below by Table 9**.** The figures indicate that traffic volumes are set to more than double over the next 30 years.

Table 9: Traffic Forecasts

Year	Car	Mini Buses<15, Pick-ups	Buses & Trucks	Trailers & > 3 axels	Total
2017	10791	3740	1117	889	**16536**
2018	11331	3927	1168	929	**17355**
2019	11942	4139	1225	975	**18281**
2020	12653	4385	1292	1029	**19359**
2021	13484	4673	1370	1090	**20618**
2022	14366	4979	1452	1156	**21954**
2023	15142	5248	1524	1213	**23127**
2024	15960	5531	1600	1273	**24364**
2025	16630	5764	1661	1322	**25377**
2026	17328	6006	1725	1373	**26432**
2027	18056	6258	1792	1426	**27532**
2028	18751	6499	1858	1478	**28586**
2029	19473	6749	1926	1533	**29681**
2030	20116	6972	1986	1581	**30655**
2031	20780	7202	2049	1631	**31661**
2032	21465	7440	2114	1682	**32701**
2033	22174	7685	2180	1735	**33774**
2034	22906	7939	2249	1790	**34883**
2035	23661	8201	2320	1846	**36028**
2036	24442	8471	2393	1904	**37211**
2037	25249	8751	2468	1964	**38432**