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Detailed Design and Environmental and Social Impact Assessment For Motorway A4, Skopje - Blace Section 2: Construction of motorway from Interchange with local road for village Blace (Interchange "Blace") to Skopje (Interchange "Stenkovec"), km 2+000 to ~km 12+250

Environmental and Social Impact Assessment Study

February, 2022

The Western Balkans Investment Framework (WBIF) is a financing facility launched in December 2009 by the European Commission, together with the Council of Europe Development Bank (CEB), the European Bank for Reconstruction and Development (EBRD), the European Investment Bank (EIB), Bilateral Donors, and Western Balkans countries with the purpose to deliver funding for strategic investment projects in beneficiary countries. Eligible sectors include infrastructure development in the environment, energy, transport, social and digital sectors as well as private sector development. KfW and the World Bank subsequently joined the Framework. In July 2017, the KfW became a partner organisation.

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РЕПУБЛИКА МАКЕДОНИЈА
МИНИСТЕРСТВО ЗА ЖИВОТНА СРЕДИНА И ПРОСТОРНО ПЛАНИРАЊЕ

П О Т В Р Д А

за положен стручен испит за стекнување на статус експерт за оцена на влијанието
на проектите врз животната средина

СПИРОВСКА Аритон МЕНКА

, дипломиран биолог од Скопје, родена на 28.12.1951 година, во Скопје, Република Македонија, на ден 10.09.2009 година, го положи **стручниот испит за стекнување на професионално знаење за оцена на влијанието на проектите врз животната средина,** пред Комисијата за полагање на стручен испит за оцена на влијанието на проекти врз животна средина, при Министерството за животна средина и просторно планирање, и се стекна со **статус на експерт за оцена на влијанието на проектите врз животната средина** и ги исполнува условите утврдени во член 85 став 2 од Законот за животна средина, со тоа се стекнува со право да биде **вклучен** во Листата на експерти за оцена на влијанието на проектите врз животната средина што ја води Министерството за животна средина и просторно планирање на Република Македонија.

Оваа потврда се издава врз основа на член 85 од Законот за животната средина ("Службен весник на Република Македонија" број 53/05, 81/05, 24/07 и 159/08).

Министерство за животна средина
и просторно планирање

Министер,
Др. Нецати Јакупи

Број 07-2038/113
31. 07 2009, година

Комисија за полагање на стручен испит за оцена на влијанието на проекти врз животна средина

Претседател,
М-р Јадранка Иванова

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Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
AFOLU	Agriculture, Forestry and Other Land Use
AQMP	Air Quality Management Plan
BAU	Business As Usual
BCP	Border Crossing Point
BMP	Biodiversity Management Plan
CITES	Convention on International Trade in Endangered Species
CHSMP	Community Health and Safety Management Plan
CWMP	Construction Waste Management Plan
CR	Critically endangered
DD	Data deficient
DW	Drilling well
EAAA	Ecologically Appropriate Area of Analysis
EBRD	European Bank is a lender for Reconstruction and Development
EEC	European Economic Community
EIA	Environmental Impact Assessment
EAPP	Emergency action and protection plan
EMP	Effluent Monitoring Plan
EPRP	Emergency Preparedness and Response Plan
ERP	Emergency Resilience Plan
EN	Endangered
ESIA	Environmental and Social Impact Assessment
ESS	Environmental and Social Scoping Report
EU	European Union
EUNIS	European Nature Information System
EX	Extinct
EW	Extinct in the wild
GET	Green Economy Transition
GHG	Green House Gasses
GUP	General Urban Plan
HMLCMP	Hazardous Materials and Leak Control Management Plan
HMI	Hydro Meteorological Institute
IESEs	Initial Environmental and Social Examinations
IFIs	International Financial Institutions
IPA	Important Plant Area

IPF	Infrastructure Project Facility-Technical Assitance
IPPC	Integrated Pollution Prevention and Control
IPPU	Industrial Processes and Product Use
ISO	International Standard Organization
IUCN	International Union for Conservation of Nature
JSC	Joint Stock Company
LARP	Land Acquisition and Resettlement Plan
LC	Least concern
MCA	Multi Criteria Analysis
MF	Ministry of Finance
MoEPP	Ministry of Environment and Physical Planning
MP	Measuring Point
MV	Measured Value
MTC	Ministry of Transport and Communications
NE	Not Evaluated
NT	Near threatened
NTS	National Transport Strategy
OG	Official Gazette
OSHP	Occupational Safety and Health Plan
OSEP	Operational Stakeholder Engagement Plan
OSMP	Operational soil monitoring plan
PERES	Plan for Evacuation and Rescue in Emergency Situations
PBF	Priority Biodiversity Features
PCE	Public Communal Enterprise
PE	Public Entity
PESR	Public Enterprise for State Roads
PRs	Performance Requirements
PIU	Project Implementation Unit
PUE	Public Utility Enterprise
RLP	Rehabilitation and Landscaping Plan
RCMP	River Crossing Management Plan
RLP	Rehabilitation and Landscaping Plan
RNM	Republic of North Macedonia
SEETO	South East Europe Transport Observatory
SEMP	Soil and Erosion Management Plan
SEP	Stakeholder Engagement Plan

SRMP	Site Rehabilitation Management Plan
TEN-T	Trans-European Transport Network
TMP	Topsoil Management Plan
TMP	Traffic Management Plan
TOR	Terms of Reference
TWI	Topographic Wetness Index
UN	United Nation
UNFCCC	United Nations Framework Convention on Climate Change
UP	Underpass
VRMP	Vegetation Removal Management Plan
VU	Vulnerable
WFD	Water Framework Directive
WMP	Waste Management Plan
WMP	Water monitoring plan

1 INTRODUCTION

1.1 General Background

The total length of the road network in the Republic of North Macedonia is 14,182 km, out of which 242 km are motorways, 911 km are national roads, 3,771.5 km are regional roads, and 9,258 km are local roads. The condition of most of the network is below standards. Road transport has the largest share of all the transport modes in the country, both in terms of freight and passengers.

The connection of the Republic of North Macedonia with Kosovo, namely the connection of Skopje with the Blace Border Crossing Point, is done via the existing national main road A4, built in 1969. The A4 main road has a single road 7 m wide, with two sidewalks of 1 m each, and a minimum horizontal radius of 80 m, which corresponds to a vehicle speed of 50 km/h.

The intensive international traffic to Kosovo, especially heavy freight traffic towards Kosovo has a tendency of permanent growth. Having in mind the technical characteristics, traffic and road profile of this road section, with all elements and dimensions from the aspect of vehicle flow and traffic safety, it can be concluded that it no longer meets the needs.

In order to overcome the current situation, there is a need this road to become a high-traffic road. The planned A4 motorway is a strategic road for the Republic of North Macedonia and has an important place in the road network of the country, and is also a strategic part for connecting with the European road Corridor X. The planned motorway A4 Skopje – Blace will connect Skopje to Kosovo via Route 6a and latter to Corridor VIII as part of the extension of the TEN-T Core Network in Western Balkan on the Orient/East-Med Corridor.

The activities for preparation of technical documentation for construction of the two-lane motorway on this section started in 2000 and 2002, when the project documentation was prepared by "Granitproekt". Additional technical documentation was prepared during the period 2015 - 2016 by Mott Macdonald, presented in **Table 1, sub chapter 1.5.**

In order to continue with the started activities for construction of the A4 motorway, which will contribute to improving the safety and driving comfort of road users, within the Project: *Horizontal Support for Coordination with International Financial Institutions (IFIs) and bilateral donors in the Western Balkans EuropeAid/138829/DH/SER/MULTI,* Contract No: 2018/395-656, whose European Bank is a lender for Reconstruction and Development (EBRD) a grant (WB18-MKD-TRA-01) is approved for preparation of: Detail design, Environmental and social impacts assessment of the project, tender documents for construction of Motorway A4 Blace – Skopje, section border crossing "Blace" - interchange "Stenkovec" on route 6a, as part of the Orient/Eastern Mediterranean corridor.

The Ministry of Transport and Communications and the Public Enterprise for State Roads (PESR) of the Republic of North Macedonia, undertake activities for preparation, completion and adjustment of the design documentation for construction of Motorway A4, section Border Crossing Blace - Skopje with a total length of about 12,427 km. The starting point of the project is at the Blace Border crossing with Kosovo, while the end point is the existing Stenkovec interchange, which is part of the Skopje A2/A4 Motorway.

Taking into account several aspects, such as: finalization of construction works on the Corridor in Kosovo (2018), high priority of the Government of the Republic of North Macedonia to connect with Corridor VIII and the existence of technical documentation prepared for parts of the alignment, in order to speed up and more economical realization/implementation of the project activities, the Government of the Republic of North Macedonia, at its 87th session held on 9th June, 2018 decided to divide the construction of the A4 motorway, section Border Crossing Point "Blace" - Skopje (interchange "Stenkovec") into two subsections:

- **Subsection 1** – Upgrading of the existing A4 road from BC “Blace” to village Blace, up to a motorway level and construction of part of motorway with interchange to local road to village Blace, km 0+000 to km 2+125 (indicative chainages) and,

- **Subsection 2** – Construction of a motorway from the interchange with a local road to village Blace (Blace interchange) to Skopje (Stenkovec interchange), km 2+125 to km 12+075 (indicative chainages).

Based on the above, at the meeting held on 05th October 2018, between the Government representatives, the Project beneficiary, funding institutions and the consultant, it was decided to give immediate priority to Subsection 1, i.e. the first 2 km of the motorway.

For that reason, the PESR in 2018 started with activities for preparation of project documentation for Subsection 1, from the Border Crossing "Blace" to the village Blace (station km 0+085 to station km 2+213).

Subsection 1, includes expansion of the existing road A4 from BCP "Blace" to the village Blace to the level of the motorway and construction of a part of the motorway with a junction for connection with a local road to the village Blace, km 0+000 to km 2+125 (indicative chainage). More specifically, the project starts from the border crossing "Blace" at km 0+085 and ends at km 2+125 (junction "Blace") and has a length of 2.1 km. Subsection 1 envisages the expansion of the existing main road A4 at the level of the motorway and its integration with the existing infrastructure of the already constructed border crossing "Blace". The integration should provide an opportunity, after the construction of the entire motorway section Blace - Skopje, the main road A4 (old mark M3), to serve as an alternative road with the rank of a regional road. The project for Subsection 1 - expansion of the existing road A4 from BCP "Blace" to the village Blace to the level of the motorway and construction of part of the motorway, with a junction for connection with a local road to the village Blace is currently under construction. The construction of this section is financed by the Government of the Republic of North Macedonia, i.e. PESR Budget.

In order to continue with the started activities for construction of the A4 motorway, the PESR has started with the preparation of project documentation for Subsection 2, i.e. Preliminary design for the Project *"Construction of motorway from Interchange with local road for village. Blace (interchange "Blace") to Skopje (Interchange "Stenkovec"), km 2+000 to ~km 12+250,* Environmental and Social Impact Assessment Study and other documents which are defined as a deliverables in the TOR.

1.1.1 Project Developer

The Ministry of Transport and Communications (MTC) is a leading institution in the country, in charge of creating and implementing the transport policy, including national strategies and action plans, inspection and enforcement. MTC will closely monitor the Project's with the overall national transport and infrastructure development priorities.

The beneficiary of the Project is the Public Enterprise for State Roads (PESR). PESR is the national road network manager, and is responsible for designing and implementing the Annual Programme for planning, funding, construction, reconstruction, maintenance, and protection of the national and regional road network.

The Ministry of Transport and Communications, and the Public Enterprise for State Roads are the institutions representing the Client, which will be involved in the project implementation.

The Ministry of Finance (MF) is in charge of creating and implementing activities related to the financing, treasury, customs, and counting systems, audit and balance of payment, loans and credits; preparation and realization of the national budget and closing account; ownership and property-legal affairs; commodity reserves. It has oversight competencies and carries out activities as provided for by the relevant legislation. MF will be involved in the financial aspects of the Project, i.e. negotiations, facilitation of the loan agreement, and monitoring of the fiscal matters.

1.2 Project objectives and scope

The Republic of North Macedonia, as part of its commitment to EU membership, aims to develop a sustainable transport sector by constantly developing and improving the network of state roads, which includes the international road sections belonging to the Trans-European Transport Network. In addition, the Republic of North Macedonia follows the EU's plans to improve multi-modal corridors in order to facilitate the anticipated growth in transport movements.

The National Transport Strategy (NTS) 2018-2030 confirms the ambition of the Republic of North Macedonia to integrate into the European Union and become a full member of the European Union, inter alia by implementing the recommendations for development of a sustainable transport sector, which is harmonized with others strategic movements of the country and has an intermodal infrastructure fully integrated in the Trans-European Transport Network (TEN-T), regulated in accordance with the principles of good governance, respecting the universal right to "mobility" for all and EU rules and regulations, including international best practices for its further development. Construction of the motorway Blace – Skopje (interchange Stenkovec) in length of 13 km is included in the strategic actions of the Implementation Plan of the National Transport Strategy, with mid-term period for implementation. Based on the Implementation Plan the transport infrastructure, at this part, will be improved which present end of the SEETO[1] - basic and comprehensive road network that passes through the territory of the country.

In the Spatial Plan of the Republic of North Macedonia (2004-2020) is predicted construction of the motorway M-3 (SCG[2] - Blace-Skopje Petrovec-M-1).

On the basis of the above, the PESR and the Ministry of Transport and communication start with preparation of the Project: *"Construction of motorway from Interchange with local road for village Blace (interchange "Blace") to Skopje (Interchange "Stenkovec"), km 2+000 to ~km 12+250.*

The objectives of the Project are:

- Increasing the transport efficiency and improvement of traffic safety on Route 6a, as part of the extension of the TEN-T Core Network in the Western Balkans on Orient/East - Med Corridor;
- Improvement of the road infrastructure, safety and conditions in the traffic network in relation to the EU transport policy;
- Development of the basic and comprehensive transport network;
- Fulfilling the objectives of the National Transport Strategy, National Spatial Plan, and objective of the other national planning and strategic documents.

With implementation of this project, an integrated and multimodal infrastructure will be developed, which will meet current and future needs of the country and international road networking.

1.3 Existing operation

Currently, the traffic between Skopje to Blace is performing via the existing national main road A4. As was mentioned before, the Subsection 1 is under construction. The corridor of the motorway that belongs to Subsection 2 in the North part passes along agricultural and forest area on the left side of the existing national main road. On the South part, the route of the corridor passes and intersects the existing national road and interchange Stenkovec, where the traffic activities are performed.

1.4 Project location and access to site

The Project for *Construction of motorway from Interchange with local road for village Blace (interchange "Blace") to Skopje (Interchange "Stenkovec"), km 2+000 to ~km 12+250* is located in the Municipality of Cucer Sandevo, which belongs to the Skopje region in the Republic of North Macedonia. The following figures show the geographical location of the Municipality of Cucer Sandevo and location of the project area.

[1] SEETO-South East Europe Transport Observatory
[2] Serbian-Montenegro Border

Figure 1 Location of the Municipality of Cucer Sandevo and location of the project area

Figure 2 Geographical location of the project area

A satellite map of the alignment of the motorway and its surrounding is shown in the following figure.

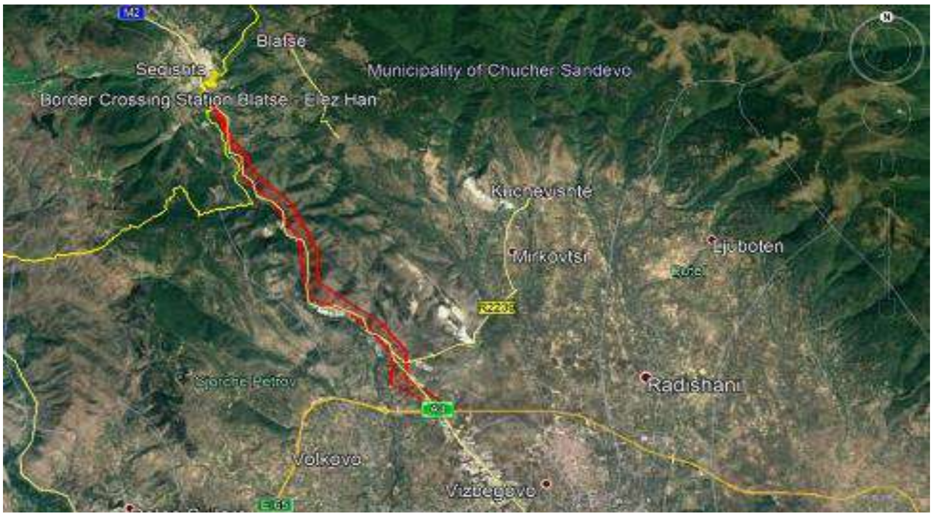


Figure 3 Satellite map of the alignment of the motorway

The route of the motorway starts from the km 2+000 and ends ~ km 12+250. Near the route of the motorway passes the existing national main road A4 Skopje-Blace Border on which are connected more local roads that provided access to the site. In addition, access to the site is provided from the motorway A2 (M-4)-ring road Skopje.

1.5 Background information and existing documents

The activities for preparation of technical documentation for construction of the two-lane motorway on this section started in 2000. Until now, many documents have been prepared by PESR, which were used as a basis for preparation of the project documentation as well as the ESIA Study. The main existing documents, related to the project are presented in the following table:

Table 1 Existing documents related to the project

Time period	Prepared documentation	Description
2000	Preliminary Design for middle section, km 1+173 - 10+675, prepared by Granitproekt	The project includes construction of a motorway with two lanes of 3.5 m on each road, with stop lanes of 2.5 m and a sidewalk of 1 m on each side; projected speed-100 km/h; construction of tunnels, viaducts and underpasses. The project documentation is at the level of the detailed design, except for the section from km 0+000 to 1+173 (connection with the Bypass, Skopje) and the section from km 10+675 - 12+427 (connection with the border crossing Blace). These sections were designed in 2016, at the level of a preliminary design.
2002	Detailed Design for middle section, km 1+173 - 10+675, prepared by Granitproekt	
2002	Geotechnical investigations at Preliminary Design, prepared by Granitproekt	/
2002	Borrow pits and landfills, Book 12 Section: interchange "Stenkovec" - Border crossing "Blace" phase: Main design prepared by Granitproekt	/
2002	Ecology, Book 13 Section: "Stenkovec" - Border crossing "Blace" phase: Main design prepared by Granitproekt	/

2003	Environmental Impact Assessment prepared by Granitproekt	/
2015	Preliminary Assessment of Project Financing for the full section, from km 0+000 - 12+427, prepared by Mott MacDonald	/
2016	Traffic Study Report for the full section, from km 0+000 - 12+427, prepared by Mott MacDonald	/
2016	Feasibility Study for full section, from km 0 +000 -12+427, prepared by Mott MacDonald	/
2016	Preliminary Design for two subsections of 3, 3 km: subsection Interchange Stenkovec and subsection Blace border crossing point, prepared by Mott MacDonald	/
2019	Detailed Design for Subsection 1 "Upgrading of the existing road A4 from BC "Blace" to Blace village to a highway level and construction of part of the highway with interchange to local road to village Blace", with length of 2 km, prepared by Hill International IPF 7 Consortium.	/
2019	Elaborate for environmental protection for the construction of Subsection 1: Upgrading of the existing road A4 from BC "Blace" to Blace village to a highway level and construction of part of the highway with interchange to local road to village Blace", prepared by Hill International IPF 7 Consortium.	In order to meet the National legal requirements for environmental protection, PESR submitted to the MoEPP a Notification Letter for implementation the project: In accordance with the submitted Notification Letter, the MoEPP issued a Decision (11-6521/2, from 14.12.2018), which instructed the PESR to prepare an Elaborate for environmental protection for construction of Subsection 1. PESR prepared an Elaborate for environmental protection, which was approved by the MoEPP (Decision for approved Elaborate no. UP1-11/4945/2019, 18.07.2019, presented in Annex1)
2019	Technical assistance preparation of climate resilience design guidelines for the Public Enterprise for State Roads in North Macedonia	/
2020	Infrastructure design for construction of A4 motorway, section BCP "Blace" - Skopje (interchange "Stenkovec"), Subsection 1 - Expansion of the existing road A4 from BCP "Blace" to village Blace to the level of the motorway and construction of part of motorway with junction for connection with a local road to the village Blace - Municipality of Cucer Sandevo (km 0+ 085 - 2+213, prepared by International IPF 7 Consortium.	/
2020-2021	Conceptual Design Report for Interchange Stenkovec-Blace Border Crossing Point, prepared by International IPF 7 Consortium.	Conceptual design report was prepared for Section: Interchange Stenkovec-Blace Border Crossing Point (12.5 km), Second Subsection from km km 2+000 until approximately km 12+075 at Stenkovec interchange, including Stenkovec Interchange. In the Conceptual

		design are presented alternatives for Subsection 2 in order to be chosen the best solution for technical, financial, environmental and social aspects etc. The first version of the Conceptual design was prepared during 2020, while in 2021 the same was amended with additional alternatives.
2020-2021	Preliminary Assessment of Environmental and Social Impacts of the Proposed Alternatives (MCA), prepared by International IPF 7 Consortium	The Preliminary assessment of the environmental and social impacts of the proposed alternatives is a part of the Conceptual design report, which refers to the Section: Interchange Stenkovec-Blace Border Crossing Point (12.5 km), Second Subsection from km 2+000 until approximately km 12+075 at Stenkovec interchange, including Stenkovec Interchange. Also, during this assessment is taken into consideration the Subsection 1. The first version of this document was finalised in July 2020, while in February 2021 the same was amended with additional alternatives and approved by the stakeholders.
2021	Draft Preliminary Design for the alignment for Section 2: Construction of motorway from Interchange with local road for village Blace (interchange "Blace") to Skopje (Interchange "Stenkovec"), km 2+000 to ~ km 12+250, prepared by International IPF 7 Consortium	This document is in still in draft phase
2021	Hydrological and hydro-technical Report, prepared by International IPF 7 Consortium	This document is prepared by the designing team for the need of the project.
2021	Geotechnical investigation program, prepared by International IPF 7 Consortium.	This document is prepared by the designing team for the need of the project.
2022	Draft Factual report for performed geotechnical investigations for Section 2, from km2+000 to km12+075,16 (Phase A), prepared by International IPF 7 Consortium.	This document is prepared by the designing team for the need of the project and delivered in January 2022.
2022	Geophysical Surveys for Site Characterization– Main Project on MotorwayA4 Skopje-Blace, Results from Field Measurements and Cabinet Processing of Data, prepared by International IPF 7 Consortium.	This document is prepared by the designing team for the need of the project and delivered in January 2022.

1.6 Information assembled by technical team and other related Project Approvals

The Ministry of transport and communication, the Public Enterprise for State Roads (PESR), the Ministry of Environment and Physical Planning, as well as the Ministry of Finance are the main institutions, responsible for project implementation and its monitoring. Other relevant institutions for implementation of the Project are:

- Ministry of Labour and Social Policy;
- Ministry of Defence;
- Ministry of Interior Affair;

- Ministry of Culture;
- Ministry of Agriculture, Forestry&Water Economy;
- National governmental agencies, directorates, public enterprises, City of Skopje, Municipality of Cucher Sandevo, etc.

As was mentioned in the previous sub chapter the technical team has prepared Draft Preliminary Design for the alignment for Section 2: Construction of motorway from Interchange with local road for village Blace (interchange "Blace") to Skopje (Interchange "Stenkovec"), km 2+000 to ~ km 12+250, during 2021.

In parallel, the technical team has started with preparation of the Infrastructural design for the alignment for Section 2. Infrastructure Design is prepared in accordance with Article 52, Law on Spatial and Urban Planning ("Official Gazette of the Republic of Macedonia" no. 199/14, 44/15, 193/15, 31/16, 163/16, 64/18 and 168/18), Rulebook on standards and norms for urban planning ("Official Gazette of the Republic of Macedonia" no. 142/15, 217/15, 222/15, 228/15, 35/16, 99/16, 134/16, 33/17 and 86/18) and Article 14-16 of the Rulebook for more detailed content, form and manner of processing of the General Urban Plan, Detailed Urban Plan, Urban Plan for the village, Urban Plan outside the settlement and Regulation Plan of the General Urban Plan, form, content and manner of processing of urban-planning documents and architectural-urban project and the content, form and manner of processing of the Infrastructure Project ("Official Gazette of RM no. 142/15).

The Infrastructural design, is preparing in parallel with the Preliminary Design and EIA Study. In accordance with the Article 52 of the Law on Spatial and Urban Planning, the Infrastructural design besides other components should contain graphical part of the Preliminary design from the architectural, construction or other technical areas, depending on the nature of the buildings and infrastructure. For approval of the Infrastructural design it is required to be prepared EIA Study.

The Preliminary design should be prepared in accordance with the Infrastructural design, as it is defined in Article 48-a of the Law on construction ("Official Gazette of the NRM" No. 279/20), while the Detail design should be prepared on the basis of the approved Infrastructural Design as it is defined in Article 47.

In accordance with the national legislation, during preparation of the Infrastructural design, the Designer's team is obliged to provide relevant information and documents, opinions/agreements from the relevant institutions in order to be reached proper land use, the proposed design of the alignment and the structures of the motorway to avoid possible conflict locations, structures that may cause environmental and social impacts.

The required data that should be provided by the relevant institutions during the designing phase, related to environmental and community protection, in the following table are presented.

Table 2 Relevant institutions and responsibility for providing required data during the designing phase

Relevant InstitQuitions	Responsibility for providing data
Ministry of Environmental and Physical Planning (MoEPP)	- Issuing physical data for planning (Planning conditions), as an extract of the National Spatial Plan; - Water management (economy) consent; - Opinions for existing (or not) designated and protected parts of the nature.
Local government of the Municipality Chucher Sandevo	- Providing data for the project area, related to existing infrastructures, facilities, sensitive areas, and possible conflicts with the proposed alignment, etc.; - Data for planned urban development of the Municipality.
Other institutions (ministries, public enterprises, agencies, etc.)	- Providing data for the project area, related to existing or planed infrastructures, networks, facilities, sensitive areas and possible conflicts with the proposed alignment, etc.

Following the legal requirements, the Designer's team has submitted requests for issuing opinions from the relevant institutions for which has obtained opinions (summary of them is presented in the table below). In some of the obtained opinions, an explanation and recommendation by some institutions are given, that the Designer should take into consideration.

Table 3 Summary of the obtained opinions and available data from the relevant institutions for the existing infrastructure which can be in conflict with the new road alignment

Institution	Number and date of issued opinion	Opinion/Recommendation
Public Enterprise "Vodovod and kanalizacija", Skopje	No. 1302-26667/2 from 15.07.2021	- In the project location there are not any hydro-technical structures which are owned by the PE, because the same is not within of the GUP of the City of Skopje, i.e. it is located outside of the solutions for water supplying and discharging of waste water which are part of the city's network. - *Part of the project location is situated on/or in the boundaries of the III protection zone of the wells area Nerezi-Lepenec, which management is under responsibility of the PE "Vodovod and kanalizacija" Skopje* - *It is recommended to be implemented measures for protection of the III zone – wider protection zone of the well area Nerezi – Lepenec, presented in the opinion.*
Public Communal Enterprise "Skopska Crna Gora", village Mirkovci, Municipality of Chucher Sandevo	No. 08-8/55 from 31.08.2021	- In the project area there are not underground installations for water supply and sewerage network owned by the PCE - PCE "Skopska Crna Gora" has no remarks regarding the project
JSC Water Economy of Republic of North Macedonia	No. 11-1703/4 from 05.08.2021	- There are no facilities and infrastructure owned by JSC at the project location
JSC MEPSO- (Eelectricity transmission power system operator of North Macedonia)	No. 11-3968/1 from 09.07.2021	- The proposed alignment not intersected electro energetic objects owned by MEPSO
EVN North Macedonia (Electro distribution, Skopje)	No. 10-55/2-297 from 16.07.2021	*The following electro energetic infrastructures and objects are presented on the location:* - *10(20)/0.4 kV substation* - *10(20)kV underground network* - *10(20)kV above ground network* - *0.4 kV underground network* - *0.4 kV above ground network* - *Through the area and its close surrounding new planned underground and aboveground medium voltage lines are passing.* - *It is obligatory to be provided a protection zone for the power facilities in accordance with the Grid Code for electricity distribution.*
JSC Macedonian Telekom	No.36787 from 12.07.2021	- *Within the borders of the project area there is existing MKT infrastructure*
A1 Macedonia Ltd Skopje	16.07.2021	- There are no underground or aboveground installations owned by A1 in the project area

JSC National Energetic Resources Skopje	No. 03-2343/2 from 19.07.2021	- There is no gas network in the project area and its construction is not planned.
PE for State Roads	No. 10-7212/2 from 15.07.2021	- In the part of the project area besides the Motorway A2 (M-4)-ring road Skopje and the existing motorway A4 (M-6) there are no other structures owned by PESR
Civil aviation agency	No. 12-8/314 from 12.07.2021	*The project area is in the zone of sport airport Skopje-Stenkovec for which are prescribed special conditions for construction in terms of air traffic safety:* - *The maximum height of any building or overhead structure in the volume should not exceed 334 meters above sea level.* - *It is forbidden to place separate poles on the antenna or poles of another type higher than 15 m.* - *In is recommended to be taken into consideration and respect the provisions presented in the opinion, which are in accordance with article 76 from the Law for aviation.*
Directorate for Protection of Cultural Heritage	No. 17-1491/2 from 16.07.2021	- There are no protective goods or goods that are primarily presumed to be cultural heritage
Protection and Rescue Directorate, Local Department Cair	No. 14/6-136/2 from 07.07.2021	- There is no existing or planned infrastructure owned by the Protection and Rescue Directorate at the project site - *It is recommended implementation of the proposed measures in opinion during preparation of the Infrastructure project.*
City of Skopje	No. 13-6776/2 from 13.07.2021	- The project area is outside of the borders of the General Urban Plan for City of Skopje and the City there is no competencies for issuing information and opinion.
Municipality of Chucher Sandevo	No. 11-769/2 from 02.08.2021	- *During the preparation of the Infrastructure project the existing local roads, regional roads, motorways to be kept and to be in function or to design appropriate underpasses and interchanges; all watercourses to be provided for uninterrupted and safe flow, which are on the territory of the municipality and to be submitted for inspection and approval.* - *The existing local road, "Kachanichko Jade", on KP 3442 KO Gluvo Brazda, which is of local importance for the municipality, must remain fully operational.* - *For all existing buildings, which are registered or the construction is pre-registered in the Real Estate Cadastre, it is necessary to provide road access, adequate protection from the railway and to confirm the facilities.* - *Submitted planning documentation for planned projects activities to be taken into consideration.*
Ministry of Internal Affairs – Sector for telecommunications	No.11.2.67500/2 from 20.08.2021	- *In the project area there is existing telecommunication network (HDPE hose, optic cable). The same should be taken into consideration.*
Ministry of Internal Affairs – Public safety bureau,	No.67501/2 from 15.07.2021	- The department does not have data and information on the proposed project area

Department for uniformed police		
Ministry for defence	19/2-11/178 from 30.07.2021	- The Ministry does not have technical documentation for presence of cable installations
Ministry for defence	19/2-32/71 from 10.12.2021	- *Regarding the requested opinion related to the route of the access dirt road as well as related to Project for construction of the motorway A4), which passes in the belt between the existing and the newly designed dirt embankment, for the needs of the private cattle breeding facilities, which are in the immediate vicinity of the shooting range "Stenkovec" Skopje, we inform you that at the shooting range "Stenkovec" regular combat shootings, exercises with military explosives and mine-explosive devices are performed and for that reason we are of the opinion that they could disrupt the safety of people who would move along the route of the newly designed dirt road.*
Ministry of environment and spatial planning – Water Department	No.11-3335/4 from 09.08.2021	- *The project location in certain places is in the immediate vicinity of the river Lepenec, covers several permanent water flows and intermittent streams, and the southern part of the area is located in the III protection zone of the wells Nerezi-Lepenec,* - *It is recommended during preparation of the project documentation to be followed the proposed criteria presented in the opinion in order to protect the existing water bodies in the project area*
Ministry of environment and spatial planning – Nature Department	No. 11-3536/4 from 22.07.2021	- The project area is outside of any borders of protected area. *However, the project area falls within the area recorded for the conservation/management of certain species. For these areas it is not proposed proclamation in any of the six categories of protection, but appropriate measures for protection of the species should be included in the relevant spatial planning documents or sectoral strategies for land use, such as forestry, hunting-economic bases, water management bases, agro-ecological program, rural development program, transport strategy, etc*.
Ministry of Agriculture, Forestry & Water Economy	No.45-6257/2 from 13.07.2021	The information is not provided, the same should be requested by the PESR.

The all provided opinions for the alignment of the motorway in Annex 2 are presented.

In accordance with the data that arise from the obtained opinions, issued by the relevant institutions, it can be concluded that in the project area and its close surrounding there are: existing and planned infrastructures (electro energetic infrastructures and objects, telecommunication infrastructures and networks, existing roads), sensitive locations (protection zone of the wells "Nerezi-Lepenec", zone of the airport "Stenkovec", shooting range "Stenkovec", river Lepenec and other water bodies-permanent and intermittent), area recorded for conservation/management of certain biodiversity species, etc.

All proposed measures and recommendations, given by the relevant institutions, for protection of the identified infrastructures, locations, water bodies, biodiversity etc., (presented in the table above and Annex 2) are taken into consideration during the designing phase (preparation of the designs and ESIA study) in order to provide appropriate protection of the all identified issues and uninterrupted project implementation.

For preparation of the technical documentation by the Municipality of Cucer Sandevo was provided the following documentation:

1. Local urban-planning documentation for a facility with a purpose G2-Light and non-polluting industry,
2. Local urban-planning documentation for a facility with a purpose G4-Warehouses,
3. Local urban-planning documentation for a facility with a purpose G3-Services (existing object),
4. Local urban planning documentation for a facility with a purpose G4-Warehouses,
5. Local urban-planning documentation for a facility with a purpose G2-Light and non-polluting industry,
6. Local urban-planning documentation for a facility with a purpose E2-Gas station and service centers with accompanying facilities,
7. Local urban-planning documentation for a building with purpose E1-Infrastructure project for local road,
8. Hydrological study for regulation of Vrazanska River, in v.Gluvo, KM Gluvo Brazda.

The urban plans have not yet been approved by the Municipality, as they are waiting for the final definition of the alignment to be defined, in order to avoid possible conflicts.

In the assessment of cumulative impacts only Local urban-planning documentation, numbered as 6 and 7, were taken into consideration.

In the process of obtaining construction permit, besides preparation of the technical project documentation (designs) and ESIA study, collection of required data for the project area and its close surrounding by the relevant institutions is performing. Some of the institutions have a responsibility of issuing permits/consents, which are precondition for issuing the construction permit for the project. In the following table are presented the most relevant institutions and documents of their competency.

Table 4 Required permits/consents and relevant institutions for their issuing during the designing phase

Permits/consents	Relevant institutions for their issuing	Explanation
Water management consent	Ministry of environment and physical planning (MoEPP)	The consent should be issued for the purpose of construction of new or reconstruction or extension of existing facilities, located in/or near surface waters, facilities that pass through or under surface waters or facilities located near surface waters or coastal lands, which can affect the water regime. This consent determines the water management conditions that must be realized during the construction phase. According to Article 176 from the Law on Water, the consent is issued by the MoEPP based on the request submitted by the Investor (during the designing phase). In accordance with the Law on Construction, Point 2. Detailed design, Article 47, (8) the Detailed design for buildings, located in or near surface waters, buildings that pass through or under surface waters, buildings that are located near surface waters or coastal lands[3], which may affect the water regime as well as for

[3] **Definition**: Coastal land is a belt of 50 meters of land, away from the boundary along which there are permanent or seasonal watercourses, rivers, lakes or springs.

		water management facilities determined by The Law on Waters[4] also contains a water management consent.
Consent for implementation of the Project	Ministry of environment and physical planning (MoEPP)	The consent should be issued by the MoEPP on the basis on submitted EIA Study (in accordance with the Law on environment). After successful implementation of the EIA process, the project developer obtains a Consent for implementation of the Project, which has a validity of 2 years. Besides issuing the Consent, the MoEPP has responsibility to carry out the EIA procedure until the issuance of the Consent.
Construction Permit	Transport and Communication (MTC)	The Construction Permit will be issued by the Ministry of Transport and Communication (MTC), upon the submission of the following list of documentation: • Urban planning documentation (Infrastructural design) - approved by MTC, • Detailed Design and reports for all phases, • Final Audit Reports for Detailed Design and Elaborate for all phases, • Elaborate for numerical data, • Opinion on mechanical strength, stability and seismic protection of the building (IZIIS), • EIA Study or Elaborate for protection of the environment, • Decision for approved EIA Study (MoEPP), • Solution for permanent change of traffic regime (MTC), • Data on cost and route length for State Statistical Office. Prior to submission of the above mentioned documentation, the entity in charge of electricity infrastructure is obliged to review the Detailed Design and within five days from the day of receipt of the request for review to submit a Consent whether the facility for which the request for construction permit was submitted, can be connected to the appropriate power system. As well as the entities in charge of water supply and sewerage infrastructure within five days from the day of receipt of the request for review are obliged to review the Detailed Design and to prepare MoM whether hydro technical conditions are fulfilled i.e. to give remarks if they are not met. The minutes shall be signed by the official and the representative of the entity and a copy of it shall be submitted to the applicant who is obliged to act upon the given remarks within the deadline referred to in Article 59 paragraph (10) of the Construction law.

Besides the above mentioned, prior starting of the construction phase, the Contractor is obliged to provide permits/consents/approvals as it is presented in the following table:

[4] **Article 163 of the Law on Waters:** Water management facilities and plants, in the sense of this law, are the facilities intended for: 1) regulation of the water regime, as follows: dams with their accumulation spaces, retention and induction pools, regulated riverbeds, defensive embankments , arranged torrents and erosion surfaces, bypass channels, pumping stations, etc. (hereinafter: protective structures); 2) provision, capture, supply and preparation of water for water supply of the population, industrial and other economic and communal needs (hereinafter: water supply facilities); provision, capture, supply and preparation of water for water supply of the population, industrial and other economic and communal needs, etc.

Table 5 Required permits/consents/approvals and relevant institutions for their issuing prior starting of the construction phase

Permits/consents/approvals	Relevant institutions for their issuing	Explanation
Water right	Ministry of environment and physical planning (MoEPP)	The legal or natural person acquires a water right on the basis of a water use permit and a water discharge permit. The conditions, manner and the procedure for issuing the permit referred to in paragraph (1) of Article 26 from the Law on Water shall be regulated by this Law. The water right referred to in paragraph (1) of Article 26 from the Law on Water may also be acquired by inheritance.
Discharge permit (waste water)	Ministry of environment and physical planning (MoEPP)	Legal and natural persons, including state bodies administration, the municipalities, the municipalities in the city of Skopje and the city of Skopje can discharge wastewater or discharge or dispose of substances and substances in recipients only after a previously obtained discharge permit, under conditions and in a manner determined by Law on Water (Article 79 Discharge permit).
Consent/approvals for storage/disposal of construction/demolition waste	Municipality of Cucer Sandevo or Ministry of environment and physical planning (MoEPP)	In accordance with the National legislation, there is not any permit required for establishing surplus material disposal sites. However, in order to be provided proper storage of waste (which beside excavated surplus materials will include other type of waste), for temporary storage or permanent disposal of waste, outside of the boundaries of the project area, should be provided consent or approvals from the relevant authorities (Municipality or MoEPP). For permanent disposal of construction and demolition waste it is necessary to be followed requirements and obligations, defined in the Law on waste management, Article 54, paragraph (3) i.e. legal entities and individuals who during construction, processing, handicrafts and other activities create inert waste (construction debris) that does not have the property of municipal waste, are obliged to collect and transport the waste to the places designated by the municipalities and the City of Skopje or hand them over to authorized legal entities and individuals who collect and transport waste. Hazardous waste management is the responsibility of the Ministry of Environment and Physical Planning. In accordance with the legal requirement only authorized companies can be involved in the collection, storage and export of the hazardous waste. In the country, there are no collection centers for temporary storage of hazardous waste. The temporary storage of hazardous waste, generated during construction phase of the project, should be at locations that have obtained a permit

		for this purpose by the MoEPP.
Environmental consents/IPPC permit	Municipality or Ministry of environment and physical planning (MoEPP)	For supplying of construction materials for the need of the project, if there is a need for opening of a new quarry and borrows pits, beside approvals and permits by the relevant institution for mining, environmental consents should be obtained by the Municipality or MOEPP on the base on Law on environment. For operation of these plants, it is required to be obtained IPPC permit in accordance with the Law on environment.

1.7 Stakeholders engagement activities

This project has been in development since 2002, when the final design was prepared and all related stakeholder engagement activities were completed for that design.

The new activities for development of this Project started in 2018, when a series of stakeholder engagement activities were undertaken.

On 13.12.2018 a site visit performed by the ESIA team of consultants included communication with individuals found on site, throughout the project area of influence. There was a couple (farmers) preparing the field for the spring yield, and the social expert took a time to discuss problems and issues with livelihood, just to get information and impression from first-hand about who are the interviewees and where and how they live, along with information who are the owners of the surrounding fields and where they live and do and how actually cultivate their fields. This event occurs close to the intersection of proposed road with Skopje ring road. Furthermore, another group of three male farmers, all members of a single agricultural holding/family (three generations), was non-formally interviewed in order to get relevant information regarding their livelihood, way of life and the owners/users of the fields. This event occurs close to the location of the Toll station. Last interviewees were a spouse couple currently visiting their small weekend house located at the lower edge of the weekend settlement. Their original residence location was Skopje, but they do often visit (excluding the cold and rainy days) their property in the weekend houses settlement, alone or with friends/relatives.

During the 06.03.2019 site visit, two owners of two different sheep pen were interviewed. Both were informed on the planned project activities and series of questions regarding way of life and doing business were asked and answered by the interviewees. Also, potential economic resettlement, access to local resources and elements of proposed project design and options were also discussed.

Field visit on 19.09.2019 included check to a weekend house that was set remote from the weekend houses settlement. The weekend house was populated at the visit, and its owner (an elderly man) along with his son and his nephews (all four residing in Skopje) were performing vegetation trimming on their parcel. The house is partially used, but renovated recently. The road is foreseen to pass some 10-15 meters next to the house, and the design included viaduct and retention wall in order to minimize avoidance and expropriation of property.

Additionally, owner of a business (printing house), whose business is located near the toll station, was non-formally interviewed. His interest was related to the project design and the potential displacement issues related (if at all) to his property and business. Potential impacts and mitigation measures, as well as ESIA procedure, were the main interest of the local interested individuals.

On 16.06.2020, refreshing site visit was performed and two different crop farmers, along with 2 different livestock farmers were interviewed. Non-formal interviews included preliminary design prospects, resettlement compensation measures for the affected people and mitigation measures that can be implemented during the construction phase.

During the pandemic times, on 19.11.2020, due to the process of confirmation of the selected project option, a joint field visit to the project area (mainly shooting range Stenkovec), was performed by the local EBRD office, IPF7 Team and ESIA Experts, PESR, RNM Gov. representative, Secretariat for European Affairs, Army, Police, Mayor of the municipality. Field visit comprises of observation of the shooting range, access roads and potential safety issues with future road users and current (illegal) land users.

Last site visit, where stakeholders were consulted, was performed on 19.05.2021. During observation of the ongoing construction activities for the section of the existing road from this project toward the border (2.1 km) with Kosovo, two representatives of local community from Dolno Blace were met, among who one was the responsible for the graveyards in the vicinity of the project footprint. Issues like Stakeholder Engagement Plan and its availability, existence of grievance mechanism, the procedure for ESIA and public disclosure of the relevant documentation as well its availability was discussed with these representatives of the Dolno Blace settlement.

PESR has continuously, since 2018, conducted thorough consultation activities with the institutional stakeholders. Means that were used for communication and consultation process with institutional stakeholders included, but not limited to:

- Consultation meetings in person;
- Online individual and group consultation meetings;
- Direct email communication;
- Official (letter) correspondence.

Numerous individual meetings and communication iterations were performed by PESR and desining team in order to obtain relevant data for the selection of project options and later during collection of relevant opinions by the responsible institutions for the preliminary design. There have been significant corrections within the proposed initial design for the motorway, in order to reach appropriate decision for project design that will fit all needs of various involved governmental institutions due to the presence of border crossing with Kosovo and army operated shooting range (training facility).

The following institutions were consulted:

- Ministry of Infrastructure and Communication
- Ministry of Finance
- Ministry of Economy
- Ministry of Environment and Spatial Planning
- Ministry of Agriculture, Forestry and Water Economy
- Ministry of Culture
- Ministry of Interior
- Ministry of Defence
- Customs Administration
- Municipality of Chucher - Sandevo
- Secretariat for European Affairs
- Government of the Republic of North Macedonia
- City of Skopje & its administration
- and others

Due to the COVID-19 pandemics and rules issued by the Government of RNM and EBRD (for avoiding physical gathering in public or closed space), it was not possible to perform stakeholder engagement activities that will include physical presence of local population or indoor meetings, beside those meetings that were already performed during the 2018-2019 period.

Hence, PESR has continuously published data regarding the project through its profiles on social media platforms. For further reference, there is a Stakeholder Engagement Plan for this project.

1.8 Actual status of the Project regarding EIA Approval at authorised Ministry

In accordance with the E&S EBRD policy, 2019 national legal requirements, as well as requirements by the TOR[5], for the Project: *"Construction of motorway from Interchange with local road for village Blace (interchange "Blace") to Skopje (Interchange "Stenkovec"), km 2+000 to ~km 12+250,* an Environmental and Social Impact Assessment Study (ESIA) should be prepared by the ESIA team, which will be a part of the deliverables that should be submitted to the PESR.

The procedure for environmental impact assessment is defined in the Law on environment[6] where the requirements of the EU Directive for EIA (85/337/EEK) are transposed.

In accordance with the Regulation on determining the projects and criteria by which the need for conducting an Environmental Impact Assessment is determined[7], the project for "Construction of motorway from Interchange with local road for village Blace (interchange "Blace") to Skopje (Interchange "Stenkovec"), km 2+000 to ~km 12+250, belongs to *Annex I, point 7. under point (b) motorways*. The projects belongs to Annex I of the Decree and environmental impact assessment is mandatory.

In accordance with the established procedure, PESR in the role of developer of the Project, submitted a Notification Letter and request for determination the scope of the EIA to the Ministry of environment and physical planning (Ref. no. 09-7112/2 from 13.07.2021). In a procedure determined by the Law on environment and the Regulation on determining the projects and criteria by which the need for conducting an Environmental Impact Assessment is determined, MoEPP issued a Decision about the need of conducting EIA procedure determine the scope of the EIA Study in October, 2021 (presented in Annex 3), stating that an EIA procedure should be implemented. The issued Decision is published in a daily newspaper (Nova Makedonija, on 27.10.2021, presented in Annex 3).

In accordance with the EBRD Environmental and Social Policy (2019), the proposed project activities belong in Category A Projects, point 6. Construction of lines for long-distance railway traffic; airports with a basic runway length of 2,100 metres or more; motorways, express roads and new roads of four or more lanes, or realignment and/or widening of existing roads to provide four or more lanes, where such new roads, or realigned and/or widened sections of road would be 10 km or more in a continuous length. For this type of project activities which belong to Category A of the EBRD Policy, environmental impact assessment is mandatory.

In accordance with the requirements of the EBRD policy, 2019 a separate Environmental and Social Scoping Report has been prepared and submitted to the EBRD for approval.

A detail description of the legal framework which includes the national legislation, EU legal requirements and E&S EBRD Policy, 2019 relevant for the Project is presented in Annex 4.

1.8.1 Transboundary procedure

In accordance with Article 3 of the Espoo Convention (Convention for assessment of impacts from individual projects in a transboundary context) and Law on environment if the proposed project is likely to cause significant trans-boundary environmental impacts in that case should be conducted trans-boundary procedure.

The trans-boundary procedure, under the Espoo Convention and national legislation, will not be conducted due to the fact that Subsection 1 is already under construction and will be finished before the time of implementation of the Subsection 2 of the Project. For Subsection 1, Elaborate for environmental protection (EIA Report) has been prepared and approved with a Decision from the MoEPP. The mentioned procedure and the level of the EIA Report is not a matter of a trans-boundary procedure under the Espoo Convention. In addition, in the Elaborate it is assessed that the

[5] Terms of references
[6] "Official Gazette of the Republic of Macedonia" no. 53/05, 81/05, 24/07, 159/08, 83/09, 48/10, 124/10, 51/11, 123/12, 93/13, 187/13, 42/14, 44/15, 129/15, 192/15, 39/16, 99/18
[7] "Official Gazette of the Republic of Macedonia" no. 74/05, 109/09, 164/12 and 202/16

construction of the Subsection 1 will not cause significant trans-boundary effects, due to the fact that construction activities will stop at the chainage of the border (RNM side).

Also, as a result of the foreseen activities for Subsection 2, in the Notification letter and request for determination of the scope of the EIA that was sent to the MoEPP, it was assessed that the project activities will not cause significant trans-boundary effects. All environmental impacts will be localised, impact on biodiversity will not be extending to Kosovo territory and river is flowing from Kosovo to N Macedonia, so that there is no possibility of transporting pollution to another country. On the basis on the mentioned, in the issued Decision by the MoEPP presented in Annex 3**,** it is noted that from the presented data it is not expected significant transboundary effects on the environment and people in Kosovo. On the bases on this it could be concluded that conducting transboundary procedure for the proposed project is not required.

1.9 Comparison of Key Implementation Standards/Guidelines

The EIA procedure is enforced pursuant to Chapter XI of the Law on environment and the appropriate bylaws. The purpose of the EIA procedure is to identify, describe and assess the impacts that a certain project (due to its character, scope or location) have or could have during its construction, operation and decommission upon: people and biodiversity, soil, water, air, and other natural resources, as well as the climate, historical and cultural heritage and the interactions of these elements.

As was mentioned in previously, the proposed project for construction of motorway belongs to Annex I, for which the Environmental impact assessment is mandatory. The EIA study should be prepared in accordance with the "Rulebook for the content of the requirements to be fulfilled by Study for assessment of the impact on the project on the environment ("Official Gazette of RM" No.33/06).

In accordance with the EBRD Environmental and social policy (2019), the proposed project belong in Category A Projects, for which environmental impact assessment is mandatory.

Since the project for construction of the motorway is a project that is financed by the EBRD, the ESIA will reflect the requirements from specific PRs defined in the Policy, as follow:

- PR 1 - Assessment and Management of Environmental and Social Risks and Impacts;
- PR 2 - Labour and Working Conditions;
- PR 3 - Resource Efficiency and Pollution Prevention and Control;
- PR 4 – Health, Safety and Security;
- PR 5 - Land Acquisition, Restrictions on Land Use and Involuntary Resettlement;
- PR 6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources;
- PR 8 - Cultural Heritage;
- PR 10 - Information Disclosure and Stakeholder Engagement.

In addition, during preparation of the ESIA will be taken into account the requirements defined in the EIA directive and national legislation.

In the TOR the content for preparation of the ESIA is proposed and it is noted that the ESIA should be prepared in a manner to fulfil the national, EU, EBRD requirements. Comparison of the content for ESIA defined in the TOR and National legislation is presented in the following table:

Table 6 Comparison of the content for ESIA defined in the TOR and National legislation

Content of the ESIA study defined in the TOR [8]	National legislation	Differences in the

[8] **Annex 2: ESIA Content outline**
It is expected that the content of the ESIA report will be mainly as described below, in accordance with the national EU, EBRD requirements. The content can be amended as needed.
The structure, content, and length of the ESIA report will comply with the national, EU, and EBRD requirement

Heading	Contents	Contents	content of the study defined in the TOR and National legal requirements
	Title page, acknowledgements, authors and contributors, table of contents (including lists of figures, tables, and maps	The need for elaboration of the title page, acknowledgements, authors and contributors, table of contents (including lists of figures, tables, and maps within the scope of the Study on EIA is not a requirement of the national legislation	The Title page, acknowledgements, authors and contributors, table of contents (including lists of figures, tables, and maps) are always part of the EIA study prepared in accordance with the national legislation
1.Introduction	General Background (also including information of Developer); Project Objectives and Scope; Existing Operations; Project Location and Access to Site; Background Information; Existing Documents; Information Assembled By Technical Team; Actual Status of the Project Regarding EIA Approval at authorized Ministry; Other Related Project EIA Approvals; Comparison of Key International Standards/Guidelines	Project description, along with information on project location, the character and scope of the project and the necessary land area. The need for elaboration of the regulatory framework within the scope of the Study on EIA is not a requirement of the national legislation	The need for elaboration of the regulatory framework within the scope of the Study on EIA is not a requirement of the national legislation, but this chapter is always part of the EIA study prepared in accordance with the national legislation
2. Project Description	Description of any previous works (like geotechnical work or else). According to project documentation, technical details of the project should be described. If any other activities which may be required as a consequence of the project is required, it should be describe.	Description of characteristics of the technology that will be used	In accordance with the national legislation, this chapter always contain physical characteristics of the project and land use during construction and operation (detailed maps of the location, borders of the location where major project activities will be performed, description of the characteristics of the design
3. Description of the Environment	The description includes information regarding: land use; overview of geomorphological, geological, hydrogeological and seismological characteristics of the terrain; water sources data; climate conditions and air quality; biological and ecological resources (terrestrial and aquatic environment - habitat, flora and	Description of the environment and its media at the project location, i.e., description of the natural, cultural and historical heritage and the landscape	In this chapter are always included information and data as it is defined in the TOR

Content of the ESIA study defined in the TOR [8]		National legislation	Differences in the content of the study defined in the TOR and National legal requirements
Heading	**Contents**	**Contents**	
	fauna, forest; natural assets – nature protection areas), landscape features; cultural heritage, socio economic baseline (with population and settlements data), economic activities (including hunting and forestry) in the project area		
4. Assessment of Alternatives studied by the project developer	For each project (especially for new construction) it is necessary to assess more alternatives, which will be described here. Selection procedure of most suitable one needs to be described (based on which criteria, procedure, results, etc.).	Description of the alternative solutions for the realization of the project that the investor had in mind and the main reasons for choosing the proposed alternative; the zero alternative is always included	No differences
5. Associated and Potential impacts	Impacts that need to be assessed are those related to: land use; groundwater and surface waters; air quality; biological and ecological resources, landscape features; cultural heritage, socio economic aspects (with population and settlements impacts assessment), economic activities (including hunting and forestry). In assessing procedure following characteristics should be considered: ✓ Direction of the impact (positive or negative), ✓ Nature of the impact (direct, indirect, primary, secondary, cumulative), ✓ Duration of the impact (short, medium and long-term, permanent and temporary), ✓ Frequency and reversibility of the impact, ✓ Extent of the impact (geographical area, size of the affected population/habitat/species), ✓ Magnitude and complexity of the impact, ✓ Probability of the impact.	Description of the type and quantities of expected emissions, especially air emissions and wastewater, solid waste, as well as other relevant information necessary for evaluation of the major project impacts on the environment. Description of the project impacts on the environment on the basis of scientific knowledge and the adopted evaluation methods	In this chapter are included information and data as it is defined in the TOR and required by the National regulation (Decision, issued by the relevant Ministry for the scope of the EIA study)
6. Green Economy Transition	Identification of the projects or project components that meet the GET principles and criteria, in line	The need for elaboration of this Chapter is not a	The need for elaboration of the Green Economy

Content of the ESIA study defined in the TOR [8]		National legislation	Differences in the content of the study defined in the TOR and National legal requirements
Heading	**Contents**	**Contents**	
potential	with the EBRD GET Handbook. Assessing the physical environmental benefits of the GET projects and project components through ex-ante estimation of the physical environmental impacts of projects and/or verification of estimations undertaken by EBRD. Confirmation of the proportion of GET finance and GET benefits of a project and explaining how these fits into the GET strategy, as well as examining other contributing factors and total GET benefits.	requirement of the national legislation	Transition potential is not requirement of the national legislation, but in the EIA will be included, as it is defined in the TOR.
7. Mitigation measures	Depending on estimated impacts on social and environment components and their strength it is necessary to propose protection measures to mitigate those impacts to the lowest possible level. Proposed Environmental protection measures should include those prescribed by law and other regulations, protection measures in accidental situations, plans and technical solutions for environmental protection, and other protective measures. Protection measures should be divided into three phases: ✓ Protection measures during project preparation; ✓ Protection measures during construction; ✓ Protection measures during utilization.	Description of the measures for prevention, reduction and elimination of the impact on the environment, as well as of the measures for restoration to the former state	No differences
8. Monitoring programme of impact on the environment and social components	For planned constructions, the planned monitoring will include at least, but not limited to: ✓ Air emissions; ✓ Water quality; ✓ Fauna (biodiversity); ✓ Noise.	The need for elaboration of this Chapter is not a requirement of the national legislation	The need for elaboration of the Monitoring programme of impact on the environment and social components within the scope of the Study on EIA is not a requirement of the national legislation, but this chapter is always included in the Study on EIA
9. Short non-	The ESIA report should contain a	Summary of the	No differences

Content of the ESIA study defined in the TOR [8]		National legislation	Differences in the content of the study defined in the TOR and National legal requirements
Heading	**Contents**	**Contents**	
technical summary	precise summary about the significant results and recommended actions; it should be written in non-technical terms. The target audiences of the summary will range from government decision-makers (who are not necessarily ESIA specialists) to the general public.	submitted Study without technical details is always part of EIA	
10.The data on technical shortcomings, absence of the appropriate expertise and skills or, impossibility of obtaining the appropriate data	Difficulties at this point particularly include: technical shortcomings, absence of the appropriate expertise and skills or, impossibility of obtaining the appropriate data and other problems that meets the developer or designer, while collecting the data or preparation the study or project.	Gap analysis (technical problems or insufficient knowledge) of the difficulties that the Investor or the Expert have come upon during the preparation of the Study on EIA Proposition of the magnitude and the characteristics of the change that imposes the need to update the Study on EIA	There are some differences, but both requirements are fulfilled.
11.ESMP	Develop an Environmental and Social Management Plan as a part of each ESIA	The need for preparation of Environmental Management Plan is not a requirement of the national legislation	The need for elaboration of the ESMP within the scope of the Study on EIA is not a requirement of the national legislation, but this chapter is always included in the Study on EIA

Notification letter for implementation of the Project, together with the scoping report, EIA study (including Non-technical summary) as deliverables that should be submitted by the Developer of the Project on the basis of which the Consent for implementation of the Project will be issued. In accordance with the E&S EBRD Policy, 2019 during conducting of the ESIA procedure should be prepared additional documents as deliverables compared to the requirements of the national legislation, such as: ESS report, ESIA study, NTS, SEP, ESAP, LARF, LARP, EBRD PR Compliance Assessment Table.

In addition, there is a difference in a timeframe for conducting the EIA/ESIA procedure. A comparative analysis for preparation of EIA/ESIA deliverables, in accordance with the National Environmental Legislation and EBRD Environmental and Social Policy, 2019 and conducting the procedure in the following table is presented.

Table 7 Comparative analysis for preparation of EIA/ESIA deliverables, in accordance with the National Environmental Legislation and EBRD Environmental and Social Policy, 2019 and conducting the procedure

National legislation for EIA		EBRD Environment and Social Policy, 2019		Comment
Deliverables	**Time frame for conducting the procedure**	**Deliverables**	**Timeframe for conducting the procedure in accordance**	
1. Notification letter for implementation of the project and request for determination the scope of the Environmental Impact Assessment Study (EIA)	30-40 days from the submission of the required documentation to the MoEPP for conducting the procedure and issuing a Decision for determining the scope of the EIA, publishing the documents for public access, etc.	**1. Environmental and Social Scoping report**	It is not defined, but it should be approved by the EBRD	/
/	/	**2. Stakeholder Engagement Plan**	It is included in the time period defined in item 4	In accordance with the national legislation, it is not necessary to be prepared a separate document for stakeholder involvement.
/	/	**3. Land Acquisition and Resettlement Framework**	It is included in the time period defined in item 4.	National legislation does not require preparation of this document. However, regulating land acquisition is a procedure defined in the national legislation required for project implementation.
2. Environmental Impact Assessment (EIA) Study	Approximately 120 days which include: - 30 days period for public involvement, holding a public hearing, -60 days for preparation of the EIA Compliance Report by the MoEPP, issuance and publication of a decision by the MoEPP for the implementation of the project, etc.,	**4. Environmental and Social Impact Assessment Study (ESIA), in which an Environmental and Social Management Plan is prepared as part of the study or a separate part, as well as a Monitoring Plan**	-120 days proposed for public consultations of the ESIA and other deliverables	/

	announced in public media and the period of submission of complaints by the affected population			
/	/	**5. Environmental and Social Action Plan**	It is included in the time period defined in item 4	National legislation does not require preparation of this document.
3. Non-technical summary	It is included in the time period defined in item 2	**6. Non-technical summary**	It is included in the time period defined in item 4	/
/	/	**7 Environmental and social appraisal: Compliance summary table**	It is included in the time period defined in item 4	National legislation does not require preparation of this document.
/	/	**8. Land Acquisition and Resettlement Plan**	It is not defined, but should be approved by the EBRD and published for public consultation	National legislation does not require preparation of this document. As a deliverable to the Bank will be prepared additionally, after the approval of the Infrastructure project and the approved Expropriation Report on the basis of which the PESR will provide an assessment of the value of the land, crops and objects by independent appraisers.

A detailed description of the EIA/ESIA procedure and the relevant national legislation, EBRD requirements, EU legislation as well as other relevant documents is presented in Annex 4.

1.9.1 Deliverables, defined in the TOR

In accordance with the TOR, the ESIA team should provide the following deliverables to the developer of the Project:

- ESIA study;
- Environmental and Social Action Plan;
- Stakeholder Engagement Plan;
- Non-Technical Summary;
- Land Acquisition and Resettlement Framework;
- Land Acquisition and Resettlement Plan;
- EBRD PR Compliance Assessment Table.

2 PROJECT DESCRIPTION

2.1 Description of the alignment

The route of the motorway that is a part of Section 2 starts at the km 2+000, which is actually the end of Section 1, and ends at the km 12+250. The following figures shows the route of the motorway Blace-Stenkovec which belongs to Section 2.

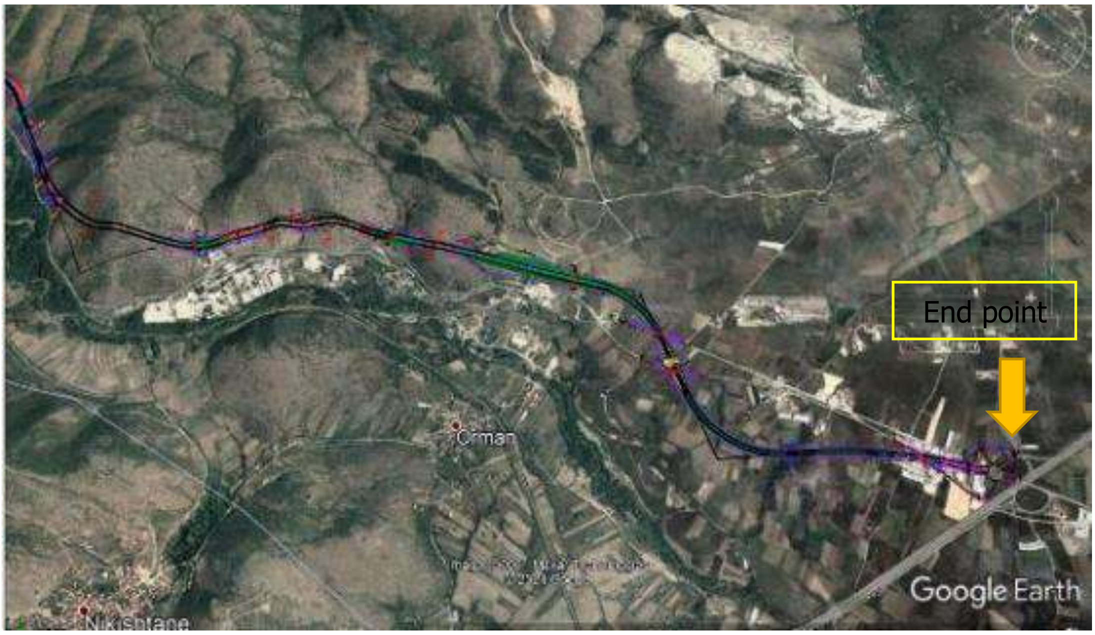


Figure 4 Alignment of the motorway for Section 2: Blace – Stenkovec

At the beginning of the alignment at km 2+000, there are no settlements. The site is covered with forest vegetation, as well as hilly parts covered with sparse vegetation. In the vicinity are local dirt roads used by the local population.

In the surroundings passes existing national road (the lower distance ~30 m) and the river Lepenec (~60 m) which flow along the existing national road. Proposed alignment intersects the intermittent stream (without name) at km: 2+200. On this part of the alignment, construction of bridges on both sides of the motorway is envisaged, i.e. left bridge B1=183.20 m (km 2+145.42 - 2+328.62) and right bridge B1=182.07 m (km 2+145.03 - 2+327.10).

Figure 5 Project area at the beginning of the alignment

The corridor of the motorway continues along hilly terrain and terrain covered with forest vegetation. In this part it is planned to be constructed a bridge on the right side of the motorway B2=148.06 m (km 2+415.08 - 2+563.14).

Then the route of the motorway will pass through a hilly area and an area covered with vegetation, where the construction of tunnels on both sides of the motorway is planned, i.e. left T1=286.71 m (km 2+569.94 - 2+856.65) and right T1=229, 37 m (km 2+630.63 - 2+860.00). After the tunnels, a bridge is planned on the right side of the motorway B3=245 m (km 3+045.00 - 3+290.00), as well as tunnels on both sides of the motorway, on the right T2=279 m (km 3+351, 00 - 3+630.00) and left T2=280.48 (km 3+315.79 - 3+596.27). The planned tunnels will pass through an area covered with forest vegetation.

After the exit from the tunnels, the motorway will pass in an area where at approximately 50-100 m (air distance) there are houses (weekend houses), arable land, cattle breeding facility and a dirt road that connected these facilities with the motorway. The route intersects intermittent stream (km 3+ 600 without name and Morav Dol near km 3+900). In this part at km 3+913,29 construction of an underpass UP1 and access road of 200 m is planned. In this part are passing transmission lines. At km 3+900 on the left side of the future motorway disposal area of excavated earth material is planned.

After that, the alignment passes through hilly terrain covered with vegetation and earth road. Close to the alignment is located a building, where the construction of a retaining wall is planned, and below at km 4 + 687.05 the construction of a underpass and UP2 and an access road with length of 182 m is planned. The national road A4 and river Lepenec are located at approximately distance of 200 m. At km 4+300 the alignment intersects the intermittent stream (without name) and at km 4+700 Pesji Dol. The following figures show the route of the motorway from km 3+000 to km 4+700 and its surroundings.

Figure 6 Project area between km: 3+000 to 4+700

Then the alignment at km: 5+000 to 5+500 passes near the sheepfold, located at the distance of 130-150 m and earth road. In the surrounding passes transmission line.

Figure 7 Surrounding near km: 5+000 to 5+500

In this part, between km 5+350 to km 5+400, construction of underpass UP3 on km 5+367.04 and access road with total length of 610 m is envisaged. At the km 5+000 on the opposite side of the motorway is the separation plant and quarry owned by the company Transmet, as well as the river Lepenec.

Figure 8 Quarry and separation plant owned by Company Transmet

Figure 9 Surrounding near km: 5+000 to 5+500

The alignment continues through the hilly terrain covered on some parts with vegetation. The national road A4 and river Lepenec follow the alignments of the right site.

The alignment continues through the hilly terrain. On this location are noticeable intermittent streams without names (km 6+000 and km 6+400). In this part, construction of bridges on both sides of the motorway is planned, on the left B4=86.97 m (km 6+308.82 - 6+395.79) and on the right B4=142.00 m (km 6+292, 00 - 6+434.00).

The route continues through hilly terrain covered with sparse vegetation. On the left side of the motorway, it is planned to be constructed a tunnel T3=1004.86 m (km 6+494.90 - 7+499.76), on the right side a tunnel T3=724.99 m (km 6+805.01 - 7+530, 00), as well as a bridge on the right side of the motorway B5=43.93 m (km 6+666.07 - 6+710.00).

Near the alignment on the right site passes the national road A4 as well on the same side is located the concrete plant owed by Granit and its administrative buildings. In this part the alignment passes close to the livestock facility (~100 m) and buildings of Granit where construction of embankments is predicted. At km 7+600 the alignment intersects the intermittent stream without name. Besides Granit's building on this part of the alignment some other industrial facilities are located. At chainage ~ km 7+760, construction of underpass UP4 and access road with total length of 189 m is planned.

Figure 10 Surrounding around livestock facility (after km 7+600)

Figure 11 Surrounding near km: 6+000 to 8+000

The route of the motorway continues to move through hilly land, covered with sparse vegetation. On this part of the route, it is planned to be constructed a tunnel on the left side T4=723.8 m (km 7+776.21 - 8+500,30), tunnel on the right T4A=150.21 m (km 8+000.00 - 8+150.21) and right T4B= 250.47 (km 8+259.53 - 8+510.00). In this part, at the ~ km 8+200, the route intersects the intermittent stream Lopotanec.

Afterwards the alignment continues and passes near the sheepfold at km 8+600. The alignment intersects part of the sheepfold and earth road. At km 8+700 intersect intermittent stream (without name). On the right site of the alignment passes the national road A4. On the national road there is a culvert (bridge).

In the surroundings of the national road A4 there are some locations which are used for illegal disposal of waste, mainly inert waste. Also, on the site of the national road some industrial buildings are located. On this part of the route, it is planned construction of an embankment, on both sides of the motorway, underpass UP5 and access road in total length of 101,5 m.

Figure 12 Surrounding near km: 8+000 to 9+000

Figure 13 Surrounding near km: 8+000 to 9+000

Then the alignment continues through the hilly terrain where construction of tunnel on both sides is predicted. After the tunnel, the alignment passes very close to the livestock facility where construction of embankment is predicted, i.e. from the left side construction of tunnel T5=205.96 (km 8+829.81 - 9+035.77), while from the right, tunnel T5=151.47 m (km 8+876.53 - 9+028.00). Then the route continues to move near the farm for cows, which is located near the km 9+100. Close to this there is a location which is owned by the Ministry of Defence and the same is used as shooting area and training. For protection of the road on this part is predicted construction of embankments.

In the surrounding there is abandoned building in a phase of disintegration, agricultural land etc. The national road passes near the alignments. The distance to the national road is ~70 m. There are the parking area, fuel station Disel Petrol, Casino Vegas and other commercial buildings around the national road. At km 9+700, construction of underpass UP6 and access road in length of 180 m is planned. The village Orman is located approximately 800-1000 m for the proposed alignment. The quarry Brazda is located approximately 1,5 km, while the other quarry is located at a distance of 800 m and they are outside the concession field of the mines.

After km 10+000 the alignment passes through agricultural land, intersect the national road A4, the road E65 and other local roads. At km 10+244.98 it is planned to build an underpass UP7 and a road in the length of 373 m. At km 10+400 it is planned construction of toll station. Near the location where the construction of the toll station is planned, as well as near the route of the motorway, there is a military warehouse for storing weapons at a distance of ~ 400 to 500 m.

After the toll station at km 10+474.40 it is planned to be constructed an underpass UP 8. Then the route passes through agricultural land, and at the km 10+875.05 a new UP9 and at km 11+809,01 the UP 10 will be constructed.

The alignment intersects Vrazanska River where construction of bridge is planned, from right B6=40 m (km 11+185,44 – 11+225,44), while on left the bridge B6=40 m (km 11+200,00 – 11+240,00), embankment on km 11+700 as well as retaining walls on more places. In the surrounding at approximately distance of ~600-700 m of the alignment is located the sport airport Stenkovec.

Near to the alignment are located weekend houses or houses used by farmers. The River Lepenec flows nearest to the alignment at a distance of ~500 m. In the figures below is presented the project area in the south part of the alignment (km 10+000 to km 12+250).









Figure 14 Project area at the south part of the alignment

2.2 Technical Description of the Project Components

2.2.1 Marginal values of geometrical characteristics

The total length of the motorway's subsection is ~10,5 km and the design speed is Ve=100-110 km/h. The maximum and minimum values of various characteristics of the motorway are:

- The minimum curve in the horizontal alignment is Rmin = 450 m (450 m);
- The maximum longitudinal gradient is 2.75% (4%);
- The minimum longitudinal gradient is 0.72% (0.50 %) (except the existing section close to booths);
- The minimum longitudinal concave curve is Rmin = 7.500 (4.000 m);
- The minimum longitudinal convex curve is Rmin = 16.000 (9.000 m);
- The maximum superelevation is qmax = 7%;
- The minimum superelevation is qmin = 2.5%.

2.2.2 Technical characteristics of the road

From starting point of the motorway until the area where Stenkovec interchange begins, the applied typical cross section is 24.50 m wide (shoulders excluded), which breaks down in:

- traffic lanes (2 per direction), 3.50 m each, of total width 14 m;

- 2 emergency lanes (1 per direction) 2.50 m each, of total width 5 m;
- 2 marginal strips towards central reserve (1 per direction) 0.50 m each, of total width 1 m;
- 2 marginal strips towards emergency lanes (1 per direction) 0.25 m each, of total width 0,50 m.
- Central reserve 4.00 m wide;
- The shoulder formation is 1,50 m wide.

On the following figure is given a profile of the road.

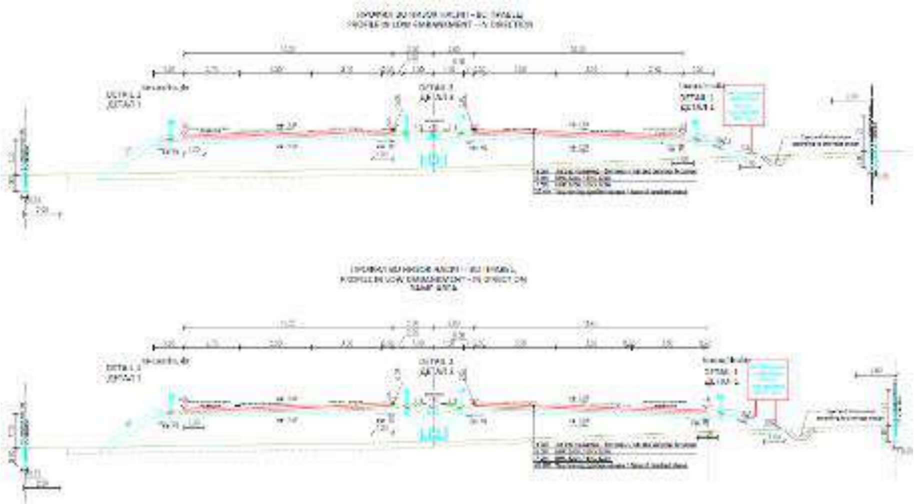


Figure 15 Profile of the road

2.2.3 Pavement

The pavement structure that has been provided is a flexible pavement. Most of the alignment is generally founded on relatively good quality semi rock mass and consequently there is no need for upgrading the roadbed layer characteristics by applying any kind of stabilization. The following table presents the recommended thickness of each layer, based on the calculated minimum road thickness by the AASHTO method, in combination with the required thickness given in the relevant standards. The construction of the motorway and the junction includes:

Table 8 Recommended Road depths according to AASHTO

	Motorway min depth (mm)	Ramps min depth (mm)
Asphalt layers	180	140
Unbound Subbase Layers	250	180

Table 9 Recommended road sub-layers

	Motorway (mm)	Ramps (mm)
Asphalt concrete AB-16s with polymer	60	60
Bituminous bearing layer BNS 22s A	60	80
Bituminous bearing layer BNS 32s A	70	/
Crushed stone subbase	250	250

Regarding the pavement on bridges, according to the international experience, the minimum total thickness of bituminous covering the pavement area should be equal to 0.10 m. The recommended pavement layers on bridges at the present project are presented at the following table.

Table 10 Pavement sublayers on bridges

	Bridges-Motorway (mm)	Bridges-Ramps (mm)
Asphalt concrete AB-16s with polymer	60	60

Bituminous bearing layer BNS 22s A	70	70

2.2.4 Structures and earthworks on the motorway

According to the Preliminary Design, 11 tunnels are planned to be constructed on the new motorway from which 5 will be on the left branch and 6 on the right branch. On the following table are given the locations of the tunnels with their lengths on the left and right branch of the motorway.

Table 11 Locations of the tunnels on the left branch of the motorway with their lengths

LEFT BRANCH				
	TUNNELS	CH. FROM	CH. TO	LENGTH
1	1	2+569,94	2+856,65	286,71
2	2	3+315,79	3+596,27	280,48
3	3	6+494,90	7+499,76	1004,86
4	4	7+776,21	8+500,00	723,79
5	5	8+829,81	9+035,77	205,96

Table 12 Locations of the tunnels on the right branch of the motorway with their lengths

RIGHT BRANCH				
	TUNNELS	CH. FROM	CH. TO	LENGTH
1	1	2+630,63	2+860,00	229,37
2	2	3+351,00	3+630,00	279,00
3	3	6+805,01	7+530,00	724,99
4	4A	8+000,00	8+150,21	150,21
5	4B	8+259,90	8+510,00	250,10
6	5	8+876,53	9+028,00	151,47

Each tunnel according to the Preliminary Design is planned to have:

- 2 traffic lanes, 3.50 m each, and
- 2 marginal strips 0.50 m each.

On the following figure is given the typical cross section of the tunnel.

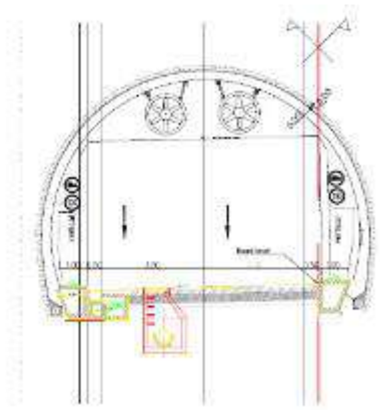


Figure 16 Typical cross section of the tunnel

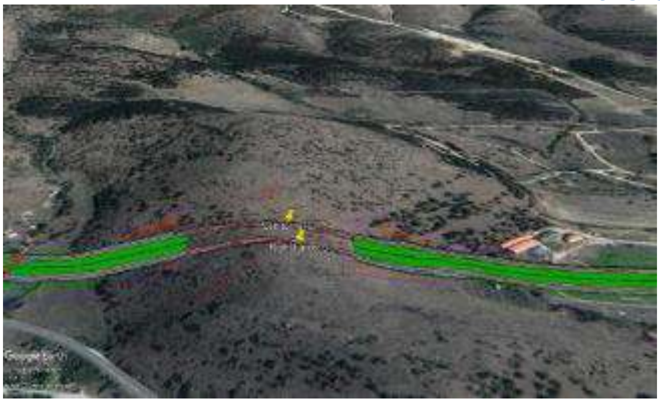
On the following figures are presented the locations of the tunnels on Google Earth maps.

Tunnel 1 Left (km 2+569.94 - 2+856.65) and right (km 2+630.63 – km 2+860.00)

Tunnel 2 Left (km 3+315.79 - 3+596.27) and right (km 3+351.00 – 3+630.00)

Tunnel 3 Left (km 6+494.90 - 7+499.76) and right (km 6+805.01 – 7+530.00)

Tunnel 4 Left (km 7+776.21 - 8+500.00) and right 4A and 4B (km 8+000.00 – 8+150.21 and km 8+259.90 – 8+510.00)



Tunnel 5 Left (km 8+829.81 - km 9+035.77) and right (km 8+876.53 – km 9+028.00)

Figure 17 Tunnels along the alignment

Bridges

Based on the Preliminary Design 9 bridges are planned to be constructed. All of the bridges will be constructed with concrete structure. 3 out of 9 bridges will be located on the left branch and 6 on the right branch. The location of each bridge with the corresponding length in the following table is given.

Table 13 Locations of the bridges on the left branch of the motorway with their lengths

LEFT BRANCH				
	BRIDGE	CH. FROM	CH. TO	LENGTH
1	1	2+145,42	2+328,62	183,20
2	4	6+308,82	6+395,79	86,97
3	6	11+185,44	11+225,44	40,00

Table 14 Locations of the bridges on the right branch of the motorway with their lengths

RIGHT BRANCH				
	BRIDGE	CH. FROM	CH. TO	LENGTH
1	1	2+145,03	2+327,10	182,07
2	2	2+415,08	2+563,14	148,07
3	3	3+045,00	3+290,00	245,00
4	4	6+292,00	6+434,00	142,00
5	5	6+666,07	6+710,00	43,93
6	6	11+200,00	11+240,00	40,00

The total width of the bridges is planned to be 10.25 m from which 2 traffic lanes with 3.50 m width each, and one emergency line with total width of 2.75 m. The cross section of the proposed bridge construction in the following figure is presented.

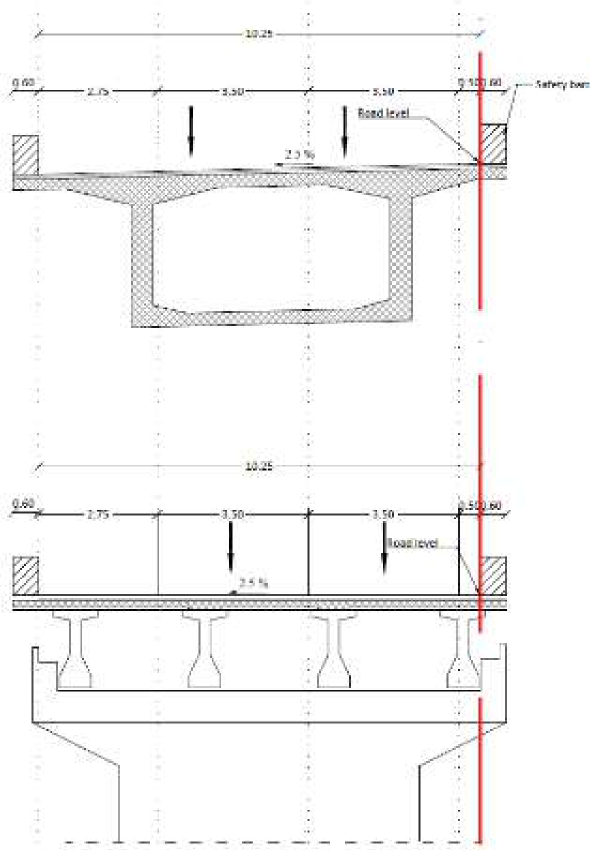


Figure 18 Cross section of the proposed bridge

On the following figures are given the locations of the bridges on Google Earth maps.

Bridge 1 Left (km 2+145.42 - 2+328.62) and Right (km 2+145.03 –2+327.10)

Bridge 2 Right (km 2+415.08 – 2+563.14)

Bridge 3 Right (km 3+045.00 – 3+290.00)

Bridge 4 Left (km 6+308.82 – 6+395.79) and Right (km 6+292.00 – 6+434.00)

Bridge 5 Right (km 6+666.07 – 6+710.00)

Bridge 6 Left (km 11+185.44 – 11+225.44) and Right (km 11+200.00 – 11+240.00)

Figure 19 Bridges along the alignment

Within the Preliminary Design 10 underpasses are predicted for the motorway Blace – Stenkovec. On the following table and figures are given the locations of each underpass.

Table 15 Location of underpasses on motorway Blace – Skopje

		LEFT BRANCH	RIGHT BRANCH
#	UP	CH.	CH.
1	1	3+913,29	3+928,53
2	2	4+687,05	4+694,00
3	3	5+367,04	5+374,94
4	4	7+589,55	7+626,25
5	5	8+670,20	8+693,98
6	6	9+681,08	9+710,40

7	7	10+244,98	10+249,13
8	8	10+474,40	10+480,33
9	9	10+875,05	10+863,29
10	10	11+809,01	11+827,57


UP1 km 3+913.29 – 3+928.53

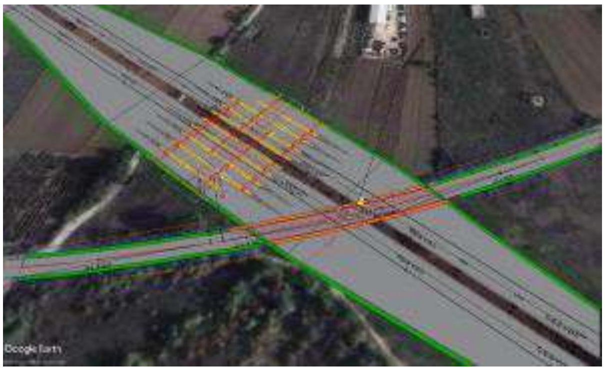

UP2 km 4+687.05 - 4+694.00

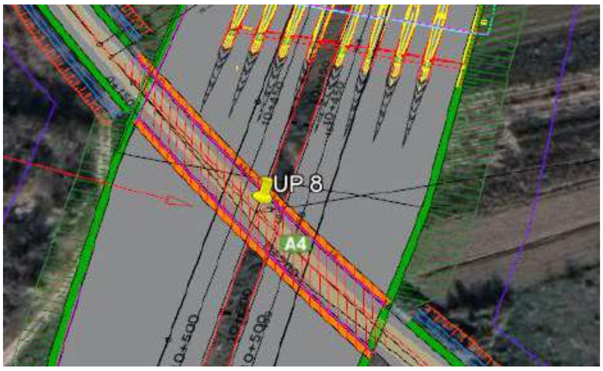

UP3 km 5+367.04 – 5+374.94


UP4 km 7+589.55 –7+626.25


UP5 km 8+670.20 – 8+693.98

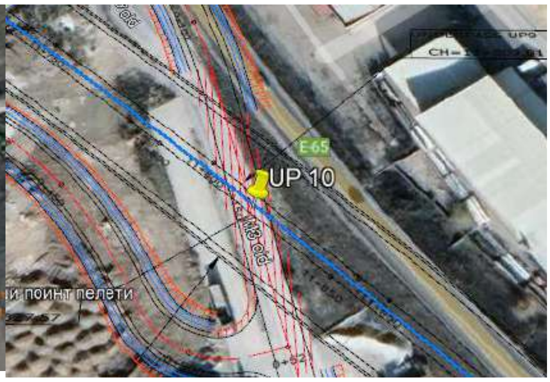

UP6 km 9+681.08 –9+710.40


UP7 km 10+244.98 – 10+249.13



UP8 km 10+474, 40 – 10+480, 33

UP 9 km 10+875,05 –10+863,29



UP 10 km 11+809, 01 - 11+827,57

Figure 20 Under passes along the alignment

Retaining walls

Along the motorway 6 retaining walls are proposed on the right branch of the alignment and 4 on the left branch. On the following table are presented the locations at each chainage and the length of each retaining wall.

Table 16 Retaining walls

LEFT BRANCH					RIGHT BRANCH				
	R.W.	CH. FROM	CH. TO	LENGTH		R.W.	CH. FROM	CH. TO	LENGTH
1	2	2+477,00	2+525,00	48,00	1	1	2+327,10	2+415,08	87,98
2	4	4+635,90	4+681,40	45,50	2	3	3+027,40	3+045,00	17,60
3	8	9+156,20	9+226,00	69,80	3	5	6+434,00	6+519,68	85,68
4	10	11+891,56	12+040,20	148,64	4	6	6+640,00	6+666,00	26,00
					5	7	6+711,30	6+750,00	38,70
					6	9	11+731,70	11+900,00	168,30

Hydrology and drainage infrastructure

At 16 locations along the motorway, culverts for drainage infrastructure will be placed. The minimum width of new box culverts is 2,00 m. The heights of culverts were defined according to hydraulic criteria, based on the elevations of terrain. In the following table are presented the locations of the culverts, their position and dimensions.

Table 17 Locations of culverts on the motorway

	LEFT AXIS	RIGHT AXIS	CULVERTS	POSITION OF CULVERTS	CULVERT DIMENSIONS
	CH	*CH*	*b*h*		
1	2+891.71	2+897.47	2*2		CULVERT C1 2.00x2.00
2	3+174.40	3+187.17	2*2 LEFT	BRIDGE RIGHT	CULVERT C2 2.00x2.00
3	3+285.01	3+283.10	2*2	BRIDGE RIGHT	CULVERT C3 2.00x2.00
4	3+668.66	3+704.86	3*2		CULVERT C4 3.00x2.00
5	3+899.22	3+909.83	5*3		CULVERT C5 5.00x3.00
6	4+339.06	4+341.19	4*2		CULVERT C6 4.00x2.00
7	4+704.02	4+706.55	6*3		CULVERT C7 6.00x3.00
8	5+012.35	5+018.20	2*2		CULVERT C8 2.00x2.00
9	5+400.51	5+403.80	2*2		CULVERT C9 2.00x2.00
10	5+513.48	5+517.50	2*2		CULVERT C10 2.00x2.00
11	5+979.03	5+983.64	4*2		CULVERT C11 4.00x2.00
12	7+636.80	7+670.97	4*2		CULVERT C12 4.00x2.00
13		7+954.09	TUNNEL LEFT	2*2 RIGHT	CULVERT C13 2.00x2.00

14		8+200.82	TUNNEL LEFT	2*2 RIGHT	CULVERT C14 2.00x2.00
15	8+688.12	8+713.95	4*3,0		CULVERT C15 4.00x3.00
16	9+443.37	9+462.09	4*2,5		CULVERT C16 4.00x2.50

Excavation and back filling

As a result of the construction works, earth material will be excavated and backfilled. On the following table are given the positions for horizontal excavation and backfilling with total length at each chainage on the left and right branch of the alignment.

Table 18 Excavation and backfilling

Excavation and backfilling										
Left branch						Right branch				
	C&C	CH. from	CH. to	Length			C&C	CH. from	CH. to	Length
1	1	2+530,02	2+560,00	29,98		1	1	2+590,01	2+630,63	40,62
2	2	2+930,00	3+002,20	72,20		2	5	6+519,68	6+600,00	80,32
3	3	4+080,00	4+172,07	92,07		3	6	6+770,28	6+805,01	34,73
4	4	6+115,92	6+250,00	134,08						
5	6	6+465,75	6+499,83	34,08						

Additionally, vertical excavation and backfilling is proposed on other different locations along the motorway. The exact locations with total high at each chainage are presented in the following tables.

Table 19 Location for excavation and backfilling

Excavation								
LEFT BRANCH					RIGHT BRANCH			
	Excavation	CH.	Hmax			Excavation	CH.	Hmax
1	1	2+039	13,0		1	1	2+940	15,2
2	2	2+450	35,5		2	2	3+640	17,4
3	3	2+919	29,3		3	3	4+900	24,9
4	4	3+730	20,4		4	4	5+840	11,5
5	5	4+075	32,1		5	5	6+620	19,7
6	6	4+176	34,2		6	6	6+760	23,4
7	7	4+447	32,8		7	7	7+540	18,7
8	8	4+896	17,2		8	8	7+900	21,5
9	9	5+156	20,2		9	9	8+180	14,3
10	10	5+798	28,5					
11	11	6+100	21,3					
12	12	6+259	22,0					
13	13	6+462	24,5					
14	14	7+765	21,3					
15	15	8+519	20,3					
16	16	8+800	17,6					
17	17	9+050	22,7					

Backfilling								
LEFT BRANCH					RIGHT BRANCH			
	EMB.	CH.	Hmax			EMB.	CH.	Hmax
1	1	3+177	13,9		1	1	3+040	8,1
2	2	4+697	12,7		2	2	3+880	5,4
3	3	8+680	7,1		3	3	4+343	11,2
4	4	9+500	11,6		4	4	4+680	13,2
					5	5	5+400	9
					6	6	6+040	18,7

		7	7	7+700	10,2	
		8	8	8+700	12,8	
		9	9	9+220	9,2	
		10	10	10+800	7,8	

The following tables show the quantities of excavated earth material of the motorway.

Table 20 Quantities of excavated earth material

	CUT [m³]	FILL [m³]	TR [m³]	TL [m³]
	excavations	**embankments**	**removal of top soil**	**top soil on embankments slopes**
LEFT AXIS	554.688,79	423.029,75	37.421,44	8.407,43
RIGHT AXIS	606.382,32	741.409,39	68.153,77	15.643,17
RIGHT & LEFT AXIS ROUND	441,90	7.726,13	1.933,59	168,24
ROUND ABOUT	2.540,95	10.911,20	2.844,12	350,20
KO_ E65 ROUND	132,95	257,39	314,10	0,00
Roundabout 1 RAMP	143,11	2.084,11	742,76	195,65
NORTH_ARM_ROUND	0,00	6.160,99	606,02	350,09
UP1	1.723,13	68,86	636,08	2,88
UP2	381,81	1.288,74	684,04	183,12
UP3	41.063,14	4.207,62	3.671,66	407,44
UP4	3.379,88	10,09	592,63	0,00
UP5	321,89	231,89	222,38	0,00
UP6	67,07	71,97	180,96	0,00
UP7	5.891,06	17,51	1.281,51	0,00
UP8	4.954,70	14,42	1.030,80	0,00
UP9	4.883,53	11.677,62	1.828,61	682,46
SR_ROUND_MEND	305,04	2.515,26	1.299,16	158,28
LSR1	240,59	2759,4	1057,41	284
RSR2	84,04	1764,37	1614,73	167,26
RSR4	3085,9	1214,5	1880,38	61,36

2.3 Proposed location for disposal of excavated earth material

Significant quantity of excavated earth material will be generated as presented in Table 20. Some part of the excavated earth material will be reused for construction of the structures along the alignment, while around 500.000 m^3 will need to be deposited.

One location for disposal of excavated earth material was determined. This location has been proposed from PESR and presented in the project "Motorway Skopje – Blace, section interchange "Stenkovec" – cross border "Blace"", prepared by Granitproject in 2002.

The disposal area is located around km 3+900 on the left side of the future motorway. According to the geo-mechanical investigation made in 2002, DW-10 (drilling well) which is close to the proposed disposal area, the following geo-mechanical profile of the landfill is obtained: humus with thickness of sj=0.20 m, sandy clay, medium plastic 22 % black gravel and c1=0.70m, and clay sand, 42 % gravel, large to medium-grained with grey colour and sj=0.80m, and at the bottom is rock. On the following figure is presented the location of the disposal area.

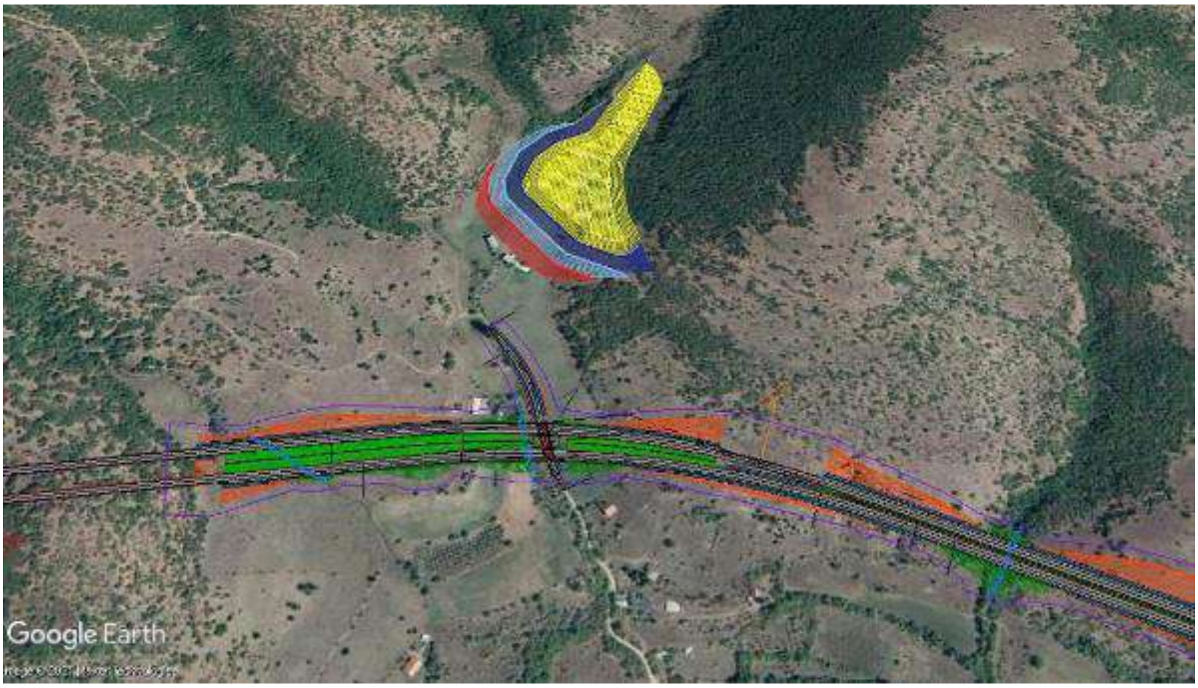


Figure 21 Proposed location for disposal of excavated earth material

In the phase of preparation of the Detailed Design for construction of the motorway, the designing team has to take into considerations this proposed location for disposal of excavated earth material. Detailed Design has to present the total area and total volume for this disposal area in order to accept all of the 500.000 m^3 of excavated earth material.

2.4 Description of any previous works

In 2002 in the frame of the project "Construction of the motorway Skopje – Blace", prepared by the company Granitproject, geotechnical investigations has been performed in order to determinate geological structure of the project area, as well as the geotechnical characteristics and the soil type. Also, the geotechnical eligibility of the materials on the road has been investigated. For the need of the current designing process for the motorway A4 Skopje-Blace, the new geotechnical investigations are performed.

2.5 Raw materials, auxiliary materials, wastewater and waste

Implementation of the planned project activities includes excavation and earthworks, construction and architectural works, concrete, asphalt and welding works, activities for construction of system for collection and treatment of storm water, electricity network, etc.

Materials, raw materials and auxiliary materials such as sand, stone, concrete, asphalt, bitumen, gypsum, insulation materials, pipes, shafts, water, electricity, paints, fuels, oils and greases will be used for implementation of the planned project activities, vehicles and mechanization, protective fence, etc. In the Preliminary design were defined the quantities of concrete and asphalt that will be used: concrete 150 000 m^3 and asphalt 40 000 m^3. The quantities of the other required raw materials are not defined yet.

For the construction works the Contractor will prepare a Dynamic work plan which will precisely define the type and quantities of materials, raw materials and auxiliary materials, their characteristics, locations from where they will be procured, locations for temporary storage of materials within of the project scope.

For the performance of the foreseen activities, mechanization with dynamic work will be used, which will be determined in the Dynamic work plan, which will be prepared by the Contractor.

Construction machinery, as an energy source, will use oil, in quantities that will depend on the dynamics of construction activities.

The number of workers and drivers of the mechanization, as well as the dynamics of the construction works, will be determined in the construction phase (in the Dynamic work plan).

As a result of the construction activities, sanitary, technical and atmospheric wastewater will be generated. Different fractions of waste will also be generated which will have hazardous and non-hazardous waste characteristics.

The Dynamic Work Plan will detail the manner of water supply with sanitary water and technical water, as well as the management of the generated wastewater and waste.

Before starting the construction works, the Contractor is obliged to prepare a program for the use of materials from borrow pits, concrete and asphalt plants, waste management, etc.

If the Contractor uses construction material from existing borrow pits, concrete and asphalt bases, they must have a permit for integrated pollution prevention and control (A or B permit or Elaborate for environmental protection, depending on the production capacity of the installation).

In case of opening new borrow pits for materials or concrete base for the needs of the project, the Investor must act in accordance with the Law on Mineral Resources, as well as the Law on Environment.

2.6 Associated facilities

By the definition, set up in the EBRD policy (2019), "Associated facilities are facilities or activities that are not financed by EBRD as part of the project but which in the view of EBRD are significant in determining the success of the project or in producing agreed project outcomes. These are new facilities or activities: (i) without which the project would not be viable, and (ii) would not be constructed, expanded, carried out or planned to be constructed or carried out if the project did not exist".

In accordance with the mentioned definition, as the associated facility to this Project could be taken into consideration "Subsection 1 – upgrading of the existing road A4 from BC "Blace" to Blace village to a highway level and construction of part of the motorway with interchange to local road to vilage Blace". This project at the moment is under construction and it is planned to be finished at the moment when Subsection 2 will start with construction activities. The Subsection 1 of the motorway is not financed by EBRD (but by the Governmental Budget). On the following figure is given general layout of the Subsection 1.

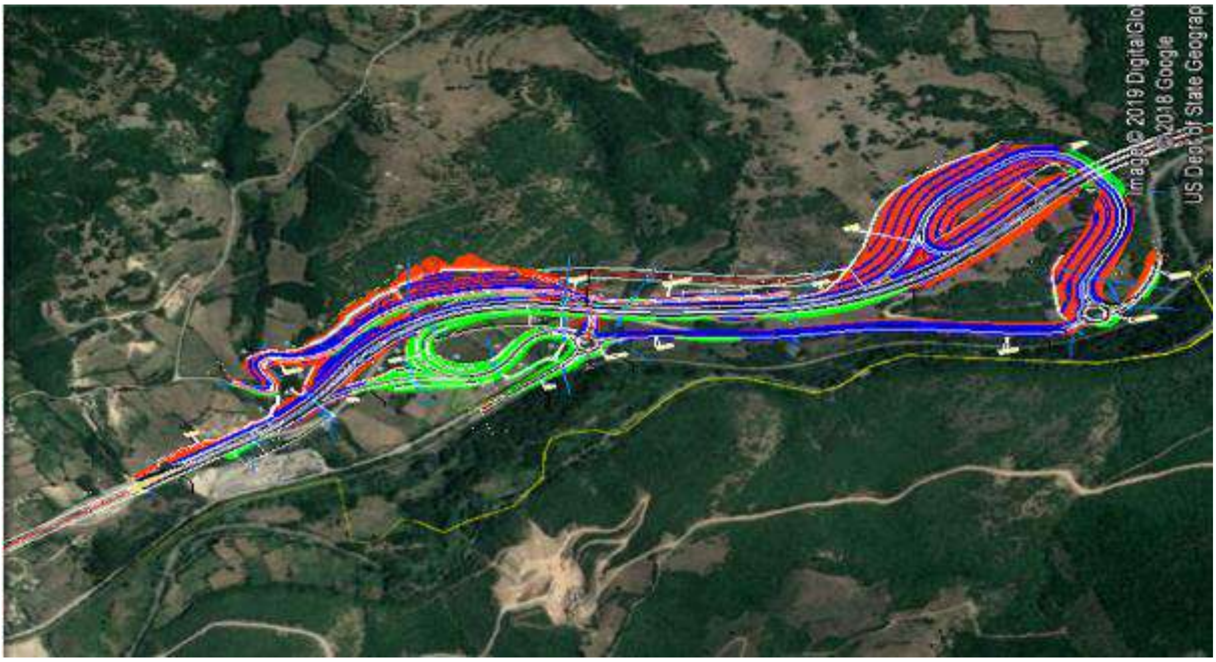


Figure 22 Motorway route for Subsection 1

In the Detail design, the starting point of the Subsection 1 starts at km 0+000 at the border crossing "Blace", but from km 0+000 to km 0+085 the existing condition of the road is retained. The route ends at km 2+000. Construction works for the motorway start from km 0+120 at the right side, where the construction of reinforced embankment is provided while the left part of the route starts at km 0+200.

2.7 Project area of influence

The implementation of the project activities will be conducted on the territory of Municipality of Chucher Sandevo. Implementation of the project activities during the construction phase may affect the environmental and social conditions in the surrounding as a result of generated emission (air, water, soil, noise, vibration), removal of vegetation and forest, changes in the land use, ownerships, limited access to existing roads agricultural land, industrial facilities, etc. Operation of the motorway may affect environmental and social conditions in the surrounding as a result of generated emission (air, water, soil, noise, vibration).

In order to give an appropriate assessment of potential environmental and social impacts and assessment of the cumulative impacts in construction and operational phase, the ESIA team has defined the project footprint, project area of influence and ecologically appropriate area of analysis (EAAA[9]) on the base of predicted project activities, conditions on the site, guidelines, policies etc.

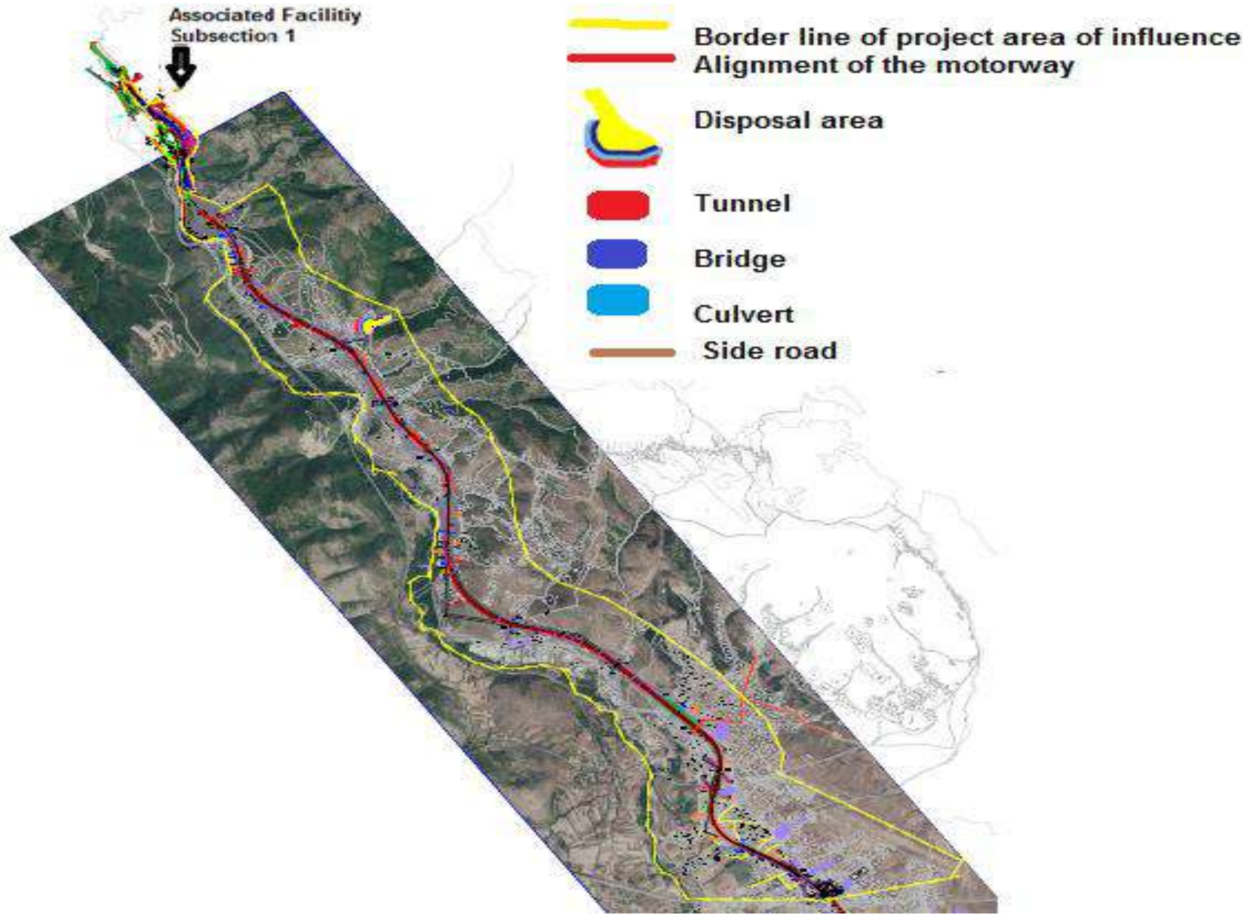


Figure 23 Project area of influence

Project footprint is the area on a project site used to install and construct all necessary structures, defined by the perimeter of the project. In other words, the area of land directly affected by project disturbance is defined as project footprint. The project footprint, as it is presented in the figure

[9] Ecologically appropriate area of analysis

above, is the area where the alignment is positioned together with the structures (bridges, underpasses, cuts and covers, tunnels etc.). The project footprint has a total area of 28,875 ha.

Project area of influence is the area where significant environmental and social impacts caused by project performance are evident on physical, biological and socioeconomic components. The project area of influence varies according to project activities and environmental and social components. Within the project area of influence are included the areas where the planned activities of the project will take place (project footprint) and more or less extensive areas that may be subject to direct and indirect impacts on the natural and human environment as a result of the construction and operation of the motorway. In other words despite of the project components in the project area of influence are included the motorway A4 (Subsection 1 in total length of 2 km), existing national road Skopje-Blace Border, ring road of City of Skopje A2, River Lepenec, urban planning projects of Municipality of Chucher Sandevo (which are planning to start with implementation after obtaining construction permit for the motorway A4), the sport airport Stenkovec, existing industrial and commercial facilities, weekend houses and/dwellings, sheepfold, cattle farm and auxiliary objects. The total surface of the influence area is ~1280 ha.

More precisely, project area of influence includes the Subsection 1 (km 0+000 to km 2+125, indicative chainages) which will be in operation when the construction of Subsection 2 will start and in this ESIA study is considered as an associated facility. At the end of Subsection 2, the border line of the project area of influence is continuing 500 m on the left from the alignment of the Subsection 2. Around km 3+900 where the disposal area is located, the border line is extended up to 700 m left from the alignment in order to include this area in the project area of influence. After the location of the disposal area, the border line of the project area of influence continues 500 m left from the alignment up to the sport airport Stenkovec. In this chainage, the project influence area is extended up to around 900 m in order to include the sport airport in the project area of influence. After the sport airport Stenkovec the border line continues up to the ring road A2 on a distance of 500 m from the alignment and is closing at the interchange Stenkovec.

On the right side of the alignment the project area of influence goes up to the Lepenec River following the river up to the end of the motorway A4, finishes at the ring road of City of Skopje A2 and is closing at the interchange Stenkovec. In the lowland area of Skopje valley it was additionally broadened due to the possible (indirect) impacts on the riverine ecosystems and human settlements as well as infrastructure.

Regarding the biological components, the following areas were taken into account:

- Areas physically occupied by motorway infrastructure and project facilities or where project activities will be carried out (area of direct impact which was used for the assessment of direct destruction of terrestrial habitats);
- Areas that may be affected by emissions and effluents, even if relatively distant from project footprint;
- Areas occupied or affected by associated structures and objects (access roads, disposal sites, toilets, etc.);

The physical footprint of non-project activities in the surrounding area that are caused by or stimulated by the project ("induced growth"), plus any areas affected by their emissions and effluents. These are generally the result of changing economic or social patterns catalysed by the project's presence, such as human settlement associated with in-migration of people seeking work in a project. This can "open" areas to exploitation, exacerbating destruction of natural habitat (e.g. increased access to sensitive areas as a result of new roads or rights-of way). In some cases, a project's indirect impacts can greatly exceed its direct impacts.

The research of biodiversity was carried out in Area of Interest (AoI). It was primarily defined as an area within the buffer of 2x500m from both sides of the highway alignment. This area was used for mapping of habitats and calculations of the coverage of habitats and land use types Separate EAAAs (**ecologically appropriate area of analysis**) were defined for critical habitats (CH) and priority biodiversity features (PBF). The aggregated EAAA extends beyond the project's physical footprint and it is wider than the project area of influence. This aggregated EAAA encompasses the whole watershed area of the river Lepenec as well as the most-likely affected villages in the area since they are situated at the bottom of the valley of river Lepenec (and as a precaution due to the expected road connection with the projected motorway), as well as the presence of birds and nesting sites. It covers an area of 2379.3 ha. In principle, the valley of river Lepenec represents a well-defined area in which the influence of the hydrography and geomorphology has an impact on the climate and biological features – landscapes and ecosystems/habitats. This area is different from the surrounding mountainous areas of Shar Planina (to the west) and Skopska Crna Gora (to the east).

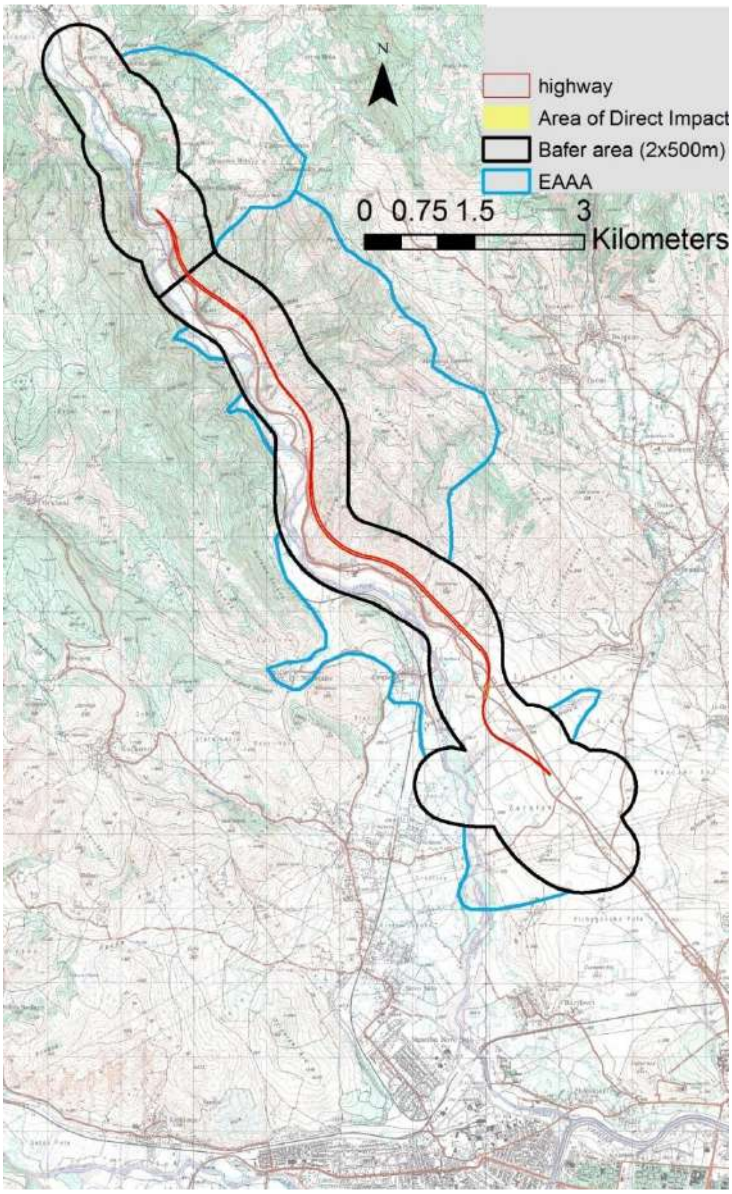


Figure 24 Analysed areas during the impact assessment process: 1) Area of direct impact; 2) Buffer area (Area of influence), 3) Aggregated Ecologically appropriate area of analysis (EAAA)

For the analyses of the possible impacts on protected areas and their natural features much wider area was taken into consideration and it is presented on the figure below.

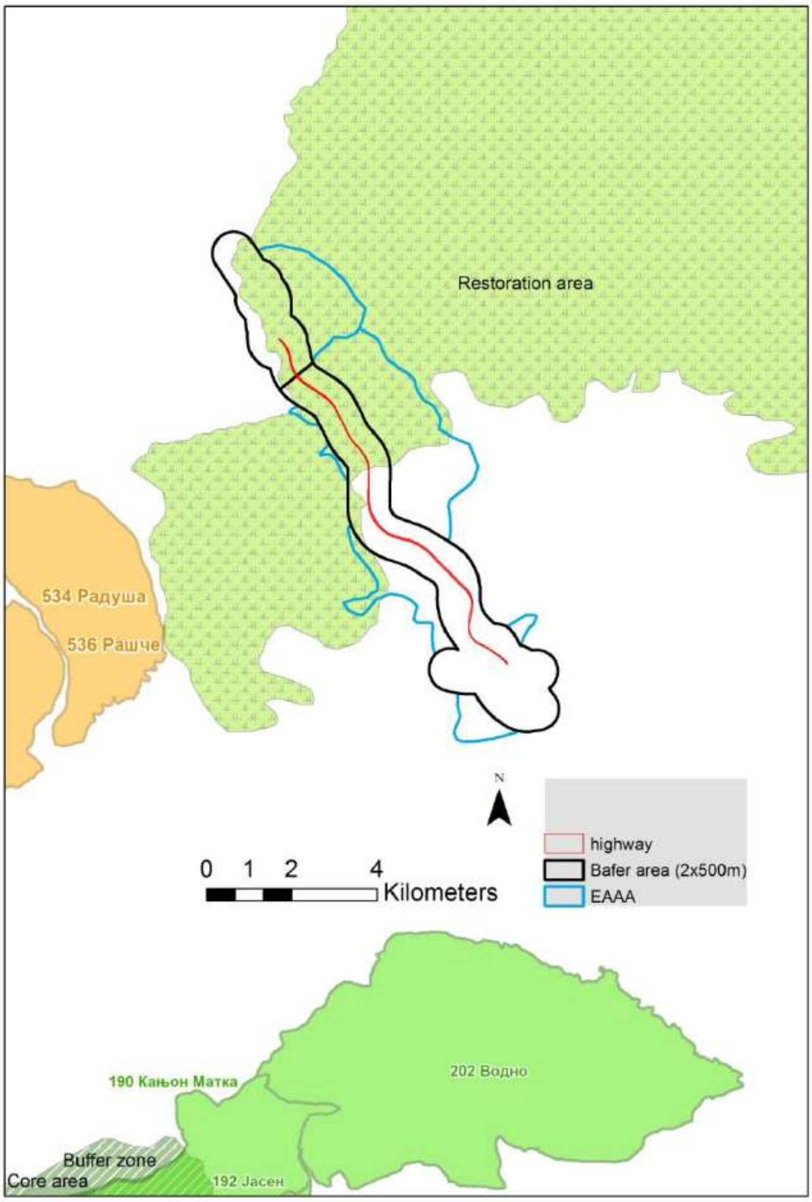


Figure 25 Broad area for consideration of the impacts on the integrity of protected and designated areas

The following table describes the project area of influence for construction and operational phase.

Table 21 Project area of influence in construction and operational phase

Components	Construction phase	Operational phase
Air quality	Physical footprint of the project, 500 m left and right from the alignment	Alignment of the motorway with all auxiliary infrastructures, 500 m left and right from the alignment
Noise and vibrations	Physical footprint of the project, 100-200 m left and right from the alignment	Alignment of the motorway with all auxiliary infrastructures, 100–200 m from the alignment
Surface and ground water	Physical footprint of the project, river Lepenec and 500 m left from the alignment	Alignment of the motorway with all auxiliary infrastructures, river Lepenec
Geology,	Physical footprint of the project, access	Alignment of the motorway with all auxiliary

erosion and soil	roads and disposal area	infrastructures
Waste	Physical footprint of the project, 700 m left and 500 right from the alignment	Alignment of the motorway with all auxiliary infrastructures
Biodiversity	Physical footprint of the project, EAAA	Alignment of the motorway with all auxiliary infrastructures, EAAA
Social	Private agriculture areas on a distance of 500 m left from the alignment, private agriculture areas up to River Lepenec on the right from the alignment, Quarry and separation plant owned by Company Transmet, concrete plant owed by Granit and its administrative buildings, sand separation plants, weekend houses and/dwellings, sheepfold, cattle farm and auxiliary objects, gas station Diesel, sport airport Stenkovec and industrial facilities close to interchange Stenkovec	Alignment of the motorway with all auxiliary infrastructures

3 DESCRIPTION OF THE ENVIRONMENTAL AND SOCIAL BASELINE

The purpose of this chapter is to be present the environmental and social baseline conditions within the project area and defined project influence area, which may be affected by implementation of the project.

For the need of the project was conducted investigations and monitoring of the environmental media and conditions as well as social aspects relevant for the project. The methodology for data collection is presented in the following chapter.

Baseline data collections for environmental media and conditions in the project area will contribute for timely and precisely assessment of possible impacts (direct, indirect, cumulative, residual, etc.) and effects and proposal of proper measures for their avoiding or mitigation.

3.1 Methodology for data collection

Description of the baseline conditions includes analyses of the environmental and social aspects along the alignment of the motorway where the project activities will take place, i.e., the conditions of the environmental media and social aspects in the municipality of Chucher Sandevo as well as the wider surroundings.

On the basis of the information, available from the project documentation, site visits carried out by the ESIA experts, as well as conducted research, measurements and communication with the local population, the sensitive receptors and project area of influence which could be affected by the implementation of the Project have been determined. Despite the information gathered from the site visits, a major part of the information is based on data gathered from the current project documentation for this Project (Preliminary Design for Motorway A4, Skopje - Blace. Section 2), statistical data, reports about the environmental quality, published by the Ministry of Environment and Physical Planning, Hydro Meteorological Institute of Republic of North Macedonia (HMI), Governmental bodies/Institutions, Municipality of Chucher Sandevo and other written or publicly accessible materials (strategic documents on a national and local level) etc.

The detailed description of the physical, biological and social environment was created based on the available project data, literature data, experts’ experiences, field research and measurements.

In the following description the methodologies for data collections physical, biological and social environment are presented:

- ***Methodology for data collection on air quality***

A number of quarries, stone crushing plants and concrete plants are located and are operational around the motorway alignment (on both Kosovo and Macedonia sides) and they certainly have an impact on the air quality. In addition, the air quality is impacted as a result of the traffic along the existing roads as well as the construction of the motorway that belongs on Subsection 1.

In order to assess the air quality status within the project area, data have been retrieved from the nearest official air pollution monitoring stations and the unofficial, but well established pulse.eco (**skopje@pulse.eco**) network. In addition, a short-term monitoring campaign was carried out on 24.06.202 at two locations close to the future motorway alignment: *MV1: 42° 4'53.72"N 21°20'49.95"E* and *MV2: 42° 6'16.65"N 21°20'4.65"E* (presented in the figure below), by the authorised company RI OPUS, Skopje. These two locations were chosen for short term monitoring campaign due to the fact that “Transmet” and “Granit” economic yards are very close to the proposed alignment and are assessed as biggest sources of air emissions.

Figure 26 Position of the measurement points

The air quality monitoring campaign includes measurement of airborne particulate matter ($PM_{2.5}$ and PM_{10}) and other pollutants in the ambient air. Airborne particular matter ($PM_{2.5}$ and PM_{10}) were determined by means of a light scattering device, the ***HT-9600*** air quality detector. The gaseous pollutants (CO, SO_2 and NO_2) were monitored applying electrochemical cell-based detectors. The ***GrayWolf Sensing Solutions*** detectors were used.

The results obtained during the monitoring campaign were compared to the *Decree on the limit values of concentrations and types of polluting substances in the ambient air and alarm thresholds, deadlines for complying with the limit values, tolerance margins for the limit values, target values and long-term goals ("Official Gazette of the Republic of Macedonia" No. 50/05)*.

- ***Methodology for data collection on water quality***

In order to be evaluated the baseline conditions and water quality of the closest and biggest surface water body in the project area i.e. River Lepenec, the chosen methodology is entirely based on the *Regulations on Procedures and manner of observations and measurements of the qualitative characteristics of water in the network of hydrological stations" ("Official Gazette of R.M" No.33/10)*, which is in compliance with the Framework Directive (WFD) 2000/60/EC and the *Law on waters ("Official Gazette of R.M" No. 87/08, 6/09, 161/09, 83/10, 51/11, 44/12, 23/13, 163/13, 180/14, 146/15, 52/16, 151/21).*

In accordance with the Annex II of the WFD, the determination of the status of surface water, in addition to biological and hydro morphological elements for classification of ecological status/potential of surface water bodies, should be determined the chemical and physico-chemical elements as supporting to the biological elements.

Monitoring of water quality on the river Lepenec was conducted on 2 measuring points (Lepenec-Border MP1–45 km from source and Lepenec - Mouth MP2 – inflow in river Vardar, 75 km from source). These monitoring stations are owned by the Hydro Meteorological Institute and are relevant for the aim of this project, because the first MP1 is before the starting point of the alignment and the second MP2 is after the end of the alignment. It is expected that the provided monitoring results will be a good bases for monitoring of eventual impacts on River water quality caused by the implementation of the project activities. The water quality and water quantity measurement points are presented on the following figure.

Figure 27 Map of water quality and water quantity measurement points

On measuring points, the samples are taken as grejfern or discrete samples, from a specific place, a specific depth and at certain times.

Figure 28 Collection of water samples

Samples of water are taken in accordance with the *Regulations on Procedures and manner of observations and measurements of the qualitative characteristics of water in the network of hydrological stations ("Official Gazette of R.M" No.33/10).*

Table 22 Water sampling standards

1	**Sampling-guide for planning program for sampling**	**ISO 5667-1 :1980**
2	Sampling - Guidance on techniques for sampling	ISO 5667-2:1991
3	Sampling-Guidance on preservation and handling of samples	ISO 5667-3:1994
4	Sampling-Guidance for sampling of rivers and streams	ISO 5667-6:1990
5	Sampling- Guidance for quality control in sampling and handling of samples of environmental water	ISO/DIS 5667-14:1996

The above standards for sampling the water are recommended when is necessary to:

- be characterized-quality status of water in a specific time and a specific place;
- provide information on the approximate range of concentrations;
- be done taking variable volumes of samples and when dealing with the flow, which is not permanent;
- detect changes in water quality, based on relatively short intervals.

Samples of surface water from the proposed measuring points included physical and chemical measurements on field and laboratory analyses.

Physical and chemical measurements, performed on field:

Organoleptic characteristics of water, physical and chemical characteristics: air and water temperature, colour, turbidity, pH, alkalinity, electro-conductivity.

Chemical measurements and analysis, performed in the laboratory: Oxygen Demand, BOD, COD, total water hardness:

Nutrients: ammonium ion (NH_4-N), nitrate (NO_3-N), nitrite (NO_2-N) and phosphate (PO_4)

Equipment	Parameter
Cary 100 Scan UV-Visible Spectrophotometer–VARIAN	(NH_4-N),(NO_3-N),(NO_2-N), (PO_4)
pH 210 Standard pH Meter, Meter Lab	pH
CDM210 Conductivity meter, Meter Lab	electro conductivity, redox potential
Merck SQ 118	turbidity (NTU)
WTW Multi 340i	pH, redox potential, O_2, saturation, electro conductivity
Thermometer	Temperature

Heavy metals:

Cadmium Cd, Chromium Cr, Copper Cu, Iron Fe, Manganese Mn, Nickel Ni and Zinc Zn.

Equipment	Parameters
VARIAN AAS flame, SpectrAA 220	Na, K, Fe, Zn and Mn
VARIAN AAS grafite furnace, SpectrAA 220	Ni,Cd, Pb, Cu, Co and Cr

In order to determine the physical and chemical status of the water, parameters and methods for surface water analyses were followed which are presented in Annex 6.

Methods of biological elements

Standard methodology for macroinvertebrate collection (EN: ISO 10870:2012) was followed.

- ***Methods of biological element Phyto-benthos***

Taking into account the provisions by the Water Framework Directive (WFD), two seasons were covered to check the environmental status of Lepenec River, during the year, in order to be determined possible changes and the reason of their occurrence. The field works was performed in the spring (high water) and autumn (low water) periods, during which samples of Phyto-benthos were collected to assess the water quality of the river.

Phyto-benthos samples were taken from all existing, suitable substrates in the river and fixed with formaldehyde in the biological laboratory at the HMS.

Estimation of river water quality according to the composition of diatomaceous communities from phytobenthos includes pre-treatment by burning material from samples, making permanent preparations, determination of diatoms and calculation of an IPS index as an indicator of the ecological status of the water body through. The combustion of the allogeneic material was done by the method of acid digestion, i.e. by using a saturated solution of $KMnO_4$ and 37% HCL. From the obtained suspension, permanent preparations have been prepared, and Naphrax, Entellan and Canada balsam have been used as media to incorporate the preparations.

The diodes are monitored and counted on a Leica DM 2000 LED light microscope, equipped with a Nikon Camera D 3300 digital camera, which allows to document photos. The species were counted up to 300 counts, according to the statistical processing of the data in the Past software package. The percentage representation of the species for all measuring points has been determined, and the obtained values have been entered in the OMNIDIA software.

According to the obtained values for the determined index, the ecological status of the water is determined, which can be excellent, good, moderate, poor or bad, and the water according to the quality can be divided into five classes as it is presented in the table below.

Table 23 Classification of Ecological status of water body

Class	Ecological status
I	High
II	Good
III	Moderate
IV	Poor
V	Bed

- ***Methods of biological element invertebrates***

During the research, conducted in 2018, 2019 and 2020, macroinvertebrates were collected from surface water on two measurement points (presented above).

Taking into consideration that the typology of the water in R. North Macedonia is still not prepared, the river monitoring followed *Rulebook on parameters of ecological and chemical status of surface waters and parameters of chemical and quantitative status of groundwater ("Official Gazette of the Republic of Serbia, No. 74/2011)*.[10]

Kick-net sampling with 500 µm mesh net presented in the figure below was used for collection of macroinvertebrates from solid substrates (stone and gravel), while sampling with „Ekman-Birge" was applied for soft substrates (mud).

Figure 29 Macroinvertebrate sampling

All collected material was preserved in 4% formaldehyde and 75% ethanol and transferred to the Water Quality Department at the National Hydro Meteorological Service for further laboratory analysis. Macroinvertebrate specimens were taxonomically identified using ZEISS-STEMI 508 stereomicroscope and proper identification keys (Sket, 1967; Karaman,1974; Wiederholm, 1983;

[10] Serbian legislation was used due to the lack of the Macedonian regulation

Kerovec, 1986; Elliott et al., 1988; Beschovski, 1994; Itämies, 1998; Timm, 2009; Kriska, 2013; Waringer and Graf, 2013; Glöer, 2015), to the lowest possible taxonomical level. All results were used in determination and analysis of the macroinvertebrate community structure on the sample sites. In the following table the mandatory level for macroinvertebrate identification is presented.

Table 24 Mandatory level for macroinvertebrate identification

Systematic group	Level of identification	Systematic group	Level of identification
Porifera	Genus	Ephemeroptera	Genus, species
Hydrozoa	Genus	Trichoptera	Genus, species
Bryozoa	Presence	Odonata	Genus, species
Turbellaria	Genus, species	Megaloptera	Genus, species
Oligochaeta	Family, genus, species	Heteroptera	Genus, species
Hirudinea	Genus, species	Coleoptera	Genus, species
Mollusca	Genus, species	Diptera	Family, genus, species
Crustacea	Genus, species	Hydracarina	Presence
Plecopterac	Genus, species		

Figure 30 Laboratory analysis of collected samples

Ecological status assessment of the sample sites on River Lepenec was conducted using different biotic indices often involved in monitoring studies, such as Saprobic Index (adapted Serbian version by Zelinka&Marvan), Average Score Per Taxon (ASPT), Number of taxa and Biological Monitoring Working Party (BMWP).

Table 25 Class boundaries for different biotic indices and ecological status classification of water body Type 2

BMWP (Serbian version)	**ASPT** (Serbian version)	**SI** (Serbian version)	**No.of taxa** (Serbian version)	**Ecological status**
>60	≥5.9	**< 2.0**	>17	high
46 - 60	5.1 – 5.8	**2.0 - 2.5**	11 – 17	good
31 - 45	4.1 - 5.0	**2.6 - 3.0**	9 - 10	moderate
10 - 30	3.1 - 4.0	**3.1 - 3.2**	5 - 8	poor
<10	<3	>**3.2**	<5	bad

Table 26 Class boundaries for different biotic indices and ecological status classification of water body Type 3

BMWP (Serbian version)	**ASPT** (Serbian version)	**SI** (Serbian version)	**No.of taxa** (Serbian version)	**Ecological status**
>90	≥6.9	**< 1.7**	>20	high
71 - 90	5.1 -6.8	**1.7 - 2.2**	16-20	good
51 - 70	4.1 - 5.0	**2.3 - 2.8**	11 - 15	moderate
30 - 50	3.1 - 4.0	**2.9 - 3.2**	5 - 10	poor
<30	<3	>**3.2**	<5	bad

Table 27 Class boundaries for different biotic indices and ecological status classification of water body Type 4

BMWP (Serbian version)	**ASPT** (Serbian version)	**SI** (Serbian version)	**No.of taxa** (Serbian version)	**Ecological status**
>90	≥6.9	**< 1.7**	>20	high
71-90	5.1 – 6.8	**1.7-2.1**	16-20	good
51-70	4.1 - 5.0	**2.2 - 2.7**	11 - 15	moderate
30-50	3.1 - 4.0	**2.8 - 3.1**	5 - 10	poor
<30	<3	**>3.1**	<5	bad

The calculation of all biotic indices is made with ASTERICS software (version 3.0; www.aqem.de). Ecological status assessment was conducted according to the classification of surface waters, given in Annex V in the Water Framework Directive (WFD).

- ***Methodology for data collection for geomorphology-geodiversity***

The methodology for baseline study of geodiversity, geo-heritage and geohazards is based on a combination of field research, analysis of all relevant bibliography and data, as well as the use of remote sensing and GIS. In terms of relevant bibliography, an existing 100k geological map and explanatory book is used (Petkovski et al., 1985), as well as some works of Arsovski (1997), Dumurdzanov et al. (2004) etc. Previous geomorphological researches for this area are insufficient (Milevski, 2016), so the new ones are done, based on field trips, free 15-m and 5-m digital elevation models, satellite imagery and drone-based aerial records. These activities were conducted starting in the fall of 2019, through 2020 and up to June, 2021. Aside from this, previously prepared models for the entire country of potential erosion risk and landslide susceptibility (Milevski, 2015; 2019) was used. During the analyses, SAGA GIS, Global Mapper and QGIS software packages were used. However, detailed methodology of the used models is presented in the referenced papers.

- ***Methodology for data collection on noise***

No information has been found so far on the ambient noise along the alignment. Therefore, a desk-based investigation of potential noise sensitive receptors has been carried out by reviewing Google earth and cadastre maps. On-site walk-through inspection has also been undertaken in order to find out if sensible receptors are present. Very few such receptors and significant noise sources along the future motorway has been detected. Only the south end of this branch of the motorway passes through an industrial zone where noise level is notable. It is a common practice to extend the noise study area some 500 m left and right of the alignment. However, due to the absence of sensitive receptors, the noise study area will be extended 100 to 200 m depending on the terrain and receptors.

In order to determine the noise level in the environment, short term ambient noise measurements were undertaken at 7 locations, all but one at 10 to 80 m from the future motorway (presented in the following table). The measurement points are chosen in order to be measured the existing noise as close as possible to the new alignment and receivers, except in one case where the monitoring point be remote due to high existing noise.

Table 28 Measurements points for noise

	Location	Coordinates
1	MP1	530409 E; 4657877 N
2	MP2	530166 E; 4658051 N
3	MP3	528749 E; 4658849 N
4	MP4	527672 E; 4661447 N
5	MP5	527258 E; 4662127 N
6	MP6	530271 E; 4656271 N
7	MP7	531254 E; 4656117 N

A class II integrating sound level meter (Extech 407780) was used during the noise measuring campaign. Fast respond time was set in order to detect maximum and minimum noise levels as close as possible. For placing the measuring device and data analysis the ISO 1996-2:2018 was followed.

- ***Methodology for data collection on biodiversity***

Project area for habitat mapping was defined in a range of 1 km width along the proposed alignment of Skopje Blace motorway (500 m on the left and 500 m of the right side of the road axis). However, the research and monitoring were also carried out in suitable habitats within the aggregated EAAA, especially for vertebrate species, which encompasses the whole watershed area of the river Lepenec, as well as the most-likely affected villages in the area.

In general, the research of biodiversity components was conducted in the period 2019-2021. In the first phases of the project, the research was focused on the vegetation and habitats with opportunistic collection of data concerning fauna. The intensive research and monitoring of different faunistic groups (amphibians, reptiles, birds and mammals) was conducted in the period 2020-2021.

- **Habitats**

The research on habitats was performed by desk survey and field observations. Apart from some general information on climate-vegetation-soil belts (Filipovski et al. 1996) there were no specific data on the habitats in the area. Thus, the information on habitats was obtained mostly during the field work. The research of habitats was carried out in the period 2019-2021 (09.03.2019, 19.09.2019, 19.12.2020, 07.06.2021). During this period all of seasons were covered (spring, summer, autumn and winter). The identification of habitats was based on the previously published data by Filipovski et al. (1996) which define the general climazonal plant communities and field work. In general, habitats were named according to national terminology (e.g. Filipovski et al. 1996) and corresponding names according to EUNIS classification system (https://eunis.eea.europa.eu/habitats-code-browser.jsp) are presented. The identification of habitats during the field work was based on detection of the edifier species (e.g. Quercus pubescens, Populus alba, etc.) by visual observation of species dominance. Practically, most of the different patches of habitats were inspected during the field work. Also, a list of accompanying plant species was made. Such inspections were carried out at selected locations in different habitats (GPS coordinates were noted together with altitude, soil type, preservation/degradation status, etc.) and are presented in the figure below. These data are presented in the chapters regarding the description of habitats. All of the data were taken with OruxMaps application on Samsung Galaxy Tab 3. The records of individual plant species were made by Memento Database free software.

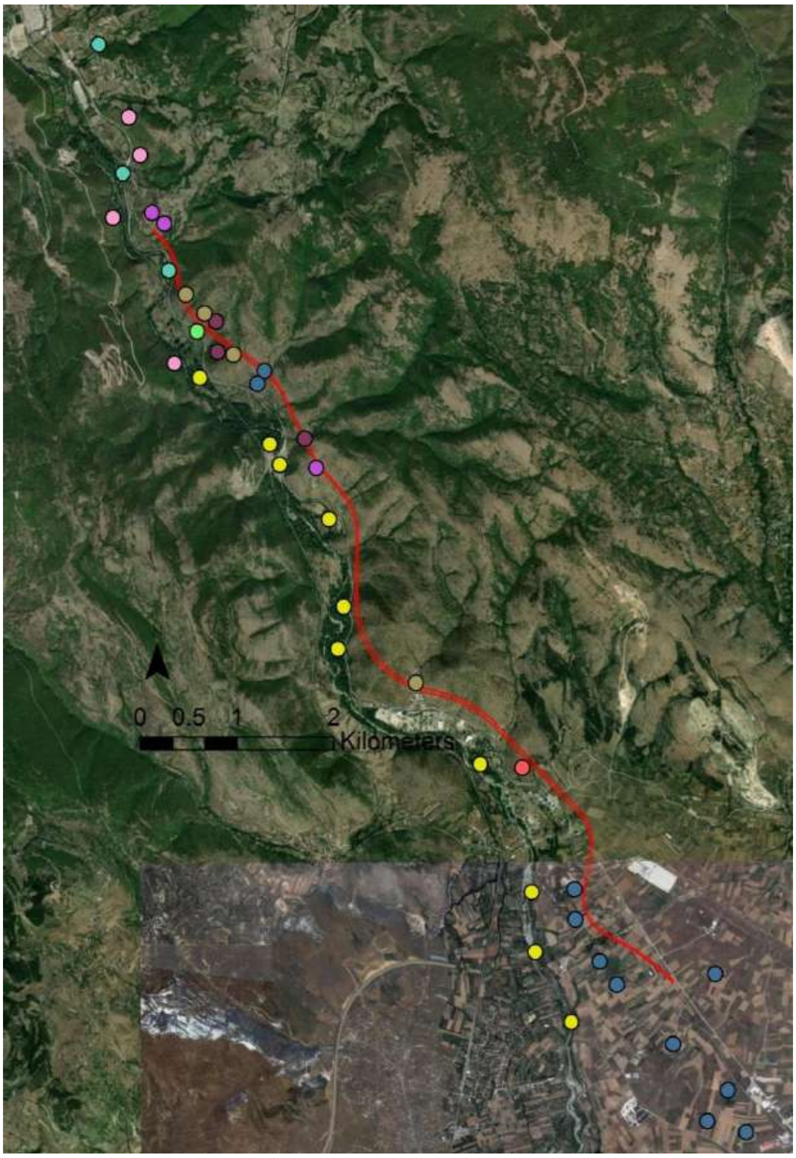


Figure 31 Sites for investigation of floristic composition of habitats

Table 29 Sites for investigation of floristic composition of habitats

Habitat	X	Y
Riparian habitats	21.3559	42.0745
Riparian habitats	21.3389	42.0889
Riparian habitats	21.3298	42.1037
Riparian habitats	21.3382	42.085
Coniferous plantation	21.3612	42.0741
Agricultural land	21.3799	42.0489
Agricultural land	21.3867	42.0447
Agricultural land	21.3851	42.0553
Agricultural land	21.3728	42.0543
Agricultural land	21.3708	42.0565
Agricultural land	21.3677	42.0603
Agricultural land	21.3676	42.0631

Riparian habitats	21.3211	42.1098
Pubescent oak forests	21.3233	42.1121
Pubescent oak forests	21.3232	42.1149
Pubescent oak forests	21.3342	42.1042
Sessile oak forests	21.3179	42.1111
Sessile oak forests	21.3123	42.1336
Sessile oak forests	21.3137	42.1301
Sessile oak forests	21.3103	42.1244
Hill pasture	21.3152	42.1248
Hill pasture	21.3167	42.1238
Hill pasture with shrubs	21.3194	42.1174
Hill pasture with shrubs	21.3217	42.1156
Hill pasture with shrubs	21.3253	42.1119
Agricultural land	21.3292	42.1104
Agricultural land	21.3283	42.1092
Agricultural land	21.3889	42.0409
Agricultural land	21.3841	42.0419
Riparian habitats	21.3627	42.0574
Riparian habitats	21.3672	42.051
Riparian habitats	21.3623	42.0628
Hill pasture with shrubs	21.348	42.0819
Riparian habitats	21.331	42.1018
Riparian habitats	21.3372	42.0968
Hill pasture	21.3356	42.1015
Broadleaf tree stand	21.3208	42.114
Meadows	21.3173	42.1196
Meadows	21.3086	42.1402
Meadows	21.3116	42.1284

- **Flora:**

The flora of the area was assessed in the EAAA on the basis of field observations (09.03.2019, 19.09.2019, 19.12.2020, 07.06.2021) and literature data (Micevski, K. (ed.) (1985–2005): Flora of the Republic of Macedonia, Vol. 1, issues 1-6 and Vol. 2, issue 1). Field observation of individual plant species were recorded in Memento Database software for Android in Samsung Galaxy Tab 3.0.

- **Fauna:**

  ✓ ***Mamals***

The assessment of the mammalian fauna was done in the EAAA. Data on mammals were collected from the available scientific literature (Karaman 1931; Kryštufek & Petkovski 1989, 1990, 2003, 2006; Kryštufek et al. 1992; Mitchell-Jones 1999; Petrov 1992; Димовски 1968; Петковски 1998) and with the field research, conducted during 2020/21 (19.06, 20.06, 25.06, 09.07.2020, 07.06.2021). During the field visits, the following methodology was applied:

❖ Sign surveys - one of the most used methods for determination of the presence of large mammal species. Transects are searched for footprints, scats, hairs and other signs of passing large mammal species. Transects are usually set in specific habitats where the possibility of encountering certain species is higher. When found, all signs were photographed and data on identified species, date, location, habitat and type of data were recorded.

- Bat Roost inspection – one of the basic and simplest methods, most suitable for species that form large colonies in visually easily accessible places. The inspection is done in natural and artificial underground sites in the area and includes observation and counting, identification of species and the assessment of bat population size.
- Ultrasound audio-detection – commonly used non-invasive method for studying bat distribution and ecology. This method requires use of a special device – ultrasound bat detector which detects and records (in internal memory or external audio device) ultrasounds emitted by bats (frequencies from 12 to 120 kHz). Recorded sounds are afterwards analysed using specialized software. During the field visits, bat calls were recorded using Pettersson D240X ultrasound detector and Edirol R-09 stereo sound recorder both along transect and on stationary census spots. Recorded sounds are afterwards analysed using the specialized software BatSound v.4.0 and the call parameters provided by Russo and Jones (2002) and Papadatou et al. (2008). Data from the analysis were stored using Memento Database application.

✓ ***Birds***

The surveying (transect and vantage points) of the ornitofauna usually took place in the first few hours after sunrise (05:00 – 11:00) when the birds are most active. However, two field visits were made at night in order to record nocturnal bird species (*Caprimulgus europeus*, *Otus scops, Bubo bubo*). Binoculars and digital camera were used for easier and better morphological identification of the recorded birds. Also, playback sounds were used in order to provoke a response especially from the nocturnal birds. Birds were identified mainly on the morphological and vocal characteristics. Within this research the following localities were visited: Glavichica (21,379658; 42,04496), Stenkovec (21,363820; 42,077133), Shtitinje (21,378099; 42,066128), Gnilishte (21,349010; 42,073207), Golema Strana (21,335031; 42,075051), Ramnishte (21,338759; 42,094969) bellow Muchovska Maala (21,316885; 42,122721) and along Lepenec River from the border with Kosovo till Orman and Stenkovec. Apart from the data obtained with this researcht, the data for ornithofauna from Study for implementation of green corridors (Dekons – Ema, 2017) are included too.

✓ ***Reptiles***

The field researches for reptile fauna were done in two consecutive years in the active period for this taxonomic group (22-26.06; 01-03.07; 01-03.09.2020; 29-31.05, 10-12.08.2021). On the filed surveys, reptile's species were determined according to the field guide of Arnold & Owenden (2002). Determining the presence/distribution of species for this class was done with the methodology "Search-and-seize" (Vogt 1982). All specimens caught on site after determination were released in the same spot of their seize. Regarding the project site the literature data on reptiles for this area are summarized in three papers by Jelic et al. 2012; Sterijovski et al. 2014; and Sterijovski & Arsovski 2019, 2020a 2020b.

✓ ***Amphibians***

Same as the reptiles, the field researches for amphibian fauna were done in two consecutive years in the active period for this taxonomic group (22-26.06; 01-03.07; 01-03.09.2020; 29-31.05, 10-12.08.2021). On the filed surveys, reptile's species were determined according to the field guide of Arnold & Owenden (2002). Determining the presence/distribution of species for this class was done with the methodology "Search-and-seize" (Vogt 1982). All specimens caught on site after determination were released in the same spot of their seize. Regarding the project site the literature data on reptiles for this area are summarized in three papers by Jelic et al. 2012; Sterijovski et al. 2014; and Sterijovski & Arsovski 2019, 2020a 2020b.

✓ ***Butterflies***

Butterflies (Lepidoptera, Rhopalocera) were recorded during the field investigation, although opportunistically. Butterfly species were recorded as part of the research of habitats. The identification of butterflies was conducted during the field visits by simple observation. No quantitative data were recorded. The fauna of butterflies was compiled according to the literature data (Schaider & Jaksic) and field work data. The following publications were used for identification of butterflies:

- Tolman T., Lewington R. (2008): Collins field guide. Butterflies of Britain and Europe. Harper Collins Publishers, London, 384 pp.
- Schaider P., Jakšić P. (1989): Die Tagfalter von Jugoslawisch Mazedonien (Rhopalocera und
- Hesperidae). Selbstverlag Paul Scheider, München, 199 pp.

✓ ***Ground beetles***

Ground beetles were collected by pitfall traps (vinegar+formaline solution was used as an attractant and for preservation of beetles) and by hand collection in several localities. The following habitats were studied: Poplar stands with natural origin, but degraded (D); sandy and muddy river banks (sites C and B, respectively), meadows (site A), wet meadows (F) and dry grasslands (site E) and sparsely vegetated river bank (site G). The determination of ground beetles was carried on the basis of specialist literature, but in general the following monographs were taken into account:

- Freude, H., Harde, K. W., & Lohse, G. A. (1976). *Die Käfer Mitteleuropas. Bd 2, Adephaga. 1*.
- Arndt, Erik. *Ground Beetles (Carabidae) of Greece*. Pensoft, 2011.
- Fedorenko, D.N., 1996. *Reclassification of world Dyschiriini, with a revision of the Palearctic fauna (Coleoptera, Carabidae)*. Pensoft.
- Hristovski, S., & Gueorguiev, B. (2015). Annotated catalogue of the carabid beetles of the Republic of Macedonia (Coleoptera: Carabidae). Zootaxa, 4002(1), 1-190.

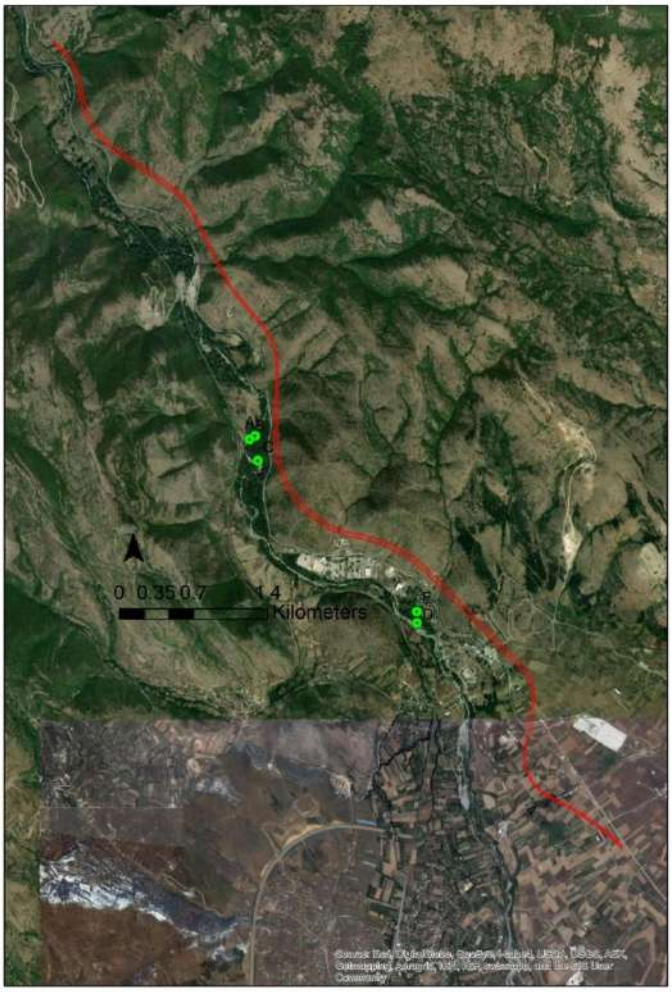


Figure 32 Study area with depicted sampling sites for ground beetles

- ***Aquatic macroinvertebrates***

River Lepenec: Collection of data for macroinvertebrates is presented in part for surface water.

River Vrazanska Reka: Aquatic invertebrate samples were planned to be collected from 4 sampling sites on the River Vrazanska Reka using Kick sampling method, a technique in which submerged aquatic vegetation, stones and other hard substrates are disturbed to encourage organisms to fall in the 500 µm mesh net. The samples were planned to be preserved with 96% ethanol and transferred into sample containers. All specimens were planned to be identified to the lowest possible taxonomic category using Nikon SMZ748 stereomicroscope and proper identification keys. After the identification, list of detected taxa was planned to be produced and detailed analyses on composition of the macroinvertebrate fauna was planned to be performed. Valorisation of biodiversity following IUCN Red Lists criteria as well as Habitats Directive Annexes should be undertaken and list of species of conservational importance present in the project area should be provided in order to assess the biodiversity values against EBRD PR6 criteria and detect possible priority biodiversity features or critical habitats.

During the field trip, total number of 4 sites were visited. Sampling was planned on only one of them (Vrazanska Reka river - Preselected sampling site behind "Tonus" factory). However, since no water in the riverbed was detected on this sampling site, the expert team decided to visit three more sites in order to check if there is any water present. Unfortunately, the whole river was dried out.

Table 30 List of visited sites during the field trip

	Description	GPS	Date of visit
Visited Site 1	Vrazanska Reka river - Preselected sampling site behind "Tonus" factory	42.058510, 21.370634	11.10.2021
Visited Site 2	Vrazanska Reka river - Bridge on the main road next to "Tonus" factory	42.059906, 21.375216	11.10.2021
Visited Site 3	Vrazanska Reka river - Bridge next to "Deluxe Aquatic 2" store	42.062065, 21.379932	11.10.2021
Visited Site 4	Banjanska Reka river - Bridge in village Brazda	42.080663, 21.404997	11.10.2021

- ***Valorization of biodiversity***

The valorisation of biodiversity was performed on the basis of national and international documents:

1. Habitats Directive (Council Directives 92/43/EEC on the conservation of natural habitats and of wild fauna and flora). The list of important habitats is given in:

  - Annex I - Natural habitat types of community interest whose conservation requires the designation of special areas of conservation, including priority habitats (*),
  - Annex II - Animal and plant species of community interest whose conservation requires the designation of special areas of conservation,
  - Annex IV - Animal and plant species of community interest in need of strict protection.

2. Presence of species listed in IUCN Global (https://www.iucnredlist.org/) and National Red Lists[11] (http://redlist.moepp.gov.mk/). The categories of the IUCN Red List are described below:

  - Extinct (EX). A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), and throughout its historic range

[11] So far, national red list have been elaborated for mammals (large carnivores and otter), amphibians, fungi and reptiles as well as selected plant species were assessed. None of these plant species are present in the area.

have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

- Extinct in the wild (EW). A taxon is Extinct in the wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual) throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
- Critically endangered (CR). A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered, and it is therefore considered to be facing an extremely high risk of extinction in the wild.
- Endangered (EN). A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (criteria A to E are not presented in this Study), and it is therefore considered to be facing a very high risk of extinction in the wild.
- Vulnerable (VU). A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (criteria A to E are not presented in this Study), and it is therefore considered to be facing a high risk of extinction in the wild.

<u>Species from the three categories listed above are considered as threatened.</u>

- Near threatened (NT). A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
- Least concern (LC). A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.
- Data deficient (DD). A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.
- Not evaluated (NE). A taxon is Not Evaluated when it has not yet been evaluated against the criteria.

3. Bern Convention

- Resolution No. 4 listing endangered natural habitats requiring specific conservation (Standing Committee of the Convention on the Conservation of European Wildlife and Natural Habitats, 1996) and
- Resolution No. 6 listing the species requiring specific habitat conservation measures (Standing Committee of the Convention on the Conservation of European Wildlife and Natural Habitats, 1998).

4. Bird Directive - Council Directive 79/409/EEC on the conservation of wild birds

- **Annex I** - Species of special conservation measures concerning their habitat in order to ensure their survival and reproduction in their area of distribution. Annex I actually lists the important bird species in EU countries. In this connection, account shall be taken of:

  (a) species in danger of extinction;

(b) species vulnerable to specific changes in their habitat;

(c) species considered rare because of small populations or restricted local distribution;

(d) other species requiring particular attention for reasons of the specific nature of their habitat.

5. Bonn Convention - The convention on the conservation of migratory species of wild animals (https://www.cms.int/). Migratory species that have an unfavourable conservation status or would benefit significantly from international co-operation organized by tailored agreements are listed in Appendix II to the Convention. For this reason, the Convention encourages the Range States to conclude global or regional Agreements for the conservation and management of individual species or, more often, of a group of species listed on.
   - **Appendix I - Species threatened by extinction**
   - **Appendix II - Migratory species conserved through Agreements**
6. Convention on International Trade with Threatened Wild Plant or Animal Species (CITES), ratified in 1999
7. Presence of endemic species (geographically restricted species).
8. Lists for Designation of Strictly Protected and Protected Wild Species in the Republic of Macedonia, 2011, Official Gazette of the Republic of Macedonia no. 139/2011.

❖ **Forest**

In general, the research of forests and forestry activity was conducted in the period 2020-2021. The research was focused on field identification of forest areas entering the surveyed area. The types of forests and forest communities within the corridor were then identified. The field research was realized according to the marching method, i.e., by direct field visit of all different types of forests and determination of the specific condition. In addition to field research, literary research was conducted through inspection of planning documents, projects, studies, reports and other professional materials.

The results obtained by the literary and field research are presented descriptively, in tabular and cartographically. In addition, a digital database of photo documentation from the field research and the condition of the forests was made and some of the pictures are shown in this Report.

The valorisation was performed based on national and international documents including the Special National Forest Management Plans and the EUNIS Classification System for Habitats and Corresponding Habitats according to the Habitats Directive and the Palearctic International Classification.

❖ **Used social methodology**

In order to collect accurate, current and project-relevant information, regarding the way of life, existing problems and potential threats and other relevant social issues, a process of consultation with key stakeholders from wide project area was conducted. For that purpose, various methodologies and strategies were implemented. The most relevant are those data collected from primary sources.

As the project was developed, and new information occurred, the project design continuously implemented changes that are the most suitable from the technical aspects and to those institutional stakeholders that diligently expressed will to collaborate on this project.

Very important aspect was the review of available technical specifications related to the proposed project aimed at identification of potential social impacts and individuals and groups likely to be affected. This served as a reference for further analysis performed in conjunction with the relevant legislation (National and EU).

Also, most relevant aspect of primary social data collection process was the implemented technique: Observations of land use in project area. A series of continuous site-visit observation iterations on the local dwelling and business objects in the wide project corridor was performed, along with systematic engagement with present farmers, by-passers, residents of nearby villages, businesses and other individuals found on site. There were six thorough field visits performed by the team of social specialists (13 December 2018; 06 March 2019; 19 September 2019; 16 June 2020; 19 November 2020; 19 May 2021). More on issues discussed with present stakeholder during the site visits, please refer to Chapter 1.7 of this document.

Furthermore, highly relevant information that actually facilitated the conclusion of current project design, was collected during the iterative process of stakeholder engagement performed via formal and non-formal consultation meetings with representatives of various stakeholders:

- Municipality of Chucher-Sandevo;
- National authorities (ministries and agencies);
- Residents living in settlements nearby the project area of influence and those found on site;
- Business operating in and near the project area of influence.

Socially relevant data that was collected in several site visits also helped in creation of a solid base for analysis of the social baseline condition of the project area of influence and its surroundings covered:

- Current condition of infrastructure (local roads, water supply, electricity, waste water and waste management);
- Housing quality and density of population;
- Living conditions in the affected settlement (way of life);
- Identify other life habits and cultural values;
- Identify economic habits and conditions that cannot be found in papers.

Secondary data have also, been collected and analysed. Review of various comparative studies and reports including available statistical material has been done. Indirectly collected data included consulting official publications and databases that have been developed mainly by the Governmental bodies/institutions. Most governmental Institutions and Agencies collect statistics appropriate for their field of work.

Reports from local government, as well as scientific sociological, ethnological, cultural, archaeological and other studies for this region are also published in various forms. Most of it is available in the National and University Libraries in printed form and some of it is internet based.

The methodological approach to data gathering was modified and it excluded the techniques such as Focus Group Discussion and Survey (Anquettes) because of two main reasons:

a) COVID-19 and inability to perform physical proximity to other individual/s (at the time all types of gathering were banned),
b) Modification of the project design that avoid creating impact to the local settlements, and thus minimizing the need to consult residents in the closest settlements (no access has been impeded).

Best part of the affected land owners is planned to be contacted during the process of writing of Resettlement plan, whereas, those who will be most affected will be engaged extensively and socio-economic survey will identify the level of household’s vulnerability, and thus propose measures to minimize to the extent possible.

Socio-economic survey for the purpose of describing the Social baseline and patterns of life in the project area of influence has not been conducted since the project footprint, in better part, does not involve or directly affects settlements and their livelihood (footprint is mainly passing through unused arable land and pastures spread on hills) so to understand their vulnerability and propose mitigation measures beyond those that would regularly include facilitation of continuous flow of people and materials on the established roads. Observations and discussions with stakeholders on site show that the settlements will not be even moderately affected beyond interest for access to property and road access to the City of Skopje, where most of the social and relevant health institutions and facilities are located. Therefore, performing activities that might distract the focus from the potentially affected (ones that should be embraced with Land Acquisition and Resettlement Plan) was minimised.

In regards of the process of public disclosure and stakeholder consultations, the current approach still sticks to the anti-covid measures issued by the government, and therefore the approach to consult stakeholders (described in SEP) is designed to minimize physical presence of the interested parties, particularly preforming it in closed spaces/rooms. Stakeholder engagement plan promotes continuous engagement and information disclosure during the whole life cycle of the project.

3.2 Lack of baseline data and limitation

Preparation of the technical documentation for the project is in the phase of adoption of the preliminary design and some investigation that should be conducted within the project will follow in the next period. In relation with the other aspect on the site, it was identified lack of data that should be taken into consideration and if there is a need to be proposed additional investigation during preparation of the project documentation in a level of Detail Design as well as prior starting of the construction phase. Identified lack of baseline data and limitation that was identified during preparation of the ESIA in the following table are presented.

Table 31 Identified lack of baseline data and limitation

Issue	Description
Project documentation (geology data)	For preparation of the project (preliminary and detail design) should be conducted geotechnical investigation. The same are not finalised yet, that will contribute in the ESIA to be presented general available data for the geological condition of the project area.
Project documentation (ground water)	Hydrogeological investigations have not been performed within the Preliminary Design and were not subject for analysis according to the ToR. As a result of this, the ESIA study will elaborate desktop analyses performed up to know within and close to project area as well as data presented in the Factual report for performed geotechnical investigations for Section 2 related to determined ground water, during geotechnical investigation. The desktop analysis will cover the direction and movement of the groundwater bodies. Request to the MoEPP has been sent in order to identify possible groundwater sources for drinking purposes within the project area and its surroundings, but they are not provided yet.
Project documentation (consolidation of agricultural land, exchange and identification of land parcels)	Missing response on submitted letter for issuing opinion sent by the designer to the Ministry of Agriculture, Forestry & Water Economy related to consolidation of agricultural land, exchange and identification of land parcels in the project area
Soil quality	The soil quality in the project has not been investigated in the northern part of the alignment. The south part of the alignment is included Geochemical atlas for Skopje region.
Air quality	The national monitoring system for measurement of the ambient air quality does not cover the area where is proposed alignment for construction of the motorway A4. There are several air monitoring stations in the City of Skopje operated by the MOEPP[12]. The one located in the district of Karposh is closest to the future motorway, but there are too many missing data, especially for CO and NO_2 concentrations. An unofficial monitoring point being part of the *pulse.eco* network is located in the district of Bardovci. Unfortunately, data on CO and NO_2 are also missing at this point.
Water quality	Vrznaska River is not included in the national monitoring for the quality of surface

[12] MOEPP Monthly reports,2020, https://air.moepp.gov.mk/?page_id=290

monitoring	water bodies and the monitoring of the water quality has not been performed up to now. During the preparation of the ESIA (summer and autumn period 2021), site visit on the River Vrazanska was performed and recognized that the river is dry, although the river is considered as a water body with permanent flow. For that reason, it was not possible to be performed water quality analysis. Also, water monitoring is not performed on the intermittent streams which has occasional flow during rainy season. Water quality of the river Lepenec does not include measurements of the following parameters: oil and grease, mineral oil, total phenols, TOC, total PAH, because the national laboratories do not perform this type of measurements. The Lepenec River is erosive active and transports large amounts of sediment, which is not sufficiently analysed due to the lack of data on measured sediment concentration in hydrological stations.
Social aspects	Data collected on site during site visits and consultation with relevant stakeholders and review of available literature and official documents issued by the relevant governmental institutions create certain lack for information. Namely, there is a lack of the data that are planned to be obtained from the relevant institutions, such as: • employed/unemployed individuals in the affected municipality; • social statistics for the municipality; • exact location of the protected cultural heritage site Davina Kula. Official figures of employed/unemployed individuals in the affected municipality (official figures for the municipality are part of the Skopje region) and it was not possible to obtain it from the Skopje's Employment Agency. Currently, there are efforts to contact local branch office of the Employment Agency, located in the municipality. Official social statistics for the municipality of Chucher – Sandevo is missing due to the slow responsiveness of the local office of the Inter-municipal Centre for Social Work in Skopje, responsible for the affected municipality. Official location of the protected cultural heritage site Davina Kula, from the Institution for protection of Cultural Heritage in Skopje. Although Davina kula is out of the project area of Influence, and there is no need to perform additional site visit (by the ESIA team) to the location, hence it is good to have official confirmation from the relevant and responsible national institutions.

3.3 Physical Environment Baseline

3.3.1 Land use

The land in the project footprint mostly used as agricultural - fields and acres, somewhere interspersed with permanent crops and meadows.

Agricultural area in the vicinity of settlements is divided in small parcels of fields with hedges, meadows and gardens. Excluding the periphery of Volkovo and the industrial/commercial part of Vizbegovo Pole, which can be characterized as a semi urban area, the motorway does not intersect with rural areas. The long-abandoned arable land in the hilly areas is commonly overgrown with anthropogenic broadleaf stands, shrubs and sparse oaks with low stems.

Hill pastures in the corridor of impact are too mostly overgrown with sparse shrubs, successioning towards degraded state of thermophillous oak forests. Most of the high stem oak forest develops on the periphery of the alignment corridor, while along the corridor it can be noted only in smaller patches interconnected with degraded oak forest covers.

In the vicinity of settlements anthropogenic broadleaved tree stands are common. Ruderal vegetation, is represented by perennials and shrubs, is common on the periphery of rural areas, industrial sites and along railroads and roads. Riparian poplar and willow stands and belts can be observed along river Lepenec. Reed belts, bulrush and shrubs can be found mostly in the vicinity or on the river Lepenec gravel bank.

Table 32 Surface of the land-use types in the Blace-Skopje motorway corridor area

Land use/Land cover in the Skopje-Blace corridor motorway	Area (ha)
Forest and semi natural areas	
311 Broad-leaved forest	40.72
312 Coniferous forest	0.27
321 Natural grasslands	209.68
323 Sclerophyllous vegetation	7.74
324 Transitional woodland-scrub	147.95
Agricultural areas	
211 Non-irrigated arable land	416.31
231 Pastures	34.93
242 Complex cultivation patterns	114.02
243 Land principally occupied by agriculture, with significant areas of natural vegetation	183.04
Artificial	
112 Discontinuous urban fabric	0.91
121 Industrial or commercial units	122.79
131 Mineral extraction sites	0.00
Total	**1278**

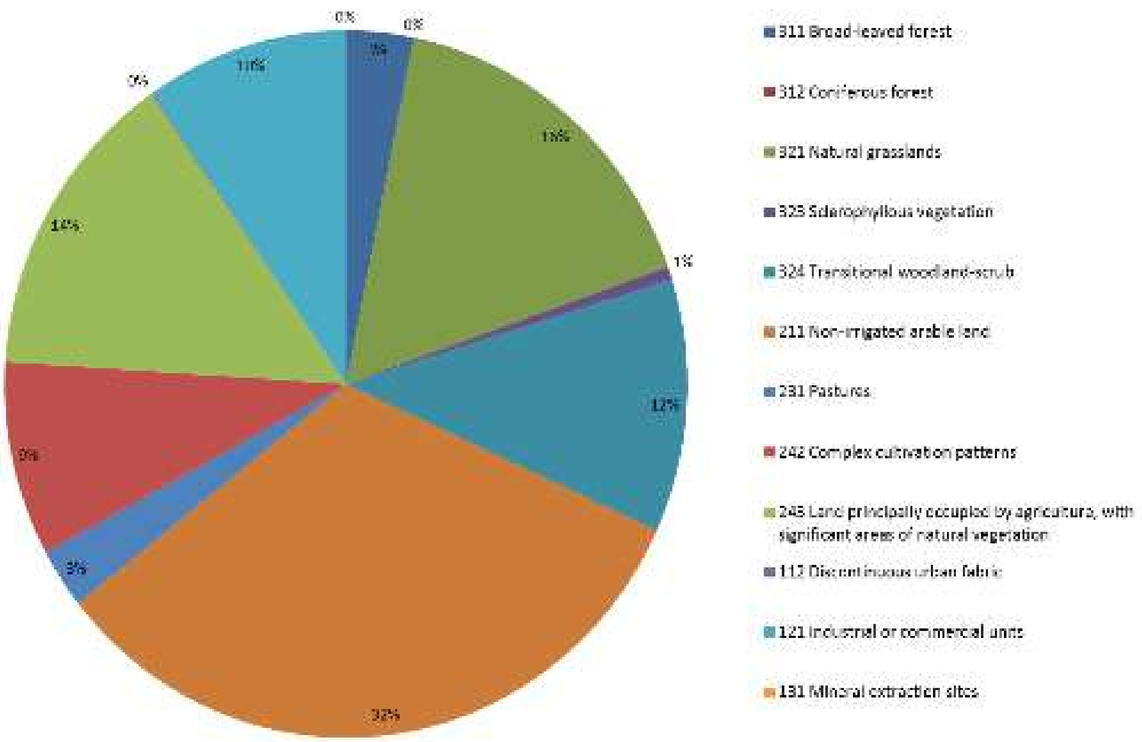


Figure 33 Land-use types participation in the Skopje-Blace motorway corridor area

3.3.2 Geology, hydrogeology, geomorphology

3.3.2.1 Geology

3.3.2.1.1 Tectonics

The alignment passes mostly through the Lepenec valley which tectonically belongs to the Vardar Zone. The Vardar zone represents a Triassic to early Cretaceous Ocean that had a long and complicated history of subduction. It began to close in the Late Jurassic and the earliest deformation is of Late Jurassic–Early Cretaceous age (Arsovski, 1997). The upperpart of the Vardar Mesozoic succession consists of Aptian to Turonian flysch, parts of which are wild flysch, deformed in late Turonian to early Senonian time (Sub-hercynian phase in the European literature), and uncomfortably overlain by Senonian and Maastrichtian fine-grained flysch with rare wild flysch and limestone units in its upper part. The Cretaceous sequences are more than 4000 m thick. Rocks within the Vardar zone were strongly deformed into narrow NNW-trending belts of different rock types bounded by faults that developed in the latest Cretaceous to Paleocene time (Laramide phase of European authors). Latest Cretaceous or earliest Cenozoic strata are absent in the Vardar zone in Macedonia, but are present in Serbia to the north. The deformed subduction-related complexes in the Vardar zone are overlain by the oldest Cenozoic sediments of Priabonian age, and perhaps older, that consist of freshwater lacustrine strata which grade upward into marine strata (Petkovski, 1976; Dumurdzanov et al., 2004).

The Kačanicka zone comprises Palaeozoic structures such as amphibolites, amphibolitic and amphibolic schists ("green rock" complexes), gneisses and to a much lesser extent marble. The surface layer, extending to a depth of around 2-3 m, comprises of river sediment (alluvium) throughout the Skopje basin and the flat portions around the Lepenec River, while the mountain foothills and local depressions are characterized by diluvia and pluvial sediments, which partially cover the basic rock types; their thickness varies between several decimetres and several meters.

Tectonically, the project area (as a part of Vardar Zone) is near to the collision with West-Macedonian Zone from the west and Pelagonian Zone from the south. Because of the high tectonic pressure from these zones, the entire terrain is cracked by the number of faults in NW-SE and NE-SW directions. For the same reason, this area is composed ofvariable Palaeozoic, Mesozoic and Cenozoic rocks which in turn are partially reflected in the current geo-settings, further elaborated through: geodiversity, geo-heritage and geo-hazards.

The project area is characterized by variable lithology, from old Precambrian to Paleozoic rocks to the youngest alluvial deposits. Also, the rocks are with very different hardness and resistance to erosion. The cause of such variability is the position of the project area in the marginal part of the Vardar zone near the border with West Macedonian zone and Pelagonian Zone, as geotectonic units. That position is also responsible for the numerous cracks-faults with Dinaric (NW-SE) direction and opposite (NE-SW) direction.

3.3.2.1.2 Lithology

Several lithogenic units of different geological ages and properties are foreseen along the alignment. Based on the available geological data, and according to the geological map (Petkovski et al., 1985) the following soil and rock formations are foreseen to be encountered:

Deluvial (d): Deluvial formation is a result of the weathering procedure of the underlying bedrock, which also controls their composition. It is composed by silty sand and a mixture of rock fragments from underlying gneiss, amphibolites, quartz, marble, etc.

Proluvial (pr): The proluvial formation has been recorded at the right side of the alignment, forming a “line” towards the Lepenec River. They are the products of the surface water flows which transports the decayed surface material from higher altitudes of the terrain towards the lower parts. Proluvial sediments are composed of rock fragments of different geological origin, their thickness is variable, over 10 m.

River terrace sediments (pct): River terrace sediments are anticipated at the start of the alignment, in the flat part of the terrain and at the left side of the riverbed of the Lepenec River. They are composed of rock boulders of different geological origin with diameter 15-25 cm, mixed with sandy silt.

Sandstones, claystones and marls (M3): These Miocene sediments appear in the north border of the Skopje valley and after the valley of the Lepenec River near General Jankovic. They are composed of sandstones, marls and clays. The series appears in the lower parts of the Miocene basin.

Flysch series (K2): The flysch series was named after Dimitrijevic (1975) and it is anticipated at the beginning of the alignment. Blocks of the most abundant rocks, irregular lenses, and entire zones of Palaeozoic crystals of shales, marbles, quartzites, sandstones, various breccias, limestones, diabase and serpentinites are arranged in this flysch series. Between these tightly bonded rock types there is a large percentage of a smaller fraction material composed of clayey sand, with rare presents of gravel or rock blocks.

Serpentinites (Se): Serpentinites are olive-green to dark green colour, fractured and intensively cracked in different directions. They appear in the form of thin and elongated zones, masses, and lenses with a northwest-southeast extending direction. They have a tectonic relation to the Palaeozoic rocks, and the cradled sediments pass through them transgressive. In the central parts of their composition there are relics from the peridotite rocks and contact with the Palaeozoic rocks has no contact changes indicating that the contacts were cold and brought from the deeper parts of the earth's crust and along a tectonic path affixed to the surrounding rocks.

Gneiss (Gmb): They appear mainly on the left side of the river Lepenec, where they retain the northwest southeast direction. They overlie amphibolite and amphibolite shales with quite sharp transitions, and gneisses transforms to biotite-muscovite shale. They are fine to medium-sized with a lepidogranoblastic structure. They comprise of quartz, muscovite and feldspar. The colour is light grey to yellowish grey.

Amphibolites (A): They appear at the beginning of the alignment. They are characterized by their colour that is light to dark greenish. Their structure is lepidoblastic and the transition to gneisses is sharp or these rocks appear in the form of thin lenses in gneisses. In the amphibolite shale, the most abundant mineral is hornblende that is elongated in the direction of foliation. Monoclinic pyroxene and a larger amount of leucocyte are also present, indicating their ortho origin. Amphibolite shales consist mainly of amphiboles, pyroxene and quartz, which vary considerably. The observed white marble lenses in amphibolite shale indicate the sedimentary-volcanic origin of these shales. On the following figure a geological map is presented.

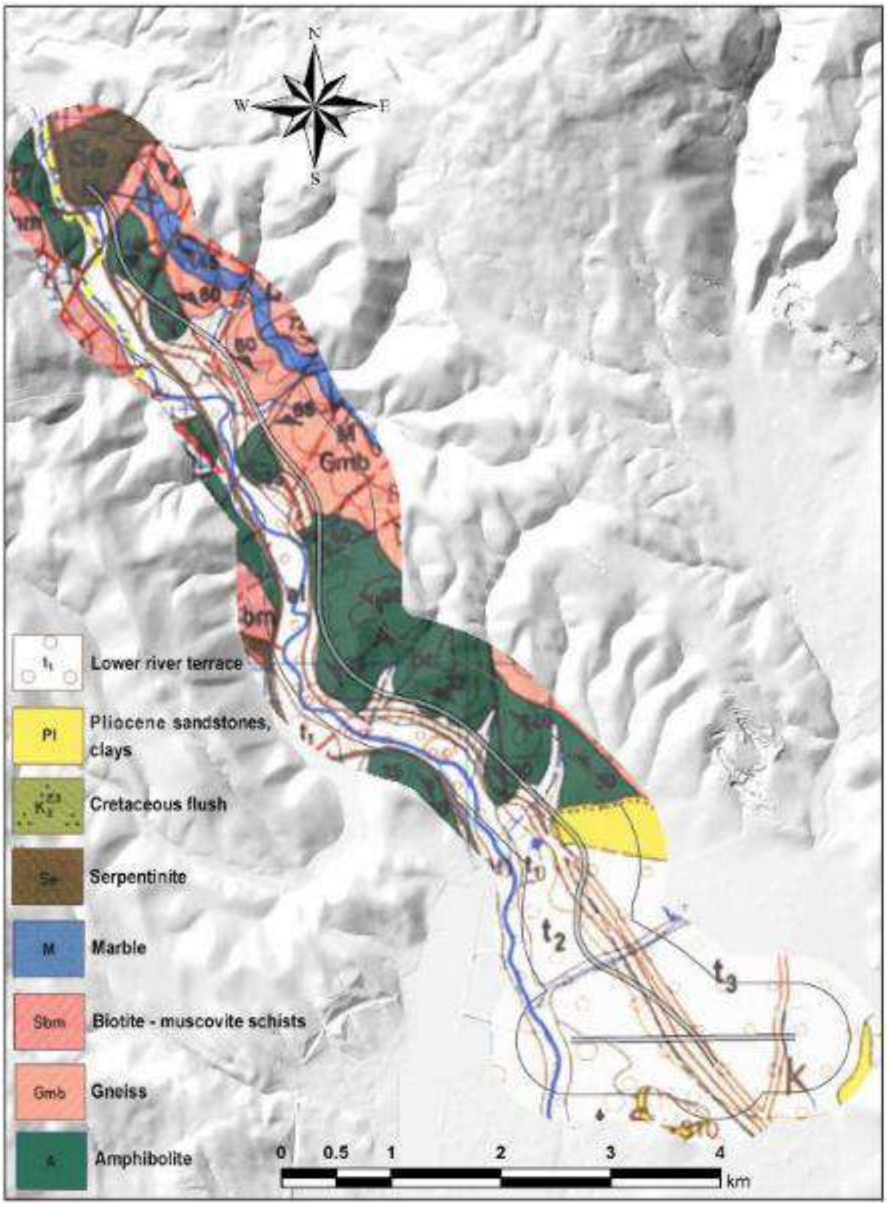


Figure 34 Geological map of the project area (from Petkovski et al., 1985)

- **Rock erodibility**

The southern part of the alignment in length of 3 km pass through soft and erodible rocks, generally represented by sands and gravels of the Lepenec and Vrazanska river terraces. From the Stenkovec hill northward, the lithology along the alignment is composed by solid rocks i.e. amphibolite (in length of 4.7 km) and gneiss (in length of 1.7 km). However, because of the weathering gneiss is partially cracked and decomposed on the surface, so it is more susceptible to erosion and landslides. Close to the inflow, Morav Dol created colluvial fan of decomposed rocks and eroded material. The most northern part of the alignment pass through cretaceous sediments and serpentinite (in length of 0.2 km) which are moderately erodible rocks. Overall, most of the alignment pass through solid and resistant rocks (6.6 km) contrary to erodible sands, gravels and colluvial material (3.3 km).

3.3.2.2 Hydro-Geological Terrain Properties

Major feature of the hydrogeological conditions in the broader area is the heterogeneous hydrogeological behaviour of the encountered geological units. This is mainly set due to the participation of various lithological phases in every geological formation, which has different hydro lithological characteristics (alternations of permeable and impermeable phases) and various cumulative thicknesses at several sites. Consequently, the formations that participate in a geological unit, have a big hydraulic anisotropy and important variation of permeability is expected both in horizontal and vertical direction. The classification of geological formations according to the category of coefficient of permeability k, is based on the classification of Terzaghi and Peck (1967) and is shown in the following table. Results of in situ permeability tests (Lugeon tests) have also been taken into account.

Table 33 Permeability coefficient classification by Terzaghi and Peck (1967)

COEFFICIENT k (m/sec)	CLASSIFICATION
$10^{-3} \leq k$	High
$10^{-5} \leq k < 10^{-3}$	Medium
$10^{-7} \leq k < 10^{-5}$	Low
$10^{-9} \leq k < 10^{-7}$	Very low
$K < 10^{-9}$	Practically impermeable formation

- **Sandstones, Claystones and Marls (M3), Flysch Series (K2)**

Serpentinites (Se), Gneiss (Gmb), Amphibolites (A)

Two main categories could be distinguished:

A. Permeable Formations

[A1] Porous Formations. Water circulation is done through their primary porosity.

[A1.1] Formations of high permeability ($10^{-3} \leq k$ m/sec).

River terrace sediments (PCt) could be classified in this category. Higher permeability is expected locally in coarse grained, clayey gravelly phases of sediments. Unconfined aquifers of high capacity is expected.

[A1.2] Formations of high to medium permeability ($10^{-5} \leq k < 10^{-3}$m/sec).

Prolluvial deposits (Pr) and Deluvial (D) could be classified in this category. Local unconfined aquifers are developed seasonally, in small depth and in relation to the surface runoff.

B. Practically Impermeable Formations

[B2] **Fractured Formations**. Water circulation is done via secondary porosity, i.e. through discontinuities (faults, joints). Nevertheless, considering that fractures are either closed or filled with clayey material (impervious) these materials are practically "impermeable".

[B2.1] *Formations of very low to insignificant permeability* ($k < 10^{-7}$ m/sec). **Serpentinites (Se), Gneiss (Gmb) and Amphibolites (A)** are classified in this category. At these formations, occurrence of typical aquifers should not be expected and that possible occurrence of groundwater may be expected only along the fault structures, separate fractures and locally.

[B2.2] *Formation of low to very low permeability* ($10^{-9} \leq k < 10^{-5}$ m/sec). **Sandstones, Claystones and Marls (M3) and Flysch Series (K2),** are classified in this category. In relation to discontinuity density and fracture grade in tectonic zones, unconfined aquifers of low to medium capacity are locally developed.

Regarding hydro-geological aspect, practically impermeable formations are characterized by fracture porosity, with very poor water permeability or practically water impermeable. However, due to the great number of fissures and fractures, locally they could be poor collectors.

Permeable formations appear mainly at the last section of the alignment, from km 9+100 up to the end of the axis and locally at the intersections of the alignment with the watercourses.

3.3.2.3 Geomorphology

In terms of geomorphology, the project area extends mostly in the foothill of the Skopska Crna Gora Mt. and in a shorter part in the Skopje Valley bottom on south. Actually, in the mountainous part, the project area extends through the Lepenec gorge north of the village Orman.

Skopska Crna Gora Mountain: Skopska Crna Gora is a medium-high mountain (1651 m), which administratively belongs to 5 municipalities, of which the municipality of Čučer Sandevo covers an area of 194.3 km^2 or 42.3%. Skopska Crna Gora extends as a horst between the Skopje basin to the south, the Kumanovo basin to the east, the Gjilan basin to the north and the Lepenec valley to the west. Geotectonically, it lies in the Vardar zone, which is why the general direction of the mountain is northwest-southeast. In that direction there are major fault structures along the valleys of the major rivers in the area: Lepenec, Banjanska, Lipkovska, Slupčanska and others. The tributaries of these rivers are usually transverse (SW-NE) and deeply incised in the mountain range. West of the main mountain ridge, on the territory of North Macedonia, the ridge that extends from Ramno west to Lepenec valley is remarkable. On it, the most prominent peaks are Gorogled (1607 m), Kara Čuka (1523 m), Crkovan Rid (1431 m) etc. Watercourses that flow to the south, such as tributaries of the Vrazanska River (which flows into Lepenec) and the Radisanska River (which flows into the Vardar), are also deeply incised in gorges. Especially characteristic is the 8 km long gorge of Banjanska Reka (Vrazanska river), upstream from the village of Banjane. In places where the river cuts marble rocks, the sides are very steep and bare. The marbles themselves have certain karst forms.

Beside the structural (ridges, peaks) and valley landscape, on the western part of Skopska Crna Gora (in the wider extent of the project area) denudation (weathering) relief, as well as remains of lake terraces, and karst landforms are found. The narrow karst area extends between the village of Blace and village of Brazda. Poorly developed karst relief is observed in the marbles of Banjanska Gorge, 2 km north of the village of Banjani. Denudation (weathering) landforms are common on the western slopes of Skopska Crna Gora in quartzites between the villages of Blace, Gluvo and Banjani.

Lepenec river gorge: Lepenec river gorge (known as Kačanik Gorge) extends north of the village Orman up to the border with Kosovo in length of about 10.5 km (and continue further to the north in Kosovo). The gorge is about 300-400 m deep, narrow and steep especially the right (west) side. This gorge is incised between the far end branches of Šar Mountain in the west and Skopska Crna Gora Mts. in the east. It is tectonically predisposed with NW-SE large fault structures, which also mark the border between the Vardar Zone in the east and the Hellenides (Šara-Pelister mountain group) in the west. Kačanik Gorge is characterized by a heterogenous lithology that had an impact on the relief dissection. Thus, at a short distance, Precambrian gneisses, Palaeozoic shales, quartzites, amphibolites and marbles, Cretaceous limestones, marbles etc., are changed. Terrain composed by resistant rocks, such as amphibolites, quartzites, marbles and limestones are higher, with mounts and hills (Vrvež 740 m, Kula 532 m, Pržnik 525 m, Stenkovec 408 m etc.). Contrary to that, terrain composed of soft rocks is under high erosion, transport and deposition with recent gullies, rockfalls, colluvial fans etc. The terrain along the alignment is composed mostly of resistant rocks (amphibolite and gneiss).

In the following figure is presented Lepenec Gorge near the village Blace, where the bottom of the gorge is filled with sediments from the river Lepenec and its tributaries.

Figure 35 Lepenec Gorge near the village Blace

Along the gorge, there are remains of the river terraces of 3-5 m, 10 m, 15 m, 30 m, 45 m, 60 m, and 100-120 m, while the bottom is filled with alluvial deposits from the river Lepenec. Above the river terraces, remains of the old (Pliocene-to-Pleistocene) lake terraces are present, especially near the village Blace on 600-800 m of altitude. Actually, the village itself is located on these terraces.

The east (left valley) side of the Kačanik Gorge is highly dissected with numerous short tributaries. Most of them are intermittent streams (Lopotenec, Banjica-Vrazanska River, Pesji Dol, Morav Dol, Proi I Leskovecit, Proi I Konopit etc.) which will pose a difficulty in the construction of the planned motorway.

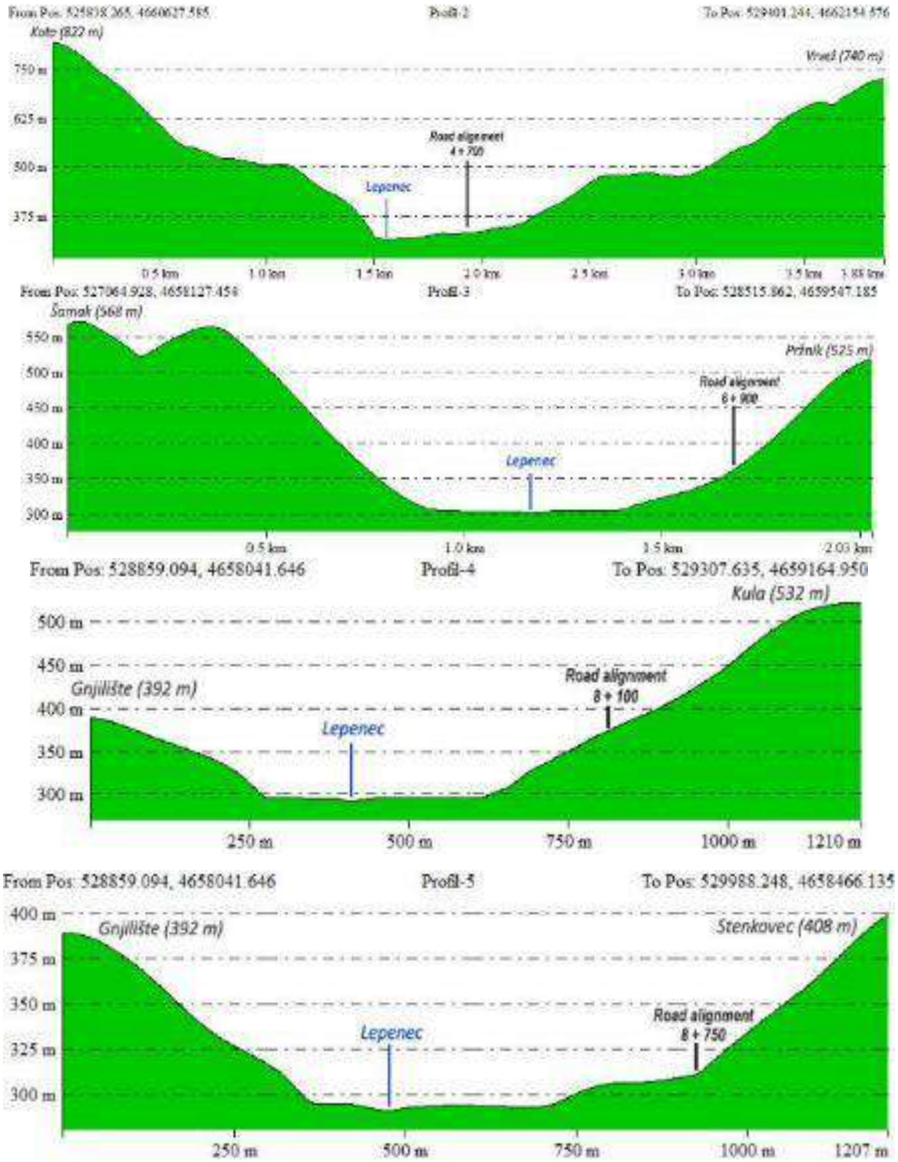


Figure 36 Topographic profiles of the Lepenec Gorge along the project area

Skopje valley bottom: South of the village Orman, the project area passes through the very flat bottom of Skopje Valley, i.e. through the alluvial deposits and lower river terraces of Lepenec and its tributaries as the river Vrazanska Reka. The Skopje basin is a Tertiary graben, directed by NNW-SSE. From the Miocene to the Lower Pleistocene, a lacustrine sedimentation occurred in the depression. Limestone hills, present on all the circumference of the basin, are the results of this sedimentation. At the Lower Pleistocene, regional tectonic activities caused a progressive drainage of the lake installed in the graben. Dumurdzanov et al. (2004) suggest that this process is completed at the Middle Pleistocene. During this time, the depression filled up with clastic sediments, derived from erosion of adjacent relief. Due to differential tectonic movements, these sediments are only present in the north-western part of the basin. They form alluvial glacis and cover the limestone hills. Since the Middle Pleistocene, the Vardar River builds its floodplain in the central part of the graben. Alluvial fans (Upper Pleistocene-Holocene) develop along the normal faults which separate the central depression from the foothills. Many other faults, some still active, compartmentalize the basin in small tectonic units, which are submitted either to a slight uplift or subsidence. This tectonic setting induces differences in the alluvial landscape. Actually, it can be noticed that steeped alluvial terraces of the Vardar River are only present in the uplifting tectonic blocks, located at the periphery of the basin. In the subsiding floodplain, the ancient alluvial deposits are buried under the recent ones. Today, the Vardar River is entirely channelled in the Skopje basin and a dam controls its flow. The Vardar River has two major tributaries in the depression, which also underwent flow regulation works: the Lepenec River, rising in Kosovo, and the Treska River, which rises in the centre of Macedonia. The adjustments of the eastern part of the alluvial plain led to the draining of seasonally marshy grounds. The geomorphic study of the basin of Skopje brings the conclusion that the main morphogenetic processes were carried out at the Pleistocene and that the Holocene morpho-logical changes are to be sought in the Vardar floodplain.

Figure 37 Skopje valley bottom (Skopje plain) in the southern section of the Skopje-Blace alignment

3.3.2.3.1 Morphometry

The project area (buffer zone of 500 m) is located within elevation of 270-560 meters while the mean elevation is 350 m. The slopes of this area are usually moderate and they are higher in the gorge part (20-40°) and much lower in the southern part - Skopje basin (0-5°). The similarly gentle slopes have the valley bottom of Lepenec along the alluvial plain. Actually, along the wider buffer area, plains (slopes <2˚) cover 37%, while slopes >10˚, cover 40.4% of the total. Another 22.6% are gentle slopes (2-10˚). The mean slope of the buffer zone is 9.9˚. The structure of slopes shows that the terrain is suitable for high erosion and mass movement processes and that construction works will be more complex.

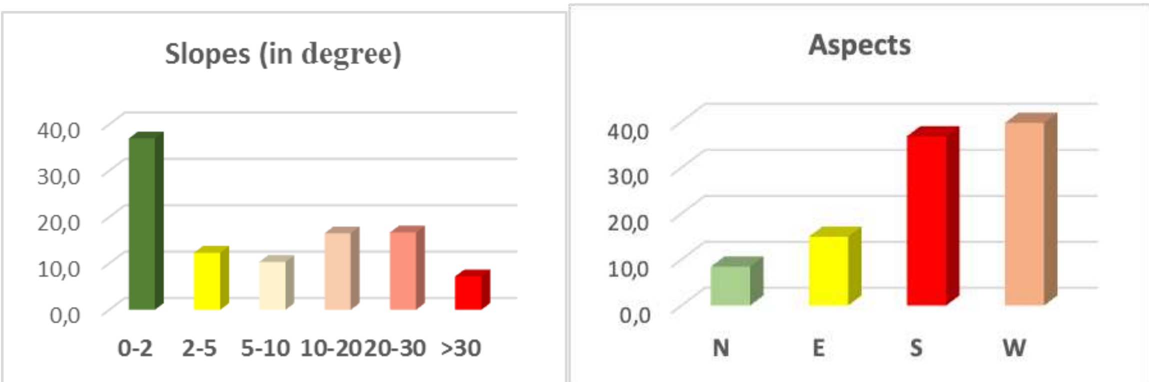


Figure 38 Structure of slopes and aspects in the project buffer area, in %

Because of the terrain morphology of the project area (the course of the Lepenec valley), West and South aspects are dominant in the buffer zone, with 39.7% and 36.8% respectively. These aspects are present mostly on the left (East) valley side of the Lepenec River i.e. this part of Skopska Crna Gora Mt., where the alignment mostly follow. The dominance of Sun-sided aspects (W, S) is narrowly connected with higher erosion rate, torrential streams and shallow mass movements which is evident here. In the following figure, elevation map and slopes of the project area are presented.

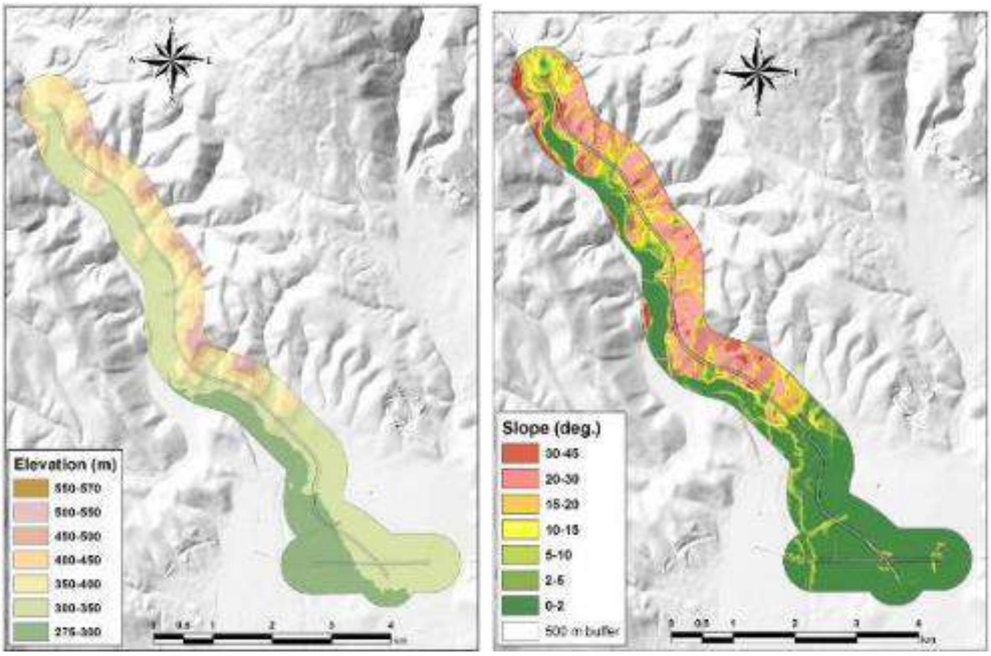


Figure 39 Map of elevation (left) and slopes (right) of the project area

3.3.2.4 Geodiversity

Within the project area, there is no noticeable geodiversity. The project area mainly covers the central and southern part of the Lepenec (Kačanik) gorge and slightly enters into Skopje Basin. In terms of geodiversity, most significant is the gorge section from the state border (villageBlace) to Stenkovec hill which is 300-500 m deep. This is a so-called protrusion type of gorge with the relatively steep sides (20-35°) and with large lacustrine terraces on 600-800 m, on which are the hamlets of the village Blace. Due to the position within the marginal part of Vardar Zone as a geotectonic unit, near the border with the West-Macedonian Zone on the west, and the Pelagonian Zone on the south, the project area is intersected by numerous faults with NW-SE and NE-SW directions, some of which are active. Between these faults are blocks with different types of rocks, including Miocene sediments, gneisses, amphibolite, serpentinite etc., as well as the quaternary alluvial deposits at the valley bottom. The relief is dissected by numerous torrential tributaries of the Lepenec. This part of the gorge is already degraded by quarries on the sides.

Figure 40 Central part of the Lepenec (Kačanik) Gorge in the project area with the river meandering on the bottom and hilly landscape on the sides

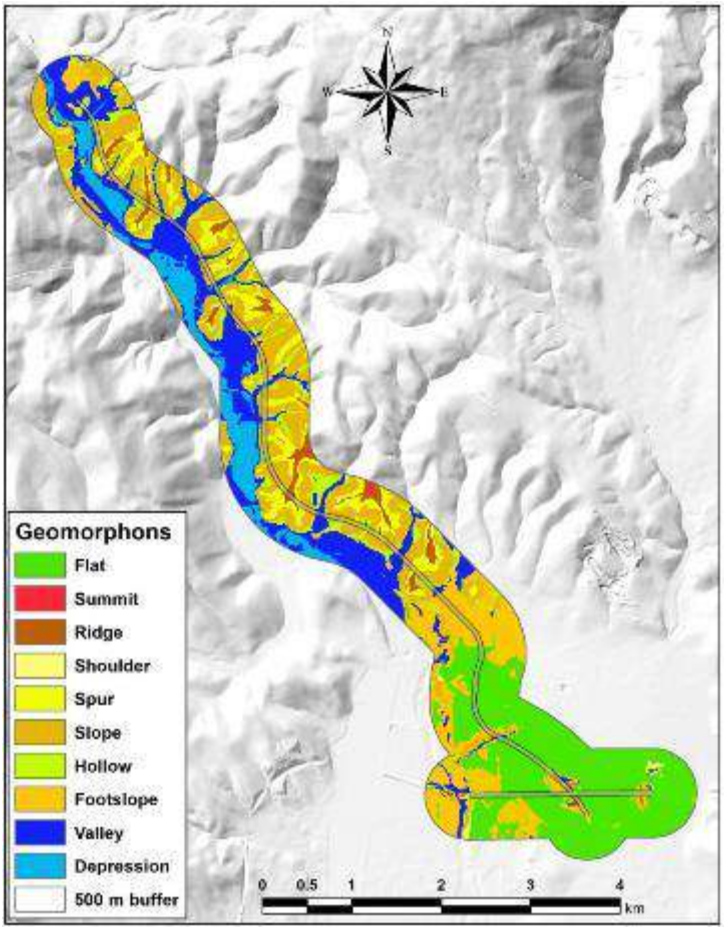


Figure 41 Map of geodiversity (geomorphons) in the project area where the most remarkable is the gorge

3.3.2.4.1 Geoheritage

In the project area and the near vicinity, there are no significant occurrences of geoheritage, except the Banjanska (Vrazanska) Reka Gorge, which is about 4-5 km away to the east, as well as the deepest parts of the Lepenec Gorge. Especially characteristic is the 8 km long gorge of Banjanska Reka (Vrazanska), upstream from the village of Banjane. The gorge is 300-500 m deep, with steep sides and narrow bottom. In places where the river cuts marble belts, the sides are very steep with small karst forms on the surface. Lepenec River is interesting by its protruding type and the remains of river terraces on the left (east) side. However, both gorges are not of the spectacular values that would have a striking effect on the geo-environment.

Figure 42 Lepenec Gorge widening near the village of Blace

3.3.3 Geo-hazards and other natural hazards and risks

Earthquakes, landslides, rock falls, and floods are being considered from the geohazards within the buffer zone of the project area. The project location is in a seismically active area between the Skopje and Kosovo seismic (epicenter) zones.

3.3.3.1 Earthquakes

According to the available seismic maps, the maximum expected magnitude here is 6M with recurrence of about 500 years and maximum expected magnitudes of 5M with recurrence of about 100 years. So, the project area is generally earthquake-prone, especially towards the southern foothills. The reason for this is the numerous neotectonic faults that intersect in the Skopje valley or pass along the southern foot of the Skopska Crna Gora Mountain. At the same time, this seismic activity is an indicator of the modern dynamic tectonics of the area. The first earthquake which was recorded is the one from 518 year, when 24 cities were destroyed, including Skupi. The quake caused 24 km long and a 4 m wide fault. As a result, the surviving inhabitants of Skupi moved a few kilometres southeast to establish the foundations of a new settlement that throughout history will be developed in the City of Skopje. The city was again affected by devastating earthquakes in 1555 (for which does not have much written data) and in 1921 before the last catastrophic earthquake of 1963 year. After 1963 seismic activity in Skopje comes down to approximately one earthquake with an intensity of V MCS per year (Mihailov and Talaganov, 1985). The activity of neotectonic faults that are cut or assembled in the form of nodes, was the cause of the Skopje earthquake of 1963, and more recently of the 5.3M earthquake on September 11, 2016. They occurred right at the S-SW foot of the mountain, near the junction where the Skopje-Kyustendil and Skopsko-crnogorski faults intersect, at a depth of about 5-10 km and a diameter of about 5 km along the fault structures. Along the two faults, the block of Skopska Crna Gora Mt. is moved vertically and in a westerly direction, as evidenced by the elbow turns of the river valleys that descend from the mountain. So, the block of Skopska Crna Gora is relatively unstable and any stronger lateral tectonic pressure leads to displacement and earthquake. Due to the seismicity expressed along the southwestern and southern foothills, it is necessary to practice solid (seismic) and careful construction of the motorway.

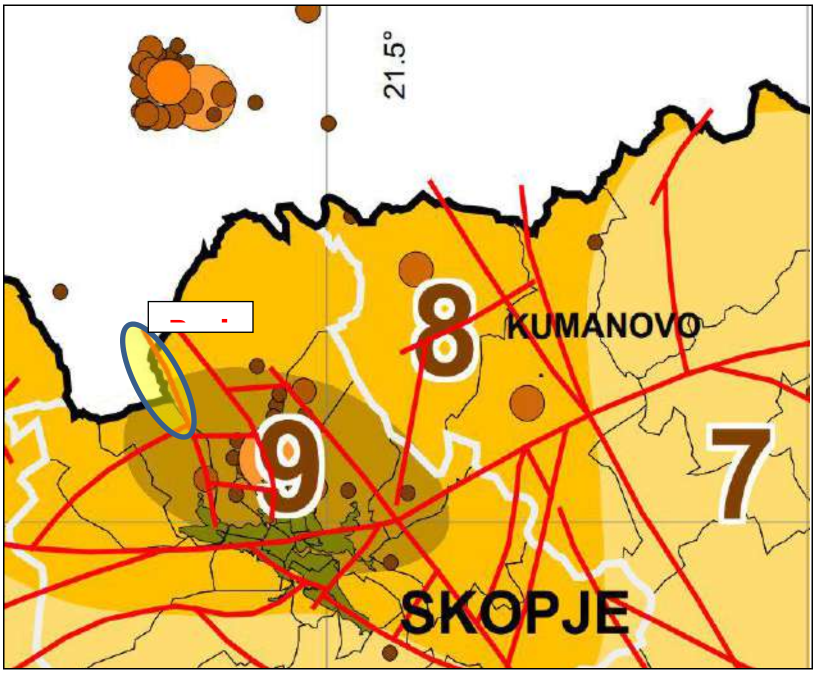


Figure 43 Active faults (red lines) and seismicity of the project area

In the following figure are presented locations which had been affected in the past period from the earthquake.

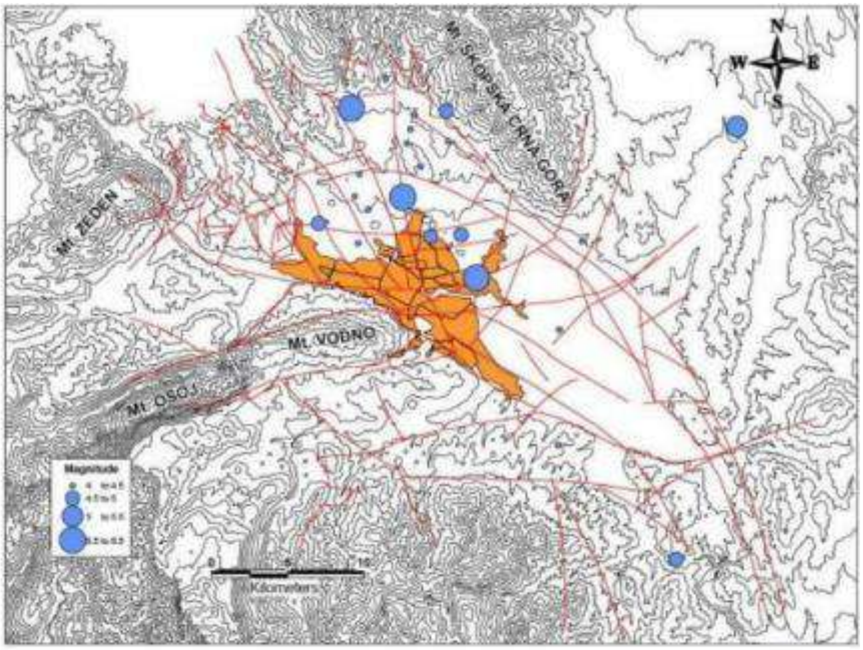


Figure 44 Seismic map of Skopje region with locations affected from earthquakes in the past period

Geophysical surveys, along 9 seismic profiles, have been performed on the location for construction of bridges and tunnels along Skopje-Blace motorway, out of which 8 profiles with a length of 121 m each and 1 seismic profile with a length of 105 m. According to the 2D seismic models obtained by analysis of data from the surveys carried out by use of the seismic refraction method, along each seismic profile, 4 lithological media of different physical-mechanical characteristics have been distinguished:

- Surface layers characterized by quite weak physical-mechanical characteristics (Vs<370 m/s) have been recorded at maximum depth within an interval of 2–4 m. Lateral variation of physical-mechanical characteristics has been recorded almost along all refraction profiles, so that no diluvium has been recorded at some positions i.e. the subsurface zone composed of crushed rock comes out on the surface.
- According to the defined values of propagation velocities of seismic waves (Vs=390-640 m/s), the subsurface zone is composed of crushed and intensively cracked rock. It is found mainly at maximum depth within an interval of 6-7 m. Improvement of the characteristics of the shallower layers has been recorded at the positions of refraction profiles Rp2 and Rp4, the maximum depth of this layer being at 4-5 m.
- The layer that is characterized by seismic velocity values within the interval of Vs=650-980 m/s, represents a transitional layer from intensively cracked to more compact rocks. The maximum depth at which it has been recorded varies within an interval of 10-15 m. At the position of refraction profiles Rp8 and Rp9, it's found at maximum depth of 18 m.
- According to the seismic velocity values, with the increase of depth, the rocks turn into compact ones (Vs>1350 m/s).

The variation of the physical-mechanical properties of the surface layers recorded in some seismic refraction profiles, points to local anomalies and discontinuities in the terrain structure. Although no significant changes in surface layers have been recorded at profile Rp6, cracked zones and discontinuities have been interpreted in the deeper layers of the terrain structure in this part of the investigated site. Hence, it can be concluded that, although the physical-mechanical properties of the rocks are improved with the increase of depth, there have been defined zones with cracks and deformations in the deeper layers.

3.3.3.2 Landslides and rock falls

In terms of landslides and rock falls, part of the project area has a high potential, especially on steep hillslopes, incisions, cuts etc. According to the landslide susceptibility map (Milevski et al., 2019), the highest risk of potential landslides is along the steep terrain composed of serpentinite and Miocene sediments near the village of Blace up to the Stenkovec hill (red color). However, given the proposed ways of constructing and arranging slopes, as well as the selected course of the alignment with short embankments, cuts, and retaining walls, the risk of landslides is expected to be minimal.

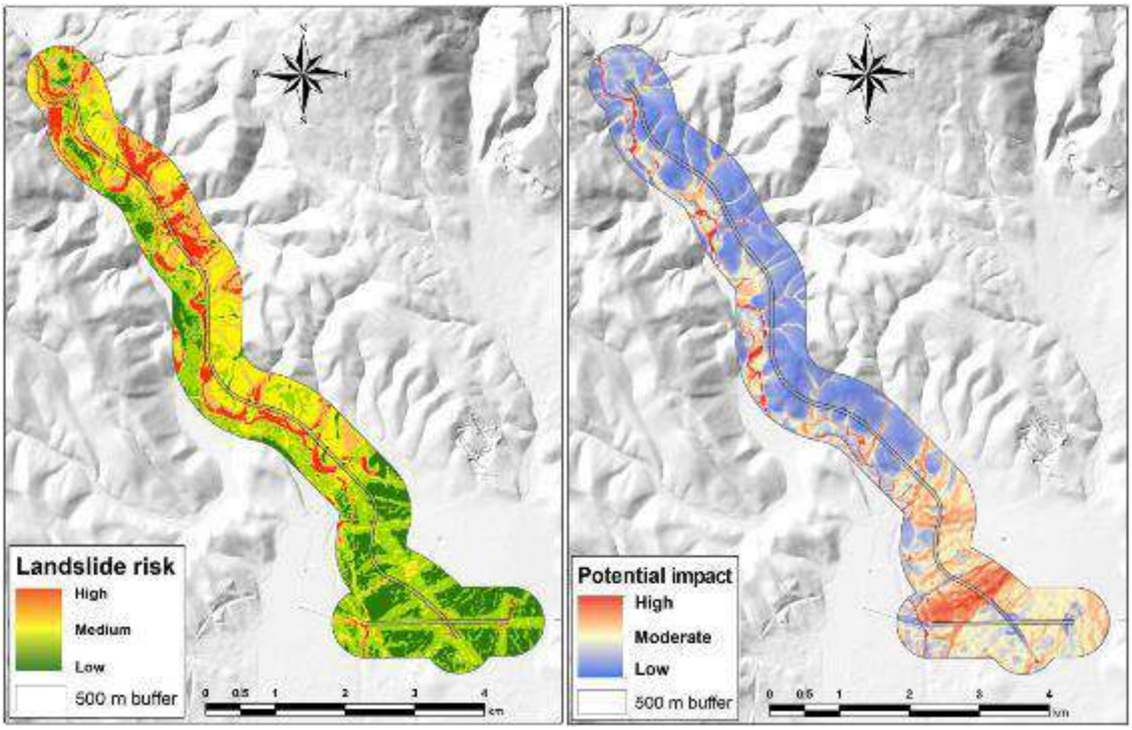


Figure 45 Map of the landslide and rockfalls susceptibility of the project area-left (current situation) and flood risk (right)

3.3.3.3 Floods

In terms of flood, the combination of intense autumn rainstorms, the confluence of the rivers and intermediate streams in the project area and their drainage area which are offering little resistance to floodwaters from floods, have caused large and sudden floods in Skopje in the past. The City of Skopje and the downstream river valley were flooded in 1876, 1895, 1916, 1935, 1937, 1962 and 1979.

In May 1916, the river Vardar overflowed from both banks, entering the streets and houses with a large amount of water. The waters that flowed to the right riverbed of the river Vardar reached the Old Railway Station. Only twenty years later two more floods occurred, and for them, for the floods of 1935 and 1937, there is much more specific information about the flows measured at the hydrological station Skopje-Iron Bridge, as well as at the hydrological station in Shisevo. The main reason for both floods as well on the flood that occurred on November 16, 1962, were the intense rains in the upper course of the river Vardar, the basin of the river Treska and the basin of the river Lepenec.

In the flood that occurred on November 16, i.e. between November 16 and 20, 1962, and which is considered to be the largest in the recent history of Skopje, there were no casualties, but 5,000 houses were flooded and great material damage was caused. After intense rain for several hours, especially in the upper reaches of the Vardar, the water level of the river suddenly rose by several meters and was so large that it filled the flow under the Stone Bridge, the river overflowed the square and the current street "Macedonia".

The water that overflowed from Vardar in a very short time flooded the central parts of the city, but also the part of Skopje where the Government of the Republic of North Macedonia is now, and a real lake formed around the City Stadium, in some places several meters deep. The water in many streets reached a height of up to one meter, and especially on those streets to the quay of Vardar. During the four days of the "flood", the municipalities of Kale and Saat-Kula on the left bank of the river were affected, and Cvetan Dimov Street was completely turned into a river.

In the meantime, the groundwater began to erupt, the Serava River additionally overflowed, so in some places in the city the water reached a level of 1.5 to 3 meters. According to the information published in the newspaper "Nova Makedonija", only with the first wave of the flood, between November 16 and 17, 1962, the water destroyed about 1,000 houses, and about 4,000 families were left homeless.

The flood in 1979 affected a large part of Skopje and the Skopje Valley, starting from Gjorce Petrov to Belimbegovo, leaving behind huge material damage, but, fortunately, without direct human casualties. In Madzari, the Hippodrome and surrounding villages, 1,400 houses were flooded, 20 were completely demolished, and 5,000 residents were evacuated.

General observations are that in conditions of intense rainfall and melting snow, the water flows from the riverbed of the river Lepenec in the Republic of North Macedonia starting immediately after the Kachanica gorge until the inflow into the river Vardar. Based on the Draft Analysis Report of the Lepenec River, it was determined that 124 ha were flooded in 1979 in the plain along the Lepenec River. At the same time, it is estimated that 50 % of the area in the Skopje region exposed to floods, estimated at 8730 ha according to the Assessment of the threat to the City of Skopje from natural disasters and other accidents, is due to the water level of the river Lepenec and its unregulated flow and the non-existence of water protection facilities that would control the flow of the river Lepenec. In addition to the flooding of the Lepenec River in the plain areas, there is a danger of contact with groundwater, due to the degradation of the river banks and the riverbed due to the excessive exploitation of sand and gravel. The Lepenec River is erosive active and transports large amounts of sediment, which is not sufficiently analysed due to the lack of data on measured sediment concentration in hydrological stations.

In the frame of the project *Technical assistance preparation of climate resilience design guidelines for the Public Enterprise for State Roads in North Macedonia, July 2019*, the project team has conduct flood analysis in order to be developed flood hazardous map for the whole regional and magisterial roads in the country. Flood hazard map based on analytic hierarchy process, presented below, produced in GIS environment shows a pattern of flood influenced strongly by rainfall intensity parameters due to high weight assigned during the multi criteria assessment procedure of analytic hierarchy process. The spatial pattern of the flood hazard map has been categorized in five levels of hazard classes namely very low, low, medium, high and very high flood hazard. On the following figure is presented the flood hazardous map for the whole country.

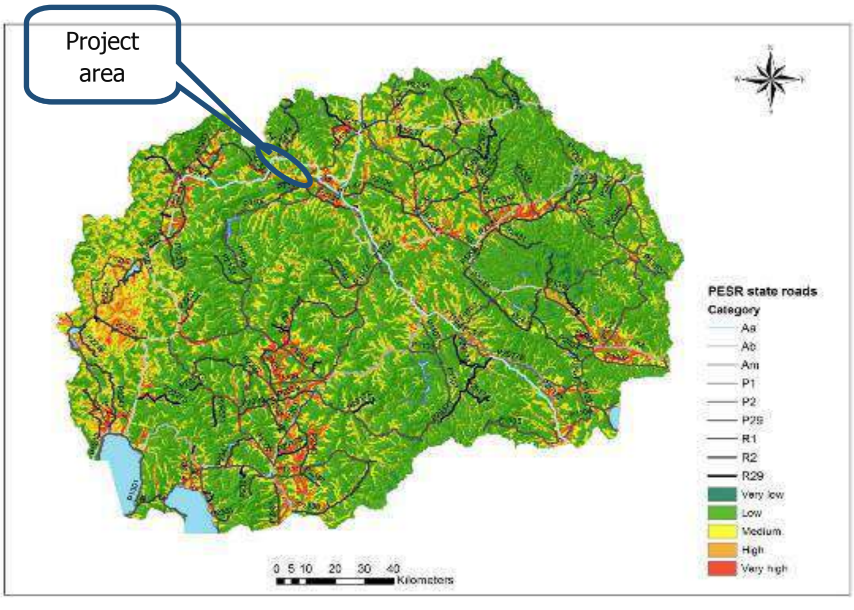


Figure 46 Flood hazardous map

Verification of the resulting flood hazard map is completed using several past flood information where infrastructural damage is evident (for these guidelines, from 2015). The results in the table below show those almost all past flood events were located in hazard classes' medium to very high.

Table 34 Classes of flood hazard and number of historical flood events

FLOOD HAZARD	NUMBER OF EVENTS
Very low	6
Medium	12
Nigh	9
Very high	13

In terms of the flood risk, it is the highest along the Lepenec valley bottom, i.e. on the existing road which is shown on the model. This model is generally based on the Topographic Wetness Index (TWI) calculated from 5-m DEM, with daily precipitations higher than 50 mm. In this scenario, only existing road as well as near surrounding areas will be at potential risk. The proposed alignment will be constructed on a higher elevation, through bridges and tunnels, reducing the risk of flooding to a minimum. The only thing that needs to be taken into account is the possible undercutting or deposition of the material around the columns of the bridges.

Figure 47 Lateral erosion of the Lepenec river with collapse of the river bank near the existing road

Considering the end part of the road section which pass through almost flat area, it is without significant geohazard risk (landslides, rock falls, floods, excess erosion or deposition), except that of the earthquake (M<6.5) from the Skopje epicentral zone.

3.3.3.4 Soil erosion

Due to the steep slopes in the Lepenec gorge, this part of the project area has significant soil erosion potential which can be seen in the presented erosion map based on the modelling of Milevski (2015). However, the lithology under the soils (bedrock) is not suitable for strong or severe erosion processes. This is especially true for terrains made of amphibolites, amphibolitic shales, gneisses, quartzites, marbles etc. There is a slightly higher intensity of erosion rate in the northern part of the project area, near the village Blace, where the terrain is built of non-resistant Serpentinites. On the other hand, the southern part of the project area in the Skopje Plain, which is very flat, is characterized by very low erosion and dominance of deposition. No significant effect on soil erosion and sediment production is expected, except on the cuts and incisions. Some erosive effect will be present on the bridge pillars foundations, which can be excavated by torrential waters or filled by eroded deposits. However, in general, the erosion of this area will not increase considerably, especially with the construction of the alignment due to the shorter length of cuts, embankments and retaining walls.

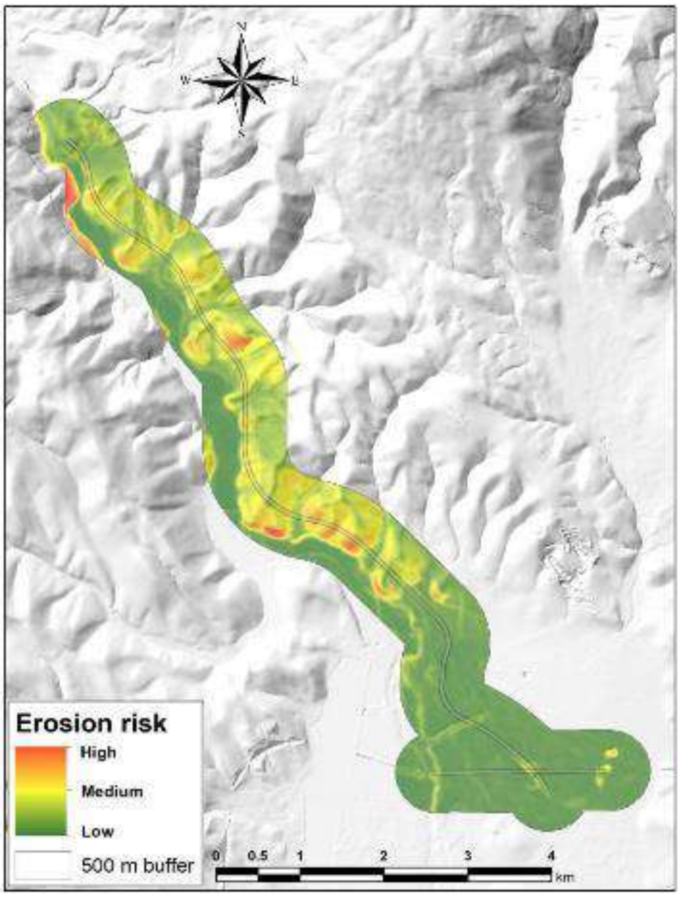


Figure 48 Map of the potential soil erosion risk in the project area

3.3.3.5 Forest fire

Forest fires are one of the biggest problems in forestry, as well as for the environment as a whole in the Republic of North Macedonia. Due to the fires, a large amount of wood mass is destroyed and this is an economic problem. Forest fires cause air, soil and water pollution. Burnt wood is a source for the development of pathogens and pests. Then there is an increase in erosive processes in the burned areas, imbalance of the water regime, loss of vegetation and relaxation. Almost 95% of forest fires are caused by humans. Forest fires in the period under review from 1999 to 2019, destroy an average of about 9,076.51 ha of forest per year. Annually, in the period from 1999 to 2019, there are 217 fires. In 2007, due to extreme droughts and human factors, there were 652 fires on an area of about 35,000 ha. On the following diagram are presented the total surface burned area and burnt wood mass.

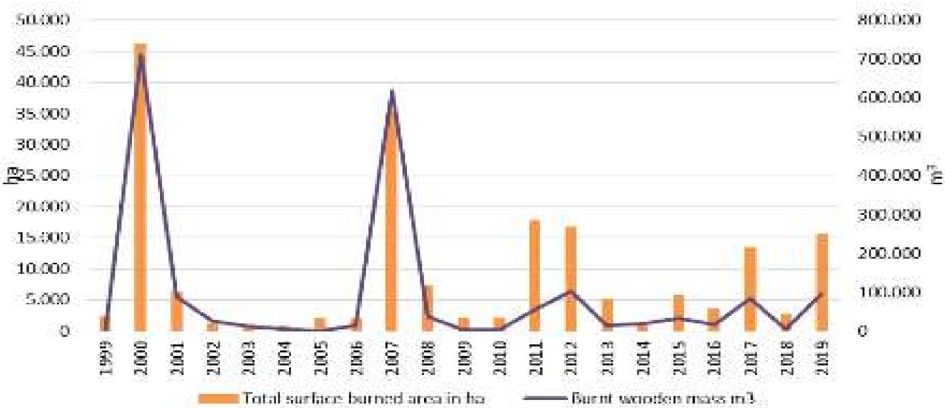


Figure 49 Total surface burned area and burnt wood mass on the territory of Republic of North Macedonia

In the project area, in the period between 2015 and 2020, two major forest fires were recorded by the PE National Forests from Skopje, the first one on Stenkovec locality, cadastral municipality (CM) Gluvo-Brazda, where 5.61 ha of Austrian pine young forest was set on fire and the second one in the forest sections 25a, 26a, 27a and 28a of the forest management unit "Skopska Crna Gora" on Blace locality in CM Blace, where 220,00 ha of oak forest area were burned.

3.3.3.6 Drought

Drought is a common phenomenon in Macedonia. Drought-related meteorological elements are P- average annual precipitation [mm], PET - potential evapotranspiration [mm], AI - aridity index, 0.05 <AI <0.65 - regions prone to desertification, Md - deficit of humidity [mm], DI - Drought Index by De Martone, PF - Rainfall factor by Lang, G - climatic designation according to Gracanin, (a) - ariden, (sa) - semi-ariden and Na, Nsa - number of arid/semi-arid months in the year.

Arid areas exist because the annual water loss (evaporation) exceeds the annual rainfall. Therefore, these regions have a permanent water deficit. Based on the calculation of the aridity index (Ai=ΣH/ PET) on an annual basis, where ΣH is the Precipitation, and PET is the Potential Evapo-Transpiration and the criteria for the RVD Region Subject to Region (Vulnerable to Desertification) according to UNCCD, a map was prepared with designated climatic stations and the aridity index (based on older data 1961-1990). On the following figure is presented the map with climatological stations and aridity index.

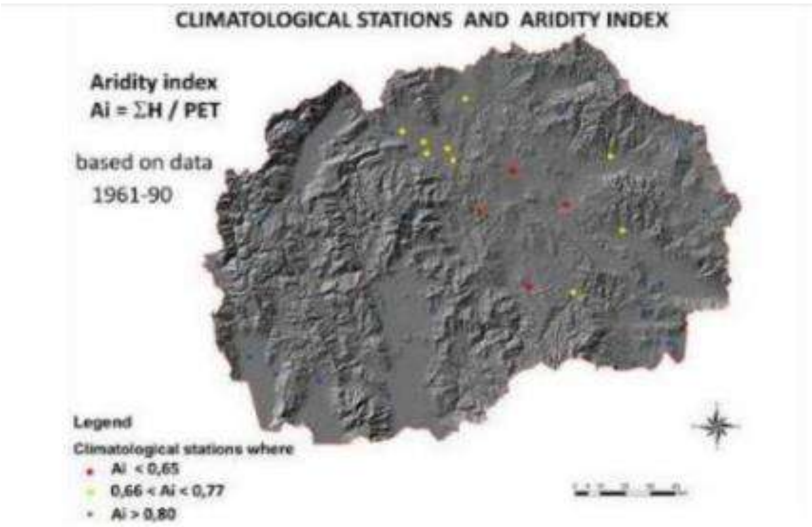


Figure 50 Climatological stations and aridity index

The aridity index for Skopje region is 0,69[13]. Detailed research on the desertification in the Republic of Macedonia, i.e. the marking of the regions subject to desertification, has not been done yet.

3.3.4 Soil (pedological characteristics and quality)

In pedological structure of the Skopje region the following types of soils could be found: vertisols, red soils (terra rossa), cambisols, solonetzes, alluvial soils and skeletal soils. The most prevalent soil type in the Skopje Field are alluvial soils, which cover an area of about 10,000 ha, mostly on the right side of the Vardar River and along the lengths of the major tributaries of Vardar: Treska, Lepenec, Pčinja and Markova Reka rivers. In addition to being very fertile, their value increases because they can be irrigated with water from the rivers (MOEPP, 2009).

Red soils present on the Skopska Crna Gora, Jakupica and Žeden mountains, in the eastern part of the valley and other locations. They are the oldest soils in the valley (MOEPP, 2009).

[13] National action plan for fight against desertification in the Republic of Macedonia (2017-2023)

The lower slopes of Skopska Crna Gora are under diluvium soils. They are composed of vertisols and red material, are sticky and are difficult to process. Terra rossa soils appear on the Karšijak and the higher hills. These clay–loam soils with small quantities of humus are hard and difficult to process; however, they are suitable for growing tobacco and vines. Thus, red soils in the villages of Dolno and Gorno Količani, Pagaruša, Umovo, Cvetkovo and others, produce an extraordinary quality of aromatic oriental tobacco called "Jaka" (Stojmilov, 2002). Cambisols originate from deluvial and alluvial soils. Most of them are present in the north-west part of the area.

Along the whole alignment of ~10,250 km, four types of soil have been identified according to the Macedonia Soil Information System.[14] Such soils are: Complex of Rendzic Leptosol and Chromic Leptic Luvisol on hard limestones, Fluvisol (Fluvial), Rendzic Leptosols and Fluvisol (Colluvium). On the figure below is presented a map of the soil types in the project area.

Colluvial soils are intensively used in agriculture for field and vegetable crops, as well as viticulture and fruit growing, especially if these soils are irrigated. The rendzinas are cultivable, and a small portion is under grassy xerophytes vegetation and forests.

The chromic cambisols (Cinnamon soils) are characterised with middle productive capacity and this type of soil is used for vineyards. Ass. Querco-Carpinetum orientalis macedonicum presents this type of soil.

The fluvisols (alluvial soils) are characterised by the highest productivity. This type of soil has favourable physical and chemical characteristics for agriculture. On this type of soils are developed following plant associations: ass. Salicetum albae fragilis, ass. Populetum albae - nigrae and ass. Tamarici - Salicetum amplexicaulis. Fluviative - meadow soils are characterised by high fertility and thev are used in agriculture.

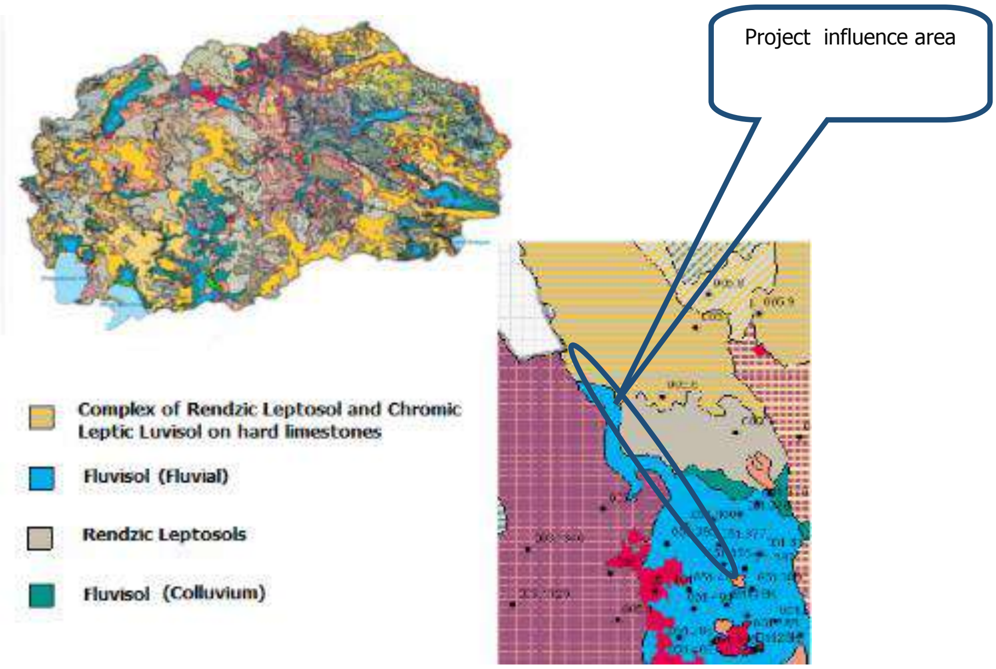


Figure 51 Soil types in project area

Geochemical atlas for Skopje region has been prepared in 2017[15]. The purpose of this atlas is monitoring and determination the distribution of heavy metals and other elements in the soil in the city of Skopje and its immediate surroundings. Soil samples were collected according to a sampling network of 2 km×2 km, 1.5 km×1.5 km and 0.5 km×0.5 km and in the investigated region samples

[14] http://www.maksoil.ukim.mk/masis/
[15] Geochemical atlas by Trajče Stafilov from the Faculty of Natural Sciences and Mathematics in Skopje, Robert Šajn from Geological Survey of Slovenia – Ljubljana and Laura Ahmeti from Faculty of Natural Sciences and Mathematics in Skopje.

were taken from 231 locations. One sample represents a mixture of five samples collected in an area of 10 m^2 from the surface layer (0–10 cm). The proposed alignment of the motorway Our project location was covered with this monitoring network at the southern part of the alignment close to Vrazanska River and Lepenec River.

The content of 17 macro elements and trace elements (Ag, Al, As, Ba, Ca, Cd, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Sr and Zn) was analysed using atomic emission spectroscopy with inductive coupled plasma (ICP-AES) and further 38 elements (Be, Br, Co, Cs, Ga, Ge, Hf, Hg, In, Mo, Nb, Pd, Pt, Rb, Rh, Sb, Sc, Sn, Ta, Ti, Tl, W, Y, Zr and rare-earth elements Ce, Dy, Er, Eu, Gd, Ho, La, Lu, Nd, Pr, Sm, Tb, Tm and Yb) using mass spectrometry with inductively coupled plasma (ICP-MS).

In addition are presented the results from the performed monitoring i.e. average contents of the chemical elements in soil according to the land use. The measuring point relevant for the project falls in the category of Industrial area.

Table 35 Average contents of the chemical elements in soil according to the land use[16]

Element Елемент	Unit Единица	Forest Шуми	Shrub Грмушки	Open area Отворени површини	Cultivated land Обработени површини	Urban area (low buildup) Урбана област (ниска градба)	Urban area (high buildup) Урбана област (високи градби)	Industrial area Индустриска област
Ag	mg/kg	2.8	2.9	2.5	2.9	2.6	2.7	1.7
Al	%	3.6	4.0	3.5	3.8	3.8	3.9	3.7
As	mg/kg	8.8	11	18	12	14	11	12
Ba	mg/kg	230	250	230	290	300	290	310
Ca	%	4.4	5.2	4.5	4.6	4.7	5.1	4.5
Cd	mg/kg	0.61	0.62	0.61	0.48	0.52	0.68	1.0
Cr	mg/kg	95	100	110	110	100	92	91
Cu	mg/kg	33	31	31	29	37	32	39
Fe	%	3.0	3.1	2.8	3.0	3.1	3.1	3.1
K	%	1.2	1.2	1.0	1.3	1.3	1.2	1.2
Mg	%	1.2	1.3	1.2	1.2	1.2	1.4	1.2
Mn	mg/kg	770	680	660	700	710	740	730
Na	%	0.43	0.57	0.47	0.52	0.55	0.67	0.51
Ni	mg/kg	74	85	87	94	86	80	73
Pb	mg/kg	38	45	48	49	61	60	76
Sr	mg/kg	73	96	81	86	93	84	87
Zn	mg/kg	97	83	110	86	120	130	160

On the following figure is presented the sampling map with the project area.

[16] Source: Geochemical atlas of Skopje region, 2017

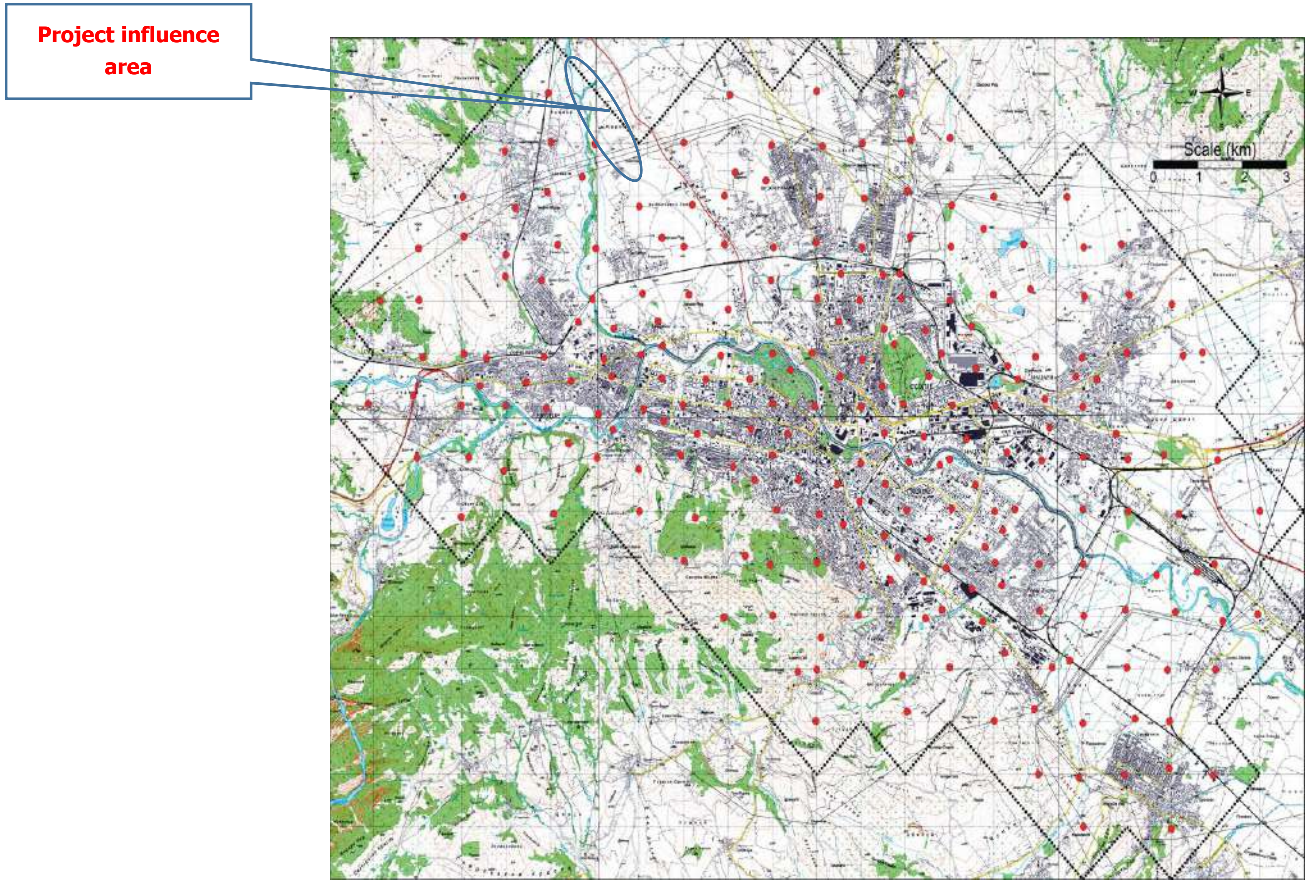


Figure 52 Location of samples[17]

[17] Geochemical atlas of Skopje region, 2017

3.3.5 Surface water

3.3.5.1 Hydrology

The hydrographical network of the analysed area is characterized by the presence of streams with temporary water flow which belong to the catchment area of the Lepenec River. The Lepenec River, a 75 km long left tributary to the Vardar River, belonging to the Aegean Sea Basin, located in southern Kosovo and northern part of N. Macedonia. The Lepenec River shapes the border between Kosovo and N. Macedonia in a length of 5 km. After its course of 60 km it leaves Kosovo. In N. Macedonia, Lepenec River basin flows through the territory of the municipalities Cucer Sandevo, Gjorce Petrov and Karpos. On its Macedonian course, the River flows through the low Skopje depression for 15 km: there are not large settlements, before it reaches the northern suburbs of Skopje, Bardovci and Novo Selo, and flows into Vardar River at the Skopje's northern borough of Gjorce Petrov at an elevation of 262 m a.s.l. According to the analyses of the Water Master Plan of the Republic of Macedonia, the total catchment area, until confluence with Vardar, river is 770 km^2; the density of the network is 0.39m/m^2; the average altitude is 955 m a.s.l.; the average stream gradient is 20% (the highest elevation at the spring is 1860 a.s.l. and the lowest is at its confluence – 262 m a.s.l). The area is characterized by a developed hydrographical network, interspersed with the tributaries of the Lepenec River, ravines with seasonal water-flow as well as occasional atmospheric water deluges which intersect the alignment. Vrazanska River (the same could be found as Banjanska River) as presented in a desktop data, is the only one permanent tributary of the Lepenec River in Macedonia with total length of 15 km. Vrazanska River is a left tributary of the river Lepenec. It rises high on the slopes of Skopska Crna Gora and flows from north to south, through a steep valley (canyon) with high incised slopes and rocks near the medieval monastery "St. Ilija" all the way to the village Banjani. From the village of Banjani it continues to flow through the vast flat plateau in the Skopje Valley to below the village of Brazda, where it joins the Kucevishka River, from where as Vrazanska River turns its direction of flow west and southwest to the confluence of the Lepenec River, opposite the village of Volkovo. During the site visits (dates given in chapter 3.1), the river was dried out and no water was present in the river bed.

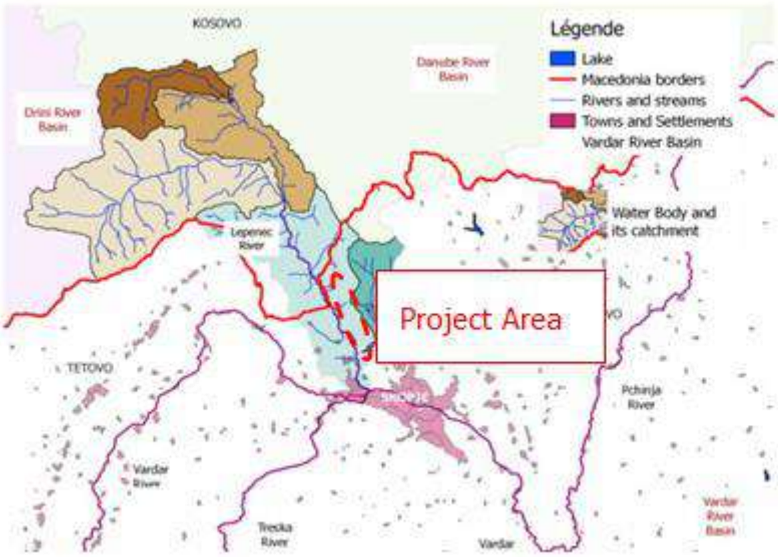


Figure 53 Hydrographic map of the project area

During 2009/2010 on the river Lepenec, at the measurement point "Border" were determined exceeding of the average values of the flow Qav=11.7 m^3/s, which is 1,49 times higher than the multi-year average flow which is Qav=7.84 m^3/s (shown in the following graph).

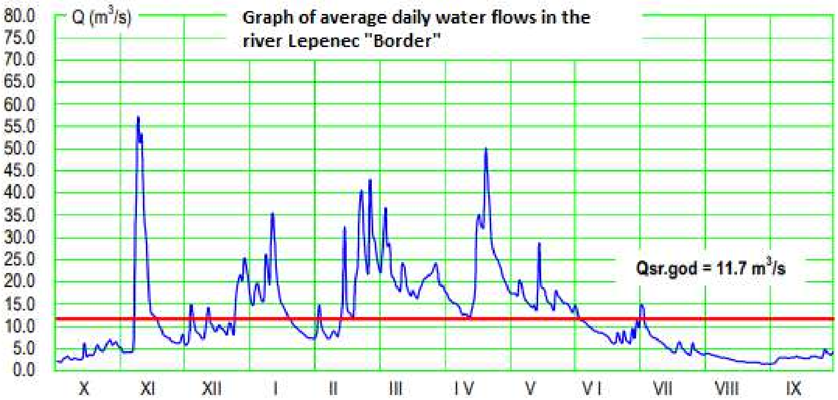


Figure 54 Graph of average daily water flows in the river Lepenec "Border"

During 2009/2010 on the river Lepenec at the measurement point "Mouth" were determined exceeding of the average values of the flow Qav=11.9 m^3/s, which is 1,51 times higher than the multi-year average flow which is Qav=7.88 m^3/s (shown in the following graph).

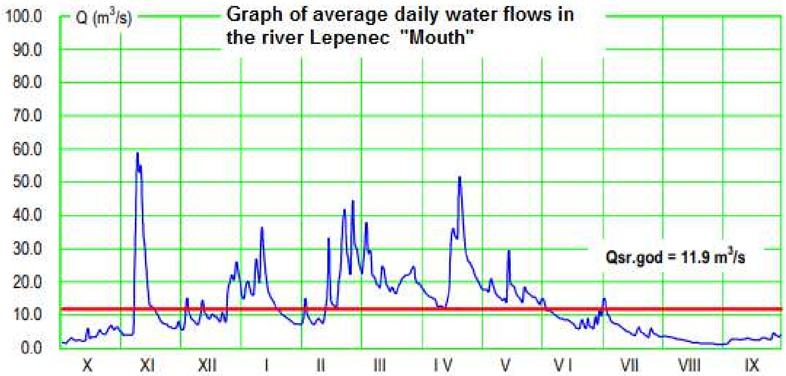


Figure 55 Graph of average daily water flows in the river Lepenec "Mouth"

Alongside or near to the corridor route of the motorway section Blace-Stenkovec flows the River Lepenec. The course of the river Lepenec passes west of the route of the motorway. At the begging of project, the route of the corridor passes near or alongside of the River Lepenec, but they are **not intersected at any place**.

The motorway corridor intersects the intermittent streams located on the following chainages:

- Intermittent stream (without name) ~ km: 2+200
- Intermittent stream (without name) - km 3 + 600
- Morav Dol - intermittent stream - km ~ 3 + 900
- Intermittent stream (without name)- km ~4+300
- Pesji Dol - intermittent stream - km ~ 4 + 700
- Intermittent stream (without name) - km 6 + 000
- Intermittent stream (without name) - km 6 + 400
- Intermittent stream (without name) - km 7+600
- Intermittent stream (without name) - km ~ 8+200
- Lopotenec - intermittent stream - km ~ 8+700
- Intermittent stream (without name) - km ~ 9+200.

On the right site of the motorway corridor flows the River Lepenec, but it is not intersected at any place. The alignment between the km: 2+000 to 3+600 intersects the intermittent stream (without name) at ~ km: 2+200, where is predicted construction of bridge. In this part the River Lepenec is located at ~40 m distance, on the opposite site of the existing road. Between the km 3+600 to ~ km 4+700 the alignment intersects the intermittent streams. In this part the lower distance of the River Lepenec is approximately 200 m. At km 6+000 the River Lepenec passes at an approximately distance of 100-150 m.

Figure 56 Intermittent stream at km: 2+00 to 3+600

Figure 57 Water bodies at km: 3+000 to 5+000

At km 6+400 bridges are predicted. The River Lepenec passes at an approximately distance of 100 m. At km 7+600 there are no predicted bridges. The River Lepenec at this chainage passes at an approximately distance of 500 m.

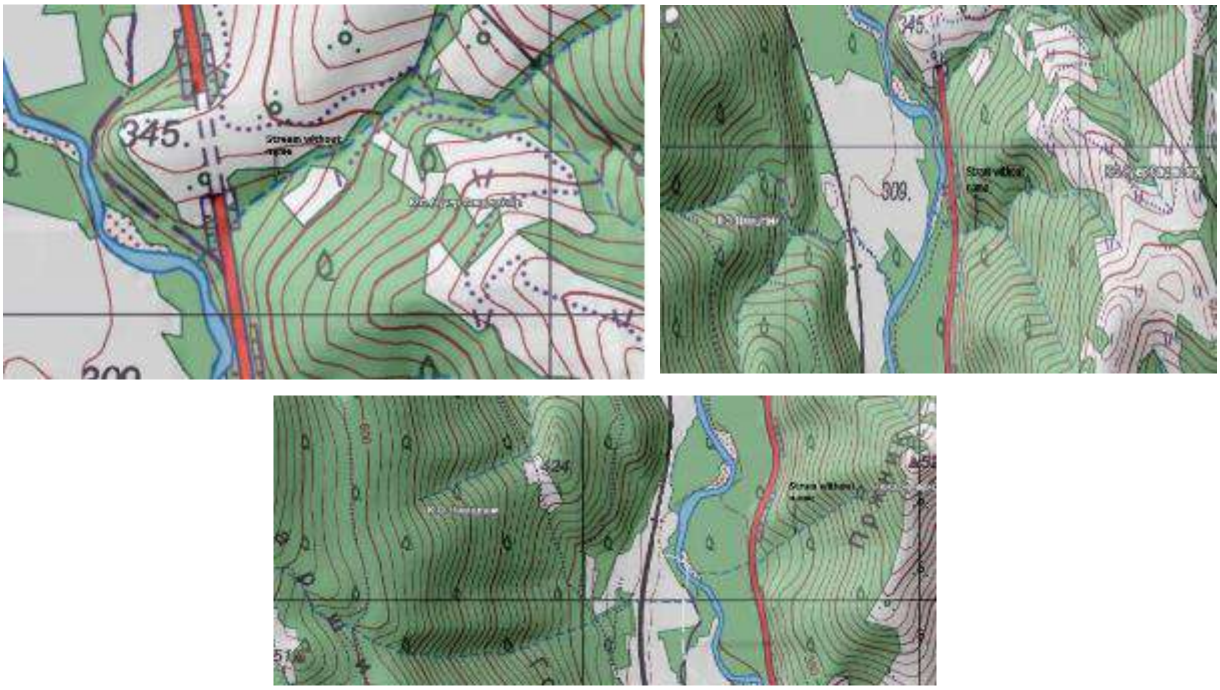


Figure 58 Water bodies between km: 5+000 to 8+000

At km 8+200 construction of tunnel 5 is predicted. At km 8+700 the temporary water course Lopotanec (part of it is canalised) intersects the alignment. The box culvert C15 4,00x3,00 (BxH) is predicted for the passage of water course Lopotanec. The culvert is proposed to be at km 8+686,55 (left axis) and km 8+715,68 (right axis) of the motorway. The River Lepenec passes at an approximately distance of 500 m.

At ~km 9+200 on the topographic map[18] (presented below) is identified intermittent streams (part of it is canalised) while in the project on km 9+450 construction of culvert is predicted. The River Lepenec passes at an approximately distance of 500 m.

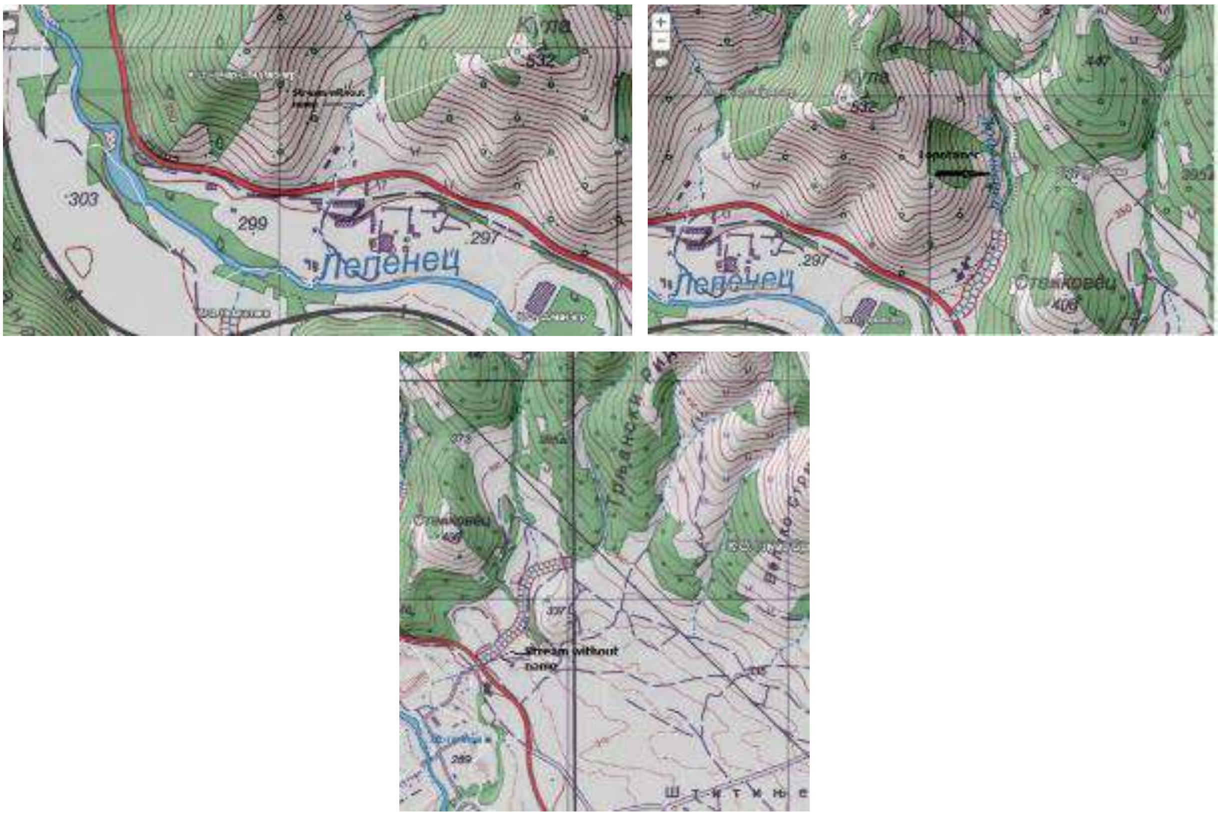


Figure 59 Water bodies between the km 8+000 to 9+200

For locations where the alignment intersect the intermittent streams and it is not predicted construction of bridges will be installed other structures such as culverts and underpasses. Also, it should be mentioned that all predicted bridges in the Conceptual design are not predicted for overpassing of the water bodies.

In the southern part of the corridor the alignment intersects the Vrazanska River at km ~11+300. The alignment for south part of the motorways is passing at distance of 500-1000 m from the river Lepenec. In the following figure is presented topographic map with identified water course in the project area.

Figure 60 Vrazanska River at km 11+300

[18]http://gis.katastar.gov.mk/arec

3.3.5.2 Surface water quality

The Lepenec River from the border with Kosovo to the Vardar River estuary (Skopje, under Zajcev Rid) is classified as a Category II watercourse, in accordance with the Decree on Water Classification ("Official Gazette of the Republic of Macedonia" No. 18/99). Water quality measurements in the river Lepenec at the measuring point - Border and at the place where Lepenec flows into the Vardar River, carried out by the Hydro Meteorological Department, indicate a category of water from IV, and even V class, which far exceeds prescribed class II. According to these facts it can be concluded that there are pollutants upstream and downstream that emit organic pollutants into the river.

In order to determine the anthropological pressures and impacts on the status of surface and groundwater within the Lepenec river basin, the point and diffuse sources of pollution are analysed. The point sources of pollution are: communal and industrial wastewater, illegal waste disposal and mining. The main potential diffuse sources of pollution are agriculture and water intakes. Some of the industrial facilities located in the southern part of the motorway discharge the industrial wastewater without prior treatment in the river Lepenec, others are using their own septic tanks. Large anthropological impact on the river Lepenec have illegal landfills for municipal waste and construction waste along the river bed, which adversely affect the flora and fauna in the river. Also, water intake has a negative anthropological impact if it significantly reduces the flow of the Lepenec River.

3.3.5.3 Ecological status of the River Lepenec according to national legislation and WFD

In order to be access ecological status of the River Lepenec according to national legislation and WDF monitoring of water on the river Lepenec was conducted on 2 measuring points (Lepenec-Border MP1 from source and Lepenec - Mouth MP2 – inflow in river Vardar in the period 2018-2020). On the bases on conducted monitoring of the River Lepenec was accessed the ecological status of the River according to the WFD. According to the Decree for water classification ("Official Gazette of RM" no.19/1999) the water is classified into 5 classes i.e. I class, II class, III class, IV class and V class based on conducted physical-chemical analyzis. The classification of the water according to the WFD is also into 5 classes i.e. bad, poor, moderate, good and high based on performed physical-chemical analysis, algae and invertrebrates. In the national legislation up to know there is no any regulation for determination the status or classes of water based on performed analysis for algae and invertrebrates. The identified classes and statuses corresponds one to another which can be seen from the following table.

Table 36 Correlation of the water classification according to the national legislation and WFD

National classification of water	WFD classification
I class	High
II class	Good
III class	Moderate
IV class	Poor
V class	Bad

In Annex 7 are presented data related to water quality and water quantity measurement points, as well as the assessment of the ecological status of the river. From assessment of ecological status of the River, the following can be concluded:

Algae: According to the IPS index for the epilipton, epipelon communities at Lepenec - Border MP1 ecological status vary from moderate to poor for the period from 2018 to 2020 and at Lepenec - Mouth MP2 from good to acceptable, in the period from 2018 to 2020 year.

Invertebrates: Based on the macroinvertebrate community structure as well as the values of the biotic indices, at Lepenec - Border MP1 and Lepenec - Mouth MP2, from 2018 to 2020 the ecological status varies from moderate to bad.

General physical-chemical elements - status is **poor** in both measuring points Lepenec – Border MP1 and Lepenec – Mouth MP2 in 2018 and 2019 year due to the high concentrations of phosphates and moderate in 2020. The other elements BOD, nitrates, nitrites, COD and conductivity also vary from moderate to poor status.

In the table below is given Ecological water body status for WB_1 Lepenec – Border MP1 and WB_2 Lepenec – Mouth MP2 according to the WFD. The results for the performed physical – chemical analysis are compered according to the Decree for water classification ("Official Gazette of RM" no.19/1999) and the WFD.

Table 37 Ecological water body status for 2018, 2019 and 2020 year

Measurement point	Water Body	General PH-CH WB status	Algae - IPS - Status	Invertebrate - Status	Ecological water body status
1. Lepenec– Border MP1 2018	WB_1	**P**	M	**P**	**P**
2. Lepenec– Mouth MP2 2018	WB_2	**P**	M	B	**B**
1. Lepenec– Border MP1 2019	WB_1	**P**	**P**	B	**B**
2. Lepenec– Mouth MP2 2019	WB_2	**P**	M	M	**B**
1. Lepenec– Border MP1 2020	WB_1	**M**	**P**	**P**	**P**
2. Lepenec– Mouth MP2 2020	WB_2	**M**	**A**	**P**	**P**

Legend: B- bad; P-poor; M-moderate: A-acceptable

Based on the performed analysis, the status of the water is from poor to bad for the period from 2018 up to 2020. As what can be seen from the identified status in the table above, in 2018 the status of the water on the MP1 is poor and on the MP2 is bad. This is as a result of the diverse industrial activities in the project area, especially in the industrial zone Vizbegovo where some of the facilities are discharging their waste water through the sewage into river Lepenec, without any treatment. Also in the southern part of the motorway few illegal landfills are identified. In 2019 the ecological status of the water in river Lepenec at both measuring points is bad. This is as a result of the industrial activities and the untreated industrial and communal waste waters from the Republic of Kosovo and Republic of North Macedonia. Also the illegal disposal of waste (along the river in both countries) contributes to the poor/bad status of the water in river Lepenec. In 2020 the ecological status of the water in the river Lepenec at both measuring points is poor. It can be concluded that the cement plant in Kosovo near the border, as well as wastewater from nearby houses and industrial facilities in the southern part of the alignment (Industrial zone Stenkovec in R.N. Macedonia). Agricultural activities, near the river in both countries, further deteriorate the ecological status of the river.

3.3.6 Ground water

Due to the lithology type and the shallow soils on the steep slopes, the project area does not have a wealth of groundwater. Several small springs have been recorded at the bottom-edge of the Lepenec valley, near the existing road.

The larger reserve of groundwater can be found in the alluvial deposits along the river Lepenec through the gorge, and especially in the river terraces at the exit from it to the Skopje basin. Since these are alluvial sediments (sand, pebble, gravel), the southern part of the motorway may affect the groundwater.

In the Interim Report No.4 for performed geotechnical investigations (for section 2 from km 2+000 to km 12+075,16), the level of the ground waters during the drilling of investigation boreholes is indicated. During the drilling and sampling (March-August, 2021) the ground waters are recorded in variable depth between 5,6 m (km 2+238) to 68,8 m (km 2+720). Shallow ground waters are finding in clastic (alluvial, colluvial and riverine) sediments and weathered rocks, while in amphibolitic schists, gneiss and clay they were much deeper or totally absent. Another thing is that during the seasons the ground water level is very changeable. Thus, the drilling shows that during the spring and early summer (March-June), ground waters are shallow, contrary to late summer (August). In this regard, the water level table is closely related to the humid or dry season. Also, it can be expected that the ground water level varies from year to year.

Table 38 Locations and depths of the registered ground water levels

Chainage (km)	Depth (m)	Structure
2+238	**5.6**	Bridge L
2+240	7.5	Bridge R
2+288	9.8	Bridge L
2+458	18.9	Cut L*
2+720	55.7	Tunnel R
2+720	68.8	Tunnel L
2+860	17.3	Tunnel L
3+140	10.5	Bridge R
3+280	8.3	Bridge R
4+320	6.2	Embank R
4+485	13.7	Cut L**
4+680	7.9	Underpass
5+372	11.0	Underpass
9+700	9.2	Underpass***
10+280	8.5	Underpass
10+510.8	6.1	Underpass
11+840	8.1	Underpass
12+122	10.2	Underpass

In the following table the variable seasonal depth of the ground waters for the three boreholes (2021) is presented.

Table 39 Variable seasonal depth of the ground waters for the three boreholes (2021)

	March	May	June	August
2+458		8.6	16.0	18.9
4+485		13.7	Collapsed	Collapsed
9+700	10.0			9.2
9+700	8.5			Collapsed

In the following figure is presented the potential vulnerability of the ground waters in the project area.

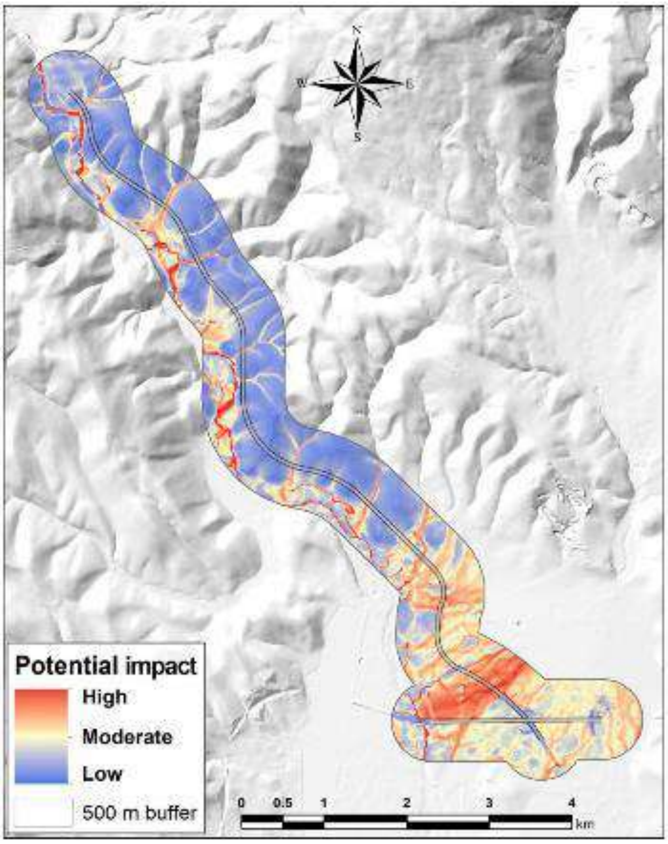


Figure 61 Map of the potential vulnerability of the ground waters in the project area

Figure 62 Entering of Lepenec River in the Skopje Basin (Skopje Plain) with huge alluvial deposits and rich ground waters which are under threat

In the project area there is no public water supplying system. The inhabitancies and industrial capacities provide water from springs and own wells, which are not registered in the competent Ministry, Municipality and Cadastre. According to the data obtained from the MoEPP (Water department) and the Agency for Real Estate Cadastre, only one well used for irrigation of private agriculture land have been officially recorded, near the existing road. On the following figure is presented the location of the well which is used for irrigation of private agriculture land.

Figure 63 Location of the well close to km 10+000

The alignment is located in the wider (3rd) protection zone of Nerezi wells up to km 9+100 and partially close to the 2nd zone, approximately distance of 300 m at km 10+400 of the alignment. On the following figure is presented a map of the protected wells area Nerezi Lepenec with the alignment of the motorway.

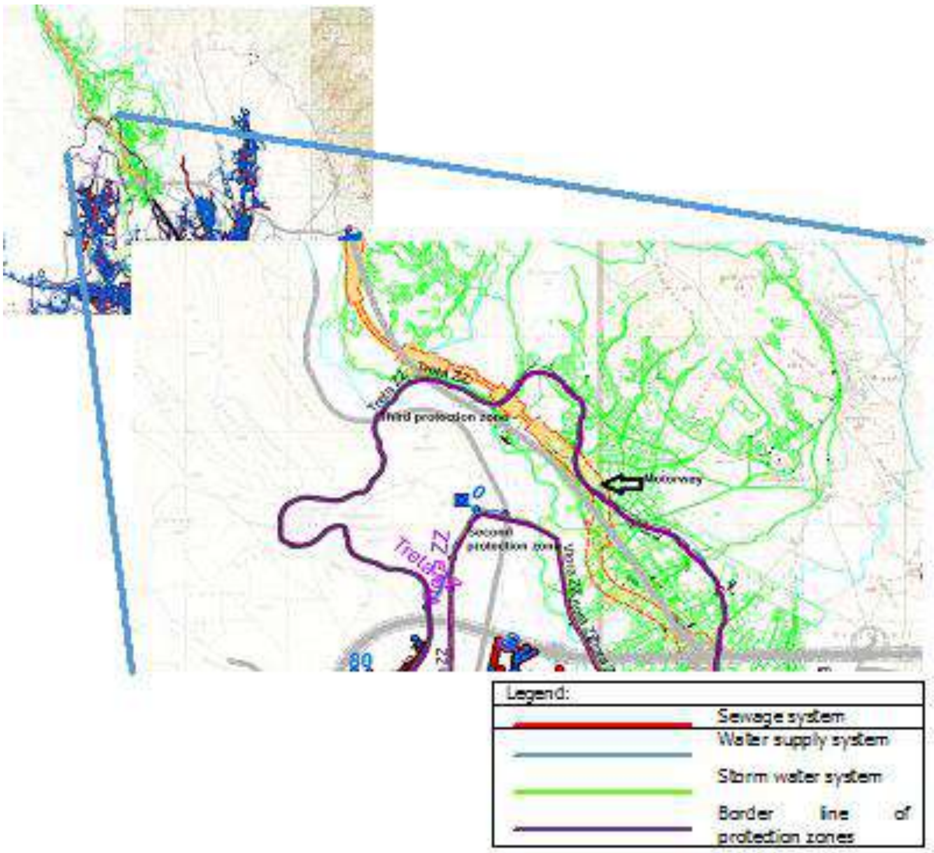


Figure 64 Map of the protected wells area Nerezi Lepenec with the alignment of the motorway

In accordance with the Decision on determining the boundaries of the protection zones in the well area Nerezi-Lepenec ("Electronic Official Gazette of the City of Skopje", No. 14, from 11/08/99), in the 2nd protection zone the following activities are prohibited:

- Construction of facilities and performance of other works, such as exploitation of slag, sand, stone and land use in a manner and scope that endangers natural values, quality, quantity and regime of surface and groundwater,
- Construction of cattle and poultry farms,
- Uncontrolled transport, storage and use of liquids that are dangerous for the underground aquifers (oil, oil derivatives, acids, etc.),
- Discharge or storage of oils, acids and other harmful, toxic and radioactive substances,
- Waste disposal and garbage,
- Direct discharge of wastewater into open watercourses.

In the wider (3rd) protection zone the following activities are prohibited:

- Exploitation of sand, stone and land use in a manner and scope that endangers natural values, quality, quantity and regime of surface and groundwater,
- Direct discharge of wastewater into open watercourses,
- Disposal and disposal of waste materials and garbage outside organized, secured and controlled landfills,
- Release of oils, acids and other harmful, dangerous and radioactive substances.

3.3.7 Climate characteristic

Climate: Two main climate zones are meet over the territory of the Republic of North Macedonia – Continental and Mediterranean. Therefore, they change to moderate continental and modified Mediterranean climate. Nevertheless, there are considerable differences in weather characteristics at different locations. Generally, July is the hottest month of the year when the temperature reaches over 40°C at certain locations, while January is the coldest one and temperatures as low as -25°C have been recorded. The amount of precipitations also varies between 490 mm in the eastern part to over 770 mm in the western part of the country.

For the purpose of the ESIA, data for the project area was collected for the location: lat=42.08°, lon=21.35° covering the period 2000 to 2020 have been retrieved from Open Weather Map (https://home.openweathermap.org/history_bulks).

Wind: Data have shown that the wind rose is pretty stable apart from the fact that in the past five years the share of North and North-Northwest winds have diminished.

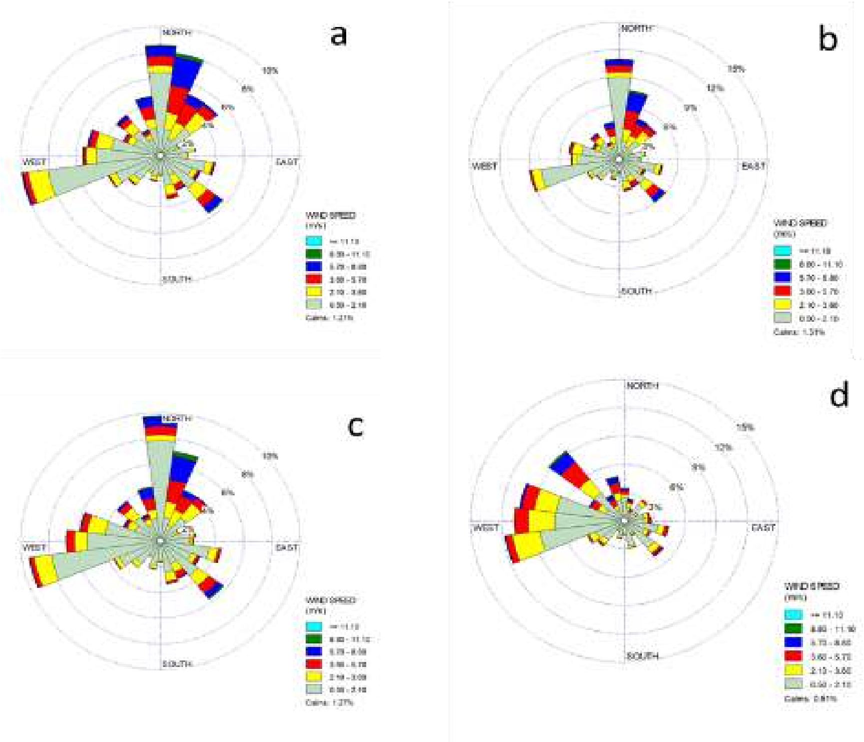


Figure 65 Wind roses for subsequent time periods: a - 2001 to 2005, b - 2006 to 2010, c - 2011 to 2015 and d – 2016 to 2020

There are no strong winds in the project area. By far most common wind class has a velocity of 0.5 to 2.0 m/s. The share of calm periods (<0.5m/s) is very low. It ranges between 0.5 and 1.3%. The distribution of wind classes is shown in the following figure.

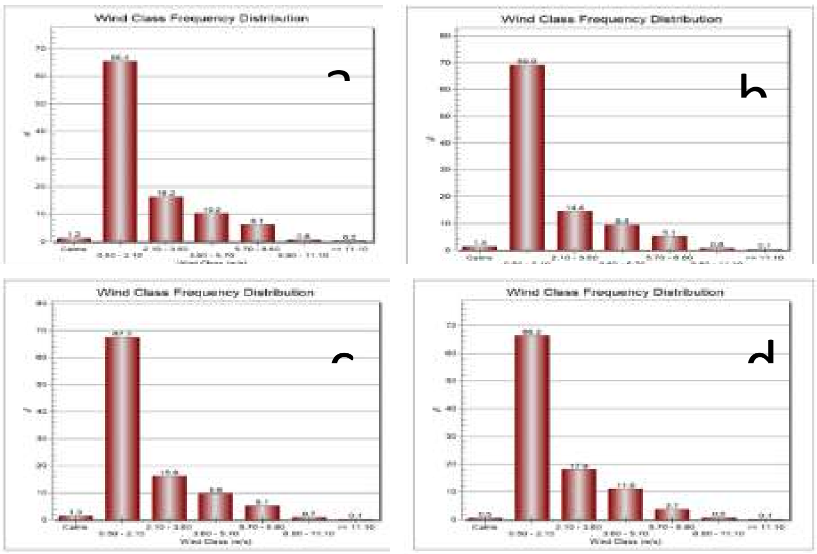


Figure 66 Distribution of wind classes for subsequent time periods: a-2001 to 2005, b-2006 to 2010, c-2011 to 2015 and d–2016 to 2020

Temperature: According to the data received from Open Weather Map (https://home.openweathermap.org/history_bulks), the temperature varied from -22.4 ^{0}C to +41.2 ^{0}C in the twenty year period. A more detailed analysis has been carried out for the years 2001, 2010 and 2020. The monthly minimum, maximum and average temperatures for the studied period are shown in the following figure. July and August are the hottest months, but only in December 2001 the monthly average temperature was below 0°C.

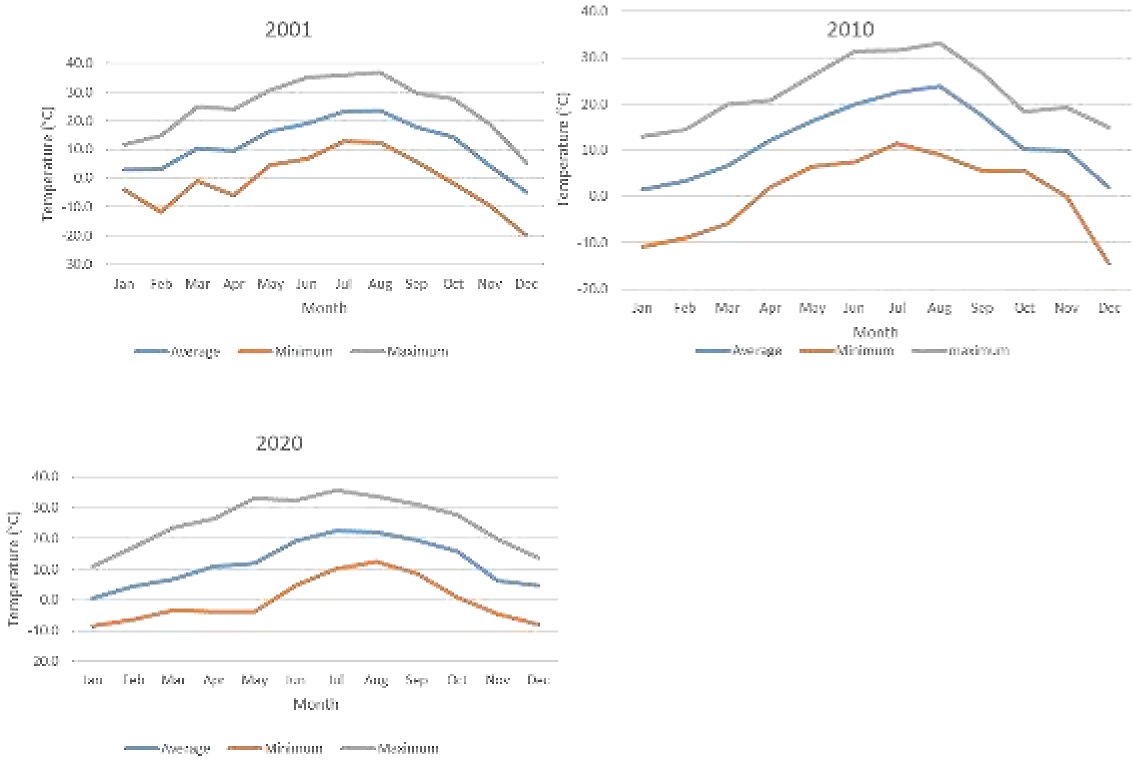


Figure 67 Minimum, maximum and average monthly temperatures at a point (lat.=42.08°, lon.=21.35°) of project area for 2001, 2010 and 2020

Precipitation: Dry period dominates in the project area. About 95% in the 20-year period from 2001 to 2020 the precipitation intensity was less than 0.5 mm/h and 4.7% between 0.5 and 2.1 mm/h. **Figure 68** shows the distribution of rain intensities and the relation between wind directions and precipitation. The average yearly precipitation in this period amounted 480 mm/year with a record of 640 in 2020. Monthly precipitations for the years 2001, 2010 and 2020 are shown in **Figure 69**.

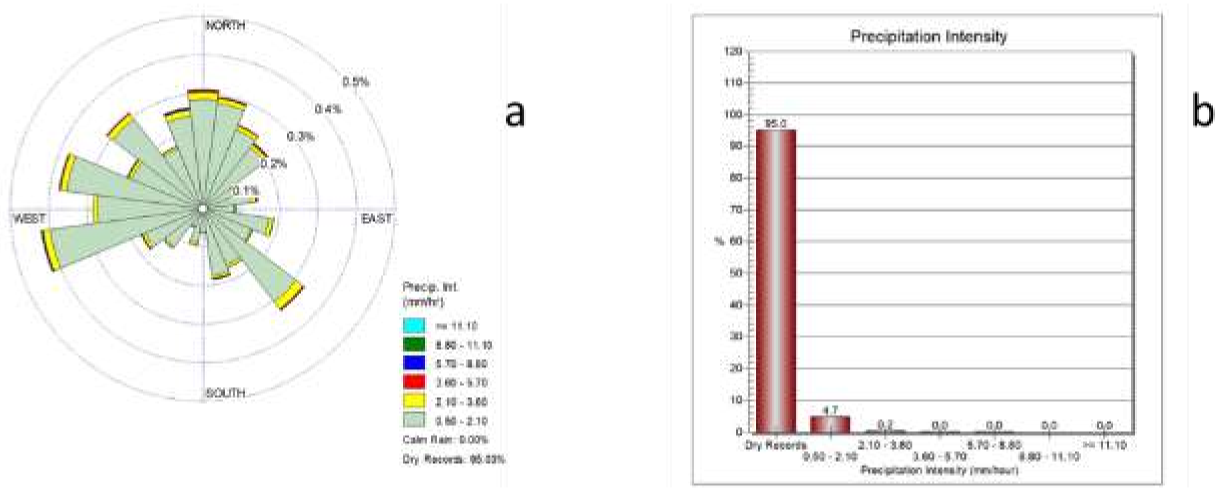


Figure 68 Rain rose (a) and precipitation intensity classes for the selected location from 2001 to 2020

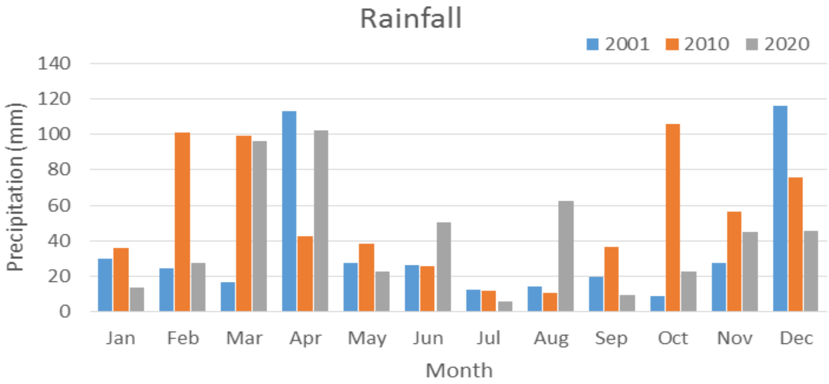


Figure 69 Monthly precipitations for selected years

In Annex 11 of this ESIA study are presented past temperature and precipitation data for the project area as well as the future projections of temperature and precipitations.

3.3.8 Climate Change

The Republic of North Macedonia, as a Non-Annex I Party to the UNFCCC, has been developing an inventory of the anthropogenic emissions by sources and removals by sinks of GHGs emitted to or removed from the atmosphere since 2000 as a part of its National Communications on Climate Change and Three Biennial Update Reports. Up to now, three National Communications (2003, 2008 and 2014) and two Biennial Update Reports (2015, 2018, 2020) have been delivered to the UNFCCC.

The Republic of North Macedonia has adopted Long-term Strategy on Climate Action (September 2021). This Strategy and its Action Plan will support the on-going process to climate action and climate resilience of the country. Moreover, the aim of the Strategy is to support the sustainable development of the country, to define the benefits and the co—benefits of the climate action, as well as to define the cost of transition and the necessary steps to meet the sustainable development pathway of the EU. The long-term objective of the Strategy is to serve as a basis for cross sectoral policy planning in the country, as well as to raise the climate awareness of all relevant stakeholders, starting from the national and the local authorities, the business sector, the academia, as well as the general public.

The inventory covers five main sectors: Energy, Industrial Processes and Product Use (IPPU), Agriculture, Forestry and Other Land Use (AFOLU) and Waste, disaggregated by categories and subcategories. It includes a database for the following GHGs: CO_2, CH_4, N_2O, PFCs and HFCs, as well as precursors and indirect emissions from: CO, NOx, NMVOC, SO_2 and NH_3. The emission of SF_6 is not estimated for the country due to unavailability of activity data.

The level assessment is performed for 1990 as a base year and for 2016, as the latest year. The results in Gg CO2-eq and percentages (up to 95%) for 2016 are presented in below. Consequently, the top five categories with the highest values of Gg CO2-eq (both emissions and removals) for the whole country include:

- Energy Industries – Solid Fuels (27.4%) (Energy sector),
- Forest Land Remaining Forest Land (17.5%) (AFOLU sector),
- **Road Transportation (16.6%) (Energy sector),**
- Enteric Fermentation (5.3%) (from Livestock in AFOLU sector),
- Manufacturing Industries and Construction – Solid Fuels (4.1%) (Energy sector).

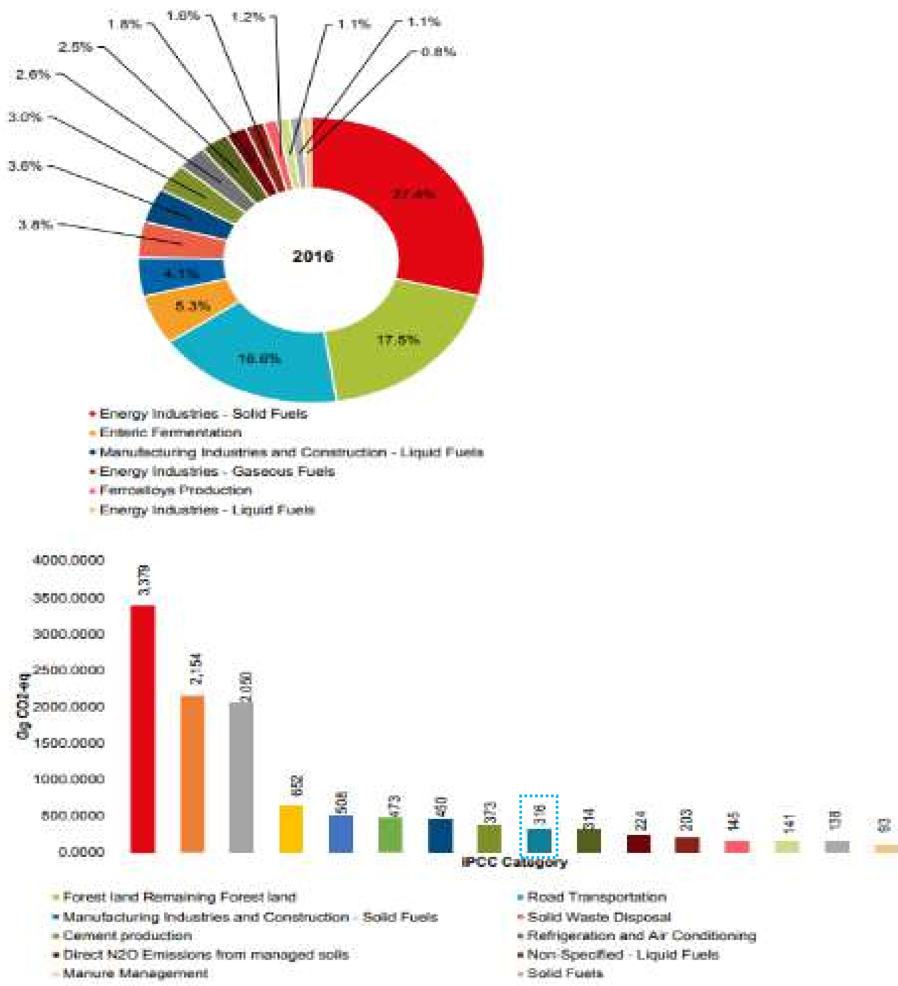


Figure 70 Level assessment of key categories and their contribution in 2016 on national level[19]

The GHG inventory in the Energy sector (sector which covers the road transportation) accounts for the emissions released as a result of fuel combustion activities, as well as the fugitive emissions from extraction of solid and transmission and distribution of liquid and gaseous fuels. The entire Energy sector emissions by category can be observed in **Figure 71** and summarized in **Table 40**. A decreasing emission trend can be seen due to reduced electricity production from the Energy Industries, replaced mainly with electricity import. It is notable that overall, the emissions in 2016 have 7.5% lower values compared with the ones in 2014 and 22.8% lower compared with 1990.

[19] Source: Macedonian third biennial update report on climate change, August 2020

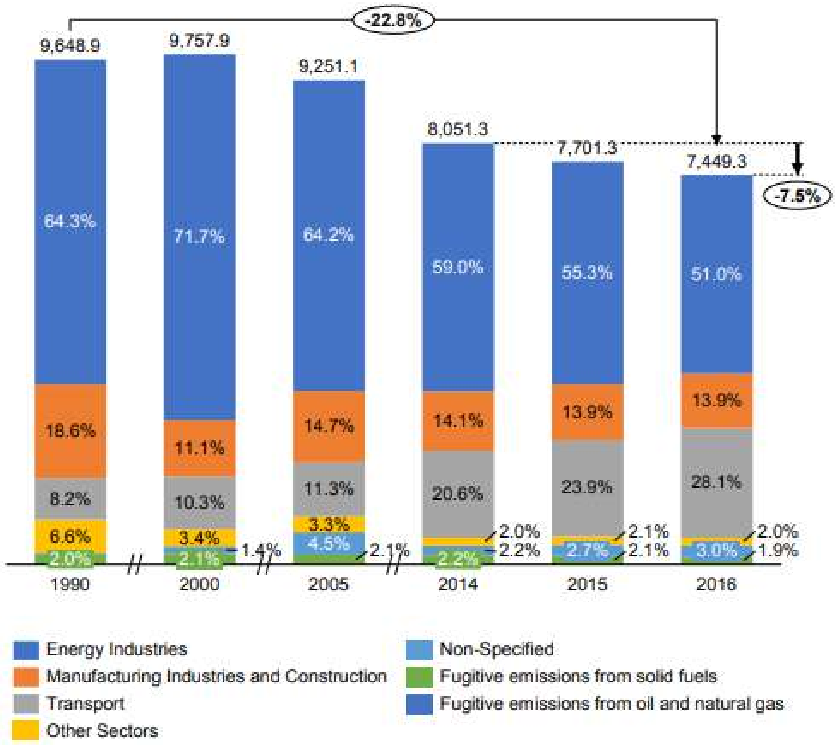


Figure 71 GHG emissions in Energy sector, by category (in Gg of CO2-eq[20])

Table 40 GHG emissions in Energy sector, by category (in Gg CO2-eq)[21]

Categories	1990	2000	2005	2014	2015	2016
Energy	9648.9	9757.9	9251.1	8051.3	7701.3	7449.3
Fuel combustion activities	9455.5	9549.9	9060.6	7872.4	7537.4	7307.1
Energy Industries	6205.3	6998.3	5940.5	4747.4	4260.6	3801.2
Manufacturing Industries and construction	1796.5	1080.6	1356.2	1132.8	1067.1	1037.4
Transport	791.1	1006.5	1043.5	1656.4	1837.8	2096.7
Other sectors	637.3	328.4	302.7	158.7	162.2	149.9
Non-Specified	25.4	136.1	417.8	177.2	209.6	222.0
Fugitive emissions from fuels	193.3	208.0	190.5	178.9	163.9	142.2
Solid fuels	192.6	207.5	189.9	178.9	163.9	142.2
Oil and natural gases	0.7	0.5	0.6	0.0	0.0	0.0

Most of the GHG emissions in 2016 occur in the category Energy Industries (51.0%), followed by Transport (28.1%) and Manufacturing Industries and Construction (13.9%). The other two categories together account for 5% of the total emissions in 2016 and the remaining around 2% are Fugitive emissions from extraction of lignite, oil refining and transmission of natural gas.

In order to respond to the climate and energy-related requirements of the Covenant of Mayors and convert these into specific measures and projects, the City of Skopje in 2011 prepared a Reference Greenhouse Gas Inventory and an Action Plan for Sustainable Energy Development. The inventory enables the identification of adequate measures for climate change mitigation in Skopje and the preparation of a strategy for the sustainable reduction of greenhouse gas emissions. The total greenhouse gas emissions in the City of Skopje were 4948 kt CO2-eq in 2008 and 5343kt CO2-eq in 2012.

[20] Source: Macedonian third biennial update report on climate change, August 2020
[21] Source: Macedonian third biennial update report on climate change, August 2020

Table 41 Total greenhouse gas emissions in the City of Skopje for 2008 and 2012[22]

Department	Emissions in 2008 (kt CO_2-eq)	Emissions in 2012 (kt CO_2-eq)
Stationary energy	3650,91	4030,20
Transportation	544,48	565,74
Waste	208,18	214,06
Industrial processes	500,01	413,75
Agriculture, forestry and other uses of the land	44,32	118,97
Total greenhouse gas emissions	4947,90	5342,72

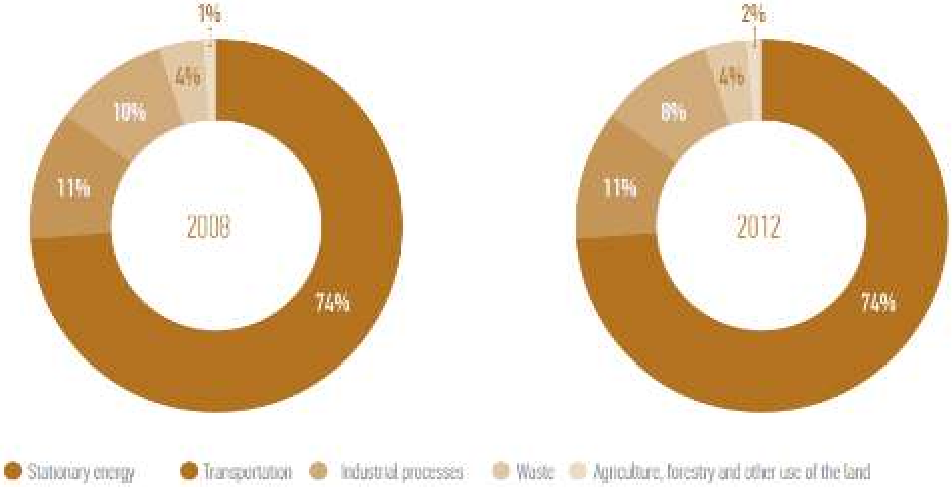


Figure 72 Total greenhouse gas emissions in the City of Skopje for 2008 and 2012[23]

The 8% increase in emissions since 2008 is mainly due to the increased production and consumption of energy in 2012, as well as the fires that damaged some of the land in the course of that year. The sector of stationary energy (i.e. emissions from residential, commercial and institutional buildings and facilities, manufacturing industries and construction, energy industries and public lighting) accounted for about 74 % of total greenhouse gas emissions in 2008 and 75 % of the total in 2012.

CO accounted for 93 % of the share in total emissions and is the most dominant gas in the Greenhouse Gas Inventory of the City of Skopje, while emissions of CH and NO accounted for about 6 % and 1 % in 2008 and in 2012.

The main emitters of greenhouse gases identified for both years fall into the following seven categories: Residential buildings; Manufacturing industries and construction; **Road transportation;** Emissions from the industrial processes within the city limits; Commercial buildings/facilities; Energy industries; Disposal of solid waste.

[22] Source: Resilient Skopje – Climate change strategy
[23] Source: Resilient Skopje – Climate change strategy

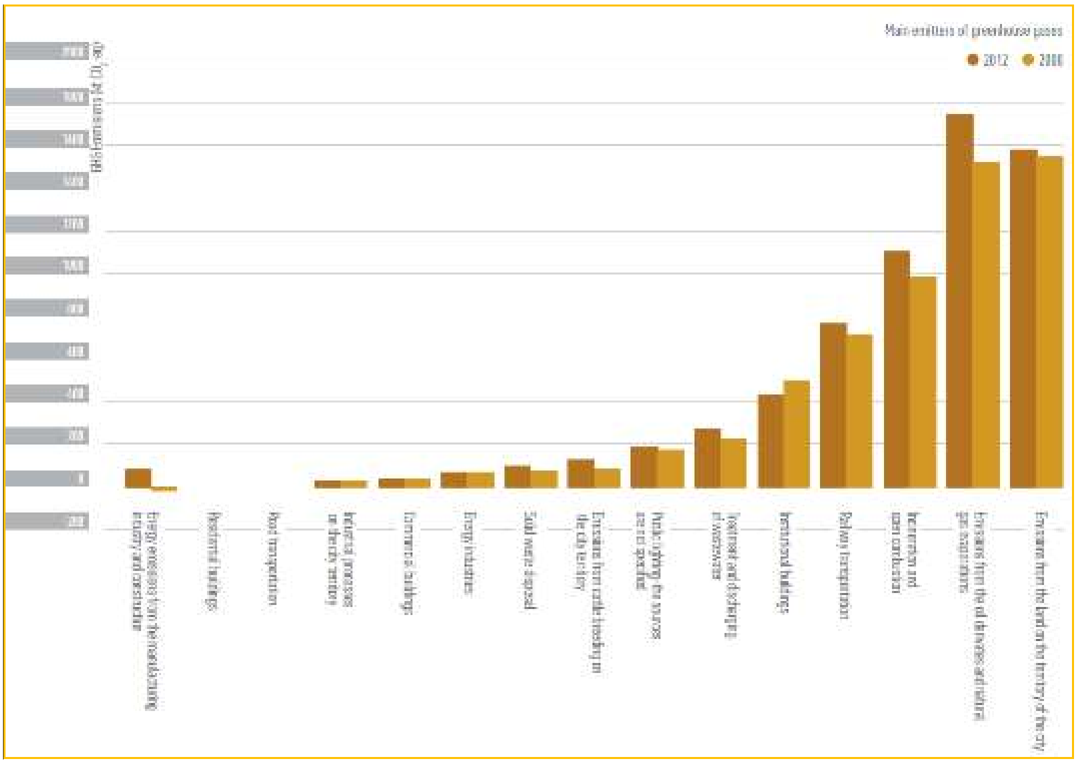


Figure 73 Main emitters of GHG in City of Skopje for 2008 and 2012[24]

The imbalance in the greenhouse gases that are emitted in an atmosphere causes systemic and cyclical change in normal atmospheric processes which in turn causes changes in world weather. Such rapid changes in weather also affect regional and local landscapes / ecosystems / biological diversity. This is because local systems are struggling to adapt and evolve with that in mind the unpredictability of extreme weather events caused by climate change.

The changes in weather (temperature, precipitation, heat waves, cold waves, ice waves) for the project area are presented in Annex 11 of this ESIA study i.e. in the Climate Resilience Report.

Related to data presented in the Climate Resilience Report, it can be concluded that:

- It is likely that in the period 2025 - 2100 there will be a continuous rise in temperature;
- Compared to the period 1961-1990, the projected changes are most intense in the warm part of the year. The summers would be warmer and the temperature rise more pronounced. An increase in air temperatures in the cold part of the year is forecast, but with lower intensity;
- The transition from winter to spring is probably the approach and equalization of the average monthly temperatures in this period.

In the following figure are presented the temperature projections based on the worst climate change scenario RCP8.5 for the analysed period.

[24] Source: Resilient Skopje – Climate change strategy

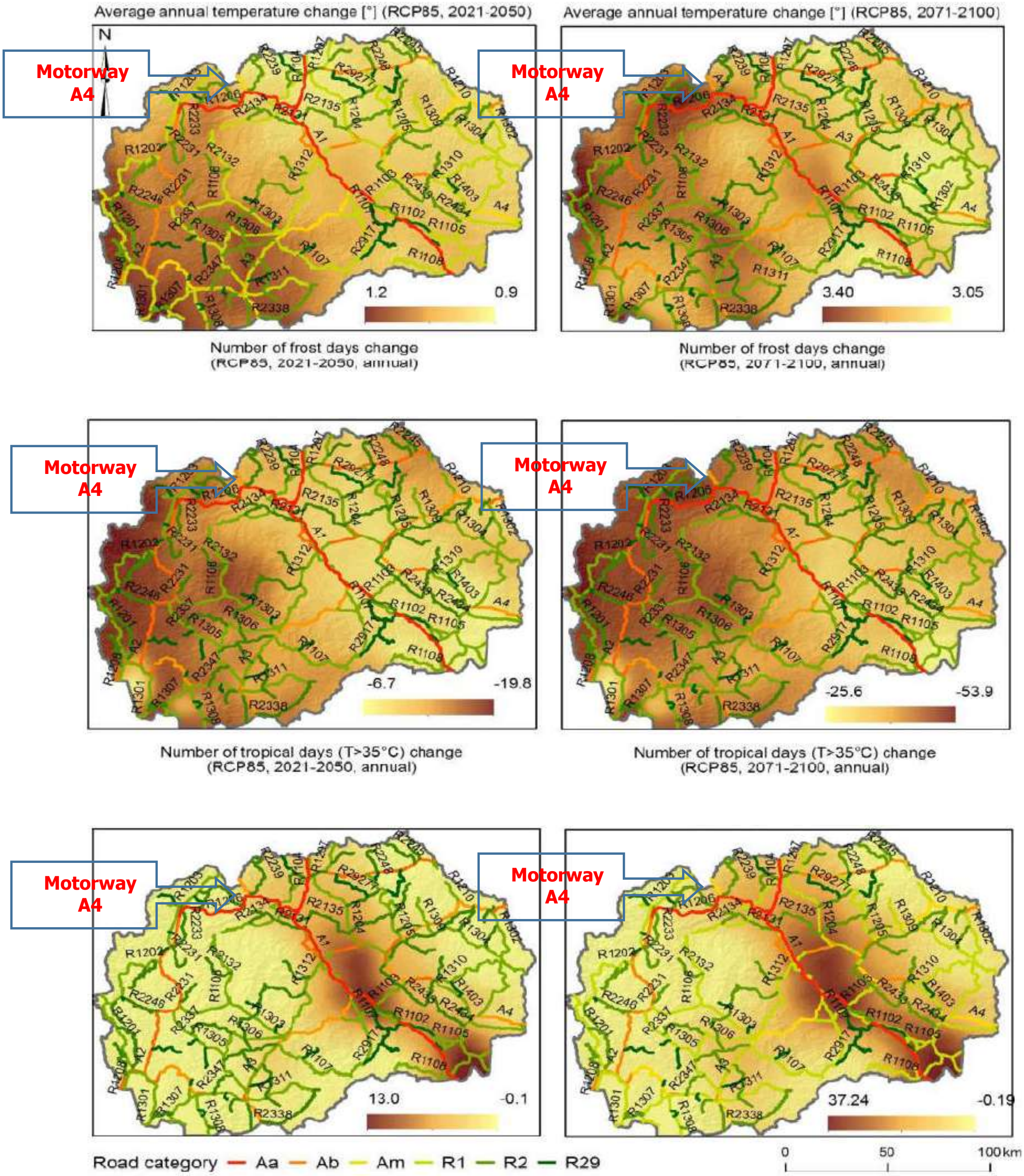


Figure 74 Temperature projections based on the worst climate change scenario RCP8.5 for the analysed period

In all seasons and annually there is a decrease in rainfall, with a maximum in the summer season. The graphs presented in the Climate Resilience Report shows the following:

- For all selected years, generally all changes in precipitation are negative, i.e. there is a decrease in the average amounts of precipitation,
- The intensity of the changes is greatest in the warm part of the year, so in July and August it can reach 80%, so it is likely that there will be no precipitation at all in those months,
- In the cold part of the year, reductions of between 20% and 34% of the average monthly quantities are predicted.
- Reduction of the average amount of precipitation,
- For all years (2025 - 2100) and intensity of changes (high, medium low) there is a maximum reduction of precipitation in the summer season (June, July, August),

- In the summer season the reduction of precipitation will be much bigger and faster than in the other seasons,
- In the cold part of the year the reductions are more moderate.

In accordance with the data presented in the Climate Resilience Report it follows that:

- It is probable that in the period 2025 - 2100 there will be a continuous decrease in the amount of precipitation,
- The predicted changes are most intense in the warm part of the year, so the summers would be drier and it is likely that some summer months (July, August) will be without precipitation. In the previous period for which there are data there were months without precipitation.
- There is probability a decrease in precipitation in the cold part but with less intensity.

In the following figure are presented the rainfall projections based on the worst climate change scenario RCP8.5 for the analysed period.

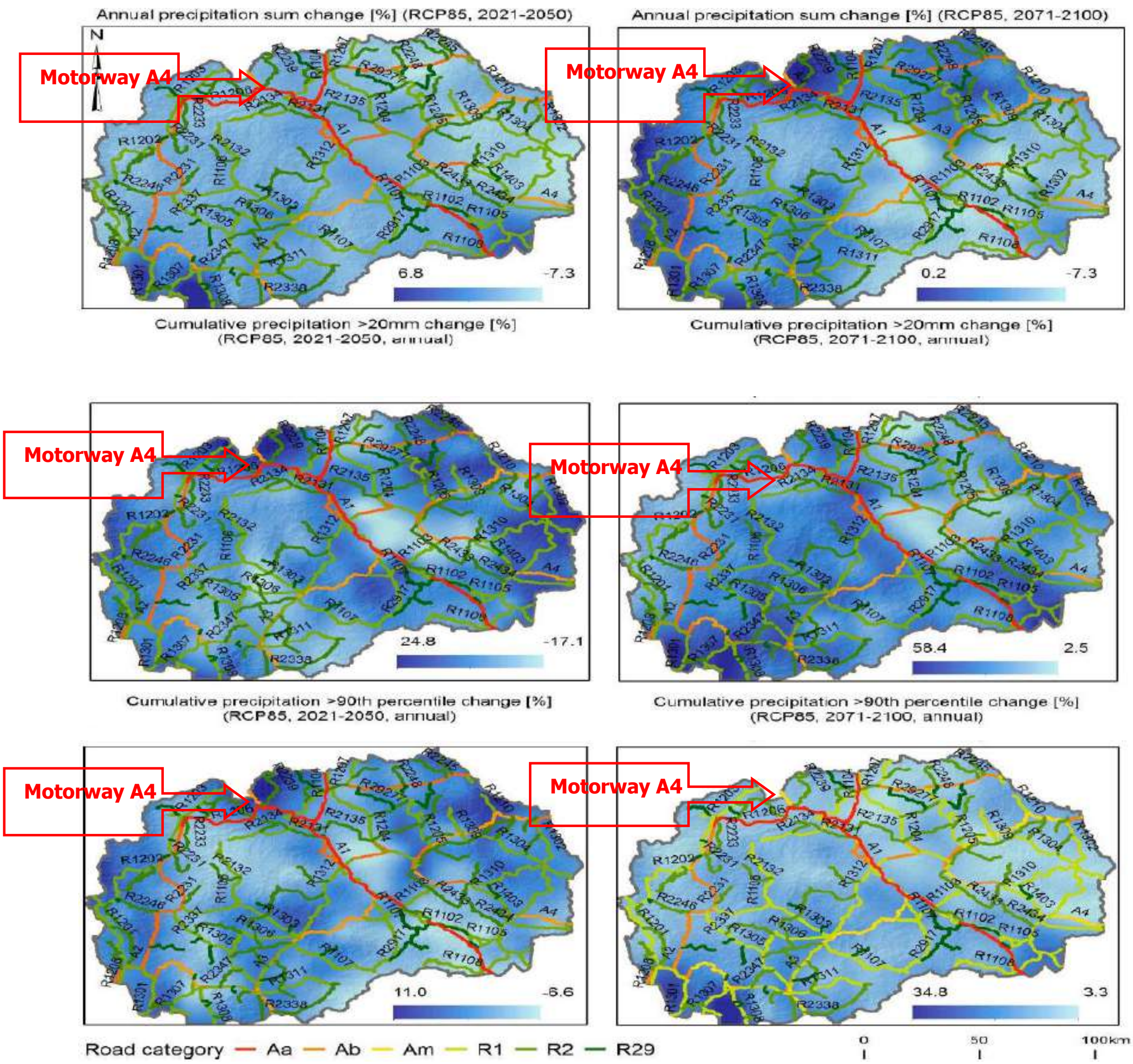


Figure 75 Rainfall projections based on the worst climate change scenario RCP85 for the analysed period[25]

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25 Technical assistance preparation of climate resilience design guidelines for the Public Enterprise for State Roads in North Macedonia, July 2019

Regarding the projections and assessed risks of landslides and floods in the project area, available data despite of the Climate Resilience report (Annex 11) are also presented and are available in Chapter 3.3.3.2 and Chapter 3.3.3.3 in this ESIA study.

3.3.9 Air quality

Hani I Elezit in Kosovo, on the north, and Skopje on the south are the two inhabited places cornering this part of the motorway. Ambient air in both of them is polluted due to industrial activities, households heating and traffic. Industry in Hani i Elezit is dominated by cement production while various industries besides the cement production such as: metallurgy, chemical industry, quarry etc. contribute to an appreciable air pollution in Skopje. A number of quarries, stone crushing plants and concrete plants are located and are operational around the motorway alignment (on both Kosovo and Macedonia sides) and they certainly have an impact on the air quality around. The quarries and stone crushing plants are presented in the **Figure 77**. In addition, the motorway alignment passes through the industrial zone Vizbegovo.

Ambient air limit values for the concentrations of particulate matter (PM_{10}), sulphur dioxide, nitrogen oxides, benzene and carbon monoxide, according to the *Decree on the limit values of concentrations and types of polluting substances in the ambient air and alarm thresholds, deadlines for complying with the limit values, tolerance margins for the limit values, target values and long term goals* ("Official Gazette of the Republic of Macedonia" No. 50/05) are shown in the table below. Tolerance margins and approaching rates are not shown in the table because the deadlines have expired since 2011.

Table 42 Ambient air limit values for SO_2, PM_{10}, NOx, benzene, SO_2 and CO

Substance	Unit	Limit Value	Allowed exceedance per year
SO_2 1 Hour 24 Hours Year (protected areas)	µg/m³	350 125 20	24 times 3 times
PM_{10} 24Hours Year	µg/m³	50 40	35 times
NO_2 1Hour Year (human health protection) Year (vegetation protection)	µg/m³	200 40 (NO_2) 30 (expressed as NOx)	18 times
Benzene Year	µg/m³	5	
CO Daily (8 hourly mean)	mg/m³	10	

The national air quality standards follow the air quality standards set in Annex 11 to the Directive 2008/50/EC on ambient air.

There is an air pollution monitoring station in Hani I Elezit situated about 3 km north of the Project start point and operated by the Hydro meteorological Institute of Kosovo[26]. This is the nearest official monitoring point to the Project area. A summary of the parameters for 2020 is presented in the following table.

Table 43 Average monthly concentrations of various pollutants based on daily averages at the Hani i Elezit monitoring station[27]

	$PM_{2.5}$ µg/m³	PM_{10} µg/m³	O_3 µg/m³	NO_2 µg/m³	SO_2 µg/m³	CO mg/m³
Jan	41.2	34.0	22.4	36.4	3.0	0.172

[26] Hydro meteorological Institute of Kosovo https://airqualitykosova.rks-gov.net/en/reports-for-the-monitoring stations/

[27] Source: https://airqualitykosova.rks-gov.net/en/reports-for-the-monitoring-stations/

Feb	30.4	22.1	19.7	48.3	2.5	0.159
Mar	33.6	21.4	17.1	52.7	3.5	0.306
Apr	23.5	14.2	16.3	68.0	4.0	0.103
May	12.6	7.7	43.6	56.2	4.2	0.157
Jun	8.4	5.6	8.1	59.3	5.0	0.115
Jul	13.7	8.7	7.2	77.0	6.2	0.074
Aug	18.3	10.5	11.7	72.2	7.4	0.091
Sep	19.3	9.6	10.3	73.4	8.5	0.133
Oct	23.2	14.2	16.6	40.7	7.6	0.125
Nov	44.5	34.0	21.0	26.4	6.1	0.371
Dec	36.7	28.9	22.0	24.5	8.3	0.403

According to the source data, maximum daily concentrations of PM_{10} and $PM_{2.5}$ of 95.7 mg/m^{3}and 68.8 mg/m^3 respectively have been recorded in 2020. The concentrations of the remaining four pollutants were well below the limit values.

The air monitoring station, managed by the Ministry of environment and physical planning is located about 5 km south from the Project end point. Unfortunately, only few parameters (PM_{10}, $PM_{2.5}$ and SO_2) are recorded at this station.

The unofficial Pulse.eco platform contains data on air quality in the village of Bardovci, a suburb of Skopje, about 1.5 km from the south endpoint of the Project. However, only data on PM_{10} and $PM_{2.5}$ have been found at this point.

Data retrieved from the last two monitoring points are shown in **Table 44.**

Due to industrial activities, inappropriate house heating and urban traffic, the air quality of Skopje is frequently below the required standards. Daily values for PM_{10} and $PM_{2.5}$ indicate that there are days with very high concentrations. In 2020 Maximum daily concentrations of PM_{10} of 177 µg/m^3 was recorded for Bardovci and 206 µg/m^3 for Karpoš. Daily PM_{10} concentration of 50 was exceeded 50 times in Karposh and 76 times in Bardovci, although the average concentration in the latter is lower.

In the same year maximum $PM_{2.5}$ concentration recorded in Karpoš was 177 µg/m^3, while for Bardovci a $PM_{2.5}$ concentration of 130 µg/m^3 was reported. No exceedances have been recorded regarding SO_2 concentrations.

Table 44 Average monthly concentrations of various pollutants based on daily averages at the Karpoš monitoring station of MOEPP and "Bardovci" monitoring point of Eco.pulse in Skopje

Month	Karpoš (MOEPP)*			Bardovci (Pulse.Eco)**	
	PM_{10}	$PM_{2.5}$	SO_2	PM_{10}	$PM_{2.5}$
Jan	91.69355	91.69355	5.4	50.13602	40.18864
Feb	56.19655	35.44815	1	28.71214	22.73755
Mar	41.01935	26.14667	0.91	24.00494	18.98963
Apr	25.89333	19.39	0.75	15.81081	11.99025
May	27.73548	19.48065	0.72	13.002	8.483483
Jun	20.89333	17.70909	0.72	10.18133	6.509966
Jul	23.26452	22.96667	1.1	13.26418	9.403048
Aug	29.23226	20.2	0.93	14.7886	10.75763
Sep	36.44	18.18421	1.1	15.08421	10.52065
Oct	38.74516	23.60345	1.31	25.43687	20.12692
Nov	92.81333	52.00333	1.1	64.19671	49.93137
Dec	70.11333	40.41935	6.9	32.07725	30.46576

*Source: MOEPP (https://air.moepp.gov.mk/?page_id=290)

**Source: Pulse.eco (https://skopje.pulse.eco/)

In order to obtain preliminary data on air pollution as near to the future motorway as possible, short-term measurements have been performed at two locations close to the alignment on 23.06.2021. The following figure shows the locations of the monitoring points and the sensitive receptors marked transparent yellow. The results obtained during the monitoring campaign are presented in the table below.

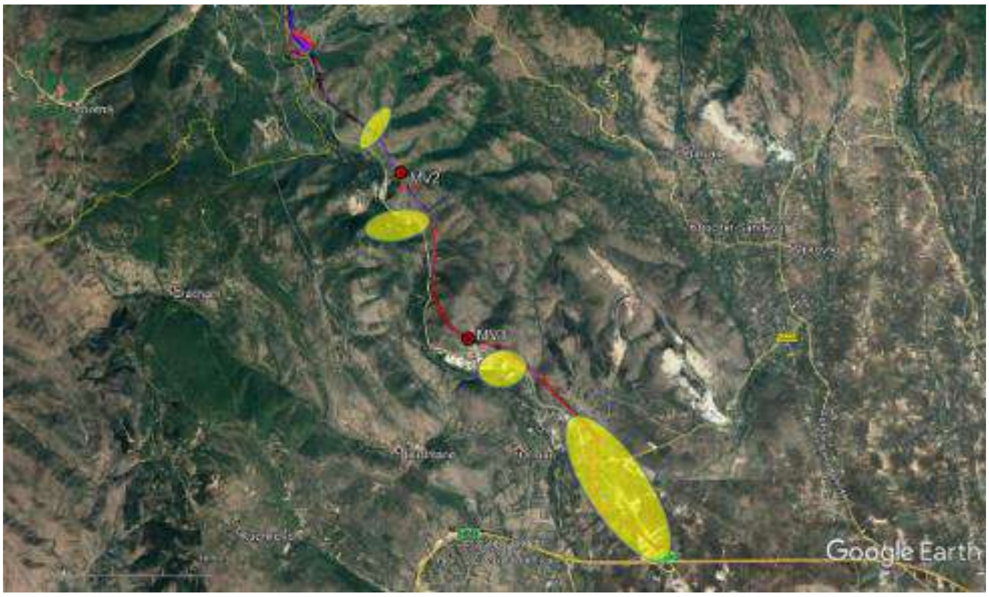


Figure 76 Locations of air quality measuring points (the potential sensitive receptors are marked transparent yellow)

Table 45 Air pollution at two locations along the future motorway

Measuring point ID	Coordinates	Date	PM_{10} (µg/m^3)	$PM_{2.5}$ (µg/m^3)	CO (mg/m^3)	SO_2 (µg/m^3)	NO_2 (µg/m^3)	TVOC (ppm)
MV1	42° 4'53.72"N 21°20'49.95"E	23.06.2021	28	6	3.35	<0.2	145	0.31
MV2	42° 6'16.65"N 21°20'4.65"E	23.06.2021	20	5	2.1	<0.2	117	0.3

Based on the results obtained from the performed measurements, it can be concluded that the present concentrations of particulate matter (PM_{10} and $PM_{2.5}$) and gaseous pollutants (CO, SO_2, NO_2, TVOC) in the ambient air are within the air quality standards prescribed in the *Decree on the limit values of concentrations and types of polluting substances in the ambient air and alarm thresholds, deadlines for complying with the limit values, tolerance margins for the limit values, target values and long term goals* ("Official Gazette of the Republic of Macedonia" No. 50/05). It should be mentioned, however, that the 24-hour NO_2 concentrations are pretty closed to the hourly EQS limit. This should be taken into account during the traffic impact assessment.

3.3.10 Noise and vibration

Noise is a matter of nuisance and therefore, noise sensitive receptors are usually considered those where people live or gather for certain purposes (schools, religious objects, sports centers etc.), although wild live is sensitive to noise as well. Quarrying, stone crushing and separation activities in addition to road traffic are the main sources of noise throughout the project area. There are very few noise sensitive receptors within the project area.

Noise limit values for different areas are regulated by Art. 6 of the Rulebook on environmental noise limit values ("Official Gazette of Republic of Macedonia No.147/08 dated 26.11.2008)[28]. These values are shown in the following table.

Table 46 Environmental noise limits for different areas

Type of area	Noise level – dB(A)		
	Ld	Le	Ln
Area exposed to intense road traffic	60	55	50
Area exposed to intense railway traffic	65	60	55
Area exposed to intense air traffic	65	65	55
Area exposed to intense industrial activities	70	70	70
Quiet areas outside agglomerations	40	35	35

The rulebook mentioned above regulates environmental noise limits according to the designation of the areas and the required degree of noise protection, presented in the table below. Article 3 clarifies possible designations of areas of particular degree of noise protection. According to this classification the entire branch of the motorway will be situated in an area of third degree of noise protection.

Table 47 Environmental noise limit values according to the degree of noise protection

Area defined according to degree of noise protection	Noise level – dB(A)		
	Ld	Le	Ln
First degree of noise protection	50	50	40
Second degree of noise protection	55	55	45
Third degree of noise protection	60	60	55
Fourth degree of noise protection	70	70	70

Undoubtedly, after the construction of the motorway is finished, the whole area will be exposed to intense road traffic, but the noise limit values in such case are lower. The additional impact of the future road traffic noise should be assessed.

Short term measurements were undertaken at seven locations within the project area, all but one at 10 to 80 m from the future motorway. These measurements were carried out aiming at beginning to determine the nature of the existing noise. Figure below shows the locations of the measuring points and the main sources of noise. This locations were selected due to the vicinity of sensitive receptors (inhabited or livestock houses).The results of conducted measurements are presented in table below. No additional noise monitoring regarding present conditions is required.

[28]https://www.moepp.gov.mk/wp-content/uploads/2014/09/Pravilnik%20za%20granicni%20vrednosti%20na%20nivoto%20na%20bucava%20vo%20zivotnata%20sredina.pdf

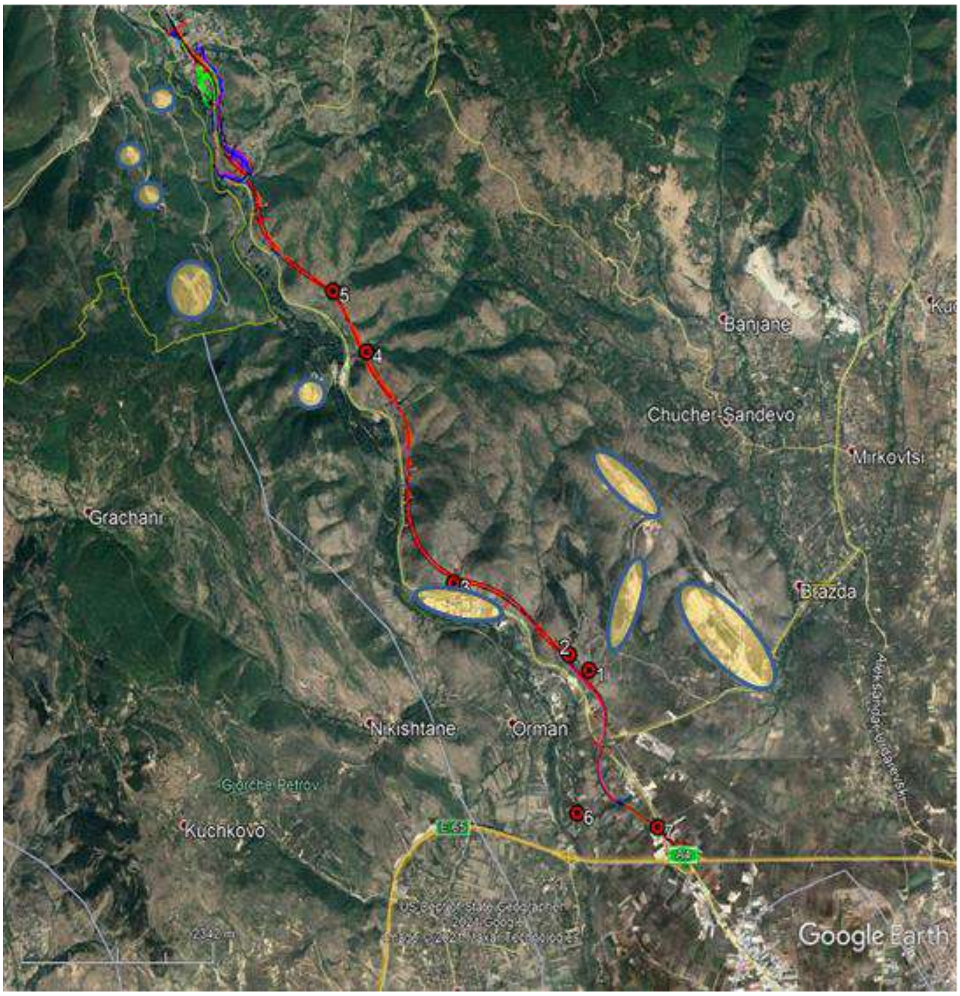


Figure 77 Location of noise measurement points (numbered) – surrounding quarries and stone crushing plants are marked transparent yellow

Table 48 Results of short term noise monitoring at seven locations along the motorway alignment

Coordinates (UTM)		Measuring point						
		1	2	3	4	5	6	7
	m E	530409	530166	528749	527672	527258	530271	531254
	m N	4657877	4658051	4658849	4661447	4662127	4656271	4656117
Date		04/06/2021						
Time		09:05:05	09:36:00	10:12:00	10:40:00	12:12:00	13:02:00	13:41:00
Sampling Time	s	1	1	1	1	1	1	1
Record Num		900	901	900	900	480	901	900
Leq Value	dB(A)	50.7	57	49.9	50.6	44.8	46.9	67.7
SEL Value	dB(A)	80.2	86.5	79.5	80.1	71.6	76.5	97.2
MAX Value	dB(A)	63.1	71.1	82.2	82.2	74.7	67	82.9
MIN Value	dB(A)	40	37	34.6	34.9	34.2	39	44.4
L10	dB(A)	54	60.5	46.6	48.4	44.1	49.8	71.2
L90	dB(A)	44.6	42.5	36.9	37.5	37.8	41.5	53.8
Freq Weighting		A	A	A	A	A	A	A
Time Weighting		Fast	Fast	Fast	Fast	Fast	Fast	Fast

Although slightly, the southern part of the project (monitoring points 1, 2 and 7) area is noisier compared to the northern one mainly due to the vicinity to the existing road and terrain characteristics. Monitoring point 7 was about 10 m from the existing road while points 1 and 2 were elevated and had a clear view to the road.

3.3.11 Waste

In the municipality of Chucher Sandevo, waste management, i.e. collection and transport of municipal waste is the responsibility of PUE "Skopska Crna Gora".

The collected waste is transported to the Drisla sanitary landfill by a special vehicle. The current way of managing municipal waste on the territory of the Municipality is far below the required level. Only the collection and transportation of municipal waste applies, while activities for waste reduction, waste selection at the source of generation (primary selection) or appropriate waste processing (secondary selection) are not undertaken.

On the territory of the Municipality are registered 3 smaller illegal dumpsites and fills with a total area of about 100 m^2, and the total amount of land filled waste is about 20 t. At certain locations, several smaller ones were observed with a smaller amount of municipal waste and industrial waste.

Illegal large dumpsite, covered with inert material, is identified in the immediate vicinity of the right bank of the Lepenec riverbed, near the km 4 + 300.00 to km 4 + 650.00 (chainages along the riverbed axis), after the railway bridge (according to the Plan for Management of River Basin Lepenec). Another smaller landfill is identified in the immediate vicinity of the cascades, before the confluence of the river Lepenec to River Vardar. Both dumpsites are shown in the following figures.

Figure 78 Dumpsite after the railway bridge **Figure 79** Dumpsite near the Lepenec' cascades

The Municipality of Chucher Sandevo does not have data on the exact amount of industrial waste generated on its territory, which is due to the non-functioning of the system of recording, informing, monitoring and supervision in the treatment of industrial waste.

If there is a smaller amount of non-hazardous waste, it is usually mixed with municipal waste in containers and collected by PUE "Skopska Crna Gora". Larger quantities of non-hazardous waste created by economic entities collect and carry it to legal entities that have a license to perform storage, treatment and processing of non-hazardous waste.

In the Municipality there are licensed companies such as "Vedran Group" v. Kuceviste and Company Jovcevski v. Brazda that collect and transport waste (metal, paper, plastic, wood, rubber, etc.).

Construction waste/demolition waste is usually dumped irregularly in certain places to fill some uneven terrain (depressions) or left at locations close to the generation site, public areas or privately owned sites. The waste created and disposed of in this way creates an ugly image that indicates the low awareness of the population.

Currently on the territory of the Municipality there is no designated space for disposal of construction waste.

One location for disposal of excavated earth material was determined by the design and ESIA team. This location has been proposed from PESR and presented in the project "Motorway Skopje – Blace, section interchange "Stenkovec" – cross border "Blace", prepared by Granitproject in 2002. The disposal area is located around km 3+900 on the left side of the future motorway.

3.4 Biological Environment Baseline

3.4.1 Biogeography

3.4.1.1 Division of biomes according Matvejev

According to the division of biomes by Matvejev&Puncer (1989), almost the entire area of the Lepenec gorge belongs to the biomass of sub-Mediterranean, mainly deciduous forests and shrubs. Parts, especially near the border with Kosovo, belong to the biome of southern European, mainly deciduous forests.

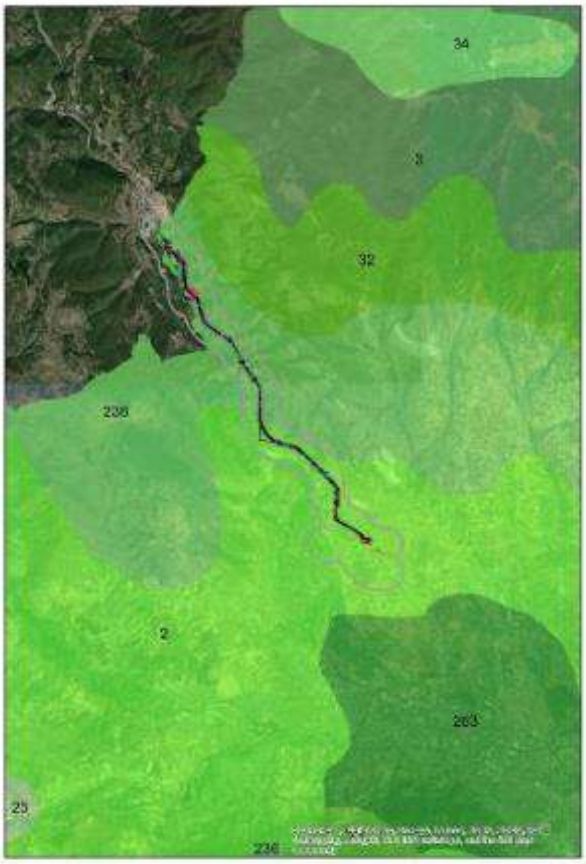
The biome of sub-Mediterranean, mainly deciduous forests and shrubs is widespread in most of the investigated corridor. The most important feature of the climate is the excessive arid period during the summer and peak rainfall occurring over from the spring and fall. These include the post-thermophilic parts of the lowest parts of the Lepenec River Gorge. Querco-Carpinetumorientalis is one of the characteristic plant communities of this biome in the area. All biocenoses are characterized by the animal forms Xeroaestisilvicola and Xeroaestidrymicola (Matvejev 1995). Terrophytes and cryptophytes predominate in plants.

The most characteristic species of the biome of sub-Mediterranean, predominantly deciduous forests and shrubberies which are found in the investigated corridor: pubescent oak *(Quercus pubescens),* Italian oak *(Quercus frainetto),* Macedonian oak *(Quercus trojana),* Oriental hornbeam *(Carpinus orientalis),* European hop-hornbeam *(Ostrya carpinifolia),* Turkish hazel *(Corylus colurna),* common hawthorn *(Crataegus monogyna),* Montpellier maple *(Acer monspessulanum).*

Most important habitats that are found in the analysed corridor are: 1) natural habitats: Italian and Turkey oakforests, forests of Pubescent oak and Oriental hornbeam, forests dominated by Macedonian oak (Quercus trojana) and 2) semi and anthropogenic habitats: degraded forests of eastern Carpinus, black pine plantations, fields with/without hedges, trees, gardens, (parts of) villages.

The biome of southern European, mostly deciduous forests occupies the highest parts of the investigated corridor, around the border with Kosovo. The characteristic plant communities of this biome within the corridor are found fragments of Italian and Turkey oak forests. Typical animal forms Theroaesti-silvicola and Herboaestisilvicola (Matvejev 1995). Specific is the smaller proportion of evergreen phanerophytes. The most important plant species in this biome are: sessile oak (*Quercus petraea),* common beech *(Fagus sylvatica),* European hornbeam *(Carpinus betulus),* common hazel *(Corylus avellana),* European spindle *(Evonymus europaea),* field maple *(Acer campestre),* sycamore maple *(Acer pseudoplatanus),* checker tree *(Sorbus torminalis),* large-leaved lime *(Tilia platyphyllos),* wild privet *(Ligustrum vulgare),* guelder rose *(Viburnum opulus),* wild cherry *(Prunus avium).*

Key habitat encountered in the analysed corridor are: 1) natural habitat: the fragments of forests and ploskac oak, Alder and willow belts along Lepenec 2) semi and anthropogenic habitat, degraded forests, fields, orchards apples, plums, pears, cherries and the village of Blace.



Legend

2. Sub-Mediterranean biome, mainly deciduous forests and shrubs;

3. South European, mostly deciduous forest biomes (ecotone-vicariant areas are marked by 23, 32 and 321 - the order of numbers depends on which environmental characteristics prevail; steppe areas are marked by 263 and 236);

6. Steppe biomes and forest-steppe biomes (there are no such biomes on the map section, only their elements)

Figure 80 Division of biomes according to Matvejev

3.4.1.2 Climate – vegetation - soil zones

According to the division of Filipovski et al. (1996) there are eight climate – vegetation - soil zones in Macedonia. Most of the corridor belongs to the continental-sub-Mediterranean area (figure below). This area is most present in the central and eastern parts of the Republic of North Macedonia and covers a total area of 8970 km^2 or 34.9% of the country's territory. Mostly it covers parts up to 600 m above sea level. According to the division of Filipovski et al. (1996) there are eight climate – vegetation - soil zones in Macedonia. Most of the corridor belongs to the continental-sub-Mediterranean area (figure below). This area is most present in the central and eastern parts of the Republic of North Macedonia and covers a total area of 8970 km^2 or 34.9% of the country's territory. Mostly it covers parts up to 600 m above sea level. The climate-zonal community is the forest of eastern hornbeam and oak (Querco-Carpinetum orientalis macedonicum Rud. apud H-t).

From the map and site inspections, it can be concluded that only fragments of warm continental area are found in the project corridor (Climazonal community: forest community of Italian and Austrian oak *Quercetum frainetto-cerris macedonicum*). In some places near the village Blace, elements of the warm continental area can be seen.

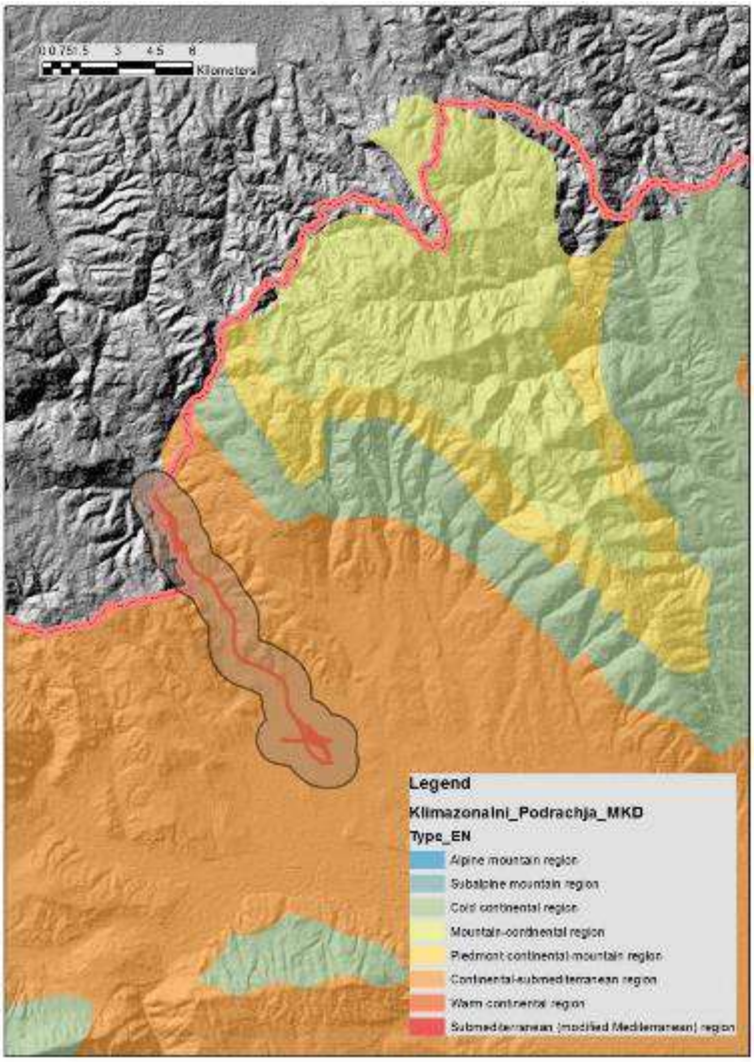


Figure 81 Climate - vegetation soil zones in the valley of Lepenec

3.4.2 Biodiversity of habitats

The area is dominated by the following natural habitats: oak-hornbeam forests, poplar riparian belts and willows and river habitats. These habitats are distributed in the gorge of river Lepenec. However, the first two kilometres of the analysed motorway buffer are dominated by agricultural and other antrhopogenic habitats. Nevertheless, all-natural habitats in the analysed section are under strong anthropogenic pressure and therefore most of the habitats are strongly to moderately degraded. The most important of the semi-natural habitats are the meadows and hilly pastures near the village Blace and anthropogenic agricultural areas (fields, orchards, abandoned fields and ruderal habitats) have been identified.

The nomenclature of habitats follows common national classification systems which is used in other impact assessment studies, but has not been legally formalized. All of these common names are associated with EUNIS habitats (https://eunis.eea.europa.eu/habitats-code-browser.jsp) to the level possible. Also, a reference to the EU Habitats Directive is provided.

The description of habitats contains general data on their physiognomy, plant associations (where possible) as well as the most common species compositions of plants and animals (species that were confirmed during the field surveys). The complete list of plants is presented in Annex 9, while animal composition is presented in the respective chapters.

Forest habitats are represented by some climazonal communities (Italian and Turkey oak forests and different degradation stages of Pubescent oak forests) as well as some riparian woodlands and belts. Few scattered patches of coniferous plantations can be found as well.

Open terrains are formed in the past with the anthropogenic degradation of climazonal forests. Some of the parts of previously existing forests are turned into agricultural land. Some other parts, mostly on steeper slopes, were used for timber exploitation which resulted in creation of degraded or much degraded forests and open terrains with grassy vegetation.

Grasslands in the motorway corridor area are represented by hill pastures of secondary origin and human managed meadows.

Water ecosystems are very important natural elements from economic and environmental point of view. They have great landscape value, but also, they are living environment for many species. The economic development of the region is often connected with water resources. The use of water for different purposes from natural water bodies is a base for human life. But also, these water ecosystems are often terminal recipient of all wastes produced by the human population. Beside pollution, very common change in water quality is eutrophication. Eutrophication or nutrient enrichment of water bodies is mainly connected with agriculture and communal waste waters. The use of phosphates as fertilizers or as a part of detergents results with increased primary production (mainly algal) but also reduced biodiversity. Many other physico-chemical features of water bodies are changed as a result of eutrophication. The oxygen regime is changed with appearance of oxygen depletion and temporal or obligate anoxia in deeper parts.

Agricultural land is represented by arable land, orchards and vineyards as well as abandoned fields and meadows. In this chapter, agricultural land is analysed in the sense of biotopes and their biodiversity value is presented.

Field and acres are the dominant habitat type in the Blace - Skopje motorway corridor area with 564.0 ha or 44.2% (table below). The second dominant habitats are the Hill pasture with sparse shrubs (241.3 ha) and the third is degraded pubescent oak forest (57.88 ha).

Table 49 Overview of the surface of habitats in the Blace – Skopje motorway corridor area in the analysed area

Habitat type	Area (ha)	Habitats %
Abandoned arable land	48.07	3.8
Broadleaf tree stand	0.62	0.0
Coniferous plantations	23.64	1.9
Degraded pubescent oak forest	57.88	4.5
Epipotamal stream	8.57	0.7
Excavation site	8.19	0.6
Fellow land	32.98	2.6
Field sand acres	564.03	44.2
Gravel bank	5.87	0.5
Hill pastures	67.15	5.3
Hill pasture with sparse shrubs	241.3	18.9
Industrial/Commercial site	42.96	3.4
Man-made structure	0.42	0.0
Meadow	15.79	1.2
Orchard	4.3	0.3
Riparian willow scrubland	13.05	1.0
Riparian willow-poplar belt	10.73	0.8
Riparian willow-poplar stand	53.76	4.2
Road	18.89	1.5
Rural area	34.25	2.7
Sessile oak forests	3.58	0.3
Urban area	14.1	1.1
Vineyard	0.69	0.1

Habitat type	Area (ha)	Habitats %
Wet meadow	2.17	0.2
Pubescent oak forest	4.29	0.3
Total	**1278**	100.0

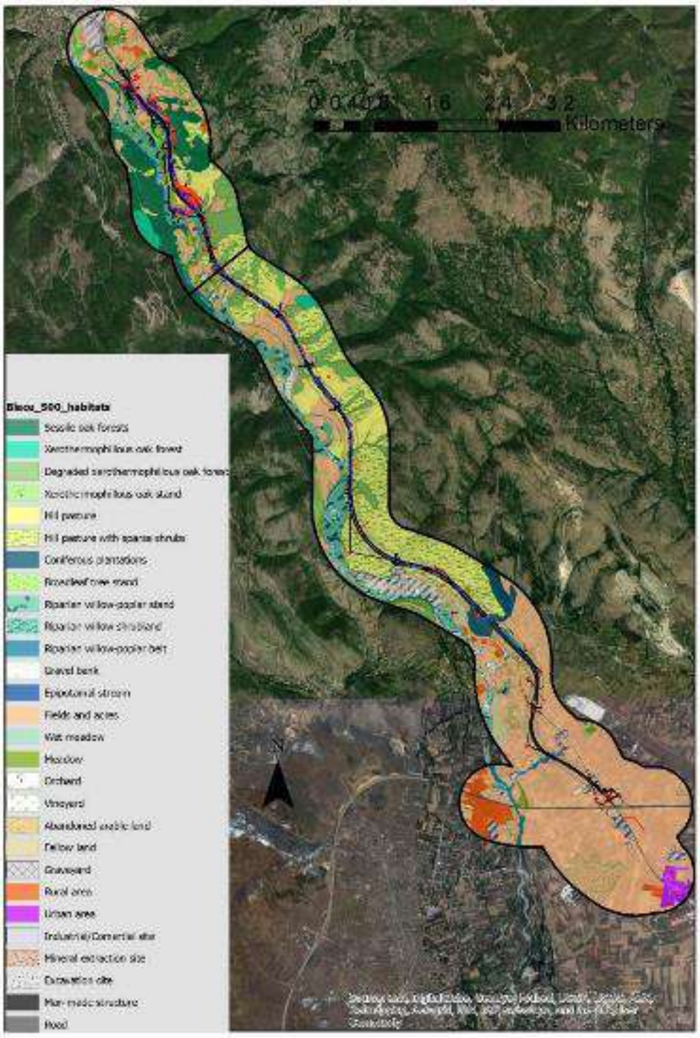


Figure 82 Map of habitats (the map of habitats presents the habitats in the whole 12.5 km stretch of the proposed motorway Skopje-Blace)

3.4.2.1 Forest habitats

The dominant forest habitat type in the area is Pubescent oak (*xerotermophyllous*) forest. There is one small patch of Sessile oak forest (3.58 ha) which is more than 400 m away from the alignment. This patch is mapped but its habitat was not described since no impacts can be foreseen. Similarly, two broadleaf tree stands (patches) of *Robinia pseudoacacia* were mapped (0.62 ha). They belong to the habitat of G1.C3 - Robinia plantations. Also, very small coniferous plantation (Black pine, Pinus nigra, 21.367701, 42.074294) is present. It belongs to the EUNIS habitat - G3.57 - Pinus nigra reforestation.

- **Pubescent oak forests**

Reference to EUNIS: G1.733 Heleno [Quercus pubescens] forests

Reference to Bern Convention (Resolution 4): G1.7 Thermophilous deciduous woodland

Reference to EU Habitat Directive Annex I: ***none***

Forests within the analysed area are represented by areas under forests and small patches. They are characterized as *Querco-Carpinetum orientalis*. This thermophilic and xerophilic community develops on skeletal soils under regional climate influence. Edification species is the oak bug (*Quercus pubescens*), and Carpinus orientalis is a common species. Besides these species in the floor of the trees and shrubs are found: manna ash (*Fraxinus ornus),* bladder-*senna (Colutea arborescens), (Coronilla emeroides),* common hawthorn *(Crataegus monogyna),* field elm *(Ulmus campestris),* checker tree *(Sorbus torminalis),* common ivy *(Hedera helix)* while grass floor is represented by fragrant hellebore (*Helleborus odorus),* ivy-leaved cyclamen *(Cyclamen neapolitanum), Lathyrus venetus,* purple gromwell *(Lithospermum purpureoviolaceum)*, etc.

Figure 83 Degraded Pubescent oak forest (higher parts are occupied by typical (degraded) community, lower parts with subass. paliuretosum)

Amphibian species that are present in this habitat type are green toad (*Bufotes viridis*) and common toad *(Bufo bufo)*, while reptile fauna is represented with turtles, lizards and snakes. The species that can be found in this habitat are: Herman tortoise (*Testudo hermanni),* Greek tortoise (*Testudo graeca),* wall lizard (*Podarcis muralis),* Balkan wall lizard *(Podarcis erhardii),* Balkan green lizard *(Lacerta trilineata),* European worm snake *(Xerotyphlops vermicularis),* whip snake *(Dolichophis caspius),* smooth snake *(Coronella austriaca),* four-lined snake *(Elaphe quatuorlineata),* Montpellier snake *(Malpolon insignitus*) and nose horned viper (*Vipera ammodytes)*.

Figure 84 Greek tortoise (*Testudo graeca*) (Foto: Bogoljub Sterijovski)

The most characteristic bird species for this habitat are European honey buzzard (*Pernis apivorus*), Eastern Orphean warbler (*Curruca crassirotris*), and European turtle dove (*Streptopelia turtur*).

Figure 85 European turtle dove (*Strpetopelia turtur*)

Typical mammal species found in this habitat are brown bear (*Ursus arctos*), grey wolf (*Canis lupus*), wild cat (*Felis silvestris*), badger (*Meles meles*), roe deer (*Capreolus capreolus*), noctule (*Nyctalus noctula*), long-tailed field mouse (*Apodemus sylvaticus*) and red squirrel (*Sciurus vulgaris*).

Well-developed Pubescent oak forests cover area of 4.29 ha. They are distributed on the locality Golem Breg, 250 m away from the mororway line.

Degraded Pubesdcent oak forest cover an area of 57.88 ha. They are distributed by scattered patches in the gorge of Lepenec river. Some of them will be crossed by the projected motorway.

- **Riparian poplar belts (Populetum albae-nigrae)**

Reference to EUNIS: G1.11212 - Eumediterranean white and crack willow galleries

Reference to Bern Convention (Resolution 4): G1.11 Riverine Salix woodland

Reference to EU Habitat Directive Annex I: 92A0 Salix alba and Populus alba galleries

The dominant plant community is *Populetum albae-nigrae* Slavnic (1942) 1952. During the site investigation, the noted plant species in the floor of the trees: silver poplar (*Populus alba), black poplar (Populus nigra),* common alder *(Alnus glutinosa)*, Grayish oak (*Quercus* cf. *pedunculiflora*). On the bush floor are: old man's beard (*Clematis vitalba),* common ivy *(Hedera helix) and holy bramble (Rubus sanguineus)*. The grass floor consists of cuckoopin (*Arum maculatum),* spotted dead-nettle *(Lamium maculatum),* greater celandine *(Chelidonium majus),* wild basil *(Brachipodium* sp., *Clinopodium vulgare)*.

In some places, poplar forests are degraded, and degraded willow communities emerge in succession. It can be expected that these communities will also, over time, move into poplar belts and small groves.

In general, the riparian belts are degraded and severely fragmented due to various human activities (sand extraction facilities and other industrial infrastructure, illegal wood cut, dirt roads, etc.).

Figure 86 Poplar belts alongside Lepenec River

Amphibian species that are present in this habitat type are fire salamander (*Salamandra salamandra),* fire belly toad *(Bombina variegata),* green toad (*Bufotes viridis)*, common toad (*Bufo bufo),* marsh frog *(Pelophylax ridibundus),* Greek stream frog *(Rana graeca),* agile frog *(Rana dalmatina) and* European tree frog *(Hyla arborea)*.

Reptile fauna is represented with turtles, lizards and snakes. The species that can be found in this habitat are: Herman tortoise (*Testudo hermanni), Greek* tortoise *(Testudo graeca),* slowworm *(Anguis fragilis),* wall lizard *(Podarcis muralis),* Erhard's wall lizard *(Podarcis erhardii),* Balkan green lizard *(Lacerta trilineata),* whip snake *(Dolichophis caspius),* smooth snake *(Coronella austriaca),* four-lined snake *(Elaphe quatuorlineata),* Montpellier snake *(Malpolon insignitus),* Aesculapian snake *(Zamenis longissimus)*, grass snake (*Natrix natrix)* and nose horned viper (*Vipera ammodytes)*.

Figure 87 Fire belly toad *(Bombina variegata*) (Photo: Bogoljub Sterijovski)

Riparian vegetation is crucial habitat for the Eurasian otter (*Lutra lutra*). Other mammal species found in this habitat are: red fox (*Vulpes vulpes*), stone marten (*Martes foina*), weasel (*Mustela nivalis*), yellow-naked field mouse (*Apodemus flavicolis*) and southern water shrew (*Neomys anomalus*).

Riparian poplar belts are the habitat with the largest number of bird species in the area of interest. Levant sparrowhawk (*Accipiter brevipes*), Turtle dove (*Streptopelia turtur*), Masked shrike (*Lanius nubicus*), Collared Flycatcher (*Ficedula albicollis*) and Euroasian hobby (*Falco subbuteo*) are identified as most important bird species in this habitat type.

Figure 88 Levant sparrow hawk (*Accipiter brevipes*) on Populus nigra

Figure 89 Masked shrike (*Lanius nubicus*)

Figure 90 Dendrocopos minor (small woodpecker) on Populus alba

Riparian belts are distributed exclusively along river Lepenec. They cover an area of 77.54 ha including Willow and Poplar belt/stands as well as willow shrubland with tamarisk (F9.3133: East Mediterranean tamarisk thickets).

3.4.2.2 Grassland (open) habitats

The grassland habitats in the analysed area were caused by degradation and destruction of forest vegetation due to the long-lasting human activities (timber exploitation, forest fires, grazing). In the analysed area they are represented by hilly pastures and meadows.

- **Hill pastures**

Reference to EUNIS: E1.332 Heleno-Balkanic short grass and therophyte communities

Reference to Bern Convention (Resolution 4): included in E1.3 Mediterranean xeric grassland

*Reference to EU Habitats Directive Annex I: *6220 Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea*

The hilly pastures are secondary habitats that develop in areas where primary forest ecosystems were developed at altitudes up to 1200 m. Therefore, different succession stages can be observed in the habitats of hilly pastures - from open pastures to heavily degraded oak - Carpinus forests. These habitats are characterized by large daily and seasonal amplitudes of air and soil temperature and lower humidity (especially during summer). Such environmental conditions are the cause of the specific spectrum of life forms i.e. higher prevalence of terophytic plants.

In the analysed area, most grasslands are in fact abandoned fields and meadows that still do not have typical features of hilly pastures.

The fauna of these habitats abounds in characteristic species, with the most typical amphibians and reptiles being such as: green toad (*Bufotes viridis)*, common toad (*Bufo bufo)*, Herman tortoise (*Testudo hermanni), Greek toad (Testudo graeca),* wall lizard *(Podarcis muralis),* Erhard's wall lizard *(Podarcis erhardii),* Balkan wall lizard *(Podarcis tauricus),* Balkan green lizard *(Lacerta trilineata),* European worm snake *(Xerotyphlops vermicularis),* whip snake *(Dolichophis caspius),* Smooth snake *(Coronella austriaca),* four-lined snake *(Elaphe quatuorlineata),* Montpellier snake *(Malpolon insignitus)* and nose horned viper (*Vipera ammodytes)*.

Figure 91 Herman tortoise (Testudo hermanni) (Photo: Bogoljub Sterijovski)

Typical mammal species found in this habitat are: red fox (*Vulpes vulpes*), stone marten (*Martes foina*), brown hare (*Lepus europaeus*), northern white-breasted hedgehog (*Erinaceus roumanicus*) and long-tailed field mouse (*Apodemus sylvaticus*). Regarding to birds diversity, Black-eared Wheatear (*Oenanthe hispanica)*, Lesser grey shrike (*Lanius minor*), Wood lark (*Lullula arborea*), Montagu's Harrier (*Circus pygargus*) are the typical representatives for this habitat type.

Hill pastures cover and area of 67.15 ha. They can be considered as typical for the EU Habitats Directive Habitat of *6220 Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea. Some of the hill pastures are overgrown by shrubs and trees. They cover an area of 241.3 ha and represent the dominant semi natural habitat type. Both hill pastures and hill pastures with shrubs are distributed in the hilly slopes of the gorge of river Lepenec (same as degraded Pubescent oak forests). The projected motorway passes through some of these patches.

Figure 92 Lesser grey shrike (Lanius minor)

Figure 93 Hill pasture with sparse shrubs

3.4.2.3 Meadows

Reference to EUNIS: E2.2 : Low and medium altitude hay meadows

Reference to Bern Convention (Resolution 4): E2.2 Low and medium altitude hay meadows

Reference to EU HD Annex I: 6510 Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis) (do not entirely correspond to the meadows in the corridor of interest)[29].

The meadows are semi natural habitats created with extensive use of grassland communities, mainly through mowing. Most of the meadows were actively managed during the field surveys which means that they have good prospects (the greatest threat to meadows is their abandonment). Almost all of the meadows are around the village of Blace, but they will not be directly threatened by the motorway construction, since they are further away of the project footprint area.

[29] Mesic mown meadows on mineral-rich soils of sub-mediterranean regions of Central Balkans belong to *Rumicion thyrsiflori* Micevski ex Carni et Mucina 2013. The habitat includes other plant phytocoenoses i.e. species-rich hay meadows on lightly to moderately fertilised soils of the plain to submontane levels, belonging to the *Arrhenatherion* and the *Brachypodio-Centaureion nemoralis* alliances. Thus, the central Balkan hay meadows are not included in the description of the habitat type 6510 Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis) but have similar phytosociological features.

Figure 94 Mowed meadow near village Blace

Amphibian and reptile fauna that can be found in the meadows are: common toad (*Bufo bufo)*, Herman tortoise (*Testudo hermanni),* wall lizard *(Podarcis muralis),* Erhard's wall lizard *(Podarcis erhardii),* Balkan wall lizard *(Podarcis tauricus),* Balkan green lizard *(Lacerta trilineata),* whip snake *(Dolychophis caspius),* smooth snake *(Coronella austriaca),* Aesculapian snake *(Zamenis longissimus)* and nose horned viper (*Vipera ammodytes)*.

Meadows are distributed along river Lepenec as well as in the valleys of the gorge of river Lepenec (valleys of intermittent streams or ravines). They cover an area of 15.79 ha.

3.4.2.4 Aquatic ecosystems (rivers and streams)

Reference to EUNIS: C2.22 Hiporhithral streams C2.31 Epipotamal streams, and C2.5: Temporary running waters

Reference to Bern Convention (Resolution 4): C2.27 Mesotrophic vegetation of fast flowing streams and C3.55 Sparsely vegetated river gravel banks,

Reference to EU HD Annex I: 3260 Watercourses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation

The Lepenec River is one of the 10 largest tributaries of the Vardar River. The total length of the river is 75 km. Some epilitic (growing on stones) algae and well-developed macrophyte communities such as Cladophora glomerata and Lemanea fluviatilis are found in the river. The composition of epilitic communities consists of diatomes and cyanobacteria (mainly Phormidium sp.). Dominant diatom species are *Cocconeis placentula* var *lineata*, *Diatoma vulgaris, Gomphonema olivaceum, Navicula lanceolata, Nitzschia dissipata* and *Rhoicosphaenia abbreviata*.

Lepenec Ihtiofauna is represented by seven species (some of which occasionally penetrate the Vardar River): common nase (*Chondrostoma nasus),* common chub *(Leuciscus cephalus),* barbel*(Barbus peloponnesius),* schneider *(Alburnoides bipunctatus),* common barbel *(Barbus barbus),* gudgeon *(Gobio gobio)* and spined loach *(Cobitis taenia).* Eurasian otter (*Lutra lutra*) is also found in Lepenec, searching for food (mainly fish). Amphibian species that are present in this habitat type are: marsh frog (*Pelophylax ridibundus),* Greek stream frog *(Rana graeca)* and European tree frog *(Hyla arborea)*. Reptile fauna is represented with two species: grass snake (*Natrix natrix) and* and dice snake *(Natrix tessellata)*.

Bird fauna in Lepenec is represented with a few species such as Common Goldeneye (*Bucephala clangula*) – present only on winter migration, and Mallard (*Anas platyrhynchos*) and Little Grebe (*Tachybaptus ruficollis*), Common coot (*Fulica atra*) present during the whole year.

Epipotamal streams cover an area of 8.57 ha while their gravel banks additional 5.87 ha.

Figure 95 Lepenec River

3.4.2.5 Agricultural habitats

There are several anthropogenic habitats in the area: fields, orchards, very few vineyards, numerous abandoned agricultural areas and mining communities.

Table 50 Value of habitats

Habitats	Eunice	Habitat Directive
Fields	I1.3 Arable land with the same crops grown by small farming methods	no
Vineyards	FB.41 Traditional vineyards	no
Orchards	G1.D4: Orchards	no
Abandoned fields	I1.53 Non-arable land with annual and perennial weed communities	no
Ruderal housing	E5.1 Anthropogenic plant communities including: E5.12 Weed communities of recently abandoned urban and semi-urban buildings; E5.13 Weed communities of recently abandoned rural buildings	no

Most common mammal species found in this habitat are: red fox (*Vulpes vulpes*), stone marten (*Martes foina*), weasel (*Mustela nivalis*), brown hare (*Lepus europaeus*), European mole (*Talpa europaea*), striped field mouse (*Apodemus agrarius*) and house mouse (*Mus musculus*).

Herpetofauna is represented by the following species: fire belly toad (*Bombina variegata),* green toad (*Bufotes viridis)*, common toad (*Bufo bufo)* agile frog *(Rana dalmatina),* Herman tortoise *(Testudo hermanni),* slowworm *(Anguis fragilis),* wall lizard *(Podarcis muralis),* Erhard's wall lizard *(Podarcis erhardii),* Balkan green lizard *(Lacerta trilineata),* whip snake *(Dolichophis caspius),* grass snake *(Natrix natrix*)and and nose horned viper (*Vipera ammodytes)*. Bird fauna is represented with 25 bird species, including Common quail (*Coturnix coturnix*), Grey partridge (*Perdix perdix*), Corn bunting (*Emberiza calandra*), Eurasian linnet (*Linaria cannabina*).

Significant is the presence of 14 orthopterans invertebrate species: *Polysarcus denticauda, Tettigonia viridissima, Tettigonia caudata, Decticus verrucivorus, Oecanthus pellucens, Acheta deserta, Omocestus ventralis, Chortippus loratus, Euchortippus declivus stichai, Dociostaurus brevicollis, Aiolopus strepens, Acrotylus insubricus, Calliptamus italicus* and *Forficula auricularia*.

In abandoned fields and ruderal habitats there are several types of herbaceous plants such as: Bermuda grass *(Cynodon dactylon), Lolium* spp., *Bromus* spp., Hordeum vulgare - Barley, as well as other herbaceous plants: greater burdock (*Arctium lappa),* henbane *(Hyosciamus niger),* thorn apple *(Datura stramonium),* Common chicory *(Cichorium intybus),* spiny cocklebur *(Xanthium spinosum), (Onopordon* sp., *Cirsium* spp.) etc.

Figure 96 Abandoned field

Agricultural land is absolutely dominant habitat type with coverage of 564.03 ha. Additionally 48.07 ha were abandoned arable land at the time of preparation of the habitat map. Abandoned arable land can be found scattered along the whole alignment, but mostly in the gorge or river Lepenec. Fields and acres are distributed along the whole alignment but mostly in the plain area of Skopje valley (first 4 km of the alignment). Few small orchards were also mapped (4.3 ha). They are distributed along the whole alignment, but mostly along river Lepenec. None of this patches will be directly affected. Also, few small vineyards were also detected with a total area of 0.69 ha.

3.4.2.6 Valorisation of habitats

The valorisation of habitats was performed on the basis of EU Habitats Directive (Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora). In general, five habitats can be identified as important, two of them riparian habitats along river Lepenec, one forest habitat, one habitat of dry grasslands and one that concerns hay meadows.

Table 51 Overview of natural and semi natural habitats and their valorisation

Habitat group	Habitat	Reference to EUNIS	Importance according to EU Habitats Directive
Forest and scrublands	Thermophyllous oak forests	G 1.7: Thermophilous deciduous woodland various degraded stages of: G1.733, G1.7C22, G1.762, F6.25, F3.12	/
	Degraded thermophyllous Pubescent oak forests		/
	Willow woodlands and belts of willows (river Lepenec and small fragment along Vrazanska Reka)	G1.11 Riverine [*Salix*] woodland - G1.112 , G1.1121 and G1.3156	92A0 *Salix alba* and *Populus alba* galleries
	Riparian willow scrubland	F9.3133: East Mediterranean tamarisk thickets	/
	Coniferous plantations	G3.57 - *Pinus nigra* reforestation	/
	Broadleaved (Black locust's) stands	G1.C3 - Robinia plantations	/
Open terrain	Hill pastures (with sparse shrubs)	n/a (E1 - Dry grasslands)	6220 Pseudo-steppe with grasses and annuals of the *Thero-Brachypodietea*
	Meadows	E2.2 - Low and medium altitude hay meadows	Only partially correspond to 6510 Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*)
	Gravel bank	n/a	/

Water ecosystems	Epipotamal streams (River Lepenec and Vrazanska River)	C2.22 Hiporhithral streams and C2.31 Epipotamal streams	3260 Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion vegetation*]
	Intermittent streams	C2.5: Temporary running waters	/
Agricultural land (in the sense of biotopes)	Fields and acres	I1.3 Arable land with unmixed crops grown by low-intensity agricultural methods	/
	Vineyards (Small parcels and plantations)	FB.41 Traditional vineyards	/
	Orchards	G1.D4 : Fruit orchards	/
	Abandoned arable land	I1.53 Fallow un-inundated fields with annual and perennial weed communities	/
	Fallow land	E5.1 Anthropogenic herb stands, including: E5.12 and E5.13	/

3.4.2.7 Flora

The list of plants contains about 554 species. The most characteristic plant species were presented in the previous chapter dealing with description of habitats. In general, the flora of the analysed area is composed of widespread species which are common for the described habitats. None of the species is listed in the red lists of threatened species on global (IUCN - https://www.iucnredlist.org/) or national (http://redlist.moepp.gov.mk/pregled-na-vidovi/#plants) level. None of the species is listed in the annexes of Habitats Directive or appendices of the Bern convention. None of the species can be considered as endemics.

Five allochtonous species were recorded during the field work: Tree of Heaven (*Ailanthus altissima* [=*glandulosa]*), White mulberry (*Morus alba),* Canada fleabane *(Erigeron canadensis*)*,* Canadian poplar *(Populus canadensis* [=*hybridus]*), Black locust (*Robinia pseudoacacia)*, etc.

Ailanthus altissima, Populus canadensis and *Morus alba* can be considered as invasive due to their spread in the natural communities, especially in the riparian habitats along river Lepenec.

Three small patches of *Robinia pseudoacacia* were mapped (21.326213, 42.113557; 21.370791, 42.068503; 21.341918, 42.083385).

Erigeron canadensis was recorded in a ruderal site close to an animal farm (21.352203, 42.080781).

3.4.2.8 Fauna

The most characteristics/common species were presented in the respective chapters for description of particular habitats. In this chapter will be presented the important species from biodiversity conservation point of view. All of the vertebrate groups are presented in the following subchapters: mammals, birds, reptiles, amphibians and fish. Out of the invertebrate groups separate subchapters are dedicated to ground beetles and butterflies. Besides the presentation of the diversity of species, all of the faunistic groups are evaluated against national and international criteria.

3.4.2.8.1 Mammals

The number of recorded mammal species in the area is 24. Most of the species (22) are common and widespread species in the Republic of North Macedonia. Most of the species were confirmed during the field research with the exception of the ones marked with an asterisk (*) in the presented **Table 52**.

The valorisation of the species was done using the following criteria: IUCN Global and European Red List, National Red List of mammals, EU Habitats Directive, Bern Convention and relevant national legislation (Law on Hunting and List of strictly protected and protected wild species – bylaw of the Law on Nature Protection).

Out of the 24 species recorded in the area, two species brown bear (*Ursus arctos)* and Eurasian otter (*Lutra lutra*) are categorized as **vulnerable (VU)** and one one wolf (*Canis lupus*) as **near threatened (NT)** according the National Red List of mammals. One species Eurasian otter (*Lutra lutra*) is categorized as **near threatened (NT) according the Global IUCN Red List.** Two species are included in Annex II & IV, four species are included in Annex IV and one in Annex II, IV and V of the Habitats Directive. Brown bear (*Ursus arctos*) and wolf (*Canis lupus*) are considered as priority species by the EU Habitats Directive. Seven species are listed as strictly protected fauna species in Appendix II and other seven are listed as protected fauna species in Appendix III of the Bern Convention. Three species are listed in Annex II of the Bonn Convention. According to the provisions of the Law on Hunting, five species are categorized as permanently protected game species, whereas three species have temporary (seasonal) protection (open and closed hunting season). Three species are listed as strictly protected species and the other two as protected species according to the Law on Nature Protection (Table 53).

The most important and priority mammal species in the area are the Brown bear (*Ursus arctos*) and the Eurasian otter (*Lutra lutra*) due to their threat status (categorized as Vulnerable). The wolf is also a priority species according to the EU Habitats Directive.

Brown bear mainly inhabits forest habitats, which provide food and shelter for the bear and serve as corridors that enables connectivity of the bear populations. Brown bear's presence was confirmed by finding bear footprints at one location in which bridges are foreseen (21.31769, 42.12212). At the same location, wolf footprints were also recorded, suggesting that this area is probably actively used by the large carnivores and may serve as a corridor. Thus, the presence, distribution and movement of Brown bear and wolf should be considered when planning and performing any activity that will have larger or smaller negative impact on the species or its habitats.

The Eurasian otter is found in a variety of both natural and men-made aquatic habitats and are strongly dependent on presence of riparian vegetation. Otter footprints were recorded at one location on the bank of river Lepenec (21.33868, 42.09036). River Lepenec is relatively away from the planned route and will not be influenced by the construction works. Therefore, Eurasian otter and its habitats will not be affected by the construction activities.

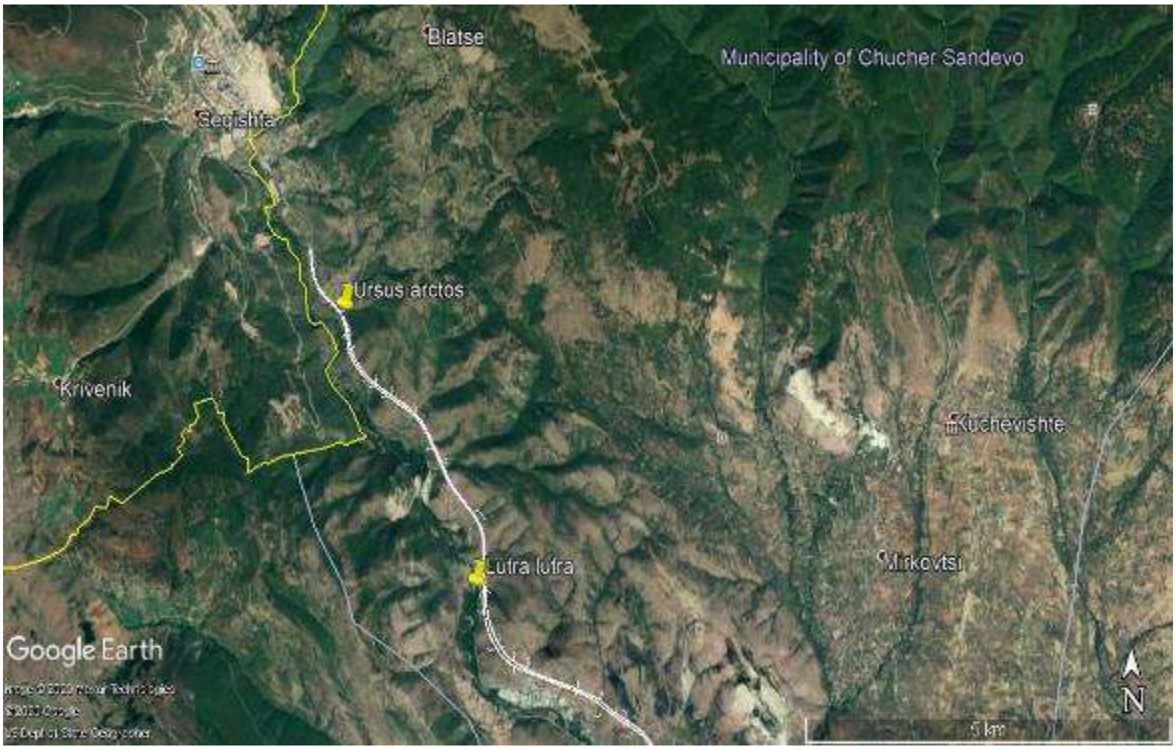


Figure 97 Locations of the important mammal species found during the field visits

Table 52 List of all mammalian species recorded during the assessment and their valorisation (species from literature only are marked with an asterisk *)

No	**Species**	**Species (English name)**	**EU Habitats Directive**	**Bern Convention**	**Bon Convention**	**IUCN Global Red List**	**IUCN European Red List**	**National Red list**	**Law on Hunting**	**Law on Nature Protection**
1	*Erinaceus roumanicus*	Northern white-breasted hedgehog				LC	LC			
2	Neomys anomalus*	Southern water shrew		App. III		LC	LC			
3	*Talpa europaea**	European mole				LC	LC			
4	*Pipistrellus nathusii*	Nathusius' pipistrelle	Ann. IV	App. II	App. II	LC	LC			
5	*Pipistrellus kuhlii*	Kuhl's pipistrelle	Ann. IV	App. II	App. II	LC	LC			
6	*Nyctalus noctula*	Noctule	Ann. IV	App. II	App. II	LC	LC			
7	*Lepus europaeus*	Brown hare		App. III		LC	LC		temporary protected	
8	*Sciurus vulgaris*	Red squirrel		App. III		LC	LC		permanently protected	protected species
9	*Apodemus agrarius**	Stripped field mouse				LC	LC			
10	*Apodemus sylvaticus**	Long-tailed field mouse				LC	LC			
11	*Apodemus flavicolis**	Yellow-necked field mouse				LC	LC			
12	*Rattus rattus**	House rat				LC	LC			
13	*Mus musculus**	House mouse				LC	LC			
14	*Nannospalax leucodon**	Lesser mole rat				DD	DD			
15	*Ursus arctos*	Brown bear	Ann. II & IV	App. II		LC	LC	**VU**	permanently protected	strictly protected species
16	*Canis lupus*	Wolf	Ann. II, IV & V	App. II		LC	LC	NT	without protection	
17	*Vulpes vulpes*	Red fox				LC	LC		without protection	

18	*Mustela nivalis*	Weasel		App. III		LC	LC		without protection	
19	*Martes foina*	Stone marten		App. III		LC	LC		without protection	
20	*Melesmeles*	Badger		App. III		LC	LC		permanently protected	protected species
21	*Lutra lutra*	Eurasian otter	Ann. II & IV	App. II		**NT**	**NT**	**VU**	permanently protected	strictly protected species
22	*Felis silvestris**	Wild cat	Ann. IV	App. II		LC	LC		permanently protected	strictly protected species
23	*Sus scrofa*	Wild boar				LC	LC		temporary protected	
24	*Capreolus capreolus*	Roe deer		App. III		LC	LC		temporary protected	

3.4.2.8.2 Birds

The results of analysis show that 105 bird species (88 recorded during the field surveys and 17 from the literature) are present in the area of interest which represents 33, 01% of total bird species present in Macedonia (Velevski and Vasić, 2017). These 105 are part of 42 families and 80 different genera. 89 bird species are identified as breeding birds for the area of interest, 12 bird species as wintering birds, 2 bird species are occurring accidentally, and 2 bird species use the area of interest only during migration.

Biogeographical characteristics of the area of interest are adequate for the presence of mainly continental, mediterranean and sub-Mediterranean bird species such as Eastern Orphean warbler and Western black-eared wheatear.

Family Muscicapidae, with 6 genera and 7 species is the most diverse. Within the research area, 6 main bird habitats were identified, from which the Riparian poplar belts (*Populetum albae-nigrae*) is habitat type with largest number of bird species – 37. The developed industry in the area of interest contributes to the small number of birds present in these types of habitat.

Riparian poplar belts (*Populetum albae-nigrae*) are habitat type with the biggest number of bird species. Of the 37 bird species present in this habitat type, 18 are possible, probable, or certain breeding species. This habitat type is well preserved along River Lepenec, where white poplar, willow and alder are dominant tree species. Levant sparrow hawk (*Accipiter brevipes*), Turtle dove (*Streptopelia turtur*) and Masked shrike (*Lanius nubicus*) are identified as the most important bird species (according to national draft list for NATURA2000 and national legislatives, IUCN (Global and EU), Bird Directive) in this habitat type. With this research two breeding territories of Levant sparrow hawk (Annex I species) were located, but the possibility for 3rd breeding pair in the area of interest is not excluded (**Figure 98**).

Figure 98 Levant sparrowhawk observations in project area

As 2nd habitat type by bird species number are the hill pastures with oak shrubs. 34 bird species are present in this habitat type, of which 33 are possible, probable, or certain breeding species. Turtle dove (*Streptopelia turtur*), Eastern Orphean warbler (*Curruca crassirostris*) and Lesser grey shrike (*Lanius minor*) are identified as one of the most important bird species present in this habitat type. The lack of livestock and under grazing contributes to the natural succession of this habitat type with oak shrubs, and this is probably the most important threat to this habitat type.

Meadows with coniferous plantations are habitat type with presence of 33 bird species which all of them are possible, probable, or certain breeding species. Most important species for this habitat type are Turtle dove (*Streptopelia turtur*), Masked shrike (*Lanius nubicus*), and Lesser grey shrike (*Lanius minor*).

Degraded pubescent oak forests are represented with 25 bird species, of which 23 are possible, probable, or certain breeding species, and 2 bird species are using this area only as migration route. Long-legged buzzard (*Buteo rufinus*), European honey buzzard (*Pernis apivorus*), and Eastern Orphean warbler (*Curruca crassirostris*) are part of the important species found in this type of habitat. Although this habitat type is not typical for the Long-legged buzzard (*Buteo rufinus*), pair was observed in breeding season at this habitat type. Additional research is needed in order to find the nest and breeding location for this bird species (it is most probably further away of the motorway since no nest was observed in the vicinity).

The ornythofauna of small agricultural land with hedges is represented with 25 bird species with all of them being possible, probable, or certain breeding species according to the methodology used in the creation of the 2nd European Breeding Bird Atlas. Although it has the same number of species as previously mentioned habitat type, there is no occurrence of important bird species apart from the Turtle dove and Lesser grey shrike.

Presence of bird species (L – literature (not confirmed within this research), F – bird species found and confirmed with field survey) in the following table are presented.

Table 53 Presence of bird species (L – literature (not confirmed within this research), F – bird species found and confirmed with field survey)

Family	No.	Species	English name	Source
Anatidae	*1*	*Anseralbifrons*	Greater White-fronted Goose	L
	2	*Bucephala clangula*	Common Goldeneye	L
	3	*Anas platyrhynchos*	Mallard	F
Phasianidae	*4*	*Coturnix coturnix*	Common Quail	F
	5	*Phasianuscolchicus*	Common Pheasant	F
	6	*Perdix perdix*	Grey Partridge	F
Podicipedidae	*7*	*Tachybaptus ruficollis*	Little Grebe	L
Columbidae	*8*	*Columba livia*	Rock Pigeon	F
	9	*Columba palumbus*	Common Wood Pigeon	F
	10	*Streptopeliaturtur*	European Turtle Dove	F
	11	*Streptopeliadecaocto*	Eurasian Collared Dove	F
Caprimulgidae	*12*	*Caprimulgus europaeus*	Eurasian Nightjar	F
Apodidae	*13*	*Apus pallidus*	Pallid Swift	F
Cuculidae	*14*	*Cuculuscanorus*	Common Cuckoo	F
Rallidae	*15*	*Gallinula chloropus*	Common Moorhen	F
	16	*Fulicaatra*	Common Coot	L
Ardeidae	*17*	*Ardea alba*	Great White Egret	F
	18	*Egrettagarzetta*	Little Egret	F
Phalacrocoracidae	*19*	*Phalacrocorax carbo*	Great Cormorant	F
Charadriidae	*20*	*Charadrius dubius*	Little Ringed Plover	F

Family	No.	Species	English name	Source
Scolopacidae	*21*	*Gallinagogallinago*	Common Snipe	L
	22	*Actitishypoleucos*	Common Sandpiper	F
	23	*Tringaochropus*	Green Sandpiper	L
	24	*Tringatotanus*	Common Redshank	L
Laridae	*25*	*Chroicocephalus ridibundus*	Black-headed Gull	L
Accipitridae	*26*	*Pernis apivorus*	European Honey Buzzard	F
	27	*Hieraaetuspennatus*	Booted Eagle	L
	28	*Circus pygargus*	Montagu's Harrier	F
	29	*Accipiter brevipes*	Levant Sparrowhawk	F
	30	*Accipiter nisus*	Eurasian Sparrowhawk	F
	31	*Buteo buteo*	Common Buzzard	F
	32	*Buteo rufinus*	Long-legged Buzzard	F
Strigidae	*33*	*Athene noctua*	Little Owl	F
	34	*Otus scops*	Common Scops Owl	F
Upupidae	*35*	*Upupa epops*	Eurasian Hoopoe	F
Picidae	*36*	*Picusviridis*	Eurasian Green Woodpecker	F
	37	*Dendrocopos minor*	Lesser Spotted Woodpecker	F
	38	*Dendrocopos medius*	Middle Spotted Woodpecker	F
	39	*Dendrocopos syriacus*	Syrian Woodpecker	F
	40	*Dendrocopos major*	Great Spotted Woodpecker	F
Meropidae	*41*	*Merops apiaster*	European Bee-eater	F
Alcedinidae	*42*	*Alcedo atthis*	Kingfishesh	F
Falconidae	*43*	*Falco tinnunculus*	Common Kestrel	F
	44	*Falco subbuteo*	Eurasian Hobby	L
Oriolidae	*45*	*Oriolus oriolus*	Eurasian Golden Oriole	F
Laniidae	*46*	*Laniuscollurio*	Red-backed Shrike	F
	47	*Lanius minor*	Lesser Grey Shrike	F
	48	*Lanius senator*	Woodchat Shrike	F
	49	*Laniusnubicus*	Masked Shrike	F
Corvidae	*50*	*Garrulus glandarius*	Eurasian Jay	F
	51	*Pica pica*	Black-billed Magpie	F
	52	*Corvus corax*	Common Raven	F
	53	*Corvus corone*	Hooded Crow	F
Prunellidae	*54*	*Prunella modularis*	Hedge Accentor	F
Passeridae	*55*	*Passer domesticus*	House Sparrow	F
	56	*Passer montanus*	Eurasian Tree Sparrow	F
Motacillidae	*57*	*Anthus trivialis*	Tree Pipit	F
	58	*Anthus spinoletta*	Water Pipit	F
	59	*Motacilla flava*	Yellow Wagtail	F
	60	*Motacilla alba*	White Wagtail	F
Fringillidae	*61*	*Fringilla coelebs*	Eurasian Chaffinch	F
	62	*Fringilla montifringilla*	Brambling	L
	63	*Coccothraustes coccothraustes*	Hawfinch	F

Family	No.	Species	English name	Source
	64	*Chloris chloris*	European Greenfinch	F
	65	*Linaria cannabina*	Eurasian Linnet	F
	66	*Carduelis carduelis*	European Goldfinch	F
Emberizidae	*67*	*Granativora melanocephala*	Black-headed Bunting	F
	68	*Emberiza calandra*	Corn Bunting	F
	69	*Emberiza cirlus*	Cirl Bunting	F
Paridae	*70*	*Poecile lugubris*	Sombre Tit	F
	71	*Cyanistes caeruleus*	Blue Tit	F
	72	*Parus major*	Great Tit	F
Remizidae	*73*	*Remiz pendulinus*	Eurasian Penduline Tit	L
Alaudidae	*74*	*Lullula arborea*	Wood Lark	F
	75	*Galerida cristata*	Crested Lark	F
Acrocephalidae	*76*	*Iduna pallida*	Eastern Olivaceous Warbler	F
	77	*Hippolaisicterina*	Icterine Warbler	L
	78	*Acrocephalus schoenobaenus*	Sedge Warbler	L
	79	*Acrocephalus palustris*	Marsh Warbler	F
Hirundinidae	*80*	*Delichon urbicum*	Northern House Martin	F
	81	*Cecropis daurica*	Red-rumped Swallow	F
	82	*Hirundo rustica*	Barn Swallow	F
	83	*Riparia riparia*	Sand Martin	F
Phylloscopidae	*84*	*Rhadina sibilatrix*	Wood Warbler	L
	85	*Phylloscopus trochilus*	Willow Warbler	F
	86	*Phylloscopus collybita*	Common Chiffchaff	F
Scotocercidae	*87*	*Cettia cetti*	Cetti's warbler	F
Aegithalidae	*88*	*Aegithalos caudatus*	Long-tailed Tit	F
Sylviidae	*89*	*Sylvia atricapilla*	Blackcap	F
	90	*Curruca crassirostris*	Orphean Warbler	F
	91	*Curruca curruca*	Lesser Whitethroat	L
	92	*Curruca cantillans*	Subalpine Warbler	F
	93	*Curruca communis*	Common Whitethroat	F
Sittidae	*94*	*Sitta europaea*	Wood Nuthatch	F
Troglodytidae	*95*	*Troglodytes troglodytes*	Winter Wren	F
Sturnidae	*96*	*Sturnus vulgaris*	Common Starling	F
Muscicapidae	*97*	*Muscicapa striata*	Spotted Flycatcher	F
	98	*Erithacus rubecula*	European Robin	F
	99	*Luscinia megarhynchos*	Common Nightingale	F
	100	*Ficedula albicollis*	Collared Flycatcher	L
	101	*Saxicola rubetra*	Whinchat	F
	102	*Oenanthe oenanthe*	Northern Wheatear	F
	103	*Oenanthe hispanica*	Black-eared Wheatear	F
Turdidae	*104*	*Turdus philomelos*	Song Thrush	F
	105	*Turdus merula*	Eurasian Blackbird	F

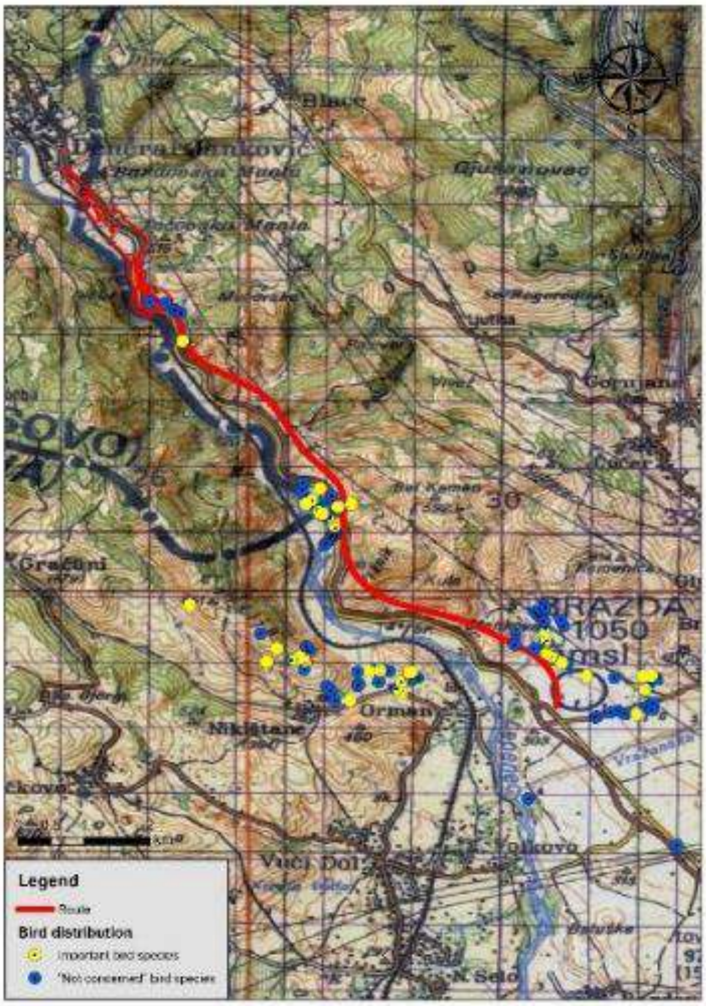


Figure 99 Distribution of registered bird species

The valorisation of the avifauna is based on several national and international documents and agreements such as: Red List of Threatened Species (IUCN, 2019), European Red List of Birds (BirdLife International, 2015), The Birds Directive (The European Parliament and The Council of the European Union, 2009), Resolution No. 6 of The Convention on the Conservation of European Wildlife and Natural Habitats (Standing Committee of the Convention on the Conservation of European Wildlife and Natural Habitats, 1998) ("Emerald species"), as well as Europe's Convention on the Conservation of European Wildlife and Natural Habitats (The Council of the European Union, 1979), The Convention on Migratory Species (UNEP/CMS Secretariat, 1979), Convention on International Trade in Endangered Species of Wild Fauna and Flora (The CITES Secretariat, 1973), List for protected and strictly protected species ("Official Gazette" of RM 139/2011) which is created according to the Law for nature protection, species listed in the Law of hunting, and relevant national legislative.

Because of the inconsistency and often repeated bird species in the above mentioned valorisation criteria, as well as the omission of some species in the national laws (Macedonian ecological society, 2012) it becomes clear that a new criteria for valorisation is needed, and this criteria will define the important bird species in Macedonia. Considering this, the data from the project for capacity building for identification of Natura 2000 sites in Macedonia (draft – list for development of Natura 2000 network (Petkov and Ruiz, 2017)) was used as a referent list for valorisation of bird species in this report. Using this list birds that are not included in Annex I of the bird directive, such as the Turtle Dove (*Streptopelia turtur*) are covered, but in the same time bird species that are common and widespread in Macedonia and included in the annexes of the above mentioned conventions are excluded.

Of the total 105 bird species registered in this research only 1 species Turtle dove (*Streptopelia turtur*) is considered vulnerable (VU) according to the Red List of Threatened Species (IUCN, 2019). However, according to the European Red List of Birds (BirdLife International, 2015), Kingfisher (*Alcedo atthis*), Turtle Dove (*Streptopelia turtur*) are considered vulnerable (VU), and the Eurasian coot (*Fulica atra*) is considered as near threatened (NT). The Turtle dove (Streptopelia turtur) is present in almost every identified habitat apart from the industrial zone, and the Kingfisher (*Alcedo atthis*) and the Euroasian coot (*Fulica atra*) are only present at the river Lepenec and in the riparian belts along Lepenec.

It is important to mention that 16 bird species, from which 14 are possible, probable, or certain breeding species for the area of interest, are included on the Annex I of the Bird Directive. Riparian belts are habitat type with the largest number of Annex I bird species present (14, 12 of which are possible, probable, or certain breeding species). The bird species that are included in Annex I of the Bird Directive are also part of the Resolution No. 6 of The Convention on the Conservation of European Wildlife and Natural Habitats ("Emerald" species).

72 of the registered bird species are included in the Appendix II of the Bern Convention and 61 of them are possible, probable, or certain breeding species. As well as Annex I of the Bird Directive, the Riparian belts are habitat type with the largest number of present bird species included in the Appendix II of the Bern Convention (65 bird species, with 58 considered to be possible, probable, or certain breeding species in this habitat type).

None of the recorded bird species in the area of interest is listed in Appendix I of Bonn Convention, but 44 of the recorded bird species are listed in Appendix II of Bonn Convention, with the number of possible, probable, or certain breeding bird species being 29.

There were no recorded bird species that are included in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, however 11 bird species are included in the Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, and 10 of them are possible, probable, or certain breeding species.

According to the national Law of nature, 19 bird species (18 of them are possible, probable, or certain breeding species) are considered as strictly protected bird species, and 10 bird species (9 of them are possible, probable, or certain breeding species) are considered protected bird species.

On the other hand, according to the Hunting Law, 19 bird species (18 bird species are possible, probable, or certain breeding) are listed as species under permanent protection, and 11 bird species (9 of them are possible, probable, or certain breeding species) are listed as birds protected by hunting season.

Finally, 29 of the total 105 bird species are identified as important according to the draft – national list for identification of Natura 2000 sites (Petkov and Ruiz, 2017). The list of important bird species consist of 16 bird species which are included in Annex I of the Bird Directive Syrian woodpecker (*Dendrocopos syriacus)* is excluded from the list of important bird species because it is a widespread species and the protection of sites is not relevant approach for the protection of this species) and 14 bird species: Little Grebe (*Tachybaptus ruficollis),* European Turtle Dove *(Streptopelia turtur),* Euroasian Coot *(Fulica atra),* Great Cormorant *(Phalacrocorax carbo),* Little Ringed Plover (*Charadrius dubius),* Common snipe (*Gallinago gallinago),* Woodchat shrike *(Lanius senator),* Blackheaded Bunting (*Granativora melanocephala),* Penduline Tit (*Remiz pendulinus),* Icterine Warbler (*Hippolais icterina),* Wood Warbler (*Rhadina sibilatrix),* Eastern Orphean Warbler (*Curruca crassirostris),* Eastern subalpine warbler *(Curruca cantillans),* Western Black-eared Wheateater (*Oenanthe hispanica*) which are considered as rare, biom restricted or have population decline on national level.

Table 54 Valorisation of the registered bird species

No.	Species	Vagrancy	IUCN GLR	IUCN ERL	Bird Directive	National list	Bern Convention	Emerald	Bonn Convention	CITES	Law of nature	Hunting law
1	*Anser albifrons*	Vag.	LC	LC	II/B & III/B	/	III	/	II	/	p	h
2	*Bucephala clangula*	Hiem.	LC	LC	II/B	/	III	/	II	/	n	p
3	*Anas platyrhynchos*	Stat.	LC	LC	II/A & III/A	/	III	/	II	/	p	h
4	*Coturnix coturnix*	Aest.	LC	LC	II/B	/	III	/	II	/	p	h
5	*Phasianus colchicus*	Stat.	LC	LC	II/A & III/A	/	III	/	/	/	p	h
6	*Perdix perdix*	Stat.	LC	LC	II/A & III/A	/	III	/	/	/	p	h
7	*Tachybaptus ruficollis*	Stat.	LC	LC	/	sp	II	/	/	/	sp	pp
8	*Columba livia*	Stat.	LC	LC	II/A	/	III	/	/	/	p	h
9	*Columba palumbus*	Stat.	LC	LC	II/A & III/A	/	/	/	/	/	p	h
10	*Streptopelia turtur*	Aest.	VU	VU	II/B	Ms	III	/	II	/	p	h
11	*Streptopelia decaocto*	Stat.	LC	LC	II/B	/	III	/	/	/	p	h
12	*Caprimulgus europaeus*	Aest.	LC	LC	I	I	II	+	/	/	n	p
13	*Apus pallidus*	Aest.	LC	LC	/	/	II	/	/	/	n	p
14	*Cuculus canorus*	Aest.	LC	LC	/	/	III	/	/	/	n	p
15	*Gallinula chloropus*	Stat.	LC	LC	II/B	/	III	/	/	/	sp	pp
16	*Fulica atra*	Stat.	LC	NT	II/A & III/B	Ms	III	/	II	/	p	h
17	*Ardea alba*	Stat.	LC	LC	I	I	II	+	II	/	sp	pp
18	*Egretta garzetta*	Stat.	LC	LC	I	I	II	+	/	/	sp	pp
19	*Phalacrocorax carbo*	Stat.	LC	LC	/	sp	III	/	/	/	n	wp
20	*Charadrius dubius*	Stat.	LC	LC	/	Ms	II	/	II	/	n	p
21	*Gallinago gallinago*	Hiem.	LC	LC	II/A & III/B	Ms	III	/	II	/	n	h
22	*Actitis hypoleucos*	Hiem.	LC	LC	/	/	II	/	II	/	n	p
23	*Tringa ochropus*	Hiem.	LC	LC	/	/	II	/	II	/	n	p
24	*Tringa totanus*	Hiem.	LC	LC	II/B	/	III	/	II	/	n	p
25	*Chroicocephalus ridibundus*	Stat.	LC	LC	II/B	/	III	/	/	/	sp	pp
26	*Pernis apivorus*	Aest.	LC	LC	I	I	II	+	II	II	sp	pp
27	*Hieraaetus pennatus*	Vag.	LC	LC	I	I	II	+	II	II	sp	pp
28	*Circus pygargus*	Aest.	LC	LC	I	I	II	+	II	II	sp	pp
29	*Accipiter brevipes*	Aest.	LC	LC	I	I	II	+	II	II	sp	pp

No.	Species	Vagrancy	IUCN GLR	IUCN ERL	Bird Directive	National list	Bern Convention	Emerald	Bonn Convention	CITES	Law of nature	Hunting law
30	*Accipiter nisus*	**Stat.**	**LC**	**LC**	**/**	**/**	**II**	**/**	**II**	**II**	**sp**	**pp**
31	*Buteo buteo*	**Stat.**	**LC**	**LC**	**/**	**/**	**II**	**/**	**II**	**II**	**sp**	**pp**
32	*Buteo rufinus*	**Stat.**	**LC**	**LC**	**I**	**I**	**II**	**+**	**II**	**II**	**sp**	**pp**
33	*Athene noctua*	**Stat.**	**LC**	**LC**	**/**	**/**	**II**	**/**	**/**	**II**	**sp**	**pp**
34	*Otus scops*	**Aest.**	**LC**	**LC**	**/**	**/**	**II**	**/**	**/**	**II**	**sp**	**pp**
35	*Upupa epops*	**Aest.**	**LC**	**LC**	**/**	**/**	**II**	**/**	**/**	**/**	**n**	**p**
36	*Picus viridis*	**Stat.**	**LC**	**LC**	**/**	**/**	**II**	**/**	**/**	**/**	**n**	**p**
37	*Dendrocopos minor*	**Stat.**	**LC**	**LC**	**/**	**/**	**II**	**/**	**/**	**/**	**n**	**p**
38	*Dendrocopos medius*	**Stat.**	**LC**	**LC**	**I**	**I**	**II**	**+**	**/**	**/**	**n**	**p**
39	*Dendrocopos syriacus*	**Stat.**	**LC**	**LC**	**I**	**/**	**II**	**+**	**/**	**/**	**n**	**p**
40	*Dendrocopos major*	**Stat.**	**LC**	**LC**	**/**	**/**	**II**	**/**	**/**	**/**	**n**	**p**
41	*Merops apiaster*	**Aest.**	**LC**	**LC**	**/**	**/**	**II**	**/**	**II**	**/**	**n**	**p**
42	*Alcedo atthis*	**Stat.**	**LC**	**VU**	**I**	**I**	**II**	**+**	**/**	**/**	**n**	**p**
43	*Falco tinnunculus*	**Stat.**	**LC**	**LC**	**/**	**/**	**II**	**/**	**II**	**II**	**sp**	**pp**
44	*Falco subbuteo*	**Aest.**	**LC**	**LC**	**/**	**/**	**II**	**/**	**II**	**II**	**sp**	**pp**
45	*Oriolus oriolus*	**Aest.**	**LC**	**LC**	**/**	**/**	**II**	**/**	**/**	**/**	**sp**	**pp**
46	*Lanius collurio*	**Aest.**	**LC**	**LC**	**I**	**I**	**II**	**+**	**/**	**/**	**n**	**p**
47	*Lanius minor*	**Aest.**	**LC**	**LC**	**I**	**I**	**II**	**+**	**/**	**/**	**n**	**p**
48	*Lanius senator*	**Aest.**	**LC**	**LC**	**/**	**Ms**	**II**	**/**	**/**	**/**	**n**	**p**
49	*Lanius nubicus*	**Aest.**	**LC**	**LC**	**I**	**I**	**II**	**+**	**/**	**/**	**n**	**p**
50	*Garrulus glandarius*	**Stat.**	**LC**	**LC**	**II/B**	**/**	**/**	**/**	**/**	**/**	**sp**	**pp**
51	*Pica pica*	**Stat.**	**LC**	**LC**	**II/B**	**/**	**/**	**/**	**/**	**/**	**n**	**wp**
52	*Corvus corax*	**Stat.**	**LC**	**LC**	**/**	**/**	**III**	**/**	**/**	**/**	**sp**	**pp**
53	*Corvus corone*	**Stat.**	**LC**	**LC**	**II/B**	**/**	**/**	**/**	**/**	**/**	**n**	**wp**
54	*Prunella modularis*	**Hiem.**	**LC**	**LC**	**/**	**/**	**II**	**/**	**/**	**/**	**n**	**p**
55	*Passer domesticus*	**Stat.**	**LC**	**LC**	**/**	**/**	**/**	**/**	**/**	**/**	**n**	**p**
56	*Passer montanus*	**Stat.**	**LC**	**LC**	**/**	**/**	**III**	**/**	**/**	**/**	**n**	**p**
57	*Anthus trivialis*	**Hiem.**	**LC**	**LC**	**/**	**/**	**II**	**/**	**/**	**/**	**n**	**p**
58	*Anthus spinoletta*	**Hiem.**	**LC**	**LC**	**/**	**/**	**II**	**/**	**/**	**/**	**n**	**p**
59	*Motacilla flava*	**Aest.**	**LC**	**LC**	**/**	**/**	**II**	**/**	**/**	**/**	**n**	**p**
60	*Motacilla alba*	**Stat.**	**LC**	**LC**	**/**	**/**	**II**	**/**	**/**	**/**	**n**	**p**
61	*Fringilla coelebs*	**Stat.**	**LC**	**LC**	**/**	**/**	**III**	**/**	**/**	**/**	**n**	**p**
62	*Fringilla montifringilla*	**Hiem.**	**LC**	**LC**	**/**	**/**	**III**	**/**	**/**	**/**	**n**	**p**
63	*Coccothraustes coccothraustes*	**Stat.**	**LC**	**LC**	**/**	**/**	**II**	**/**	**/**	**/**	**n**	**p**
64	*Chloris chloris*	**Stat.**	**LC**	**LC**	**/**	**/**	**II**	**/**	**/**	**/**	**n**	**p**
65	*Linaria cannabina*	**Stat.**	**LC**	**LC**	**/**	**/**	**II**	**/**	**/**	**/**	**n**	**p**
66	*Carduelis carduelis*	**Stat.**	**LC**	**LC**	**/**	**/**	**II**	**/**	**/**	**/**	**n**	**p**
67	*Granativora melanocephala*	**Aest.**	**LC**	**LC**	**/**	**Ms**	**II**	**/**	**/**	**/**	**n**	**p**
68	*Emberiza calandra*	**Stat.**	**LC**	**LC**	**/**	**/**	**III**	**/**	**/**	**/**	**n**	**p**

No.	Species	Vagrancy	IUCN GLR	IUCN ERL	Bird Directive	National list	Bern Convention	Emerald	Bonn Convention	CITES	Law of nature	Hunting law
69	*Emberiza cirlus*	Stat.	LC	LC	/	/	II	/	/	/	n	p
70	*Poecile lugubris*	Stat.	LC	LC	/	/	II	/	/	/	n	p
71	*Cyanistes caeruleus*	Stat.	LC	LC	/	/	II	/	/	/	n	p
72	*Parus major*	Stat.	LC	LC	/	/	II	/	/	/	n	p
73	*Remiz pendulinus*	Stat.	LC	LC	/	Ms	III	/	/	/	n	p
74	*Lullula arborea*	Aest.	LC	LC	I	I	III	+	/	/	n	p
75	*Galerida cristata*	Stat.	LC	LC	/	/	III	/	/	/	n	p
76	*Iduna pallida*	Aest.	LC	LC	/	/	II	/	II	/	n	p
77	*Hippolais icterina*	Trans.	LC	LC	/	Ms	II	/	II	/	n	p
78	*Acrocephalus schoenobaenus*	Hiem.	LC	LC	/	/	II	/	II	/	n	p
79	*Acrocephalus palustris*	Aest.	LC	LC	/	/	II	/	II	/	n	p
80	*Delichon urbicum*	Aest.	LC	LC	/	/	II	/	/	/	n	p
81	*Cecropis daurica*	Aest.	LC	LC	/	/	II	/	/	/	n	p
82	*Hirundo rustica*	Aest.	LC	LC	/	/	II	/	/	/	n	p
83	*Riparia riparia*	Aest.	LC	LC	/	/	II	/	/	/	n	p
84	*Rhadina sibilatrix*	Hiem.	LC	LC	/	Ms	II	/	II	/	n	p
85	*Phylloscopus trochilus*	Hiem.	LC	LC	/	/	II	/	II	/	n	p
86	*Phylloscopus collybita*	Stat.	LC	LC	/	/	II	/	II	/	n	p
87	*Cettia cetti*	Stat.	LC	LC	/	/	II	/	II	/	n	p
88	*Aegithalos caudatus*	Stat.	LC	LC	/	/	III	/	/	/	n	p
89	*Sylvia atricapilla*	Aest.	LC	LC	/	/	II	/	II	/	n	p
90	*Curruca crassirostris*	Aest.	LC	LC	/	Ms	II	/	II	/	n	p
91	*Curruca curruca*	Aest.	LC	LC	/	/	II	/	II	/	n	p
92	*Curruca cantillans*	Aest.	LC	LC	/	Ms	II	/	II	/	n	p
93	*Curruca communis*	Aest.	LC	LC	/	/	II	/	II	/	n	p
94	*Sitta europaea*	Stat.	LC	LC	/	/	II	/	/	/	n	p
95	*Troglodytes troglodytes*	Stat.	LC	LC	/	/	II	/	/	/	n	p
96	*Sturnus vulgaris*	Stat.	LC	LC	II/B	/	/	/	/	/	n	wp
97	*Muscicapa striata*	Aest.	LC	LC	/	/	II	/	II	/	n	p
98	*Erithacus rubecula*	Stat.	LC	LC	/	/	II	/	II	/	n	p
99	*Luscinia megarhynchos*	Aest.	LC	LC	/	/	II	/	II	/	n	p
100	*Ficedula albicollis*	Trans.	LC	LC	I	I	II	+	II	/	n	p
101	*Saxicola rubetra*	Aest.	LC	LC	/	/	II	/	II	/	n	p
102	*Oenanthe oenanthe*	Aest.	LC	LC	/	/	II	/	II	/	n	p
103	*Oenanthe hispanica*	Aest.	LC	LC	/	Ms	II	/	II	/	n	p
104	*Turdus philomelos*	Stat.	LC	LC	II/B	/	III	/	II	/	n	p
105	*Turdus merula*	Stat.	LC	LC	II/B	/	III	/	II	/	n	p

(p – protected species, n – not protected, sp – strictly protected species, pp – under permanent protection, h-hunting game, wp – without protection)

3.4.2.8.3 Reptiles

From the literature and the field work conducted in 2020 and 2021, there is a solid knowledge of the qualitative status of the reptiles in the project area of the corridor "Blace-Stenkovec".

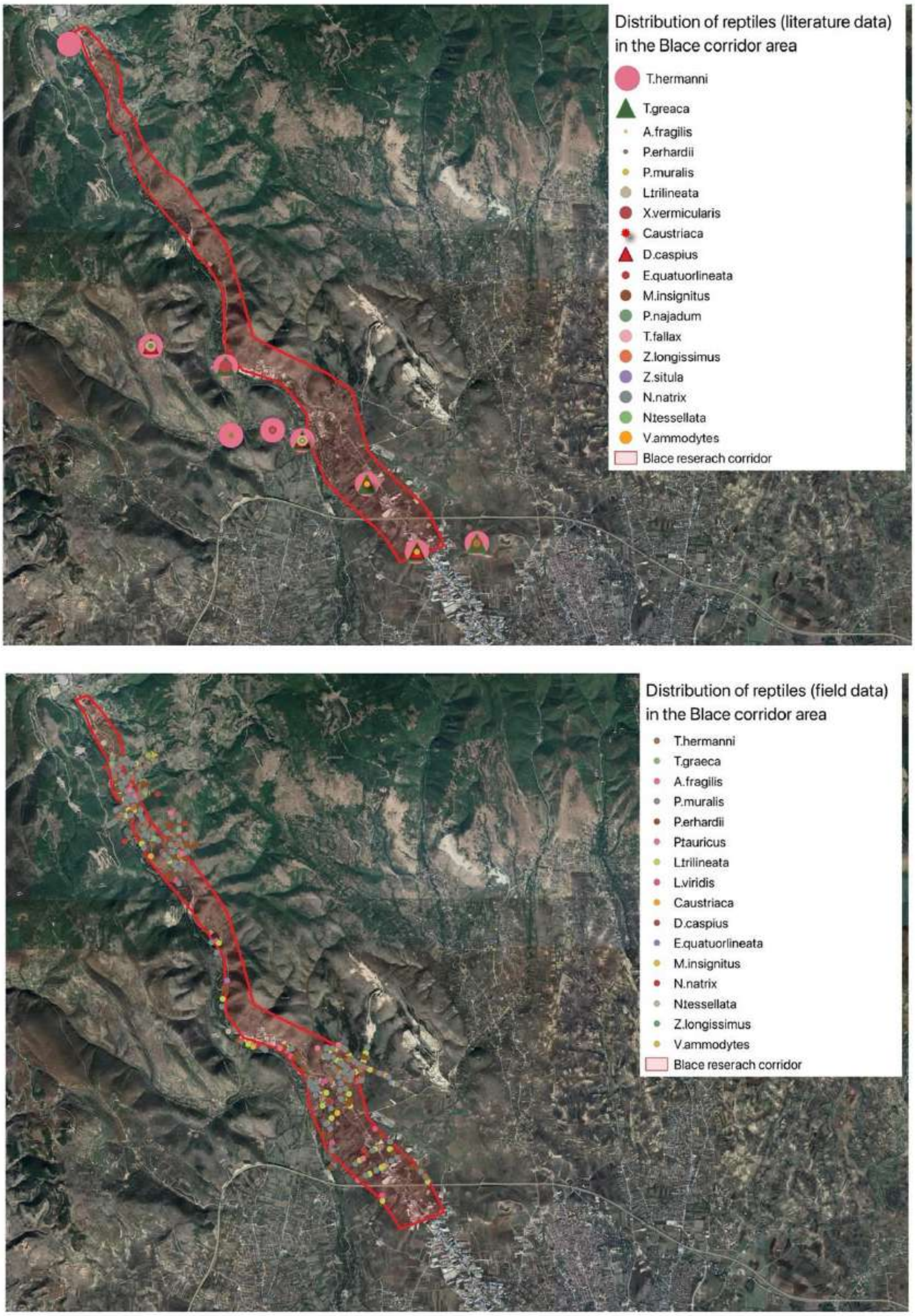


Figure 100 Distribution of reptiles in "Blace" project corridor area (literature and field and data)

The List of reptile species (with scientific, English and Macedonian name) recorded in the literature and on the field research in the project area of "Blace-Stenkovec" corridor in the following figure are presented:

Table 55 List of reptile species

Scientific name	English name	Macedonian name	Source	
			Literature	Field
***Testudo graeca* (Linnaeus 1758)**	Greek tortoise	Шумска желка	x	x
***Testudo hermanni* (Gmelin 1788)**	Herman's tortoise	Ридска желка	x	x
***Anguis fragilis* (Linnaeus 1758)**	Slowworm	Слепче	x	x
***Lacerta trilineata* (Bedriaga 1886)**	Balkan green lizard	Голем зелен гуштер	x	x
***Lacerta viridis* (Laurenti 1768)**	Green lizard	Зелен гуштер		x
***Podarcis erhardi* (Bedriaga 1882)**	Erhard's wall lizard	Балканска sидна гуштерица	x	x
***Podarcis muralis* (Laurenti 1768)**	Wall lizard	Ѕидна гуштерица	x	x
Podarcis tauricus (Pallas, 1814)	Balkan wall lizard	Ливадска гуштерица		x
***Xeroyphlops vermicularis* (Merrem 1820)**	European worm snake	Црвовидна змија	x	
***Coronella austriaca* (Laurenti 1768)**	Smooth snake	Планински смок	x	x
***Dolichophis caspius* (Gmelin 1789)**	Caspian whip snake	Жолт смок	x	x
***Elaphe quatuorlineata* (Lacepede 1789)**	Four-lined snake	Ждрепка	x	x
***Malpolon insignitus* (Hermann 1804)**	Eastern Montpellier snake	Длабокочелен смок	x	x
***Platyceps najadum* (Eichwald, 1831)**	Slender whip snake	Цитка	x	
***Natrix natrix* (Linnaeus 1758)**	Grass snake	Белоушка	x	x
***Natrix tessellata* (Laurenti 1768)**	Dice snake	Змија рибарка	x	x
***Zamenis longissimus* (Laurenti 1768)**	Aesculapian snake	Шумски смок	x	x
***Zamenis situla* (Linnaeus 1758)**	European rat snake	Леопардов смок	x	
***Vipera ammodytes* (Linnaeus 1758)**	Nose-horned viper	Поскок	x	x

Bearing in mind that there are 32 species of reptiles that are recorded for the Republic of North Macedonia (Sterijovski et al. 2014) from the data 56.25% of the total species recorded on National level are present in the project area of the corridor "Blace-Stenkovec". On the field research three species were not confirmed form the literature worm snake (*Xerotyphlops vermicularis)*, slender whip snake (*Platyceps najadum)* and European rat snake (*Zamenis situla*). However, one new species was found within the research area green lizard (*Lacerta viridis*). From this number of reptile species, it can be concluded that there is a rich diversity of reptiles in the research area. Considering that there is a huge contrast between the shoreline of the river Lepenec and the hilly geographical structures on the right side of the gorge there is a high diversity of species present in the explored area of the corridor "Blace-Stenkovec". Except in a few small valleys and along the river, it is generally an arid area with very limited water sources which in most cases dries up during the summer. Through these valleys, dispersion of reptiles is provided in the hilly part along the Kachanicka gorge, using these parts for reproduction and hibernation during the inactive months (usually from mid-October to early March).

The above leads to the conclusion that the researched area has a capacity in terms of favorable habitats for reptiles, which is due to the fact of their high diversity in this region. In total, 18 reptiles were recorded in the project area (out of 32 on national level). Almost all of them can be considered as important according to different valorization criteria (**Table** 56):

- National Red List of reptiles; Greek tortoise *(Testudo graeca)* and Herman's tortoise *(Testudo hermanni)* are assessed as vulnerable (VU) and six species Balkan wall lizard, four-lined snake, European rat snake, eastern Montpellier snake, slender whip snake and dice snake (*Podarcis .tauricus, Elaphe quatuorlineata, Zamenis situla, Malpoloninsignitus, Platyceps najadum* and *Natrix tessellata*) are considered as near threatened (NT) (**Table** 56);
- IUCN Global Red List of Threatened Species (Version 2021-1): only one species Greek tortoise (*Testudo graeca*) is categorized as vulnerable (VU). Two species Herman's tortoise and four-lined snake (*Testudo hermanni* and *Elaphe quatuorlineata*) are considered as near threatened (NT) (**Table 56**);
- IUCN European Red List of Threatened Species (Version 2021-1): similar to the Global one except the case with slowworm (*Anguis fragilis)* which is not assessed in the Global IUCN red list while it is recognized as LC in IUCN European red list (**Table 56**);
- EU Habitats directive: four species Greek tortoise, Herman's tortoise, four-lined snake and European rat snake (*Testudo graeca, Testudo hermanni, Elaphe quatuorlineata* and *Zamenis situla*) are listed on Annex II while there are 13 species on Annex IV (**Table 56**);
- Bern convention: 14 species are on the Appendix II while all remain species are listed on the Appendix III (**Table 56**),
- Two species Greek tortoise and Herman's tortoise (*Testudo greaca* and *Testudo hermanni*) are on the Appendix II on the CITES list (**Table 56**),
- List of Strictly Protected and Protected Wild Species: 14 species are listed as *protected* (**Table 56**),
- The species Erhard's wall lizard (*Podarcis Erhardii)* according to Sindaco & Jeremčenko (2008) in terms of distribution this species is considered a Balkan endemic.

Table 56 Valorisation of reptiles in the project area of "Blace-Stenkovec" corridor

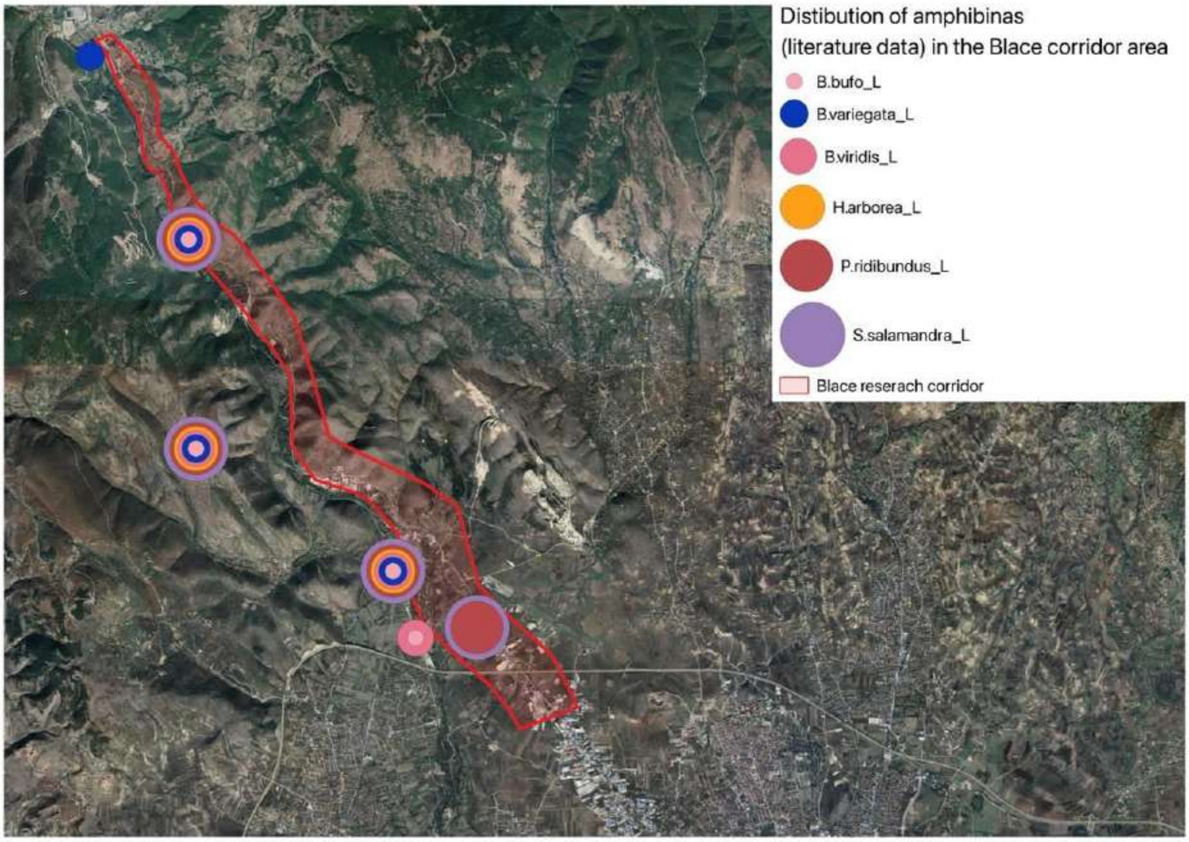
	Reptiles	National Red Lists	IUCN Global (2021-1)	IUCN EU (2021-1)	Habitat directive (Annex II, IV, V)	Bern convention (Appendix II, III)	CITES (Appendix II)	List of Strictly Protected and Protected Wild Species
1	*Testudo graeca*	VU	VU	VU	II, IV	II	II	Protected
2	*Testudo hermanni*	VU	NT	NT	II, IV	II	II	Protected
3	*Lacerta trilineata*	LC	LC	LC	IV	II	/	Protected
4	*Lacerta viridis*	LC	LC	LC	IV	II	/	Protected
5	*Podarcis erhardii*	LC	LC	LC	IV	II	/	Protected
6	*Podarcis muralis*	LC	LC	LC	IV	II	/	Protected
7	*Podarcis tauricus*	NT	LC	LC	IV	II	/	/
8	*Anguis fragilis*	LC	/	LC	/	III	/	/
9	*Xerotyphlops vermicularis*	DD	LC	LC	/	III	/	/
10	*Dolichophis caspius*	LC	LC	LC	IV	II	/	Protected
11	*Coronella austriaca*	LC	LC	LC	IV	II	/	Protected

12	*Elaphe quatuorlineata*	NT	NT	NT	II, IV	II	/	Protected
13	*Zamenis longissimus*	LC	LC	LC	IV	II	/	Protected
14	*Zamenis situla*	NT	LC	LC	II, IV	II	/	Protected
15	*Malpolon insignitus*	NT	LC	LC	/	III	/	/
16	*Platyceps najadum*	NT	LC	LC	/	II		Protected
17	*Natrix natrix*	LC	LC	LC	/	III	/	/
18	*Natrix tessellata*	NT	LC	LC	IV	II	/	Protected
19	*Vipera ammodytes*	LC	LC	LC	IV	II	/	Protected

3.4.2.8.4 Amphibians

From the aspect of amphibians, along the River Lepenec and the Kacanichka gorge, the only data that have been published are within the Assessment of the Red List of amphibians and reptiles of Northern Macedonia (Sterijovski & Arsovski 2019, 2020a, 2020b). According to the literature, in the researched area there are 6 species of amphibians: fire salamander, fire belly toad, common toad, green toad, European tree frog and marsh frog *(Salamandra salamandra, Bombina variegata, Bufo bufo, Bufotes viridis, Hyla arborea,* and *Pelophylax ridibundus)*.

Taking into account the published literature and data obtained for field research in 2020, 8 species of amphibians were registered for the project area of the corridor "Blace-Skopje".



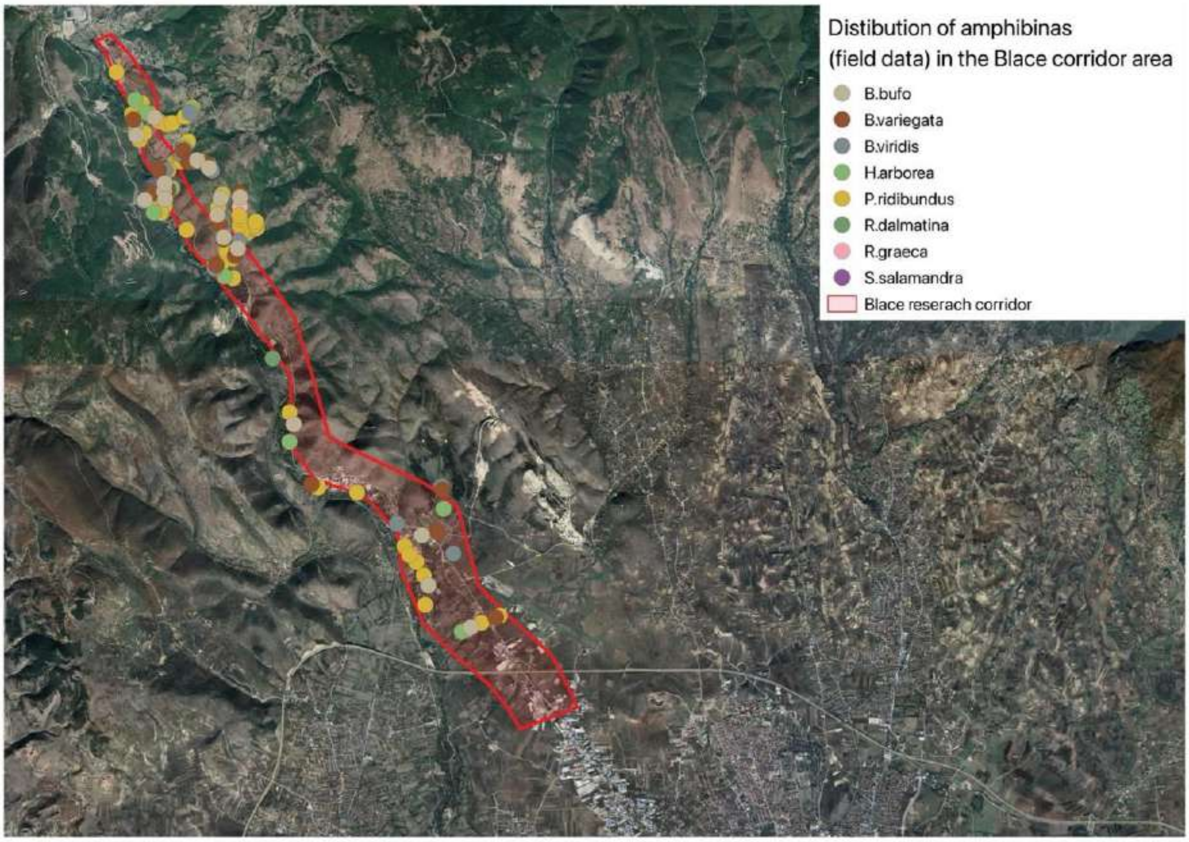


Figure 101 Distribution of amphibians in "Blace" project corridor area (literature and field and data)

At the national level, 14 species of amphibians were recorded from the Republic of North Macedonia (Petkovski 2009), so that the findings for the project area of the corridor "Blace-Skopje" represent 57.1% of all types of amphibians recorded at the national level.

From this number it can be concluded that there is a rich diversity of amphibians in the research area. This is mainly influenced by the preferred climatic conditions, low altitude and the presence of the river Lepenec which is a constant source of water throughout the year, which is vital for the survival of species of this class.

The List of amphibian species (with scientific, English and Macedonian name) recorded in the literature and on the field research in the project area of the "Blace-Stenkovec" corridor in the following table are presented.

Table 57 List of amphibian species

Scientific name	English name	Macedonian name
Salamandra salamandra **(Linnaeus 1758)**	Fire salamander	Дождовник
Bombina variegata **(Mertens & Muller 1928)**	Fire belly toad	Жолтмукач
Hyla arborea **(Linnaeus 1758)**	European tree frog	Гаталинка
Bufo bufo **(Mertens & Muller 1928)**	Common toad	Обичнакраставажаба
Bufotes viridis **(Laurenti 1768)**	Green toad	Зеленакраставажаба
Rana graeca **Boulenger 1891**	Greek stream frog	Поточнажаба
Rana dalmatina **Fitzinger 1839**	Agile frog	Шумскажаба
Pelophylax ridibundus **(Pallas 1771)**	Marsh frog	Езерскажаба

The results of field research for amphibian species show that they are mainly distributed in the Kachanichka gorge along the river Lepenec as well as the small rivers and springs that are tributaries of this river such as Vrazanska Reka (N42.057596, E21.369167), Vrtacica (N42.072977, E21.366230), Lopotanac (N42.078277, E21.359950), Banjica (N42.104885, E21.343594), Pasji Dol (N42.108036, E21.342402), Morav Dol (N42.116284, E21.333572) and Muckovski Dol (N42.124474, E21.320027).

However, this is not the case with common toad and green toad (*Bufo bufo* and *Bufotes viridis)* that are species that does not require water but more moisture so they are dispersed all over the researched area (for these two species the last is not refered for the reproduction season considering the fact that they do need water bodies for laying eggs).

The above-mentioned rivers and springs are also migratory routes for this taxonomic group which are used in the reproductive period for migration towards suitable reproductive centres that can be found along this aquatic ecosystem.

Valorization of amphibians has been done according to the national and international conventions and legislatives for protection of threatened species on National, European or Global level. The last includes: National Red List of Threatened Amphibians; IUCN Global Red List; IUCN European Red List; Habitats Directive Annex II, Annex IV and Annex V; Bern Convention – Conservation of European Wildlife and Natural Habitats; CITES Convention - Convention on International Trade in Endangered Species; List of Strictly Protected and Protected Wild Species ("Official gazette of Republic of Macedonia" No. 139/11 dated 07.10.2011); Endemism.

The results of the valorization of the amphibians are as follows:

- National Red Lists of amphibians: three species - Greek stream frog, agile frog, European tree frog (*Rana.graeca*, *Rana dalmatina* and *Hyla arborea*) are considered as near threatened (NT).
- IUCN red list of threatened species Global and European (Version 2021-1): none of the species is threatened.
- EU Habitats directive: only one species fire belly toad (*Bombina variegata*) is on the Annex II while five species are on the Annex IV. One species five species - fire belly toad, green toad, Greek stream frog, agile frog, European tree frog *ridibundus*) is listed on the Annex V.
- CITES: None of the species is on the CITES list.
- National List of Strictly Protected and Protected Wild Species: five species - fire belly toad, green toad, Greek stream frog, agile frog, European tree frog (*Bombina variegata*, *Bufotes viridis, Rana graeca, Rana dalmatina* and *Hyla arborea)* are recognized as *protected*.

The subspecies (*B.variegata scabra*) and the species *Rana graeca* are considered as a Balkan endemic regarding the distribution.

Table 58 Valorization of amphibians in the project area of "Blace-Stenkovec" corridor

Amphibians		National Red Lists	IUCN Global (2021-1)	IUCN EU (2021-1)	Habitat directive (Annex II, IV, V)	Bern convention (Appendix II, III)	CITES (Appendix II)	List of Strictly Protected and Protected Wild Species	Endemism
1	*Salamandra salamandra*	LC	LC	LC	/	III	/	/	/
2	*Bombina variegata*	LC	LC	LC	II, IV	II	/	Protected	Balkan endemic[30]
3	*Pelophylax ridibundus*	LC	LC	LC	V	III	/	/	/
4	*Rana graeca*	NT	LC	LC	IV	II	/	Protected	Balkan endemic[31]
5	*Rana dalmatina*	NT	LC	LC	IV	II	/	Protected	/
6	*Bufo bufo*	LC	LC	LC	/	III	/	/	/
7	*Bufotes viridis*	LC	LC	LC	IV	II	/	Protected	/
8	*Hyla arborea*	NT	LC	LC	IV	II	/	Protected	/

3.4.2.8.5 Fish species

The ichtiofauna of river Lepenec is represented by 7 species: common nose (*Chondrostoma nasus),* common chub *(Leuciscus cephalus),* peloponesian barbel *(Barbus peloponnesius),* schneider *(Alburnoides bipunctatus),* common barbel*, (Barbus barbus),* gudgeon *(Gobio gobio)* and spined loach (*Cobitis taenia)*. River Lepenec is spawn place for fish population from river Vardar. Three species (*C. nasus, L. cephalus* and *B. peloponnesius*) are entering river Lepenec from river Vardar.

Table 59 Valorisation of fish species in the project area of "Blace-Stenkovec" corridor

Fish species	**English name**	**IUCN Global (2021-1)**	**Habitats directive**	**Bern convention**	**List of Strictly Protected and Protected Wild Species**
Chondrostoma nasus	common nase	LC			/
Leuciscus cephalus	common chub	LC			/
Barbus barbus	common barbel	LC	V		/
Barbus peloponnesius	peloponesian barbel	LC	V	III	/
Alburnoides bipunctatus	schneider	/		**III**	/
Gobio gobio	gudgeon	LC			/
Cobitis taenia	spined loach	LC	II		/

The valorization of icthyofauna of river Lepenec and its tributations in the project area showed that none of the species is threatened or endangered according to the Global IUCN red list (there is no national red list of fish species) i.e. all of the assessed species are considered to be Least Concern (LC). Also, none of the species is listed are strictly protected or protected according to the national

[30] According to Pabijan et al (2013), the subspecies *Bombina variegata scabra* distribution is limited for the Balkan. In North Macedonia only this subspecies is present
[31] According to Dubois (1992) the distribution of this species is restricted only for the Balkan Peninsula

legislation. Two species are listed in Appendix III of the Bern Convention (*Barbus peloponnesius* and *Alburnoides bipunctatus*). Only one species (Cobitis taenia) is listed in Annex II of the EU Habitats Directive.

3.4.2.8.6 Ground beetles

In total, 56 ground beetle species were identified. The faunistic composition shows the domination of species characteristic for riparian habitats and smaller number of species that are connected to dry grassland habitats. The most common species were *Dyschirius agnatus, Stenolophus teutonus, Elaphrus aureus aureus, Limodromus assimilis, Chlaenius nitidulus* and *Bembidion subcostatum vau.*

The richest habitats in species were muddy banks and wet meadows with 28 and 27 species, respectively (Hristovski 2017). The lowest number of species was recorded in Poplar stand, probably to the high level of degradation of this habitat in Lepenec valley (Jovanovska et al. 2013; Hadži Pecova et al. 2017) due to land conversion and wood exploitation. Otherwise, higher species diversity can be expected in better preserved Poplar habitats in Europe (Allegro and Sciaky 2003).

Table 60 Ground beetles (Coleoptera, Carabidae) collected in Lepenec river valley

Species	A	B	C	D	E	F	G	Total
***Agonum* sp.**		8				2		10
***Agonum viduum* (Panzer, 1796)**		3				1		4
***Amara communis* (Panzer, 1797)**	1							1
***Anchomenus dorsalis* (Pontoppidan, 1763)**	6	2						8
***Anisodactylus binotatus* (Fabricius, 1787)**	6	3						9
***Asaphidion flavipes* (Linnaeus, 1761)**	11	4						15
***Bembidion articulatum* (Panzer, 1796)**		4	9					13
***Bembidion azurescens azurescens* Dalla Torre, 1877**		5	10					15
***Bembidion bualei bualei* Jacquelin du Val, 1852**						1		1
***Bembidion dalmatinum dalmatinum* Dejean, 1831**		1						1
***Bembidion splendidum splendidum* Sturm, 1825**		1	1			3		5
***Bembidion subcostatum vau* Netolitzky, 1913**	2	6	1			11		20
***Carabus granulatus interstitialis* Duftschmid, 1812**	2							2
***Chlaenius festivus festivus* (Panzer, 1796)**	1	5						6
***Chlaenius nitidulus* (Schrank, 1781)**	5	16						21
***Chlaenius vestitus* (Paykull, 1790)**	1	13				1		15
***Cicindela campestriscampestris* Linnaeus, 1758**						1		1
***Clivina collaris* (Herbst, 1784)**	4	6				1		11
***Diachromus germanus* (Linnaeus, 1758)**	1		1					2
***Ditomus calydonius calydonius*(P. Rossi, 1790)**							1	1
***Dyschirius agnatus* Motschulsky, 1844**		20	8					28
***Dyschirius intermedius* Putzeys, 1846**	2		2					4
***Dyschirius laeviusculus* Putzeys, 1846**		1						1
***Dyschirius substriatus priscus*J.Muller, 1922**		1						1
***Elaphrus aureus aureus* P. W. J. Müller, 1821**	4	19						23
***Harpalus autumnalis* (Duftschmid, 1812)**	3							3
***Harpalus calceatus* (Duftschmid, 1812)**							1	1

Species	A	B	C	D	E	F	G	Total
Harpalus froelichii **Sturm, 1818**							2	2
Harpalus progrediens **Schauberger, 1922**	4							4
Harpalus rubripes **(Duftschmid, 1812)**	3				3			6
Harpalus serripes serripes **(Quensel, 1806)**				2	3	1		6
Harpalus solitaris **Dejean, 1829**							1	1
Harpalus subcylindricus **Dejean, 1829**	1				1	2		4
Limodromus assimilis **(Paykull, 1790)**	1	20				1		22
Myas chalybaeus **(Palliardi, 1825)**				1				1
Omophron limbatum **(Fabricius, 1777)**	1	1						2
Ophonus ardosiacus**(Lutschnik, 1922)**							2	2
Ophonus cribricollis **(Dejean, 1829)**							1	1
Ophonus oblongus**(Schaum, 1858)**							2	2
Ophonus rufibarbis **(Fabricius, 1792)**				1				1
Ophonus subquadratus **(Dejean, 1829)**	2							2
Paranchus albipes **(Fabricius, 1796)**		3						3
Paratachys micros **(Fischer von Waldheim, 1828)**			1					1
Parophonus dejeani **(Csiki, 1932)**	14							14
Parophonus hirsutulus **(Dejean, 1829)**	1				3	3		7
Parophonus maculicornis **(Duftschmid, 1812)**	6							6
Parophonus planicollis **(Dejean, 1829)**							1	1
Poecilus cupreus cupreus **(Linnaeus, 1758)**		1						1
Pterostichus anthracinus **(Illiger, 1798)**	1	2				2		5
Pterostichus elongatus**(Duftschmid, 1812)**							1	1
Pterostichus leonisi **Apfelbeck, 1904**	1	1						2
Pterostichus nigrita **(Paykull, 1790)**		1						1
Sinechostictus tarsicus **(Peyron, 1858)**	1	2				5		8
Stenolophus discophorus **(Fischer von Waldheim, 1823)**		1						1
Stenolophus teutonus **(Schrank, 1781)**	20	3	1					24
Syntomus obscuroguttatus **(Duftschmid, 1812)**					1	1		2
Total	**105**	**153**	**34**	**4**	**11**	**35**	**12**	**354**

A: Skopje, Lepenec, meadow, 310m a.s.l.. B: Skopje, Lepenec, muddy bank, 310m a.s.l.. C: Skopje, Lepenec, sandy bank, 310m a.s.l.. D: Skopje, Lepenec, Poplar stand, 285m a.s.l.. E: Skopje, Lepenec, dry grassland, 290m a.s.l.. F: Skopje, Lepenec, wet meadows, 250 m a.s.l. G: Skopje, Momin Potok, Lepenec inflow into Vardar, 250m a.s.l., 04.08.2004 (published in Hristovski & Guèorguiev 2015).

No internationally important species were recorded. Also, none of the species is listed in the national legislation regarding strictly protected and protected species.

Dyschirius substriatus priscus represents a new record for the Macedonian fauna. This subspecies is distributed on the Pyrenees, Balkan Peninsula (Albania, Bulgaria, Greece, Romania), lower Dnieper area and Turkey (Fedorenko 1996; Loebl and Smetana 2003; Arndt et al. 2011).

Dyschirius laeviusculus, Parophonus planicollis, Ophonus ardosiacus and *Ditomus calydonius* can be considered rare species in Macedonia due to the small number of known localities (Hristovski and Guéorguiev 2015).

3.4.2.8.7 Butterflies

The fauna of butterflies was compiled according to the literature data (Schaider & Jaksic) and field work data. In total, 87 species are listed for the analyzed corridor area. All of the species are common without any important species from biodiversity conservation aspect. The most frequent species (field investigation) are: meadow brown (*Maniola jurtin*a), (*Pararge aegeria*) speckled wood in the forested habitats in associated ecotones; southern white admiral (*Limenitis reducta*), comma (*Polygonia c-album*), large tortoiseshell (*Nymphalis polychloros*) in riparian forests. The greatest number of species was noted for open habitat types. The following species were common in hill pastures: Great Banded Grayling (*Brintesia circe*), *Hipparchia syriaca*, Freyer's grayling (*Neohipparchia fatua*), hermit (*Chazara briseis*), marbled whit (*Melanargia galathea*), small heath (*Coenonympha pamphilus*), European beak (*Lybithea celtis).* List of butterflies species recorded in other grassland habitats are presented in Annex 10.

3.4.2.8.8 Aquatic macroinvertebrates

River Lepenec

The analysis of the samples from river Lepenec at the border with Kosovo (May/June and October) showed certain diversity of macroinvertebrates (16 taxa) and low number of EPT[32] taxa (7). During the spring/summer months of 2018 the community was composed of macroinvertebrates that are adapted to moderately high concentrations of nutrients, such as mayflies *Baetis spp.*(23.7%) and *Ephemerella ignita* (17.8%), as well as moderately sensitive amphipod crustaceans *Gammarus balcanicus* (0.7%) and *Gammarus roeseli* (1.0%). Some tolerant aquatic snails were also present: *Physa sp.* (0.3%). The presence of Trichoptera larve was noted: *Hydropsyche pellucidula* (8.2%), *Hydropsyche fulvipes* (4.9%), *Psychomia pussila* (0.7%) as well as increased abundance of *Oligochaeta* species (31.6%). Larvae of *Simulium sp.*(5.3%) (Diptera), indicate increased suspended substances in the water. The ecological status was assessed as **good**.

In October 2020 the diversity was lower (12 taxa) and low number of EPT (5). The community was represented by *Baetis spp.* (29.4%), *Ephemerella ignita* (5,9%), *Orthocladinae spp.* (5,9%), *Tanypodinae sp.* (2.9%), *Hydropsyche spp*. (2.9%), *Hydropsyche pellucidula* (11.8%), *Hydropsyche fulvipes* (8.8%), *Gammarus balcanicus* (2.9%), *Oligochaeta sp* (20.6%). The ecological status was assessed as **poor**.

Table 61 Overview of the ecological status of river Lepenec

Indices	May/June	October
Saprobic Index (German new version)	2.0	1.7
ASPT	5.4	4.9
Number of taxa	16	12
BMWP Score	75	44
Ecological Status	**Good**	**Poor**

Vrazanska River

The only knowledge on the aquatic invertebrate diversity in Vrazanska River was gained during some previous investigations at the upper part of Vrazanska Reka river (Banjanska Reka river) and at the confluence of river Lepenec in river Vardar (Slavevska – Stamenković & Hinić, unpublished data). The available data showed that the upper part of Vrazanska River, near village Banjani contains suitable habitats that support the presence of the stone crayfish (Austropotamobius torrentium), a Natura 2000 species. This species trigger PBF (priority biodiversity feature) criterion ii – Vulnerable Species, as is listed on the Annex II of the EU (92/43/EEC). However, the locality where this species was encountered are more than 10 kilometres away from the target locality in this project, so the stone crayfish populations are not expected to be compromised by the construction activities.

[32] The EPT Index is named for **three** orders of aquatic insects that are common in the benthic macroinvertebrate community: Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). The EPT Index is based on the premise that high-quality streams usually have the greatest species richness.

Vrazanska Reka river - Preselected sampling site behind "Tonus" factory

Vrazanska Reka river - Bridge on the main road next to "Tonus" factory

Vrazanska Reka river - Bridge next to "Deluxe Aquatic 2" store

Banjanska Reka river - Bridge in village Brazda

Figure 102 Photos from the visited sites

3.4.3 Protected areas

The projected Motorway Skopje-Blace lies in the Valley of Lepenec River. There are no protected areas in the vicinity i.e. areas that might be affected by the construction. The closest is Radusha, an area proposed to be protected in the category of Park of Nature. This area was proposed on the basis of its floristic and geologic values. It is approximately 5 kilometres away from the corridor area (6 km from the motorway alignment) and no impacts can be expected.

Figure 103 Protected areas in the Skopje valley and surroundings (190-Matka canyon, 192-Jasen, 202-Vodno, 465-Ostrovo, 534-Radusha, 536-Rashche; green – protected; orange – proposed for protection)

There are no internationally designated areas (Important Bird Areas, Important Plant Areas, Key Biodiversity Areas, Prime Butterfly Areas, Emerald sites, proposed Natura 2000 sites)in the vicinity of the projected motorway corridor (Melovski et al. 2010; Velevski et al. 2010). The Important Plant Area "Skopska Crna Gora" is 7, 8 km on the east, IPA "Radusha" is 3, 7 km on the west, while IPA "Vodno" is 6, 1 km on the south of the projected motorway corridor. None of these IPA's will be affected by the motorway corridor.

Figure 104 Internationally designated areas in the Skopje valley and surroundings (green - Important Plant Areas)

As Macedonian Ecological Network[33] is concerned (MAK-NEN) there are no important corridors identified in the projects area. However, the highway corridor area crosses the proposed Restoration Area "Skopska Crna Gora" (Brajanoska et al. 2011). These are areas where degraded functions of landscape may be restored, especially in cases where habitats fragmentation prevents normal performance of the processes of matter and energy flow through landscapes, i.e. threatening local species populations. These areas are important because they may improve the ecological connectivity and functionality of the system in the frames of the MAK-NEN. Skopska Crna Gora was identified as a restoration area in which there are no vital bear populations, while habitats are in degraded condition or there are other threats to bear. In case certain conservation and restoration measures are undertaken, establishment of stable bear population can be expected.

[33] MAK-NEN is not official document, i.e. it is still not adopted by the Government.

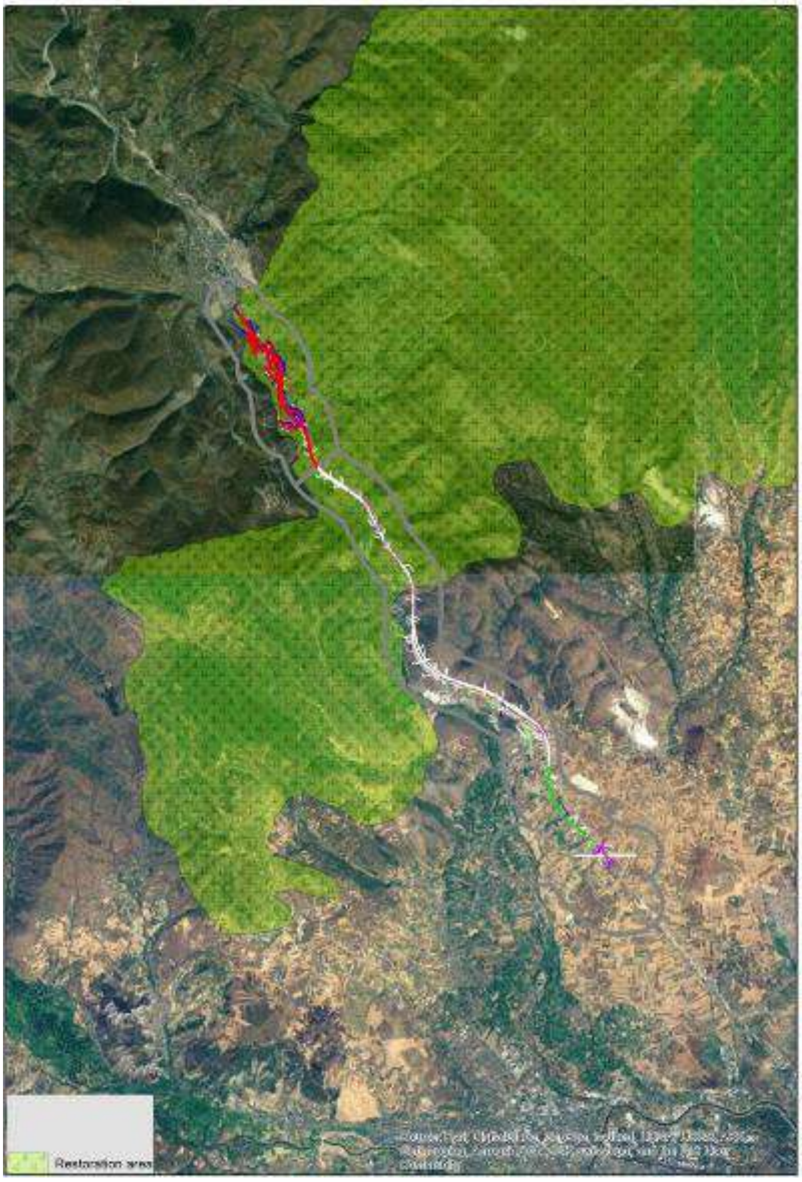


Figure 105 Components in the Macedonian Ecological Network (MAK-NEN) in the in the Skopje valley and surroundings (green area - Restoration Area "Skopska Crna Gora")

3.4.4 Assessment of Key Biodiversity Features (Critical Habitat – CH and Priority Biodiversity Features - PBF)

Assessment of Critical Habitat and Priority Biodiversity Features was performed according to the PR6 guidelines[34]. The objectives of PR6 are to protect and conserve biodiversity; maintain core ecological functions of ecosystem services and biodiversity they support; adapt the mitigation hierarchy approach; and promote the sustainable management of living natural resources through the adoption of good international practices.

EBRD PR 6 defines critical habitats (CH) as:

(i) highly threatened or unique ecosystems;

(ii) habitats of significant importance to endangered or critically endangered species

[34] Guidance Note: EBRD Performance Requirement 6. Biodiversity Conservation and Sustainable Management of Living Natural Resources. https://www.ebrd.com/environment/pdf-guidance-note-ebrd-performance-requirement-6.pdf

(iii) habitats of significant importance to endemic or geographically restricted species;

(iv) habitats supporting globally significant migratory or congregatory species;

(v) areas associated with key evolutionary processes; or

(vi) ecological functions that are vital to maintaining the viability of biodiversity features described above.

Priority biodiversity features (PBF) are below critical habitat in terms of sensitivity, however, they still require careful consideration as part of the assessment and development of mitigation. They include threatened habitats; vulnerable species and significant biodiversity features identified by a broad set of stakeholders or governments and the ecological structures and functions needed to maintain their viability.

There are three important habitats[35] according to the EU Habitats Directive (92A0 Salix alba and Populus alba galleries; *6220 Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea; 3260 Watercourses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation) as well as several threatened species of vertebrates that are targeted during the assessment. This concerns especially vulnerable species on national/international lists: Brown bear (*Ursus arctos*), Otter (*Lutra lutra*), European turtle dove (*Streptopelia turtur*), common kingfisher (*Alcedo atthis*); near-threatened species (e.g. *Fulica atra, Podarcis tauricus, Elaphe quatuorlineata, Zamenis situla, Malpolon insignitus, Platyceps najadum, Natrix tessellata, Rana graeca, Rana dalmatina, Hyla arborea*), other species that trigger designation of Emerald sites (Bern Convention), Natura 2000 sites (Habitats & Birds Directive) as well as other important species.

Table 62 Habitats that trigger critical habitats or priority biodiversity features

Habitats	Biodiversity feature	Distribution and estimates	Comment
3260 Watercourses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation	Priority biodiversity features (PBF) This habitat is listed in Annex I of the EU Habitats Directive		This habitat represents the permanent water courses in the area i.e. of river Lepenec.
*6220 Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea	Critical habitat (CH) This habitat is considered as priority habitat (*) according to the EU Habitats Directive	There are no global estimates for 6220 available, but the habitat occurs mainly in Europe. European estimate (EU only) of 6220* – 706,122 ha. Mediterranean estimate (EU only) – 693,747 ha (98% of EU total) There is no national estimate but it is well known that this habitat is widespread in NRM and occupies large surfaces.	In the habitat map it is named "Hill pasture" (67.15 ha) and "Hill pasture with sparse shrubs" (241.3 ha). The latter is overgrown by shrubs of different species in the area (*Paliurus spina-christi, Quercus pubescens,* etc.) and does not represent typical habitat 6220.
92A0 *Salix alba* and *Populus alba galleries*	Priority biodiversity feature (PBF) This habitat is listed in Annex I of the EU Habitats Directive		This habitat is presented on the habitat map as: Riparian willow-poplar belt (10.73 ha) and Riparian willow-poplar stand (53.76 ha).

35 As discusses in the Biodiversity baseline chapter the hay meadows in the area are of different type than the EU Habitats Directive habitat 6510 Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*). Nevertheless, these meadows will be not directly affected.

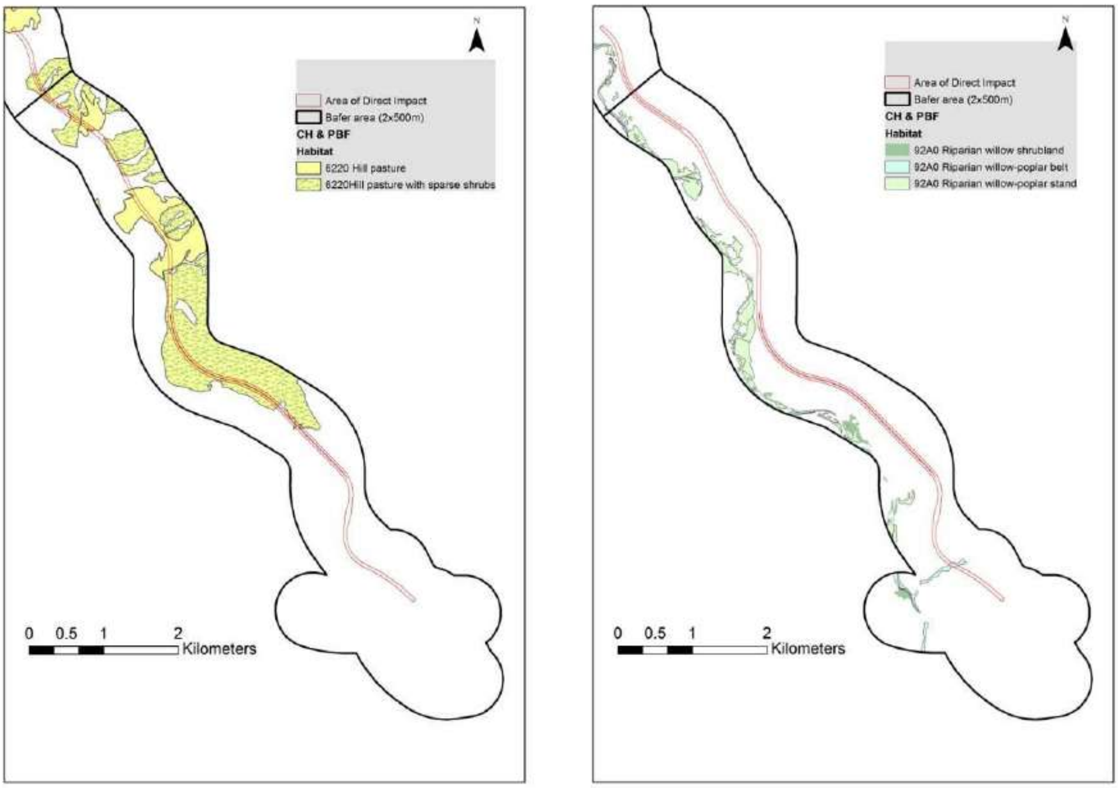


Figure 106 Distribution of habitats 6220 and 92A0 in the buffer area of the motorway Skopje-Blace

The species that trigger critical habitats or priority biodiversity features in the following table are presented:

Table 63 Species that trigger critical habitats or priority biodiversity features

Species	Biodiversity feature	Distribution and estimates
Brown bear (*Ursus arctos*)	Priority Biodiversity feature. The species is assessed as vulnerable (VU) on the National Red List of mammals, and is included in Annex II and IV of the EU Habitats Directive.	Brown bear is found in mountainous areas in western, central and southern parts of N. Macedonia, with estimated population of 333-380 bears in entire country. The species most likely inhabits the forest habitats within the project area.
European turtle dove (*Streptopelia turtur*)	Priority Biodiversity feature. According to the global and European IUCN – red lists it is accessed as vulnerable (VU), and listed on Annex I of the Birds Directive.	The turtle dove is widespread bird species in the valleys of Macedonia, as well as in the project area. It is common and present in the majority of the habitat types in the project area apart from the industrial and rural habitat types.
Otter (*Lutra lutra*)	Priority Biodiversity feature. The species is assessed as vulnerable (VU) on the National Red List of mammals, and is included in Annex II and IV of the EU Habitats Directive.	The Eurasian otter inhabits most of the existing major water bodies in N. Macedonia. The population size is estimated to be 350-400 individuals. Otters are strongly dependent on riparian vegetation and availability of denning sites (holts). Within the project area, the species is present along the watercourse of Lepenec.
Common kingfisher	Because of the negative trend in Europe of the population of Common	The common kingfisher is present at most of the bigger watercourses and waterbodies In Macedonia.

(*Alcedo atthis*)	kingfisher it is listed as vulnerable (VU) on the European Red List of threatened Species, and least concern (LC) by the global Red List of threatened Species	Within the project area it is found along river Lepenec and the number of birds present is higher in winter, because of the wintering birds coming from northern parts of Europe.
Levant sparrowhawk (*Accipiter brevipes)*	This species is listed on Annex I of the Bird Directive and according to national draft list for NATURA2000 it is identified as species of conservation concern	The Levant sparrow hawk is a rare breeding bird species in Macedonia. Its breeding ground represents well preserved riparian forests. 2 breeding pairs were identified within the project area, but the possibility for 3rd breeding pair is not excluded.
Herman's tortoise *(Testudo hermanni)*	This species is on National Red Lists of Threatened Reptiles assessed as vulnerable (VU). Also, it is on Annex II and IV on the Habitat Directive as well as listed on Appendix II on the CITES.	In North Macedonia the population size is not accurately determined. The abundance of the species is variable across the country, spanning from the highest known species-specific population densities (100-150 individuals/hectare) in protected areas (Bonnet et al., 2016; Arsovski, 2018) to average densities (10-15 individuals/hectare) and even lower densities in populations severely affected by habitat destruction resulting in heavy fragmentation and/or collection for illegal trade in the south-eastern and eastern parts of the country (unpublished observations). National population size is estimated at 17.000.000 coming from the rough estimate of an approximate average national density of 10 individuals per hectare, with 1.700.000 hectares of suitable habitat (unpublished data).
Greek tortoise *(Testudo graeca)*	This species is on National Red Lists of Threatened Reptiles assessed as vulnerable (VU). On IUCN Global and IUCN Europe lists it is recognized as vulnerable (VU). Also, it is on Annex II and IV on the Habitat Directive as well as listed on Appendix II on the CITES.	National population trends of the Spur-thighed tortoise have not been assessed and are thus unknown. Nevertheless, intensive habitat degradation and being the target of some legal and illegal harvest suggest a decreasing population trend, and urge the inference of potential severe fragmentation or fluctuations in numbers of subpopulations.
Fire belly toad *(Bombina variegata)*	This species is on Annex II and IV on the Habitat Directive	Preliminary monitoring studies indicate a declining population trend within North Macedonia (unpublished data), which is mainly being caused by habitat destruction and the effects of climate change.

3.4.5 Landscapes

In the area of the Blace-Stenkovec motorway corridor there are two landscape types and additionally one more that only touches the defined corridor. According to the Strategy for Nature Protection there are 24 landscape types which were considered as important on national level. The selection of the important landscape types was performed on the bases of the following criteria: condition, biodiversity values, cultural values, sensitivity, connectivity and uniqueness. None of the landscape types in the area are considered as important.

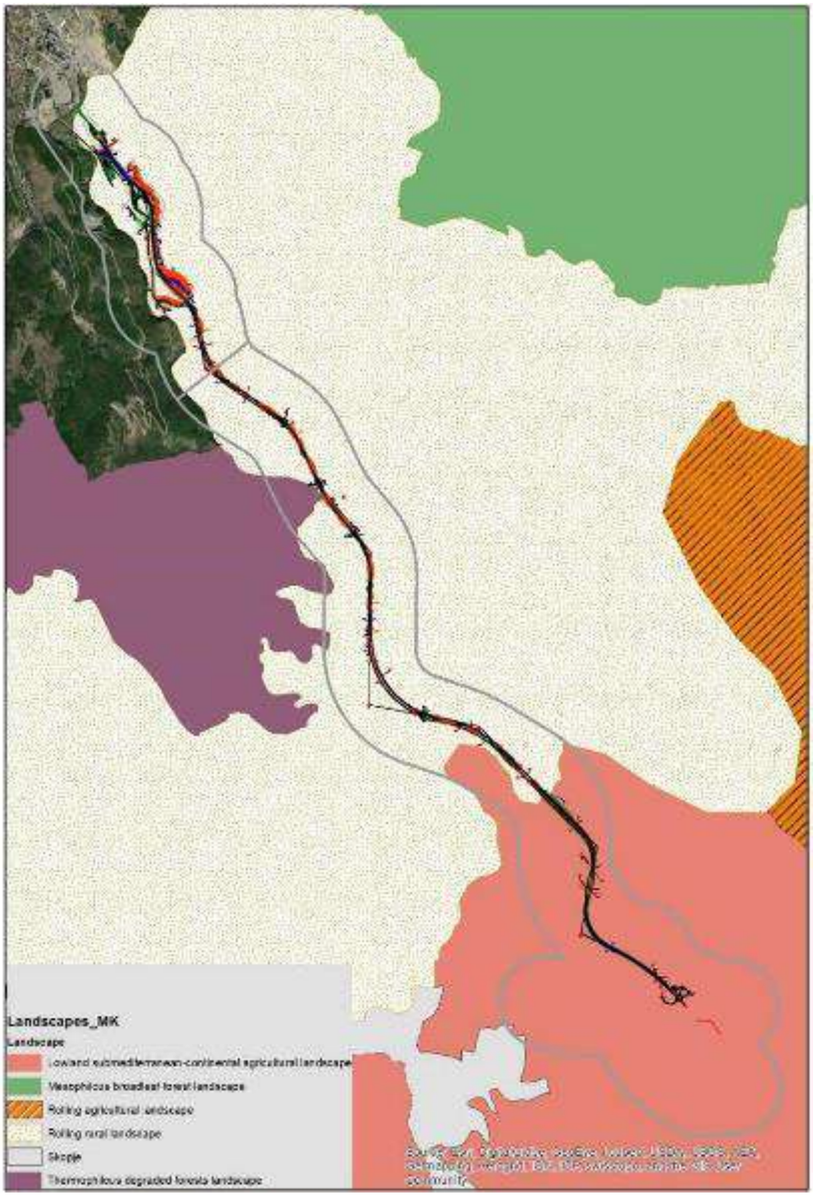


Figure 107 Map of the landscape types in the Skopje-Blace motorway corridor

Flatland submediterranean-continental agricultural landscape – typical: In broader sense this landscape is characteristic for most of the valleys in Macedonia which are under the strong submediterranean climatic influence. Typical feature for these areas is long lasting (from prehistoric times) permanent human presence which has left a strong anthropogenic footprint on the landscape structure. The intensive agriculture has contributed for almost complete extinction of the potential natural vegetation (which in these areas would be thermophilous and xerothermophilous oak-Oriental hornbeam forests). This landscape type in the area of interest for this project covers small area compared to rolling rural landscape. The visual aspect of the landscape in the area of interest is also very poor. Spatially poorly planned industrial development is visible, abandoned object (industrial and warehouses) are numerous, as well as line infrastructure (transmission lines roads etc.).

Rolling submediterranean-continental rural landscape (Rolling rural landscape). This landscape occupies small areas mainly in the eastern part of Macedonia. In the area of the highway corridor it is characteristic for the upper part of the corridor (toward Kosovo border). The bedrock in the landscape is composed almost exclusively of silicate rocks. Main relief characteristic is gently sloping hill sides and wavy hillocks. The climate in the region is modified submediterranean. From the structural point of view, the rural character of the landscape is determined mostly by the presence of the extensive agricultural land use types and semi-natural vegetation. Visual values of the landscape are low as well due to the increasing abandonment (loss of rural values). Additionally, poor spatial planning and uncontrolled development of various anthropogenic objects in the area ruins the visual aspects of the landscape in the area.

Hilly submediterranean-continental degraded thermophillous forest landscape (Thermophillous degraded forests landscape): This landscape type is one of the most characteristic landscapes in Macedonia. However, in the area of the project interest it only touches the highway corridor and does not play any important role in the land structure and biodiversity in the area.

3.4.6 Forests and forest community

The corridor of the motorway is mainly represented by natural broad-leaved forests, as well as smaller areas of artificially raised plantations of coniferous forests. According to the division of forests by forest management units in the Republic of North Macedonia, oak forests and black pine forests, which are complexes, are included in the forestry unit "Skopska Crna Gora", for which a Special Forest Management Plan has been prepared for the period 2014-2023. These forests are managed by the Public Enterprise National Forests from Skopje through its subsidiary Karadzica from Skopje. Riparian forests and belts are not covered by the forest management plan.

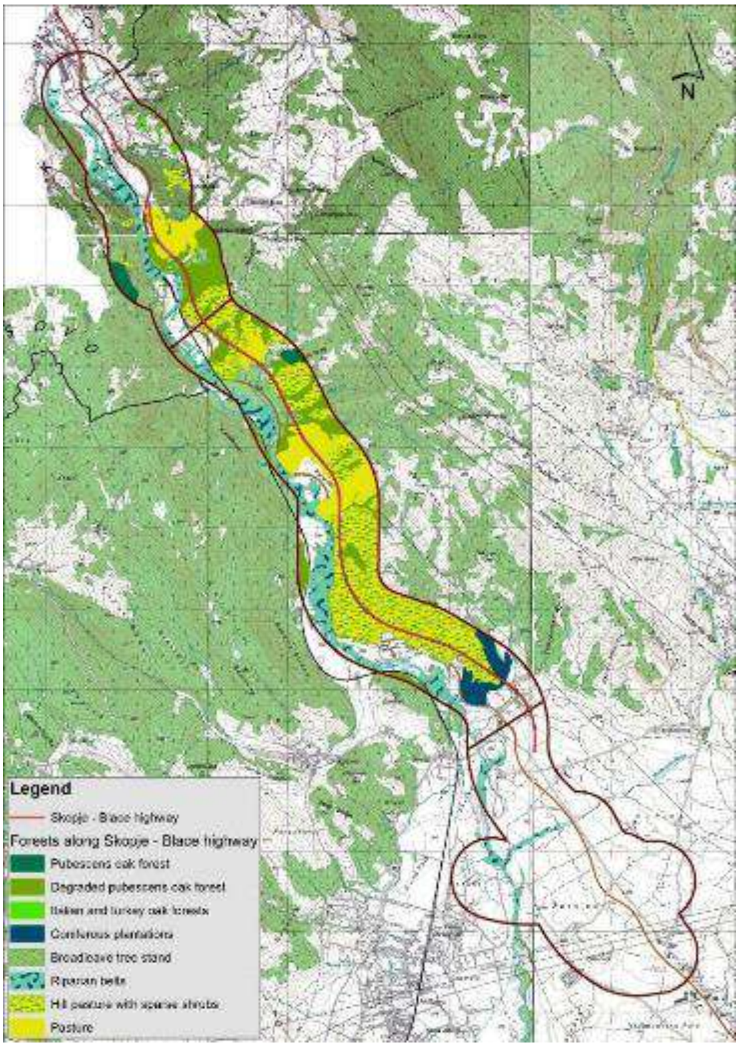


Figure 108 Forests along Blace-Stenkovec motorway

3.4.6.1 Forests of pubescent (downy) oak and white hornbeam

Most of the natural forests are composed of pubescent (downy) oak (*Quercus pubescens* Willd.) and white hornbeam (*Carpinus orientalis* Mill.). They are distributed in xero-thermophilic habitat, where the soil is light brown, shallow, dry with a small amount of humus. Due to the strong anthropogenic influence, they are largely degraded and turned into forests of vegetative origin. Their renewal is mainly from shoots, and only in some more inclined places, where soils are deeper, there is also renewal of generative origin, i.e. from seeds. These forests are covered by the forest community ass. *Querco – Carpinetum orientalis macedonicum* Rud.1939 ap. Ht.1946 - community of pubescent (downy) oak and white hornbeam.It is a xerophilic and thermophilic community with a kind of physiognomy and ecology, which has a climazonal distribution. The dominant role in its floristic composition is played by the pubescent (downy) oak (*Quercus pubescens* Willd.) and white hornbeam (*Carpinus orientalis* Mill.). In addition to pubescent (downy) oak and white hornbeam, its floristic composition includes flowering (manna) ash (*Fraxinus ornus* L.), Montpellier maple (*Acer monspessulanum* L.), European cornel (*Cornus mas* L.), Hairy euonimus (Euonymus verrucosa L.), *Coluteaarborescens, Coronillaemeroides,Crataegus monogyna, Ulmus campestris, Sorbus torminalis, Hedera helix*, *Paliurus spina-christi, Juniperus oxycedrus, Juniperus communis, Malus silvestrus* and others. In the tier of grasses are found: *Helleborus odorus, Cyclamen neapolitanum, Lathyrus venetus, Lithospermum purpureoviolaceum,* etc.

These forests are covered by the Special Forest Management Plans of the Public Enterprise National Forests from Skopje, but due to the poor quality and low productivity they have little economic significance.

Figure 109 ass. *Querco – Carpinetum orientalis macedonicum*

3.4.6.2 Forests of Italian oak and Turkey oak

In the project area, on smaller part are found fragment of community ass. *Quercetum frainetto-cerris* Oberd. 1948 Em. Ht. 1959 – community of Italian oak (*Quercus frainetto* Ten.) and Turkey oak (*Quercus cerris* L.). Due to the intensive use, they are also turned into forests of vegetative origin with a certain degree of degradation.

The forests of this community are characterized by rare canopy, medium productivity, poor quality, and in some places degraded. They are distributed on light brown forest soils (cambisols), medium to shallow, with a thin layer of humus and leaf debris and partially eroded. This forest community is another one of climazonal character and is widespread in the warm continental area.

Main species in this forest association are the Italian oak (*Quercus frainetto* Ten.) and Turkey oak (*Quercus cerris* L.) and in more open areas the pubescent (downy) oak (*Quercus pubescens*Willd.) is found as well.

The most common species in the trees tier are *Quercus frainetto* (Italian oak)*, Quercus cerris* (Turkey oak)*, Fraxinus ornus* (flowering/manna ash), *Sorbus torminalis* (checker tree), *Malus Florentina* (Florentine crabapple) and others. The tier of the bushes is mainly represented by: *Evonimus verrucose* (Hairy euonymus), *Rubus tomentosus* (Black berry), *Crategus monogina* (Common hawthorn), *Cornus mas* (European cornel) etc. Regarding the ground tier vegetation, most often are found *Danna cornubiensis, Lathyrus inermis*, *Lathyrus niger*, *Galium purpureum*, *Trifolium pignantii* and others. These forests are covered by the Special Forest Management Plans of the Public Enterprise National Forests from Skopje and have a certain economic significance.

Figure 110 ass. *Quercetum frainetto-cerris*

3.4.6.3 Riparian poplar and willow belts

Along the river Lepenec, as well as in some deeper valleys that are connected to the bed of the river Lepenec, there are natural poplar and willow belts covered by the community ass. *Populetum albae-nigrae* Slavnic (1942) 1952. The main species in this community are the white poplar (*Populus alba* L.), the brittle willow (*Salix fragilis* L.) and the white willow (*Salix alba* L.). The black poplar (*Populus nigra* L.) is found on a smaller scale, individually or in groups along agricultural lands.

In the trees tier are found the following tree species: *Populus alba, Populus nigra, Alnus glutinosa, Salix alba* and *Salix fragilis*. On open spaces *Juglans regia*is found as well. In the bush tier are present: *Clematis vitalba, Hedera helix* and *Rubus sanguineus.* In the tier of grasses are found *Arum maculatum, Lamium maculatum, Chelidonium majus, Brachipodium*sp*., Clinopodium vulgare* etc.

In some places, poplar forests are degraded, and degraded willow communities emerge in succession. It can be expected that these communities will also, over time, move into poplar belts and small groves.

This community occurs fragmentarily but is considered a priority habitat for conservation under EU Directive 92/43EEC. These forests are not covered by the Special Forest Management Plans and are not economically significant for the Public Enterprise National Forests from Skopje which manages the state forests, but from an environmental point of view are very important.

Figure 111 ass. *Populetum albae-nigrae*

3.4.6.4 Forest plantations of Austrian (black) Pine

In smaller areas of the corridor, there are artificially raised plantations of Austrian (black) pine (*Pinus nigra* Arn.), as well as groups of Black locusts (*Robinia pseudoacacia* L.). Wild olives (*Elaeagnus angustifolia* L.) are also planted in groups on smaller areas.

These afforestation were carried out because certain zoo anthropogenic impacts on forests in the past were so intense that they were either severely degraded or destroyed.Certain degradation processes were also visible on the land. That is why these afforestation with Austrian (black) pine, Black locust and Wild olives have been undertaken. Although the purpose of these afforestation was to completely cover the land and restore the natural vegetation, the success is very modest, because many of these forests have suffered in forest fires or are not well cared for.

In many places where the natural forest has been destroyed and the afforestation with non-native species has not been successful enough, shrubs of Christ's thorn (*Paliurus spina-christi* Mill.) are spreading naturally.

Figure 112 Forest plantations of Austrian (black) pine, Black locust and Wild olives

Figure 113 Damaged black pine plantations with nat ural vegetation of Christ's thorn

3.4.7 Ecosystem services

The ecosystem is an interactive whole, composed of biotic (living) and abiotic (inanimate) elements in a defined area, which may be of different surface area and of a different type. By introducing the concept of ecosystem, a lot of researches are dedicated to connectivity of man with ecosystems and what they may offer for his welfare. On that, the term ecosystem services are also introduced in order to describe and evaluate the benefits of ecosystems.

The International documents and treats, as well as the National Strategy for Biodiversity with the Action Plan (2018-2023)[36] defines four groups of ecosystem services: provisioning, regulatory, cultural and supportive.

Provisioning services - this category relates to biomass and other resources that satisfy human needs by providing food, raw material, energy and genetic material.

Regulation services - the functions of the natural and semi-natural ecosystem to regulate ecological processes and life supports system through biogeochemical cycles and bio-spheric processes. These processes lead to a healthy ecosystem. The regulation services are therefore a precondition necessary for all other services.

Cultural and amenity services - natural ecosystems have an important reference function vital for the maintenance of good health by providing the inspiration for reflection, spiritual enrichment, cognitive development, re-creation and aesthetic values.

Supportive services - ecosystems provides the necessary conditions for the flora and fauna to survive and regenerate. Habitat function helps in conserving biological and genetic diversity and evolutionary processes. The different species of flora and fauna require different conditions and can be interpreted in terms of carrying capacity and spatial needs.

The concept of ecosystem services in Macedonia has started to be implemented by adapting the official worldwide used methodologies and strategies, four years ago. So far, few studies have been accomplished which presents a good basis for future research and appliance of this concept. According to the latest report *Mapping and Assessment of Ecosystem condition in Macedonia* (Nature Protection Program 2016-2019), there are 22 different sub-types of ecosystems identified and mapped in details on a national level. For 15 of these, an assessment has been performed by using

[36] As it is set up in the international agreements (CBD) and threats, as well methodologies and guides

specific indicators, process done by following the MAES[37] guidelines (MAES, 2013). For the area of interest, as it can be seen from the pie, 10 sub-types (3rd level classification) of ecosystems are present. Most of them are natural or semi-natural, while only few are mainly anthropogenic ecosystems.

Table 64 Identified ecosystem sub types in the project area

Ecosystem	area (m^2)	area (%)
Agroecosystems	4243580	36,824
Big rivers	115596	1,003
Coniferous forests	4634	0,040
Decidous forests	3419856	29,676
Small rivers	160	0,001
Lowland shrubs	1299410	11,276
Lowland riparian forests	512087	4,444
Lowland pastures/meadows	610408	5,297
Mine and industrial ecosystesm	1236547	10,730
Rural and other anthropogenic ecosystems	81527	0,707
Total	11523804	100,000

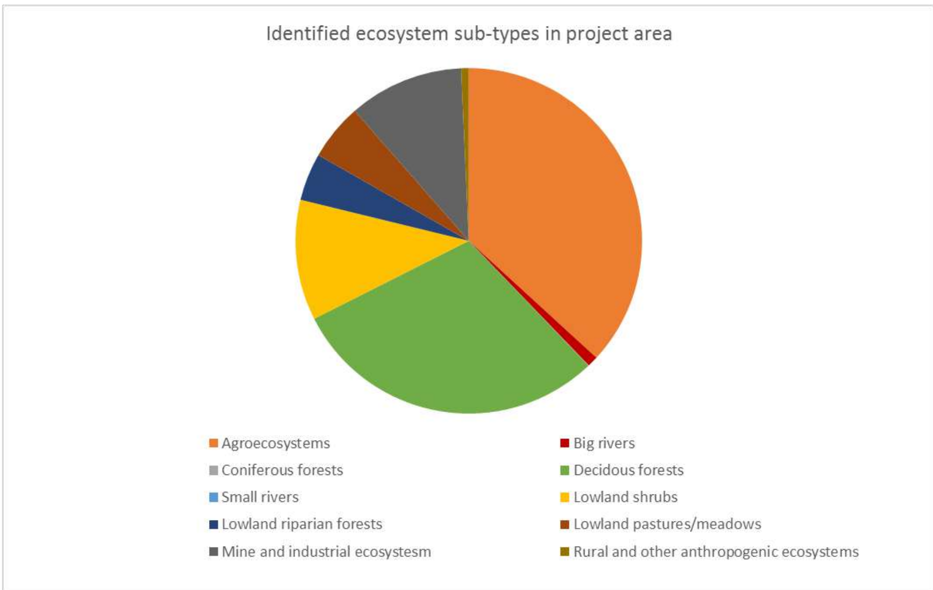


Figure 114 Identified ecosystem sub types in the project area

[37] Mapping and Assessment of Ecosystems and their Services

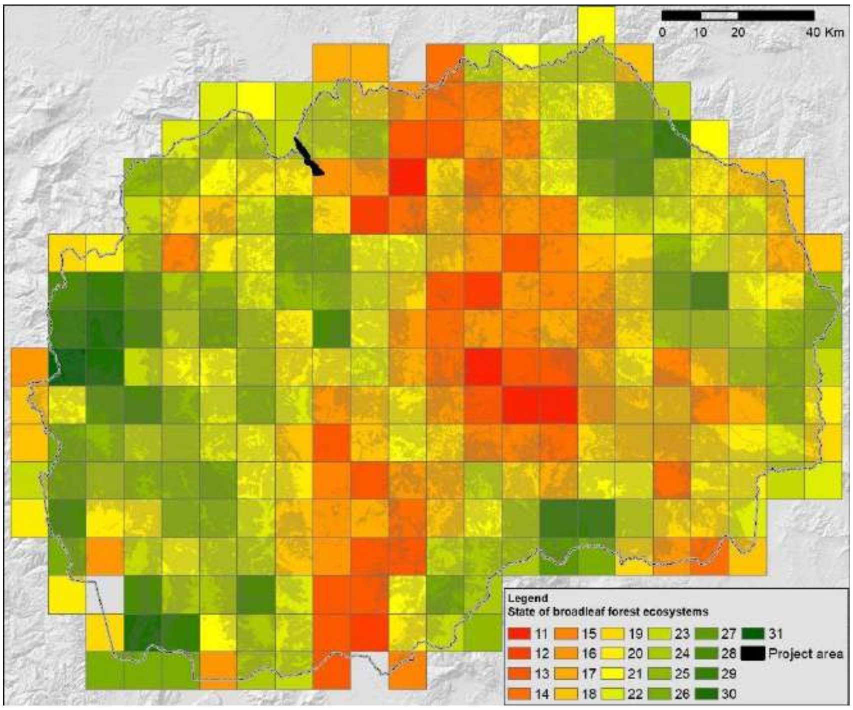


Figure 115 State of broadleaf forest ecosystem

The assessment of the national ecosystem's condition was done within UTM squares (10x10 km^2) using indicators and formulas so the final product looks like on the map with squares in different colors. The higher the sum is, the better the condition of the particular ecosystem is. In this case, the ecosystem of deciduous forests in the project area is not in very good condition, hence its ability for normal functioning and providing of ecosystem services is also obscure.

As presented on the map bellow as well, deciduous forests and agro-ecosystems has the majority of coverage in the project area.

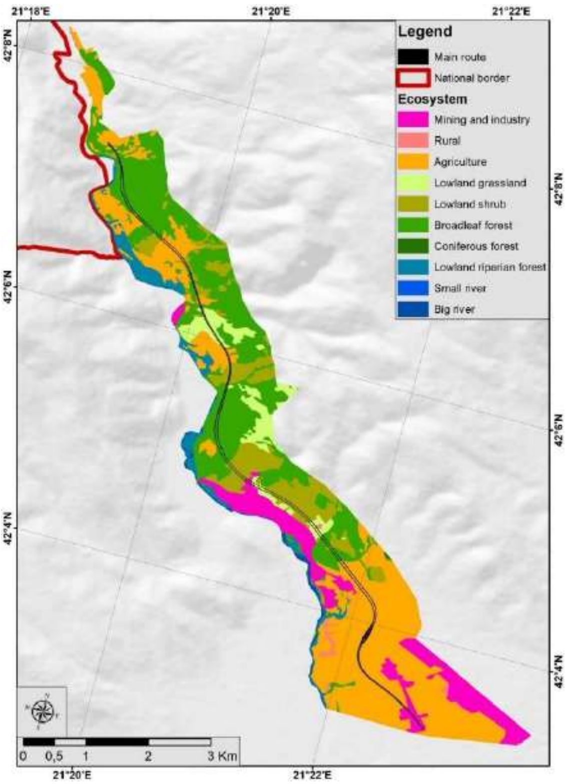


Figure 116 Ecosystems along the route

From the composition and surface of the ecosystem types in the project area, at this stage of the Project development (Preliminary design), can be given a very basic opinion on which ecosystem services are important to be taken into consideration. All of them are in the category of regulation ecosystem services, which is expected in this case given the mosaic of ecosystem types in the area. A number of ecosystem services are particularly important to road projects, either because roads depend on these services to reduce risk from natural hazards and rates of deterioration, or because roads can reduce the benefits which these services provide to people. Even though in the table below the list of mostly affected ecosystem services is presented.

Table 65 Adapted from Mandle, L., Griffin, R.M. & Goldstein, J.H. (2014). Ecosystem services affected by the construction

Ecosystem service	Importance to this road project
Flood regulation	Protecting or restoring vegetation in key locations upstream of roadways can reduce flood risk to roads. Vegetation reduces peak storm flows and flood height by enhancing soil infiltration and increasing water storage, reducing storm runoff.
Erosion control	Vegetation holds soil in place and captures sediment, preventing erosion and keeping sediment out of drainage systems and waterways. Vegetation that is maintained or restored upstream of roadways reduces the amount of sediment in runoff and storm water from reaching roadways.
Landslide prevention	Vegetation can help to stabilize soils and hillsides, contributing to the prevention of landslides in risk-prone areas. Protecting and restoring vegetation uphill of roads can reduce the risk of a landslide impacting a road. This in turn can result in reduced safety concerns for road users, reduced maintenance costs, and enhanced road use reliability
Water quality regulation	When roads replace or lead to the conversion of vegetation, they can impact water quality by reducing the ability of ecosystems to filter and retain pollutants.
Air quality regulation	Air pollution has negative consequences for human health . Roads, and especially the traffic they generate, reduce air quality. Vegetation can help to mitigate these impacts of roads on air quality by trapping and filtering pollutants.
Carbon sequestration and storage for climate regulation	By storing carbon in vegetation, ecosystems keep carbon dioxide out of the atmosphere, where it would otherwise contribute to climate change. Restoration of vegetation can offset carbon emissions associated with road construction, leading to a carbon neutral project.

Assessment on agroecosystems or rural and urban ecosystems is missing in our country, so we cannot give some overview of what would be (if any) the implication on ecosystem functioning or ecosystem services that these ecosystems provide to people who live in the Project area. Information used from separate personal projects, site visits and communication performed with the Municipality, communities and individuals, evidence that there is no significant usage of provisional services from the area in terms of secondary wood products, medicinal plants, fish, mushrooms, game and others.

In the project area of influence there are four sheep pen and one cattle farm with their auxiliary objects and all of them use the grazing resources freely available in the project area of influence[38].

When comes to cultural ecosystem services it is worth to be mentioned that in the project area are identified few locations of cultural heritage importance: Blace cemetery, at a distance of 350 m from the starting point of the project footprint; archaeological site Davina Kula, at a distance of approximately 500-600 m east of the motorway and archaeological site Gradishte – Brazda, at a distance more than two kilometers from the motorway footprint. The statistics shows that the mentioned sites are not very popular for the tourists and local population (except the cemetery) and are very rare visited. There are not any places in the project area which are used for picnic or marked trails for hiking.

3.5 Social Environment Baseline

3.5.1 Administrative Organization of the Project Area

The project footprint is completely located in the municipality of Chucher – Sandevo, which is a rural municipality located in the wide Skopje Region, north of the City of Skopje. The Municipality of Chucher – Sandevo consists of 12 villages, with administrative centre in the largest village in the municipality-Kuchevishte. The municipality is attached to the City of Skopje, and this project ends at one of the important economic zones of the City of Skopje, named Vizbegovo. The following map indicates the position of the Municipality in the country, as well as in the Skopje region.

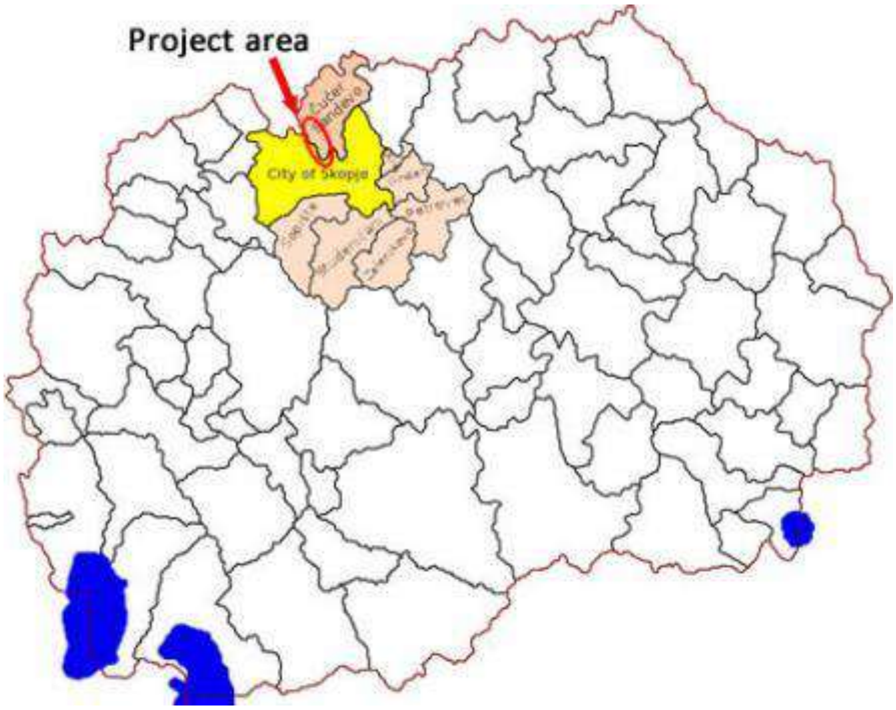


Figure 117 Location of the project area in the country and the Skopje region

The Municipality of Chucher Sandevo covers an area of 235 km^2, and it includes the following settlements: Banjani, Blace, Brazda, Brest, Brodec, Gluvo, Gornanje, Kuchevishte, Mirkovci, Pobozhje, Tanushevci and Chucher - Sandevo.

To the north and northwest municipality borders with Kosovo and Serbia as well with the following municipalities: Gjorche Petrov, Karposh, Shuto Orizari, Butel (all four are part of City of Skopje, as a separate local self-government bodies) and Lipkovo.

[38] Presented in the chapter 3.5.6 Economy, employment and occupation

3.5.2 Population and Settlements

The closest villages to the project area (up to 3 km) in the municipality of Chucher – Sandevo are Dolno Blace (Bardovska Maala) – registered as part of Blace, Gluvo and Brazda. The remaining villages in the municipality are significantly far from the project area. Although this project is located in the territory of the Municipality of Chucher – Sandevo, the closest settlements to the project footprint administratively belong to other four municipalities, who actually are part of the City of Skopje. These settlements close to the Project area, located within the administrative boundaries of the City of Skopje, are: Nikishtane, Orman and Volkovo (all in municipality of Gjorche Petrov), Gorno Orizari and Shuto Orizari (in municipality of Shuto Orizari), Vizbegovo (in municipality of Butel), and Bardovci (in Municipality of Karposh).

The project footprint does not include populated settlements, though there are few populated houses among active industrial and business entities operating in the area. Between the nearest settlement Orman (located across the river Lepenec) and the closest part of the project footprint there are three sand separation plants and a sand stone quarry. The following table presents the relative distance of project footprint to the closest houses located on the edge of the settlements.

Table 66 Overview of closest settlements to the project area

Settlement	Municipality	Relative distance of the settlement to the closest points of the Project footprint (km)	Population by Census 2002	Female
Blace	Chucher -Sandevo	3	972	476
Chucher -Sandevo	Chucher -Sandevo	3.3	299	137
Gluvo	Chucher -Sandevo	3	349	170
Brazda	Chucher -Sandevo	2.8	480	232
City of Skopje	**City of Skopje**	**1**	**467257**	**237772**
Vizbegovo	Butel (City of Skopje)	3	2817	1348
Bardovci	Karposh (City of Skopje)	3	1472	722
Volkovo	Gjorche Petrov (City of Skopje)	2	6750	3296
Nikishtane	Gjorche Petrov (City of Skopje)	2.2	1114	551
Orman	Gjorche Petrov (City of Skopje)	1	461	226
Shuto Orizari	Shuto Orizari (City of Skopje)	3.5	15353	7734
Gorno Orizari	Shuto Orizari (City of Skopje)	2.5	454	214

3.5.3 Demographic Overview

According to last registered population condition on 31 December 2020 which are official estimations made by State Statistical Office and published on its website, the total population in Municipality of Chucer - Sandevo numbered 10197 residents. In a period of 18 year (since 2002) the total population in municipality increased by 1704 people, or 20,1 % of the total population, whereas on national level the population has increased by 2,3 %.

The following table refers to the state of population in Municipality of Chucer - Sandevo for the period 2002 (last official census held) and the peak date of 31.12.2020 which are official estimations made by State Statistical Office and published on its website.

Table 67 Review of state population in project area[39]

Territory	Estimations 31.12.2020	Census (2002)	Dwellings (2002)	Households (2002)	(km^2)	Density (2020)	Density (2002)	Population growth
Chucher - Sandevo	10197	8493	3925	2321	241	42	35	1704
R. N. Macedonia	2068808	2022547	698143	564296	25713	80	79	46261

[39] Source: (State Statistical Office's website)

By gender, according to data from the last estimation there were 4855 women which is 47,6 % of total population in the municipality. Men dominates where the difference is 5 % of total population and higher number of male population in the intervals 0f 30-69 years of life means that that there is more unmarried and/or divorced/widowed. The young population up to 29 years represents 58,3 % and the biggest group that holds population aged 10-14 years.

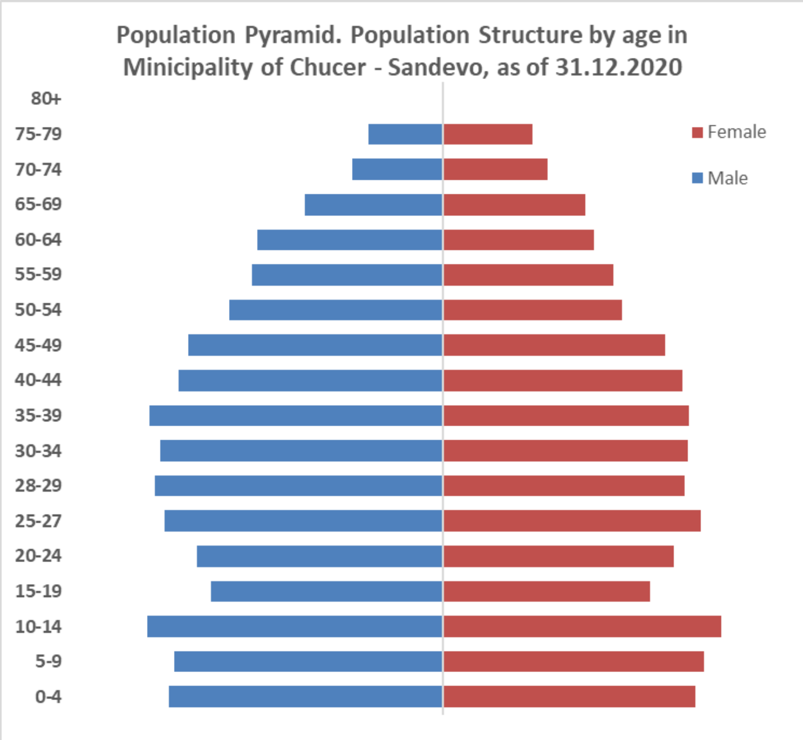


Figure 118 Population structure in Chucher – Sandevo by age and gender[40]

Ethnic structure of the population in the project affected municipality is presented on the following figure.

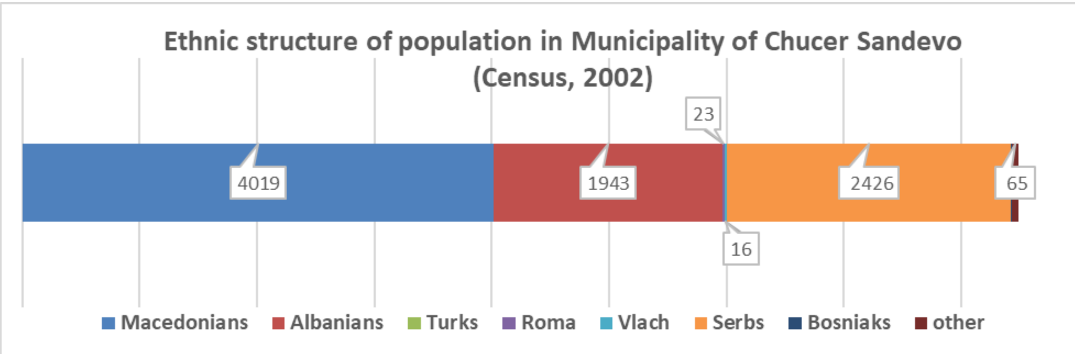


Figure 119 Ethnic structure of population in Chucher - Sandevo[41]

The migration processes in the municipality are not so evident due to the proximity of the city of Skopje which allows residents to travel on a daily basis using all the social benefits offered by the city.

3.5.4 Property, Dwelling, Infrastructure and Communication

Residents in the municipality live in their own individual houses. Rural settlements still note wide presence of Extended families, where several generations are living in a single household. These

[40] (Source: State Statistical Office's website)
[41] Source: State Statistical Office's website

households are dominantly agricultural holdings and are attached to the land and farming activities. Hence the situation is changing during the past 2 decades and more households in the rural parts are consist of nuclear family.

Typical rural dwelling in the Project area, can be described often as a two storey houses, built of compacted material (bricks the most) and surrounded by fences/walls, connected from parcel to parcel, with wide doors and gates for vehicles to enter and exit courtyards. These fences separate the private property from the streets and behind the gates, houses have internal courtyards, with storage space, garages, etc. All houses in the rural areas have small kitchen gardens and some have small orchards. Farming and animal husbandry are highly visible to be present in some of the houses in the settlements of the municipality.

All villages are supplied with electric power and all have access to internet. The settlements Banjani, Gornjani, Chucher-Sandevo, Gluvo, Brazda, Mirkovci, Kuchevishte and Pobozhje are supplied with drinking water through the local water supply network managed by Public Communal Enterprise (PCE) "Skopska Crna Gora". The Blace settlement is supplied with drinking water through a local water supply operated by the Blace local community, and part of the population in Pobozhje (Senora) is supplied with drinking water through the water supply system Skopska Crna Gora - weekend settlement Pobozje.

In the settlements Gluvo, Brazda, Mirkovci and Chucher - Sandevo a sewerage network has been constructed, while in the settlements Banjani, Gornjane and Kuchevishte it is planned to begin the construction of the sewage network in the nearest future. There is a wastewater treatment plant in the village of Brazda.

The municipal waste collection is managed by the same PCE "Skopska Crna Gora" but also there are two licensed companies which collect and transport waste (metal, paper, plastic, wood, rubber, etc.).

Passenger transport in the municipality is organized by the Public Transport Enterprise (JSP) Skopje. Residents in lower part of the municipality use city's Taxi companies and several private carries (particularly in Blace, Tanushevci and Brest).

In the municipality there is a police station located in the village Mirkovci, a post office in the settlement Kuchevishte as well as two customs terminals located in settlements Blace and Stenkovec. Also, there is sport airport Stenkovec and an object for performance of culture named "Partizanski Dom Sandevo" located in the village Chucher - Sandevo, and two sport halls within the schools "Cyril and Methodius" and "Aleksandar Urdarevski".

The wider area is covered by a developed road network. The national main road M-3, i.e. the section of the highway E-65 Skopje-Blace, the border with Kosovo M3, the Bypass around Skopje that connects E-65 and E75 as well as the local roads to the surrounding villages and municipalities and formerly built access routes the location also contributes to the establishment of a good communication link.

The following road routes pass through the Municipality:

- Regional Road: Stenkovec – Brazda – Chardak – Kuchevishte – Pobozhje - Tanushevci;
- Industrial route: Butel - Shuto Orizari - Gorno Orizari – Chardak - Mirkovci - Rudnik Banjani;
- Local roads: Shuto Orizari - Gorno Orizari – Brazda – Gluvo – Sandevo – Chucher – Gornjani - Blace, then Butel - Kucheviska Bara - Kucheviste and local road Radishani - Pobozhje.

Significant number of freight vehicles are moving on the roads of the Municipality of Chucher Sandevo due to the agricultural activities of the population, but also a certain number of economic entities that gravitate on the territory of the municipality. The current state of roads in the Municipality is presented on the following table:

Table 68 Road network in the municipality[42]

Chucher – Sandevo	y. 2019 (in km)

[42] Source: State Statistical Office's website

Chucher – Sandevo	y. 2019 (in km)
Total roads	**128**
Asphalt and Cobbled Street	72
Macadam road	7
Earth road	49
Designed road	-

The municipality of Chucher-Sandevo is located near the capital of the country, Skopje. Several roads that are of great importance for local economic development pass through the territory of this municipality, namely the motorway ring road that is bypassing the city Skopje and also serve as a border between the municipality and city of Skopje, as well as the road toward Kosovo and its capital City of Prishtina. Other roads that are passing the municipality are:

- Regional road: Stenkovec-Brazda-Chardak-Kuchevishte-Pobozhje-Tanushevci;
- Industrial road: Butel-Shuto Orizari-Gorno Orizari-Chardak-Mirkovci-RudnikBanjani;
- Local roads: Shuto Orizari-Gorno Orizari-Brazda-Gluvo-Sandevo-Chucher-Gornjani-Blace, then Butel-Kuchevishka Bara-Kuchevishte and the local road Radishani-Pobozhje.

Within the project area of influence there is a road (see following figure, turquoise color) that goes from village Orman over the river Lepenec and connects to the main A4 (or E-65) road, and this road serves as a secondary connection point for the villages Orman and Nikishtane, beside the main road that leads toward the city's neighbourhood Volkovo (yellow color).

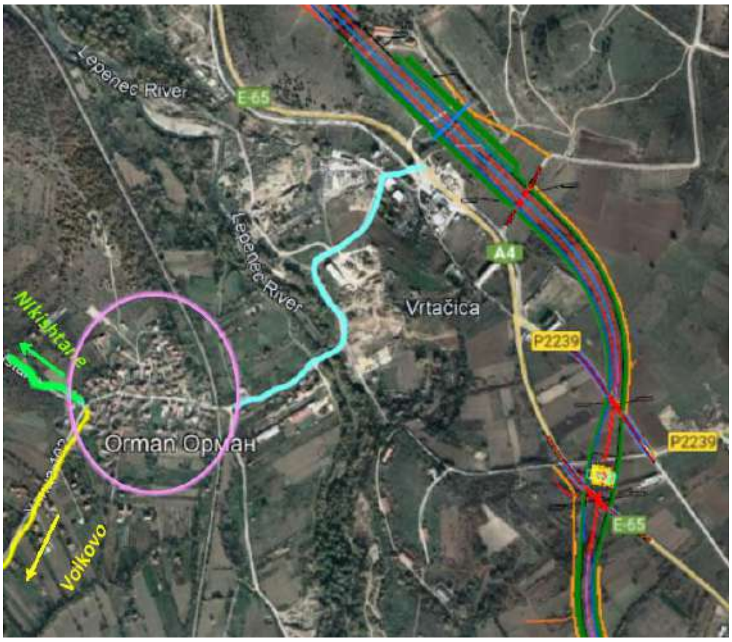


Figure 120 Road network passing through the project area of influence

Roads in all settlements of the municipalty are paved and the local road network is in relatively good condition.

Within the corridor of the motorway and the immediate surroundings there is a permanent low and medium voltage network (above and below ground) and two substations, an existing telecommunication network. There is no hydro-technical infrastructure within the project area of influence.

3.5.5 Distribution of the affected properties in the Project footprint

In general, the motorway alignment passes through areas that consist of barely used pastures and some fields also are partially used. Hence there are some locations that do attract attention, beside the pastures and field. The location I on the map below, consists of group of weekend houses and/dwellings, mostly abandoned. Only 1 dwelling object is actively used on a daily basis, some 6 moths throughout the year. Occassionally, and in accordance with the weather conditions, owners do overnight in this weekend house. Other houses/dwelling objects do remain empty, and some are abandoned.

LOCATION I

Figure 121 Housing objects in the weekend settlement

Isolated weekend house at the II is populated only during the summer period. Its owner is an elderly person who is regularly accompanied by his son or nephew. The owner, same as his son with his family, lives in the city of Skopje.

LOCATION II

Figure 122 Isolated housing object

At the location III some free and available resources (water) can be found. These are used by the farmers who operate sheepfold on this location. There is a catchment of water in the upper parts of the hill and the water is brought to the location by rubber hose. Sheep from this pen are taken to graze on the local hils, above the location.

LOCATION III

Figure 123 Sheep pen and free water resources

At the location IV, there is a some business property (former accommodation facility and storage) part of wider construction base used by Construction Company Granit, might be affected. Some 200 m further, a sheep pen is located.

LOCATION IV

Figure 124 Construction company storage and accommodation facility and a sheep pen

At the location V there is also a sheepfold that consist of two different sheep pen objects, two auxiliary facilities and a shepherd's house.

LOCATION V

Figure 125 Sheep pen at the location V

At the location VI, there is a cow farm. Property consists of dwelling objects with 6 apartments, cattle farm and three auxiliary objects; all belong to an extended blood-related family with at least 4 households, set illegally on a governmental land, previously used by the army as a shooting range and still owned by the military.

At the location VII there are some fields actively used for agricultural (commercial) purposes. Crops and flowers were notified.

The last location that holds potential adverse social impacts is near the junction of the existing road with the Skopje Ring Road. Namely there are two companies whose property (storage area) shall be affected. These companies are located next to the proposed alignment and active road.The following map determines the position of settlements in relation to the project area, as well as relevant locations for social consideration.

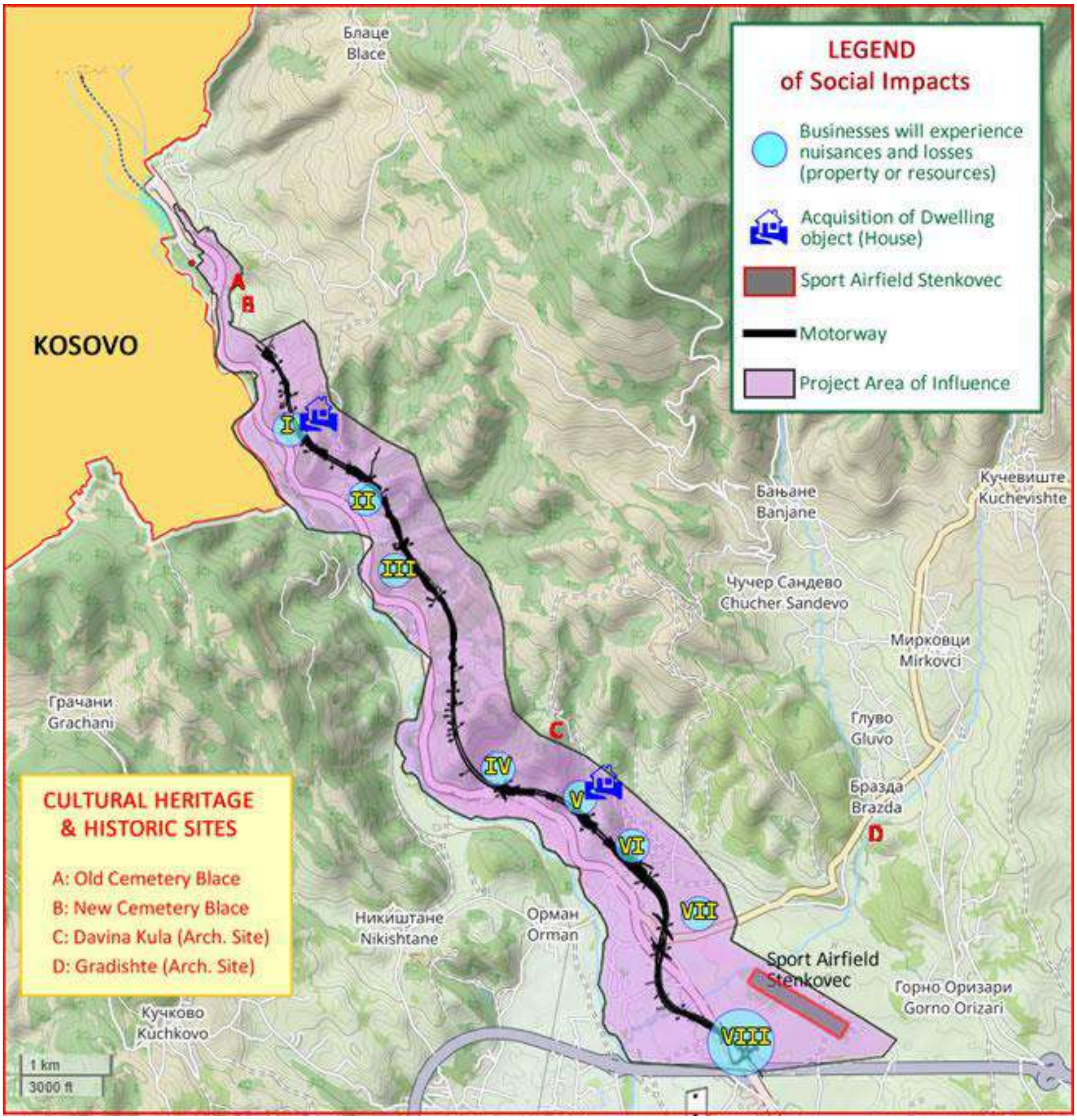


Figure 126 Relevant locations from social perspective within the project footprint and Project Area of Influence

3.5.6 Economy, employment and occupation

3.5.6.1 Income providing strategy

Macedonian citizens, generally, provide their income by:

- Engaging their personal effort and skills (salary and other income),
- Income from property and property rights (renting real-estate and other means),
- Income realized as individual farmers and independent service providers,
- Transferable incomes (retirement, social transfers, transfers to unemployed and current private transfers from abroad),

- Capital gains (income from securities sale, capital participation and real-estate),
- Dividend and interest inflow (inflow of investments or capital inflows).

The most common source of income is engaging own labour for salary, or other benefits, although other types of income are not rare. Increased living costs imply the need for achieving additional income which is very difficult to record, but is notable in good consumption, growth of personal savings in banks and other creation of tangible goods, primarily property.

People living in the settlements near the project area of influence combine agricultural activity with salary income. Renting real-estate of property, for example fertile farmland, unregistered garage business and workshops, illegal logging, selling meat, cross - border trade etc. are some of the means of additional income in the project area. Some people gather plants for the pharmaceutical industry and for culinary needs (rare herbs plants and fungi etc. found in less visited places).

What is most important in regards of emoloyment and livelihood of the local population living in the settlements close to the project footprint and the project area of influence is that the vicinity of the City of Skopje, as well as the Economic zone Vizbegovo, represent main resource for employment of the residents living in these settlements.

3.5.6.2 Industry and business entities

Chucher - Sandevo is a rural municipality and agriculture is being its main income source of most households.

Most of the businesses are located in the lower part of the municipality, where the project footprint ends, next to the industrial zone Vizbegovo.The Skopje’s Industrial Zone Vizbegovo partially extends into the municipality of Chucher - Sandevo, along the existing road toward Kosovo, with low level impact onto the municipality’s economy. The biggest company that significantly contribute to the economy of the municipality is the Banjani Mine.

The exploitation of mineral resources is also present in the Municipality through another Granit – Brazda mine who has surface pits quarry and granulate separation, some located in the project area of influence.

The following figure presents the locations of businesses set in the lower part of the municipality, all in the project area of influence.

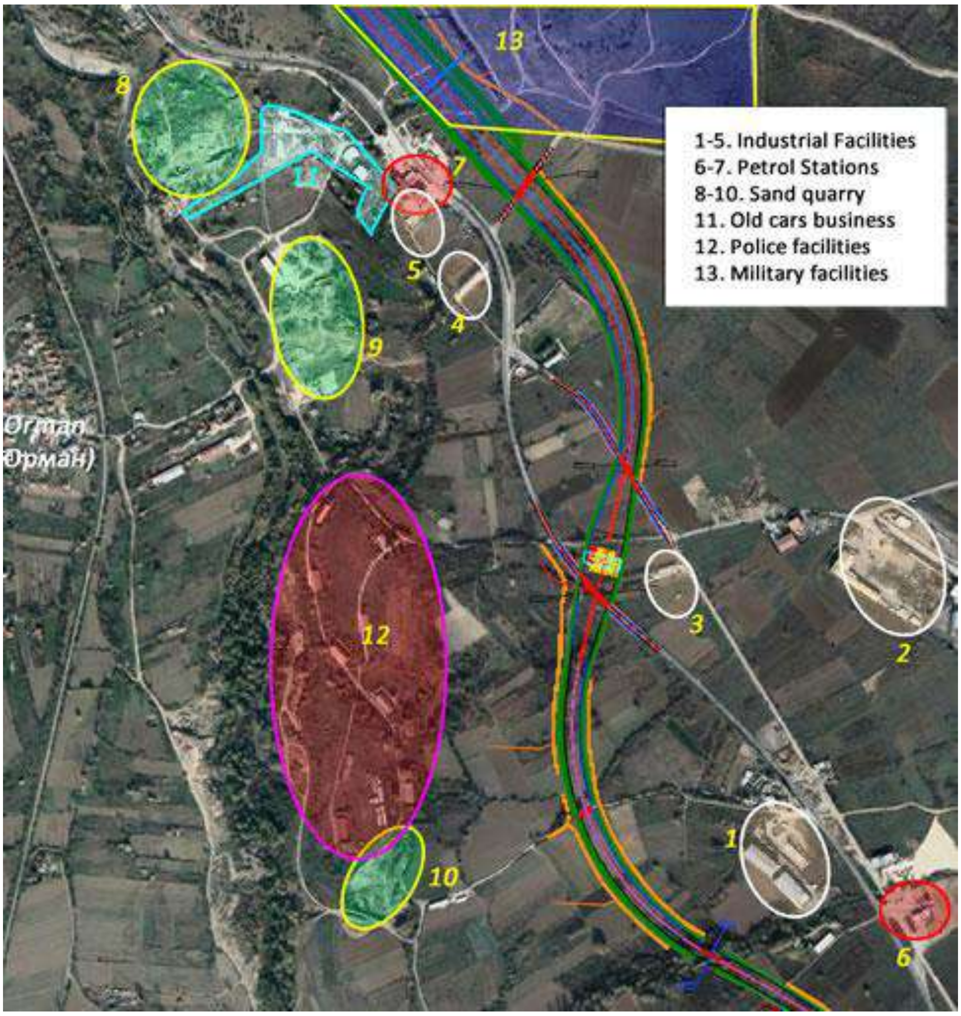


Figure 127 Businesses in the project area of influence (lower part of the municipality)

Between the nearest settlement Orman (located across the river Lepenec) and the closest part of the project footprint there are three sand separation plants and a sand stone quarry.The following table gives overview of active concessions for mineral exploitation in the municipality.

Table 69 Active quarries in the municipality[43]

Concessionaire	Raw material	Locality	Area (km2)
GRANIT DOO	Limestone	village Brazda	2,250
RIDKOP DOO	Sand and gravel	Stenkovec village Brazda	0.011571
STRITBILD INŽENERING DOO	Quartzite	Markov Kamen	0.9925
STRITBILD INŽENERING DOO	Limestone	Markov Kamen	0.9925
EURO ACTIVA DOO Skopje	Limestone	Pasiver	0,869026

There are different types of private companies in the Municipality, such as: locksmiths, brick plants, carpentry, construction warehouses, restaurants, trade and others.

The following table gives an overview of active business entities by section of activities in the municipality. Wholesale and retail trade, motor vehicles and motorbike repair sector hold the largest figure of companies (23,5%) in the municipality. Some 16% of all companies are operating in the Construction domain, and identical number of companies perform Transport and storage, as their main economic activity.

Table 70 Active business entities in the Municipality by sector of activities[44]

[43]Source: website of the Ministry for Economy

31.12.2020	Chucher - Sandevo
Total	**183**
Agriculture, forestry and fish-farming	5
Mining and rock extraction	1
Processing industry	31
Supply of electric energy, gas, steam and acclimatization	2
Supply of water, waste removal, waste management and environment renovation activities	2
Construction	29
Wholesale and retail trade motor vehicles and motorbike repair	43
Transportation and storage	29
Accommodation objects and service activities with food	11
Information and communication	1
Financial activities and insurance activities	1
Real-estate activities	1
Expert, scientific and technical activities	6
Administrative and ancillary services and activities	4
Public authorities and defence, mandatory social insurance	1
Education	4
Activities of health and social protection	6
Art, fun and recreation	2
Other service activities	4
Activities of households as employers, activities of households producing different goods and performing different services for personal needs	-
Activities of extraterritorial organizations and bodies	-

The following table gives overview of the trend of performing business in the municipality. Figures show promising state for the local economy. Namely, in 2020 there were 3 large companies that operate in the municipality, of which 1 turned from medium sized company (50-249 employees) to large (250+ employees). The number of small companies (10-49 employees) is also on the rise, while number of micro companies (0-9 employees) in the municipality is somewhat steady in the last 5 years.

Table 71 Active business entities by size and year (on 31st December)[45]

31 December	Municipality of Chucher - Sandevo				
	Total	Micro	Small	Medium	Large
2020	183	103	71	6	3
2019	192	117	65	8	2
2018	173	103	65	4	1
2017	170	103	64	2	1
2016	165	97	65	3	0

3.5.6.3 Agriculture, Forestry and Animal Husbandry

The Municipality of Chucher - Sandevo is dominated by agriculture, and according to the geographic conditions and settlement's location, it has good opportunities for development of the agricultural and forestry economy. The most common are vegetable crops: potatoes, beans, onions, tomatoes, peppers cabbage, cucumbers, etc. Next are the cereals vineyards, fruits (with the most apples). Actively used agricultural parcels are mainly privately owned.

According to data from Census of Agriculture in 2007, 30 % of total population in municipality conducted agricultural activities. Most of them 54 % worked on growing crops, whereas growing crops combined with farming animals practiced 34 % as agricultural activity. Only 2,7 % of the active household members that conduct agricultural activities only farm domestic animals. The following table gives an overview of the human resources used in agriculture activities.

[44] Source: State Statistical Office's website
[45] Source: State Statistical Office's website

Table 72 Household members who work at individual agricultural holdings[46]

Activity	Chucher -Sandevo
Growing crops	1646
Farming animals	82
Growing crops combined with farming animals	1041
Agricultural service activities	233
Hunting and game propagation	1
Forestry and logging	40
Fishing and fish farming	4
Total	**3047**

The average parts of used agricultural plots in the municipality counts 0,61 ha, and from the total available land the municipality has a relative high percent of land use 71%.

Used land in Municipality of Chucher - Sandevo is consists of meadows (35,3%), pastures (7,1%) and arable land, gardens and kitchen gardens (51,6%) of which 55% is under cereals, and 36,5% under vegetables. The following table shows the amount of used land in municipality.

Table 73 Area of utilized agricultural land[47]

Area of utilised agricultural land	ha
Total utilised agricultural land	**2301**
Meadows	813
Pastures	164
Orchards	20
Vineyards	114
Nurseries	2
Arable land, gardens and kitchen gardens	**1188**
Cereals	649
Industrial crops	6
Fodder crops	62
Vegetables	434
Aromatic and medical plants	0
Flowers and decorative plants	3
Seeds and seedlings	4
Fallow land and other uncultivated land	30

The data from the Census (2007) shows that from the total 1367 registered agricultural households in the municipality 65% grow vegetables, 59% grow cereals, 47,8% grow vineyards as well industrial plants were grown from 47,8% of total agriculture holdings.

The following figure gives overview of the exact number of individual holdings that utilizes different types of agricultural land and makes comparison of figures with Skopje and the country.

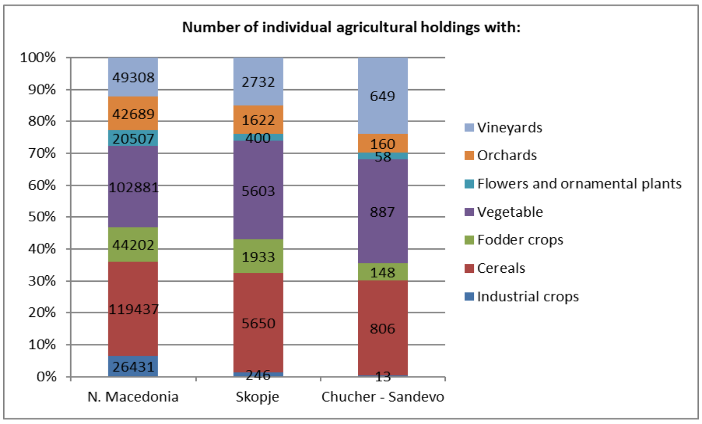


Figure 128 Structure of households that using their land for agricultural activities[48]

[46]Source: State Statistical Office's website
[47] Source: State Statistical Office - Census of Agriculture, 2007
[48] Source: State Statistical Office's website

According to the number of domestic units in the agriculture holdings, sheep are the most present (73 individual holdings with 11010 heads), followed by poultry (400 individual holdings with 6702 heads), cattle (358 individual holdings with 3099 heads) and pigs (336 individual holdings with 1436 heads).

The residents in the municipality of Chucher - Sandevo irrigate the most, land under cereals (¾), followed by orchards (near ¼).

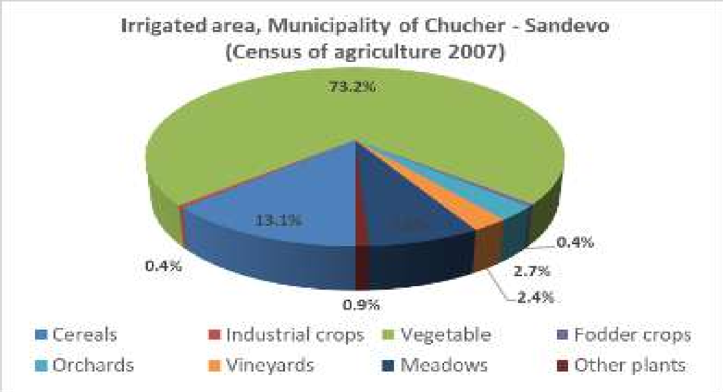


Figure 129 Structure of households that using their land for agricultural activities[49]

In the project area of influence there are four sheep pen and one cattle farm with their auxiliary objects and all of them use the grazing resources freely available in the project area of inflence.

Within the cattle farm, there is a building with 4 dwelling appartments. The following map presents the location of sheep pens and cattle farm.

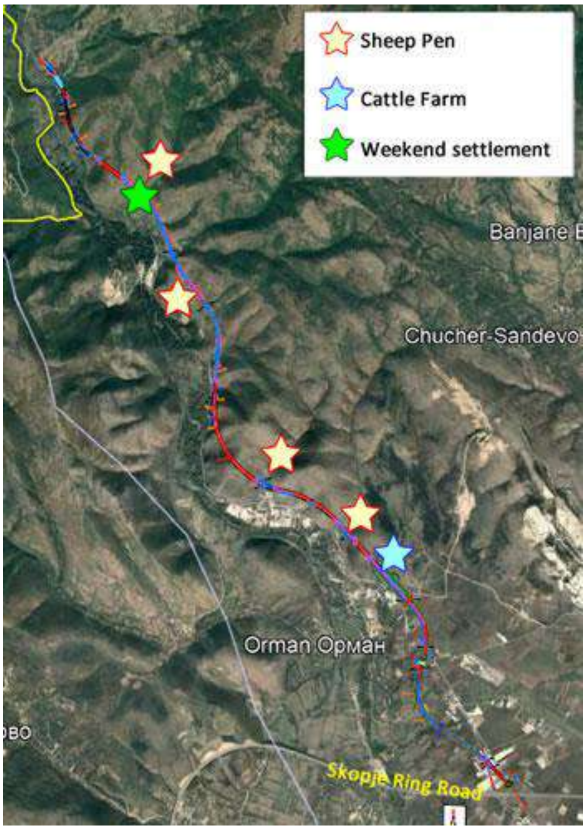


Figure 130 Location of livestock farms in the project area of influence

[49] Source: State Statistical Office's website

3.5.7 Education, Social and Health Care

3.5.7.1 Education

Education in the municipality of Chucher - Sandevo is organized in three primary schools. There is a kindergarten named "Milo moe" but is still no operational. There is no high school in municipality.

The primary school "Cyril and Methodius" is located in village Kuchevishte and it has premises located in the village Pobozhje. In the main building all nine grades are taught, while in the premises of Pobozhje the lectures are given only till the fifth grade. Teaching in booth schools is performed in Macedonian and Serbian. Primary school "Aleksandar Urdarevski" is other primary school located in village Chucher - Sandevo. All nine grades receive lectures in Macedonian language.

The third primary school named "Mihal Gramenno" (nine grades) is located in the village Brest and teaching is performed in Albanian language. The following table shows the number of children attending school in the municipality.

Table 74 Number of children in primary education[50]

Education	Primary school		
Municipality of Chucher - Sandevo	**Total**	**Female**	**%**
2019/2020	662	330	49.8%
2018/2019	678	308	45.4%
2017/2018	709	324	45.7%
2016/2017	696	321	46.1%
2015/2016	689	323	46.9%
2014/2015	701	332	47.4%

There are no schools or other educational facilities in the project area of influence.

3.5.7.2 Social Care and Inclusion

Social protection is defined as a system of measures, activities and policies to prevent and overcame the basic social risks to which the citizens is exposed during his life, to reduce poverty and social exclusion and to strengthen his capacity for self-protection. Socio-economic security is key to the well-being of the individual and the family in every society. By responding to people's needs, social protection fosters social inclusion and cohesion-secure communities and stable societies.

After its independence RNM inherited a social system based on high centralization which was largely realized through financial transfers and benefits for the citizens exposed to social risk. The social services like non – financial measures aimed to improve the social functioning of individuals and groups exposed to social risk, were insignificantly developed and were reduced to institutional forms of protection. In that period the main role of the state was to act as a protector provider, and the participation of the non-governmental, private and religious sector in social protection activities was quite insignificant.

Today, the emphasis in the field of social protection is aimed at developing alternative forms of protection in order to reduce the once dominant dependence on institutional protection and realization of the process of de-institutionalization.

The social protection in Municipality of Chucher - Sandevo is implemented by the Intermunicipal Centre for Social Works, located in city of Skopje. The centre is responsible about registration delivering financial aid in difference social areas: assistance and care allowance; child protection; parental allowance, special allowance, permanent financial assistance and social – cash benefits.

3.5.7.3 Poverty and vulnerable groups

According to the State Statistical Office, for 2019 the at-risk-of-poverty rate in the country was 21.6 %, or calculated in number 448471 citizens of total population were poor. Analysed by household types, the most vulnerable were households of two adults with three or more depend children with poverty rate of 44,7%. The Single-person households (one adult 65 years or older) had the lowest

[50] Source: State Statistical Office's website

poverty rate 3,1%. According to the most frequent activity status the at-risk-of-poverty rate for unemployed persons is 41,7% while the at-risk-of-poverty rate for employed was 8,5%.

In 2019 the young people under 18 were at a higher risk of poverty, 27,8% while the risk was the lowest among persons aged 65 + that primarily rely on pensions and social transfers. By gender the poverty rate was higher among women 22%.

Unfortunately, in RNM there are only few municipalities that have developed local strategies and local action plan to tackle poverty and social exclusion. Accordingly, Municipality of Chucher - Sandevo has no such strategy and plan: based on available statistical data in this Municipality, we can conclude that main socially vulnerable group are people with no or low education. According to the available data from Census 2002, out of the total population of 6579, 3579 people have either no education, have not finished primary, or have completed only primary education.

The social position of this population category, due to lack of education, is affected in various way: first they face reduced employment opportunity and non-competitiveness; secondly, they are ignorant about their rights and opportunities; third they fail to motivate their children to gain better education, which turns into vicious cycle of deepening poverty etc.

During assessments and preparation of this document, potential groups in the wide area around the project who might be affected by this project, differently due to their gender, age, ethnicity, religion and other cultural, physical or other attributes (i.e. due to the digital divide, without internet access, rural areas, poor farmers), were examined. This assessment shows that there might be vulnerable or disadvantaged individuals in the project affected area of influence that will be affected with the activities of this project and/or might require different channels of communication. These are affected land owner/users and elderly people.

3.5.7.4 Health Care

The healthcare system consists of three segments of three segments: primary, secondary and tertiary healthcare. The primary healthcare in Republic of North Macedonia is based on a network of private and public health facilities: clinics and health canters. The system of primary protection includes preventive, promotional and curative services through different profiles of health workers and affiliate professionals: doctors, general medicine specialist, dentists, paediatricians, school medicine specialists, gynaecologists and labour medicine specialists. The secondary health is practiced throughout a system of specialist advice services, general and special hospital and institutes. The tertiary health care is practiced in clinical hospitals and the University clinical centre in Skopje. These two levels are responsible for providing preventive, curative and rehabilitative health services through different specialists and subspecialists. Republic of North Macedonia has a working health care system, geographic and financial approach, disease control and almost full coverage of the population with vaccination.

The health care system is mostly financed through a mandatory healthcare insurance, which gives an option for all citizens to be healthcare insured. The mandatory healthcare insurance is financed by salary allocated amounts, intended for healthcare insurance. Furthermore, North Macedonia's state budget delivers funds for covering the health insurance expenses for citizens who do not fall under health insurance by any basis, including groups such as: underage children under 18 years of age (26 if they are students), pregnant women, nursing mothers, people above 65 years etc.

The public health is constantly monitored by the Institute of Public Health, and the latest data and healthcare analyses are included in the Health Map of the Republic of North Macedonia 2019.

In the country in 2018, in accordance to the established ambulant-polyclinic morbidity groups, on first place are diseases of the circulatory system (53,9%), followed by neoplasms (18,9%), symptom, signs and unspecified conditions (9%), endocrine, nutritional and metabolic disease 4,7% and disease of respiratory system 4,1%. Compared to 2017, in some groups the morbidity rate has increase especially in signs symptom an unexpected conditions and certain consequences caused by external reasons. (IPH, Health map of the Republic of North Macedonia 2019).

The Health Region Skopje, where Municipality of Chucher - Sandevo belongs consists of 1858 km^2 with 142 populated settlements and 629.215 numbers of inhabitants. Average number of inhabitants per square kilometre (km2) is 324,4 inhabitants. The following table gives overview of the situation in Health Region Skopje along the country's figure.

Table 75 Healthcare sector coverage in the Skopje Health Region and Republic of North Macedonia[51]

2018	Skopje	NRM
NUMBER OF DOCTORS IN THE HEALTH REGIONS OF RNM		
Number of residents per 1 doctor	222,7	326,2
Total number of Doctors	**2825**	**6364**
General Practice	558	1825
General Practice (% of the total number of Doctors)	19,8%	28,7%
At Specialization	308	708
At Specialization (% of the total number of Doctors)	10,9%	11,1%
Specialists	1959	3831
Specialists (% of the total number of Doctors)	69,3%	60,2%
Number of Dentists	**671**	**1861**
Number of residents per 1 dentist	937,7	1115,6
Number of Pharmacists	**299**	**1105**
Number of residents per 1 pharmacist	2104,4	1878,9
STAFF IN THE MEDICAL UNITS IN RURAL AREAS, BY HEALTH REGIONS, IN RNM		
Permanent Doctors	80	308
Periodical Doctors	0	4
Health w orkers w ith High School and Vocational school	83	351
Hot spots	48	215

According to the health map of Republic of North Macedonia, the most frequent cause of death of all death cases in health region Skopje in 2018 were the circulatory system disease with 47,4%.

The Polyclinic Chair provides health care services for the inhabitants of Chucher - Sandevo. Also, there are private health practices in the municipality general practice - 4 in total, dentistry - 2 in total and 2 pharmacies.

3.5.8 Cultural Heritage

Accoridng to the authorities responsible for protected and unprotected cultural heritage in the Skopje region it is confirmed (see table 3 in chapter 1.6.) that there are no protected cultural heritage site sites within the project footprint and project area of influence.

Close to the Motorway footprint there are few locations of cultural heritage importance. The Blace cemetery (see figures in the following table) are at a distance of 350 m from the starting point of the project footprint. Cemeteries are accessible by road, directly from village Blace, as well as from the existing road (there is a road section that provides direct access to both cemeteries).

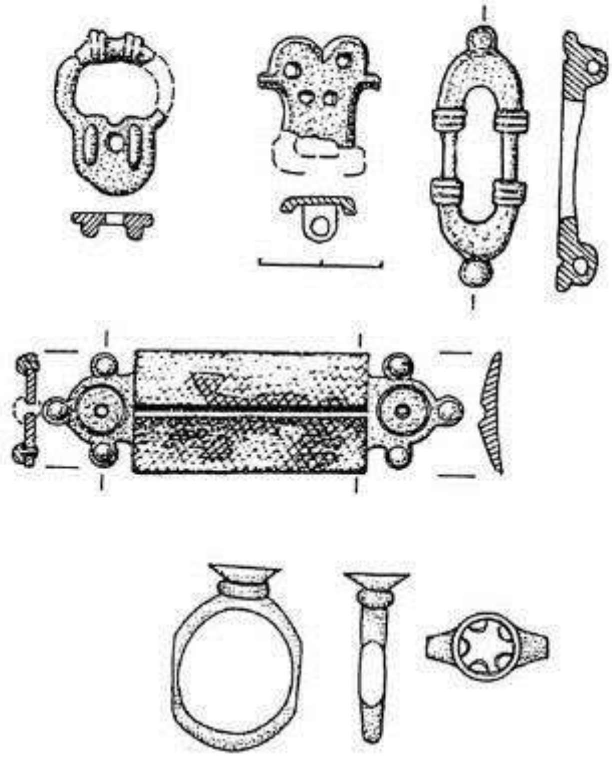
The archaeological site Davina Kula (see figures in the following table) is at a distance of approximately 500-600 m, east of the motorway, while the other closest cultural heritage site (archaeological site) Gradishte - Brazda is at a distance more than two kilometres from the motorway footprint.

[51] Source: Health map of the Republic of North Macedonia, 2019

Table 76 Cultural Heritage sites in the vicinity of the Project area[52]

Archaeological site	Description
The Blace cemetery	  
Davina Kula (also called **Markova Kula**)	Davina (Markova) Kula, a castle / building from Roman and Late Antiquity. 3 km southwest of Chucher, at the southern end of the Kachanichka Klisura, 320 m high above the river Lepenec and the highway Skopje-Kachanik, on a peak flattened in long terraces, a late antique construction site was erected. The hillside is steep on all sides and at the top there are remnants of a strong wall, which encloses a space of 100-120 m^2. There are pottery and coins dating from the Roman era. At the highest level is the acropolis with a double belt of defensive walls built of stone and lime mortar.[53] Inside there are well preserved remains of an early Christian Basilica and a dozen other buildings. To the north of the acropolis lies the core of the city covered by two belts of walled walls. In the centre there is a square forum with many public and private buildings around it. There is a large gate on the north face of the outer wall, and the whole space in the walls is about 8.5 hectares.

[52] Source: State Statistical Office's website
[53] ISBN 9989649286. Koco Dimche (1996). 'Archaeological Map of the Republic of Macedonia' II. Skopje: Macedonian Academy of Sciences and Arts (Коцо, Димче (1996). „Археолошка карта на Република Македонија". II. Скопје: Македонска академија на науките и уметностите.)

Archaeological site	Description
	North of the construction site lies the necropolis.  (Findings from 7-8th and 13th Century)  
Gradishte – Brazda	A fortified settlement from the Iron, early antica, Roman and late ancient times, known as Archaea Park, is the first archaeological park in Macedonia, formed in cooperation with the Association of Archaeology, Museum of Macedonia and ESM. The archaeological site "Gradishte – Brazda" is situated on a humble hill that rises over the village of Brazda, 2500 meters of the footprint project area and 10 km north from the center of Skopje. According to information (data) obtained through past researches, the site is classified as a fortified early antique settlement, dating from the 5th to the 3rd century BC and spreading over an area of 3.5 ha, which make it the largest settlement in the Skopje valley. With the excavation of the monumental architectural edifice, known as "The Royal tomb" in 1986, the archaeological site Gradishte claims a significant place in the archaeological circles as well as the wider public. With its specific characteristics, the Royal tomb at Brazda represents a unique instance of its kind on the wider Balkan peninsula. It is a representative structure with a rectangular chamber with dimension of 9.8 by 6.6 meters and a dromos (passageway) with over 20 meters in length that steeply descends toward the west entrance of the tomb. The entire structure is built from large travertine blocks with an average weight of 500 to 1500 kg. Although it is a structure buried in the ground, the chamber blocks are decorated with a smooth rectangular frame encompassing the salient middle. The exquisite

Archaeological site	Description
	decoration of the rock, as well as the fact that the closest travertine mines are on a distance of 20 km from the site, are arguments enough to determine the economic power of the deceased and the settlement at large which was one of the more important settlements in the 5th century BC.

No other cultural heritage sites are identified within the corridor of the proposed road alignments.

4 ASSESSMENT OF THE ALTERNATIVES STUDIED BY THE PROJECT DEVELOPER

4.1 Short overview of the alternatives assessment procedure

The objective of the alternatives assessment is to identify the possible environmental and social impacts that may be caused by implementation of the proposed technical options (alternatives) and select the most favourable or preferred alternative for further implementation.

The technical, financial, environmental and social assessment is done on the basis of available technical documentation, i.e. Conceptual design, site visits and investigation of current conditions in the project area/road corridor and its surrounding, desk study analyses, stakeholder consultations, through implementation of multi-criteria assessment which is part of the Preliminary Assessment of Environmental and Social Impacts of the Proposed Alternatives, where the possible impacts are analysed for each proposed alternative.

In the Conceptual Design for Subsection 2, developed in 2020, the alternative solutions were initially considered for the north side of the proposed motorway, from km 2+000 to km 10+000, including an alternative arising from the Detail Design prepared in 2002 (named as DD2002) and alternative solutions on the south side, from km 10+000 to km 12+500. More specifically, DD2002, ALT 1 and ALT 2 were proposed and analysed for the northern part of the route, while ALT1 and ALT2 for the southern part.

The short overview of the alternative assessment procedure, involvement of the stakeholders during these procedure, documentation prepared during this period in the following table are presented:

Table 77 Overview of the alternative assessment procedure for Subsection 2

Prepared documentation	Analysed alternatives	Preferred alternatives	Acceptance of alternatives by the stakeholders		Reasons for not acceptance	Followed up activities by the Stakeholders	Followed up activities by the Designing and ESIA team
			Pros	Cons			
Preparation of Conceptual design and Preliminary Assessment of Environmental and Social Impacts of the Proposed Alternatives (May-July, 2020):	BAU, DD2002, Alt 1 and Alt 2 North BAU, Alt 1 and Alt 2 South	Alt 1 North and Alt 1 South	Majority of the stakeholders	Ministry of Defence	Alignment passes through the shooting range area "Stenkovec" (owned by the Ministry of Defence).	Ministry of Defence has set boundaries where the new route of the alignment can passes.	Site visits and meetings with the stakeholders; Proposal of new alternatives
				Municipality of Cucer Sandevo	Alignments were in conflict with already adopted/planned urban plans in the northern part.	Municipality provided information on the urban plans and set the boundaries for the new route of the motorway	
Proposal of new alternatives by the Designing team (November-December, 2020)	Alt 1B and Alt 1C	/	Alt 1B and Alt 1C by the Ministry of Defence (official letter is presented in Annex	/	/	Given instruction related to embankment height and traffic connection with the shooting	Updating of the Conceptual design and MCA with Alt 1C (North and South)

			5)			range	
			Alt 1C by the PESR		/	/	
			Alt 1C by the Municipality (official letter is presented in Annex 5)	/	Great part of the Alt 1B passes along the agricultural land as part urbanised land for industrial zone Stenkovec	Given instruction related to further planning of the aliment related to the existing infrastructure	
Preparation of Conceptual design and Preliminary Assessment of Environmental and Social Impacts of the Proposed Alternatives (January-February, 2021)	BAU, DD2002, Alt 1, Alt 2, Alt 1C, North and BAU, Alt 1, Alt 2, Alt 1C, North	Alt 1C North and Alt 1C South	Accepted by all stakeholders	/	/	/	/

4.2 Technical and other characteristics and comparison of the proposed alternatives

The entire route of the motorway was divided into two sections, namely north and south, and for each section the following alternatives were considered:

Section North: Blace Stenkovec (chainage km 2+000 to chainage km 10+000)

- Alternative BAU (Businees as Usual) – Blace-Stenkovec North
- Alternative Blace-Stenkovec DD 2002 (ALT DD2002)
- Alternative Blace-Stenkovec North 1 (ALT1 North)
- Alternative Blace-Stenkovec North 2 (ALT2 North)
- Alternative BlaceStenkovec North 1C (ALT1C North)

The Detailed Design 2002 will not further be examined since is not feasible to be implemented. In the following table the alternative alignments are compared based on their technical characteristics, structures, financial costs.

Table 78 Comparison of the proposed alternatives for the alignments Blace-Stenkove North

Parameters	Blace-Stenkove North		
	Alt 1	**Alt 2**	**Alt1C**
Length of the alignment	8 km	8 km	8 km
Modification of the alignment in accordance with the DD2002	Shifted to the east to eliminate bridges	Modified near v.Orman, to avoid dense occupied area	Shifted to the east (~10 m) to reduce the lengths/number of bridges, retaining walls.
Effects on the public infrastructure and utilities	bigger	bigger	smaller
Underground conditions	same	same	same
Cuts	1.426.000 m^3	900.000 m^3	1.154.373 m^3
Embankments	500.000 m^3	535.000 m^3	889.651 m^3
Length of bridges	940 m	2430 m	940 m
Length of tunnels	5595 m	4260 m	5155 m

Retaining walls	1600 m	7300 m	1600 m
No. of significant structures	17	25	17
Construction cost	115.217.000 €	121.602.000 €	109.409.000 €
Duration of construction work	longer	shorter	longer
Travelling time	same	same	same

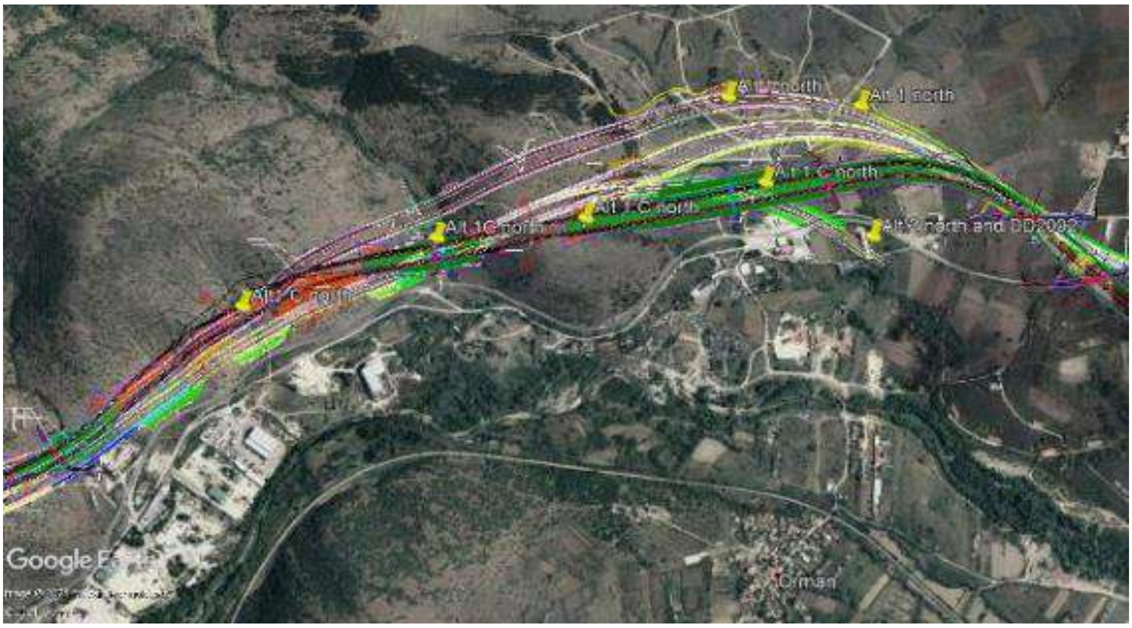


Figure 131 Proposed alternatives in the North Section (DD 2002, ALT1, ALT 2, and ALT1 C)

Section South: Blace Stenkovec (chainage km 10+000 to chainage km 12+500)

- Alternative BAU (Businees as Ussual) - Blace - Stenkovec South
- Alternative Blace-Stenkovec South 1 (ALT1 South)
- Alternative Blace-Stenkovec South 2 (ALT2 South)
- Alternative BlaceStenkovec South 1C (ALT1C South)

In the following table the alternative alignments are compared based on their technical characteristics, structures, financial costs.

Table 79 Comparison of the proposed alternatives for the alignments Blace-Stenkove South

Parameters	Blace-Stenkove South		
	Alt 1	**Alt 2**	**Alt 1C**
Length of the alignment	2,5 km	2,5 km	2,5 km
Modification of the alignment in accordance with the DD2002	Existing structures and roads retains and two roundabouts replace the existing "T" at grade junctions which connect the highway from Blace with the ring road A2 Skopje.	Should be designed underground the existing ring road from km 11+800 - 12+800 (through tunnel).	It is based on Alt1 and instructions by the City of Skopje and PESR.
Effects on the public infrastructure and utilities	nearly the same	nearly the same	nearly the same
Request of big structures	no	yes	no
Length of bridges	240 m	240 m	240 m
Length of tunnels	0	1200 m	0
No. of significant structures	2	3	2
Additional analytical investigation	no	yes	no
Construction cost	14.340.000 €	45.442.000 €	12.662.000 €
Risk of construction and accident	smaller	bigger	smaller
Duration of construction work	smaller	bigger	smaller
Travelling time	same	same	same

Figure 132 Proposed alternatives in the South section (ALT 1, ALT 2 and ALT1 C)

4.3 Spatial characteristics of the proposed alternatives

The spatial characteristics of the proposed alignment grouped as Blace – Stenkovec North and Blace – Stenkovec South are presented in the following description:

Section 2: Blace - Stenkovec North

Spatial characteristics from km: 2+000 to 5+000

Alternative	Inhabited places/Buildings	Terrain Characteristic	Surface water	Infrastructures
All	Houses (weekend houses), beehives, cow breeding facility, fenced part for breeding cows, building located at ~50-100 m (air distance).	Hilly terrain covered with vegetation and forest; Arable land.	River Lepenec (~30 m to 200 m); Intersect intermittent streams at: 2+200; 3+600; ~3+900 (Morav Dol); 4+300; 4+700 (Pesji Dol)	Passes electric lines; Existing national road (~30 m to 200 m); Intersect earth roads.

Spatial characteristics from km: 5+000 to 8+000

Alternative	Inhabited places/Buildings	Terrain Characteristic	Surface water	Infrastructures
All	Presence of sheepfold (~130-150 m) at 5+000 to 5+500; In the surroundings are located: quarry and separation plant owned by Company Transmet, concrete plant and administrative buildings owed by Granit, other industrial facilities.	Hilly terrain cover on some parts with vegetation. Arable land.	River Lepenec (~ 40 m to ~200 m) Intersect intermittent streams at: 6+000; 6+400; 7+600.	On the right site of the alignments passes national road A4. Intersect earth roads
Alt 1 and Alt1C	Passes close to sheepfold facility (~100 m) and buildings of Granit			
DD2002 and Alt 2	Intersect part of the buildings of Granit			

Figure 133 Project area at the begging of the alignments

Figure 134 urrounding between km: 3+000 to 4+700

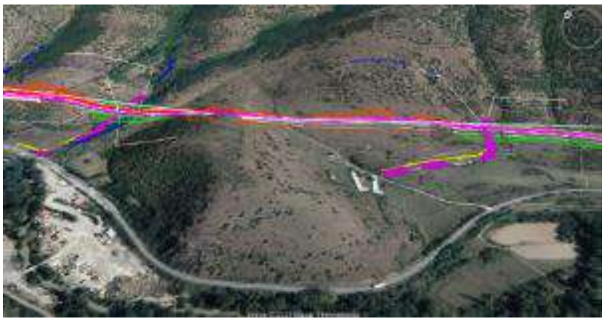


Figure 135 Surrounding near km: 5+000 to 5+500

Figure 136 Surrounding near km: 6+000 to 8+000

Spatial characteristics from km: 8+000 to 10+000

Alternative	Inhabited places/Buildings	Terrain Characteristic	Surface water	Infrastructures
All	Passes near the sheepfold; Presence of abandoned building; In the surrounding near the national road are located: parking area, fuel station Disel Petrol, Casino Vegas, other commercial buildings; Village Orman(~800-1000 m); Quarry Brazda (~1,5 km); Other quarry at 700 m from the closest alternative Alt1.	Hilly terrain cover on some parts with vegetation; Arable land.	Intersect intermittent streams at: ~ 8+200 (Lopotanec); ~ 8+700; 9+200	On the right site of the alignments passes national road A4. Intersect earth roads
Alt 1	Intersect part of the sheepfold; Passes on the north site of the livestock facility (~150 m); Passes in the shooting area owed by the Ministry of Defence			Intersect earth roads
Alt1C	Intersect part of the sheepfold; Passes very close to the livestock facility.			
DD2002[54] and Alt 2	Intersect part of the buildings of Granit; Passes near and intersect part of the livestock facility and dwelling object; Passes in the shooting area owed by the Ministry of Defence; DD2002 intersects commercial facilities located to the fuel station.			Intersect earth roads DD200 intersects the national road

[54] The alternative 2002 in the Conceptual Design finish approximately one kilometre before other two alternatives.

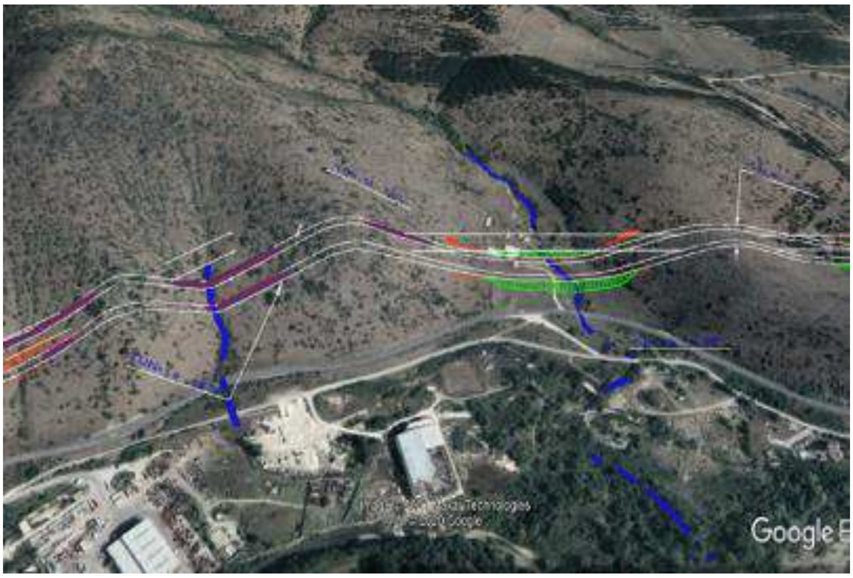


Figure 137 Surrounding near km: 8+000 to 9+000

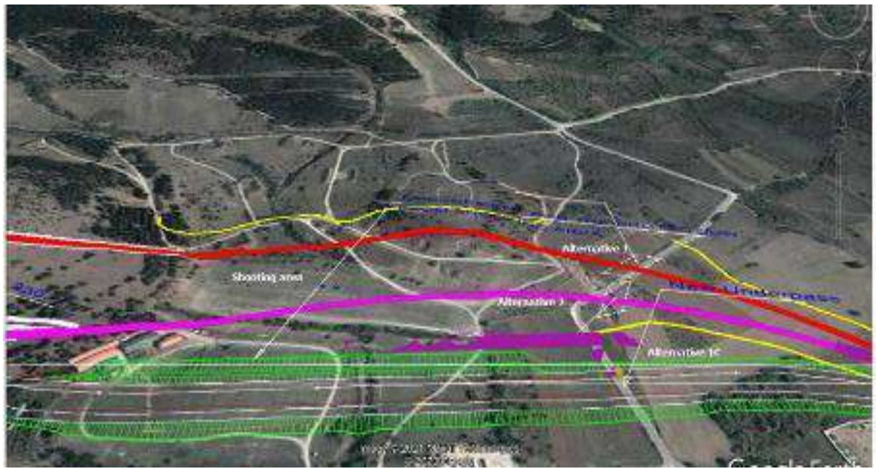


Figure 138 Surrounding near km: 9+000 to 10+000

At km 10+000 finish the alternative alignments for North Section and start alternatives for connection with the southern part of the alignments.

Section 2: Blace - Stenkovec South

Spatial characteristic from km: 10+000 to 12+500

Alternative	Inhabited places/Buildings	Terrain Characteristic	Surface water	Infrastructures
All	Passes near: Fuel station "Besa Petrol"; Sport airport Stenkovec (400-500 m) Military warehouse (400 to 500 m) Industrial facilities of the industrial zone Vizbegovo or intersect part of them.	Agricultural land	Intersect the Vrazanska River at km ~ 11+ 300	Intersect the national road A4, the road E65 and other access roads
All 1C	Presence of weekend houses or houses used by farmers.			River Lepenec (~500 m)

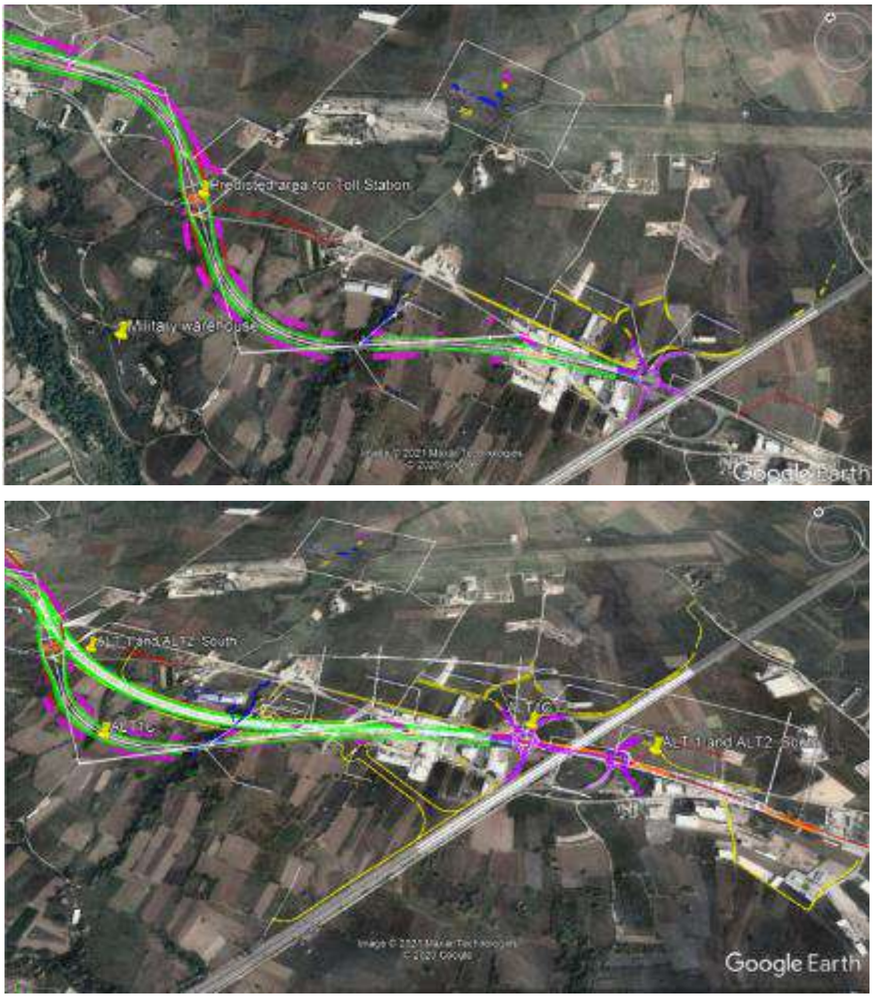


Figure 139 Project area around South alternatives

4.4 Environmental and social assessment of the alternatives

For the proposed alternatives in order to be selected the most preferable one from environmental and social aspects, the Multi criteria analyses (MCA) was prepared. The assessment in the MCA comprises the following steps:

- Definition of suitable evaluation criteria (main criteria; criteria; sub criteria),
- Definition of the aim of each sub criteria,
- Definition of suitable indicators for evaluation of the sub criteria,
- Evaluation of the level of achievement of the objective for each sub criterion of each alternative,
- Description of the reasons for the given evaluation,
- Sensitivity Analysis of Assessment Results,
- Results.

For which analysed media and aspect, the assessment is based on the methodology which includes: aim, indicator, methodology, classification scheme (level of achievement of objective). The scoring criteria that was used in the Preliminary Assessment of Environmental and Social Impacts of the Proposed Alternatives-MCA of the considered alternatives allow an approximate quantification of the significant impacts. The Consultants carried out an analysis, based on qualitative evaluation of parameters. Where possible, quantifiable values are included to give a better overview of the impacts that may affect the environment and community. The methodology and classification scheme on each identified environmental and social media and area, analyses of the alternatives and score of the MCA are presented in Annex 8.

Summary: In the Multi criteria analyses all proposed alternatives and the alternative BAU (Business as Usual) are analysed. On the base on the preliminary environmental and social assessment of the proposed alternatives, the preferable alternatives are:

- **Section North: Blace-Stenkovec:** For this part beside the Alternative BAU, the **Alternative 1 C North** has the lower score value, i.e. **this is the most preferable.**
- **Section South: Blace-Stenkovec:** For this part beside the Alternative BAU, the **Alternative 1 C South** has the lower score value, i.e. **this is the most preferable**.

BAU Alternatives: The alternatives BAU (Business as usual) for both sections of the project have the smaller or the same weight of the set criteria, compared to the new proposed alternatives, but it does not mean that this is an acceptable option.

Taking into consideration the objectives of the projects, particularly related to increasing the transport efficiency and improvement of traffic safety on Route 6a, as part of the extension of the TEN-T Core Network in the Western Balkans on Orient/East - Med Corridor, it could be concluded BAU alternatives are not acceptable.

Without implementation of the project will not be performed activities which may cause environmental and social impacts, but taking into consideration the current conditions of the existing roads and emission that are generated as a result of the increased traffic flow and traffic jam and emissions that will be additionally generated in the future as a result of predicted frequency of the traffic. On the bases of this, also should be concluded that BAU is not acceptable solution.

In the North Section the Alt 1C has smaller score compared to the other analysed alternatives only in the analysed topic *Resettlement and livelihood* that was crucial issue for the choice of this alternative. This mean that this alternative passes in an area with low level of farming activities conducted on the fields that will be acquired for the project purpose. Up to 5 business are expected to lose part of the property and no people are expected to be physically resettled. The area used for the need of Ministry of Defence and locations with adopted urban documentations are avoided.

In the South Section the Alt 1C for some criteria the Alt1 has different scores**,** the same or bigger score compared to other analysed alternatives, but estimation shown that this is a preferable option.

Based on above, it can be concluded that these alternatives for the North and South section are chosen as a preferred alternatives and the same are used as a basis for preparation of the Draft preliminary design for the motorway which is a subject of assessment in this ESIA.

5 ASSOSIATED AND POTENTIAL IMPACTS

5.1 Methodology for environmental and social impact assessment

The Environmental and Social Impact Assessment (ESIA) has been prepared on the basis of the EBRD policy (2019) and Macedonian national legislation. The assessment of the environmental and social impacts has been performed following the appropriate PRs from the EBRD policy. The Performance Requirement 1 establishes the importance of integrated assessment in order to identify the potential environmental and social impacts and issues which are associated with the project and Client's management of the environmental and social performance throughout the whole life of the project.

5.1.1 Identification and evaluation of environmental and social impact assessment criteria

The assessment will characterize potential future adverse impacts associated with the project, identify potential improvement opportunities, and recommend measures needed to avoid, or where avoidance is not possible, minimize and mitigate adverse impacts. The environmental and social impact assessment will be based on the description of the baseline data, applicable of the environmental and social law and regulatory data, project description and the requirements under the appropriate PRs. Due to the fact that this project is classified as Category A project, potential significant environmental and social impacts, typically site specific will be identified and addressed through mitigation measures. All of the needed structures which are needed for operation of the alignment has been included in the Preliminary Design and will be part of the Detailed Design.

The analysis of impacts considers all of the potential environmental changes (positive or negative) that can arise due to Project implementation. The level of change determines the significance of the impact, assessed in terms of spatial scale (scope), duration, probability and intensity. The impact assessment gives directions for the changes that are considered significant.

The Environmental and Social Impact Assessment (ESIA) summarizes the potential impacts and the effects that may arise during the implementation of the Project. For that purpose, a distinction between impacts and effects has been made, i.e.:

- Impacts are envisaged changes of the baseline environmental scenario that arise due to the implementation of the Project; and
- Effects are consequences of the environmental impacts, resources or receptors that have a certain significance or sensitivity.

Quantitative assessment of the **significance of the impacts** is carried out when possible, based on comparative analysis of certain criteria. In case when it is not possible to carry out a quantitative significance assessment, the level of uncertainty is reduced by using assessment based on previously defined qualitative criteria. This includes importance or sensitivity assessment of the receptors in relation to the intensity of the envisaged effect.

In case when no standards are available or sufficient information for the significance assessment of a certain impact is not provided, then the significance is assessed in a manner which considers the magnitude of the impact or the sensitivity of the affected resource or receptor.

The magnitude of the impact is determined based on a combination of many characteristics, such as its nature, scope, duration or frequency and probability of appearance.

Regarding the differences between resources/receptors (and, in many cases, between different types of impacts that affect a certain resource/receptor), the definitions for the characterisations of the magnitude are differently defined in accordance with the resources/receptors or depending on the type of impact. Whenever it is needed, they are defined based on professional judgement and expert's experience.

The experts with appropriate professional background have assessed all the topics included within the scope of the ESIA that are common for this type of projects. During the assessment of each environmental medium and area of interest, a framework was adopted that includes the following steps:

- Review of the existing data related to the baseline environmental and social condition (provided via existing data, surveys and research),
- Consultation with the stakeholders in order to identify the major problems and to provide additional information where necessary,
- Appropriateness assessment and limitations of the methodology for impact assessment,
- Identification of the resources and the receptors,
- Prediction of impacts,
- Identification of effects,
- Intensity assessment,
- Identification of the mitigation measures and
- Assessment of residual effects[55] or risks.

The Environmental and Social Impact Assessment identifies the environmental and social impacts that may arise due to the project implementation during different stages: pre-construction, construction, operation and decommission.

The **pre-construction** phase includes activities for preparation of project documentation and plans, as well as providing the necessary permits/contracts that will enable a proper project implementation.

The **construction phase** involves preparation/clearing of the project area and the performance of construction activities for the motorway and other required infrastructure. The construction phase is planned to starts at fourth quarter of 2022 and to last 36 months.

The **operation of the motorway** includes activities for motorway operation, its regular maintenance, repair and needed reconstruction. The impacts that may arise due to these activities are subject of analysis in the operational phase. The operation of the motorway is planned to start after fourth quarter of 2025.

The **decommission phase** includes activities that may cause environmental and social impacts similar to those in the construction phase due to nature of the activities. Because this project is going to has long life cycle, currently it is not possible to predict the manner of decommissioning, developments of the project of influence, therefore these impacts are not subject of analysis.

The assessment of the environmental impacts will be conducted following the criteria given in the table below. These characteristics generally describe the: nature, type, time of appearance, scope, probability, duration, size/magnitude, reversibility and sensitivity. To facilitate a structured description of impact magnitude, a qualitative scale was applied, ranking the magnitude of change as negligible, minor, moderate or major developed for each of the magnitude characteristics. Receptor sensitivity is the degree to which a particular receptor is more or less susceptible to a given impact. Receptor sensitivity takes into consideration receptor resilience and value. Receptor resilience describes the ability of the receptor to withstand adverse impacts. It takes into consideration not only activity-impact receptor pathways, but also environmental characteristics of the receptor that might make it more or less resilient to change.

Table 80 Environmental and social impacts assessment criteria

Criteria	Assessment	Description
Impact nature	Positive	Impact which is considered to help improve the baseline scenario or introduce positive change
	Negative	Impact which is considered to cause negative change or introduce undesired effects to the baseline scenario
Type	Direct	Impact which is a result of a direct interaction between the project activities and the resource/receptor
	Indirect	Impact which is a result of an activity which is not directly linked to the

[55] Residual effects are effects that remain even after the implementation of the mitigation measures

Criteria	Assessment	Description
		project, but occurs as a project consequence
Time of appearance	Immediate	The impact is evident immediately and follows the project activities
	Delayed	The impacts are evident after a certain time interval and often appear after the completion of project activities
Scope	Location	The impact effects may be felt within the frames or in the immediate vicinity of 100 m from the project area
	Local	The impact effects may be felt within the frames or in the immediate vicinity of 1 km from the project area
	Area	The impact effects may be felt in the radius of 1 km to 10 km from the project area
	Regional	The impact effects may be felt in the radius of 10 km to 50 km from the project area
	National	The impact effects may be felt in the radius of over 50 km from the project area
	Cross border	The impact effects may be felt across the border of a neighbouring country
Probability	Certain	The impact will definitely occur during normal working conditions
	Highly likely	It is highly likely that the impact will occur during normal working conditions
	Likely	There is a likelihood that an impact may occur during normal working conditions
	Unlikely	It is unlikely that an impact may occur, but sometimes it may occur during normal working conditions
Duration	Temporary	It is estimated that the impact will have a duration shorter than the construction duration and/or will have a temporary character
	Short-term	Impact estimated to last only during construction phase
	Medium-term	Impact estimated to last even after construction
	Long-term	The impact and its effects will continue and will last during the whole operational phase of the project
Size/Magnitude	Negligible negative	No changes of the analysed specific baseline scenario have been registered
	Negligible positive	Very small positive benefit on the analysed specific baseline scenario have been registered
	Minor negative	Minor negative changes of the analysed specific baseline scenario have been registered
	Minor positive	Minor positive changes and benefits of the analysed specific baseline scenario have been registered
	Moderate negative	A change in the analysed specific baseline scenario has been registered, resulting in non-fundamental temporary or permanent changes
	Moderate positive	Positive change in the analysed specific baseline scenario has been registered, resulting in fundamental temporary or permanent benefit
	Major negative	A fundamental change in the analysed specific baseline scenario resulting in a long-term or permanent change, therefore requiring significant interventions in order to be returned to the baseline scenario; surpassing national standards and borders
	Major positive	A fundamental positive change in the analysed specific baseline scenario resulting in a long-term or permanent benefit, surpassing national standards and borders
Reversibility	Reversible	The potential impact is temporary and reversible
	Irreversible	The potential impact is constant and irreversible
Sensitivity	Negligible	Very low importance and rarity, local scale
	Minor	Minor importance and rarity, local scale
	Moderate	Moderate importance and rarity, regional scale, limited potential for substitution

Criteria	Assessment	Description
	Major	Large importance and rarity, national scale, and limited potential for substitution

5.1.1.1 Significance of impacts

The significance of the impacts has been performed using a matrix based on the magnitude/size of the impact and the sensitivity of the impact on the identified receptors. In addition is presented the matrix for evaluation of the impact significance which will be used in the process of assessment.

For every environmental and social component, the assessment will identify and report the likely significant environmental or social impacts. The significance can be described as the product of the degree of change predicted (the magnitude of impact) and the value of the receptor that is subjected to that change (sensitivity of receptor). For each impact, the likely magnitude of the impact and the sensitivity of the receptor are defined, quantitatively to the extent possible[56].

Table 81 Matrix for evaluation of the impact significance

Magnitude								
Sensitivity		Adverse				Beneficial		
		Major	Moderate	Minor	Negligible	Minor	Moderate	Major
	Major	Major	Major	Moderate	Negligible	Moderate	Major	Major
	Moderate	Major	Moderate	Minor	Negligible	Minor	Moderate	Major
	Minor	Moderate	Minor	Negligible	Negligible	Negligible	Minor	Moderate
	Negligible	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Minor

Four categories of impact significance have been identified for assessment of impact's significance that will arise from construction and operation activities. The description of each category of impact significance is presented in the following table.

Table 82 Description of each category of impact significance

Negligible	The disturbance of the environment, species and habitats in the short-term is localized and reversible. Consequences to appear; however, the impact is very minor (mitigated and unmitigated) and is within the allowed standards or the receptors are characterized with low sensitivity or value.
Minor	The impact on the environment, species and habitats is short-term or medium-term. The ecosystem integrity will not be negatively affected in the long-term, however, there is a probability that the effects on specific species or receptors to be short-term or medium-term. The area/region will be able to recover through natural regeneration and renewal. The impact can be characterized with a broad scope, starting just above the border value of negligible impact, ending on a level which almost surpasses legal limits. If it is possible, mitigation measures should be undertaken.
Moderate	The impact on the environment, species and habitats (for example, during the project lifespan) can significantly and in long-term change the ecosystems and natural resources, on a local and regional level, and can impact sustainability. Returning them to the baseline scenario cannot happen without an intervention. The long-term impacts on environmental media and conditions may cause irreversible local and regional effects.
Major	Impact of major importance is one that exceeds permissible limits and standards, or is of major importance to highly valued/sensitive resources.

[56] Typically, the approach for the assessments associated with social impacts and climate change impacts on project (climate resilience) deviate from the methodology presented in the following sub-sections as significance cannot be uniformly assigned to the risks or impacts identified in these sections. Specific approaches and methodologies for these assessments are defined within these respective sections.

Criteria for assessing possible social impacts take slightly different approach from the criteria assessing environmental impacts. The Social Impact Assessment Approach (SIA) follows the standard procedure of the established international practice for assessing social impacts: a description of the current social environment (taken as a starting point), reviewing the changes in the social environment caused by the Project, determining the significance of those impacts and addressing appropriate mitigation measures.

The methodology for assessment of social impact depends on the significance of the potential social impacts. Determining the significance of impacts relies on a reasonable argument, a professional judgment, and consideration of the views and considerations of the respective organizations.

Significance is considered as a function of the magnitude of the impact and the likelihood of its occurrence. The significance matrix is described in the following table.

Table 83 Matrix for determination of significance of social impacts

SIGNIFICANCE=Magnitude x Likelihood		**LIKELIHOOD**			
		Unlikely	Likely	Highly Likely	Certain
MAGNITUDE	Negligible	Negligible	Negligible	Negligible	Negligible
	Minor	Negligible	Low	Low	Low
	Moderate	Low	Medium	Medium	Medium
	Large	Medium	Medium	High	High

Since all the social impacts considered in this study are not always negative, but have influences that are favourable to the local or wider community and to affected groups, the next colour coding is created to offer assistance in visual identification of the impacts that this project will cause.

Table 84 Colour of Significance for coding the social impacts

Negative significance	Positive significance
Negligible	Negligible
Low	Low
Medium	Medium
High	High

5.2 Environmental impact assessment

5.2.1 Resource efficiency

In the construction and operational phase of project implementation, different resources will be used such as energy, water and raw materials. Impact assessment of those resources in construction and operational phase is performed.

5.2.1.1 Construction phase

Energy use

For implementation of the project activities there is a need of electricity and fuel for possible preparation of construction materials on site, working of equipment, mechanisation and vehicles, heating and cooling of worker's offices and camps, etc. In this phase the manner and sources of energy supplying and needed quantity for consumption are not defined. The use of electricity for the project's needs will depend on availability and distances of public electricity grid. In the urbanised areas, there is a possibility the Contractor to provide electricity from the public electricity grid.

As a result of the scope of works and predicted needs of electricity, it is not expected that the project activities will be significant consumers of the electricity in the construction phase.

The great part of the equipment, mechanisation and vehicles will use fuel and it is expected significant consumption of fuel. Providing of fuel will be done from the existing petrol stations located near project area. The consumptions of fuel will depend on age, technical specifications and maintenance of the equipment, mechanization and vehicles, length of the traffic routes, implementation of GIIP etc.

Consumption of electricity and fuel may have direct and indirect impacts on the environment. The direct impacts can occur in cases of accidents and air emission from combustion machines, as well as failing the electricity system and temporary cut off from the network that may affect the community and economic zone which is supplying with energy provided from the same public networks. Indirect impact on the environment is related to the manner of producing the electricity and fuel (fossil fuel, renewable sources etc.), but the intensity of this impact could not be defined, due to the lack of data and statistics.

- ***Water use***

During the Construction phase it is required use of technical and sanitary water, in order fully implementation of proposed construction activities and implementation of GIIP. The sanitary water is required for everyday needs of the workers, i.e. for drinking, sanitation and hygiene needs. The technical water is required for technical purposes i.e. dust suppression, washing out of wheels of transport tracks, firefighting, possible preparation of construction materials, maintenance of already laid concrete, etc. At this phase of the Project development there is no information about the source, quantity and manner of the water supplying (sanitary and technical needs). It will be resolved at the construction phase, by the Contractor.

- ***Raw material use***

For the project implementation will be required different types of natural materials such as gravel, sand, soil, as well as concrete, asphalts etc. According to the data in the Preliminary Design, the type and quantities of some raw materials are known and presented in Chapter 2.4, but location for their supplying are not defined in this phase. In the surrounding of the project area there are few operational borrow pits which may be used for supplying of construction raw materials . It may contribute for reduction of time, cost and environmental impact caused as a result of transport activities for materials supplying. Some of the waste materials that will be generated during the construction activities will be reused (as a raw material), such as excavated soil.

Taking into consideration that the project requires a significant amount of natural materials, beside indirect impacts caused on the environment as a result of exploitation of natural materials, possible inefficient use or missing of reused of some waste fractions as a construction material, may cause additional adverse impacts on the environment and natural resources (direct and indirect). Providing of raw materials on construction site, prior their detail testing that will confirm their suitability, may cause adverse impacts on the environment because the same will be not usable for the project and may ends up as a waste.

5.2.1.2 Operational phase

- ***Energy use***

In operational phase energy will be used in form of electricity and fuel. Electricity will be used for lightning of the alignment, tunnels, operation of the tool station and for the electric vehicle charging station. The equipment, mechanization and vehicles for maintenance of the motorway will operate using a fuel/electricity.

Taking into consideration that for operation of the motorway will be used electricity, it could be expected that the consumption of the electricity on a national level will increase, but it is not expected that will cause significantly affect the public electricity networks or communities. Because in this phase the consumption of electricity is not defined, the intensity of this impact could not be defined. The environmental impacts, caused by connection of the alignment to the electricity grid will be limited due to the presence of electricity grid close to the alignment. The strategic goals of the country is to be in compliance with the Paris Agreement and the recommendations from the Green Deal. Due to that, the Republic of North Macedonia at the moment is under preparation of new legislations in terms of use of energy efficient fuels for vehicles and mechanization and increasing the fees of using non ecological fuel. This means that the impacts, generated as a result of combustion of fuel will be reduced and with low emissions on the environment. Consumption of fuel for maintenance of the motorway it is not expect to cause significant impact.

- ***Water use***

At the operational phase of the project, there is a need of providing technical and sanitary water. Namely, sanitary water will be required for workers at the tool station and hygiene needs, while technical water will be required for firefighting and maintenance of green areas. There is no information about the sources, quantities and manner of water supplying, but it is not expect that the water supplying will cause significant impact natural water resources or built water-supplying systems.

- ***Raw materials***

In the operational phase of the motorway, raw materials will be needed for regular and incidental maintenance of the motorway and its structures. At this stage the needed quantities of the raw materials for maintenance could not be defined. The type, quantity and the source of these materials are unknown and will depend on the prescribed dynamic for maintenance of the motorway, but it is not expected that the use of material will cause significant impact on the environment.

5.2.1.3 Assessment of impacts

Resourse efficiency											
Impact source	**Impact nature**	**Time of appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Magnitude**	**Sensitivity**	**Significance**	**Mitigation measures**
Construction phase											
Energy use	Negative	Immediate	Direct/indirect	Location/local area, regional, national	Short term	Certain	Reversible	Minor	Negligible	Negligible	No
Water use	Negative	Immediate	Direct/indirect	Location/local	Short term	Certain	Reversible	Minor	Negligible	Negligible	No
Raw material use	Negative	Immediate	Direct/indirect	Local/regional	Short term	Certain	irreversible	Minor	Negligible	Negligible	No
Operational phase											
Increased energy use for road and tunnels lightning purposes	Negative	Immediate	Direct/indirect	Location/local	Long term	Certain	Reversible	Minor	Moderate	Minor	Yes
Water use	Negative	Immediate	Direct/indirect	Location/local	Long term	Certain	Reversible	Negligible	Negligible	Negligible	No
Raw material use	Negative	Immediate	Direct/indirect	Local/regional	Short term	Likely	Irreversible	Negligible	Negligible	Negligible	No

5.2.2 Geology and geomorphology

The alignment passes mostly through the Lepenec valley which tectonically belongs to the Vardar Zone. The project area is characterized by variable lithology, from old Precambrian to Paleozoic rocks to the youngest alluvial deposits. Also, the rocks are with very different hardness and resistance to erosion. The cause of such variability is the position of the project area in the marginal part of the Vardar zone near the border with West Macedonian zone and Pelagonian Zone, as geotectonic units. That position is also responsible for the numerous cracks-faults with Dinaric (NW-SE) direction and opposite (NE-SW) direction.

In terms of geomorphology, the project area extends through the two geomorphological landscapes: the narrow Lepenec gorge north of the v. Orman, and the alluvial plain of the Skopje Valley bottom on south. Both are without significant occurrences of geoheritage, except the Banjanska Reka Gorge (Vrazanska River), which is about 4-5 km away to the east, as well as deepest parts of the Lepenec Gorge.

There are no sites with high geomorphological or scenic value nor protected or recognised for protection geo-heritage sites in the project influence area.

5.2.2.1 Construction phase

The expected impacts of the motorway on the geological structures in construction phase would be generally in the form of degradation of certain geological formations (mostly the Quaternary deposits and Neogene sediments) along the project area. During the construction of the motorway, the impact will be generally limited to the motorway corridor, disposal area site, and especially on the sites with larger construction activities (tunnels and bridges). However, attention should be paid to the soil and rock's substrate due to their susceptibility to erosion and hillslope processes almost all along the alignment and on stepper slope on the embankments. Temporary occupation and utilization of land for the accommodation of construction-related facilities (e.g. contractor’s yard, temporary access, transport or diversion roads) and for the temporary storage of construction materials, construction debris, top soil, cut to spoil or cut to fill; etc. will have negative impact on the geology in the project area through the accelerated erosion (rills, gullies), deposition (accumulation of sediments), activation of hillslope precesses, newly exposed rock weathering etc.

In terms of engineering-geological phenomena and processes, potential impacts to be addressed are:

- Activation of landslides and rock-falls, during the construction of the motorway and accessible roads,
- Slide and fall of excavated material on the cuts and embankments on the motorway, on the access roads and on disposal site, and
- Formation of new rills and gullies on the slopes of the cuts and embankments on the motorway, on the access roads and on disposal area.

According to the FR+AHP model used in the study (Milevski et al., 2019) the highest risk of potential landslides is along the steep terrain (>10˚) composed of serpentinite and gneiss between the village of Blace and Stenkovec hill (red color in **Figure 45**). Aside of the relatively solid rocks (amphibolites, gneiss) along the alignment, the steep slopes in the Lepenec gorge is suitable for smaller rockfalls especially if the embankments are not protected well. According to the created model, the most susceptible terrain is near 3+000, then between km 3+600 to km 5+300 and around km 7+800.

In terms of geomorphology and geo-heritage the potential impacts are related mainly, but not limited to the local changes of the slopes, intensity of erosion and deposition.

5.2.2.2 Operational phase

Regarding the operational phase, the impact of the motorway on the geological structures and the engineering-geological phenomena and processes are not expected. In the operational phase of the motorway, impacts on the geomorphological structures and geoheritage will be similar in scope as in the construction phase, because of the irreversible changes (degradation) of most of the landscape (relief) components. They will be especially visible in the Lepenec Gorge in form of new landforms: rockfalls, landslides, rills, disposal area – hill etc.

5.2.2.3 Assessment of impacts

Geology and geomorphology											
Impact source	**Impact nature**	**Time of appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Magnitude**	**Sensitivity**	**Significance**	**Mitigation measures**
Constructionphase											
Activation of landslides and rock-falls, during the construction of the motorway and accessible roads,	Negative	Immediate	Direct/Indirect	Local	Short term	Likely	Reversible	Moderate	Minor	Minor	Yes
Slide and fall of excavated material on the cuts and embankments on the motorway, on the access roads and on disposal site	Negative	Immediate/ Delayed	Direct/Indirect	Local	Short term	Likely	Reversible	Moderate	Minor	Minor	Yes
Local changes of the slopes, intensity of erosion and deposition	Negative	Immediate/ Delayed	Direct/Indirect	Local	Short to long term	Likely	Irreversible	Moderate	Moderate	Moderate	Yes
Operational phase											
Local changes of the slopes, intensity of erosion and deposition	Negative	Immediate/ Delayed	Direct/Indirect	Local	Long term	Likely	Irreversible	Minor	Moderate	Minor	Yes

5.2.3 Soil

5.2.3.1 Construction phase

As a result of the prescribed project activities in construction phase, soil degradation is expected as a result of:

- Removal of top soil;
- Accelerated erosion process and occurrence of excess sedimentation;
- Soil contamination;
- Soil compaction.

During the construction activities, around 110,000 m^3 of top soil will be excavated, transported to a temporary storage area, stored and re-applied. In the whole process of construction of the motorway, the soils will be strongly impacted along the entire alignment. Taken into consideration the whole project area, its terrain and already set up infrastructures, erosion is possible particularly on the steeper sections of cuttings and embankments. Also, erosion is expected if the Contractor is not applying good construction practice, in other words, the excavation is not properly done, the slopes are not adequately stabilized, too much vegetation has been removed etc. Erosion risks will remain through the operational life of the motorway if the soil is left unprotected and/or devoid of vegetation. There is a risk of landslides, especially in the incised areas.

✓ Removal of top soil

Based on the prescribed construction activities in the Preliminary Design, excavation of top soil is planned almost on the whole length of the motorway alignment. The most vulnerable locations along the whole alignment are these which have well developed vegetation, with soils having reached the climax stage of a certain degree of evolution. Such soils are of significance, because they are part of a wider ecosystem, whose destruction would destroy the entire ecosystem and ecosystem functions. This is especially presented along the part in Skopje Plain (near Stenkovec) where deep soils are present. The soils along this part of the alignment are already in bigger parts degraded by human factor.

✓ Soil erosion

The foreseen activities in the construction phase can cause soil erosion, which will pose a threat to soil resources. Soil erosion can be caused by:

- removal and disposal of vegetation;
- execution of earthworks along the entire alignment (excavations and embankments);
- construction of access roads to the construction site;
- temporary storing the excavated topsoil and waste;
- land use (borrow pits and disposal area).

Soil erosion is a complex process and is a result of the cumulative impact of all factors. Parameters that determine the erosion process of artificially created slopes are: angle of inclination (slope), slope length along the incline, the type of the surface of the slope and the amount of water flowing to the surface of the slope.

Removal and disposal of vegetation in the project area will cause erosion. Erosion can be extended around if no appropriate measures are taken to stabilize the slopes (the excavation slopes are stabilized, if possible, while the biotechnical stabilization of the inclines is obligatory for the embankment slopes). Soil erosion may also occur on sites that will be used as borrow pits and temporary dumping grounds for soil, materials, etc.

The possibility of erosion, as well as the type and the intensity of erosion, will depend on other factors. In the case of postings (if they are close to the project area), the erodibility will be similar to the alignment as a result of the similar pedological and geological composition of the soil.

Soil erosion can cause indirect impact on the water, i.e. affect the water infiltration (as a result of soil sealing), cause chemical pollution of the water (if it is contaminated eroded sediment), mechanical pollution of the waters with the eroded deposit etc.

- ✓ Soil contamination

Contamination of the soil with dangerous substances and contaminated inert material, during construction activities may occur in case of unwanted leakages or inadequate storage at locations where the construction activities are carried out, at the locations where raw materials, auxiliary materials and energy sources are stored (fuel, oil and fats, chemical substances, etc.), as well as on the locations where temporary waste of different waste fractions will be stored. In other words, soil contamination will occur during construction works due to leaks and accidental spills of hydrocarbons from construction vehicles and machinery, as well as with the use of lubricants, paints, solvents, resins, or acids. Soil contamination can occur in the case of non-compliance with appropriate procedures during manipulation with various materials used in construction (paint, solvents, fuel, lubricants etc.), which may result in their infiltration into the ground and underground. More precisely, uncontrolled discharge/accidental spillage of hydrocarbons (oils, fuel, lubricants, solvents, dyes etc.) at the construction site, along construction and haul routes may impair soil quality. Also, infiltration of leachate from uncontrolled deposits of waste and construction materials etc. may impact on the soil quality. As a result of the transportation activities, loading and unloading of raw materials airborne pollution is presented which may pollute the soil by depositing of the dust particles on the soil surface. Also, soil contamination may occur as a result of sedimentation from the air.

Contamination of the soil can also occur when mixing fertile and quality soils with contaminated soil during activities such as: excavation of the topsoil, its transport and storage. Also, contamination may occur by spreading contaminated soil material during its manipulation. High risk of this type of contamination is on the section of the alignment in the Skopje Basin (Skopje Plain or Stenkovec Plain).

In addition, contaminated soils pose a serious threat to other natural resources, primarily ground and surface waters in the Lepenec River catchment. During the construction activities there is a serious possibility of erosion of the soil, where contaminated sediment can come to the surface water bodies and pollute them.

- ✓ Soil compaction

Compaction of the surface layer is another form of degradation of soils that leads to the loss of physical and mechanical properties of the soil that makes it unfit for reuse. In the construction phase, there is a possibility of compaction of the soil as a result of the following activities:

- cleaning and preparation of the location for the construction of the alignment and associated facilities and infrastructure;
- excavation of the topsoil and part of the subsoil layer, its transport and storage, and re-application;
- movement and presence of workers, use of heavy machinery;
- transport activities;
- temporary storage of construction material and waste.

In partial compaction of soils, their geo-mechanical convenience for reuse and application is temporarily lost. But if the soil is heavily loaded, there is a permanent loss of its functions and the process is irreversible.

5.2.3.2 Operational phase

In the operational phase, as a result of the operation and maintenance of the motorway, soil erosion and soil contamination is expected.

- ✓ Soil erosion

In the operational phase soil erosion may occur if the Operator not maintain the vegetation and the anti-erosion structures along the alignment on a proper manner, as it is described in this ESIA. Too much removal of the vegetation on both sides of the alignment and near the infrastructure may pose risk of soil erosion.

Also, soil erosion may occur in cases when the Contractor is not performed the anti-erosion measures as prescribed in the Deatil Design and in cases when the prescribed mitigation measures are insufficient which will result with residual impacts as well.

Improper maintenance of the culverts along the alignment may cause soil erosion. The culverts are filling with deposits when the storm water is flowing through them. In cases of heavy rains and improper cleaning of the culverts, the sediment material can cause floating and eroding of the formation width.

- ✓ Soil contamination

In this phase disruption and soil erosion may be present, as well as direct and indirect pollution of soils and aquifers through vertical infiltration of fuel, oil or chemicals. Soil erosion may occur if erosion measures for the slopes are not applied or if the structures are not properly maintained and monitored. Soil contamination can occur as a result of depositing of sediment from the air (deposited sediments may occur a distance of 10 meters from the road), due to the fast sedimentation of substances heavier than air. Contaminated soils can affect watercourses (surface and groundwater) and fertile land in the project environment.

5.2.3.3 Assessment of impacts

Soil											
Impact source	**Impact nature**	**Time of appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Magnitude**	**Sensitivity**	**Significance**	**Mitigation measures**
Construction phase											
Soil erosion	Negative	Immediate/ Delayed	Direct/Indirect	Local	Short to medium term	Likely	Reversible	Moderate	Minor	Minor	Yes
Soil contamination	Negative	Immediate/ Delayed	Direct/Indirect	Local	Short term	Likely	Reversible	Moderate	Minor	Minor	Yes
Soil compaction	Negative	Immediate/ Delayed	Direct/Indirect	Local	Medium-term	Likely	Reversible	Moderate	Minor	Minor	Yes
Operational phase											
Soil erosion	Negative	Immediate/ Delayed	Direct/Indirect	Local	Medium-term	Likely	Reversible	Minor	Negligible	Negligible	No
Soil contamination	Negative	Immediate/ Delayed	Direct/Indirect	Local	Medium-term	Likely	Reversible	Minor	Moderate	Minor	Yes

5.2.4 Hydrology, surface and ground water

The area, where the road alignment passes has different hydro lithological characteristics (alternations of permeable and impermeable phases) and various cumulative thicknesses at several sites. Consequently, the formations that participate in a geological unit, have a big hydraulic anisotropy and important variation of permeability is expected both in horizontal and vertical direction.. In the project influence area is the watershed of river Lepenec, to which belongs r. Lepenec and few intermittent streams, of which river Vrazanska is the biggest one. All the intermittent streams (including River Vrazanska) are dry during the all seasons of the year, but during the high precipitation there are possibility of occurrence of water flow which can wash away any pollution and take it to the river Lepenec. There are not identified fresh water wells, in the project influence area, or water captures used for water supply.

Existing water supply wells for town of Skopje, location-Lepenec Nerezi, will not be disturbed by the project activities in all the phases of its development, due to its distance from the project influence area, but implementation of strict measures to its protection are obligatory in accordance with the legal requirements and GIIP.

5.2.4.1 Construction phase

The foreseen project activities for construction of the motorway with all necessary facilities and presence of workers may cause adverse impacts of the surface waters (river Lepenec and intermittent streams) and ground water in the project influence area.

The main expected impacts during construction may be caused by: preparation of the construction site which includes removal of vegetation, location of the worker’s camp, deep excavation and construction of the motorway and its structures, storage and handling of excavated soil, materials and waste, incidental leaking of chemicals, fuels, lubricants, possible occurrence of soil erosion which can generate sediments that may affect physical characteristics of the surface water, presence of the machinery (including irregular maintenance), washing up the equipment and mechanisation near/within water body, possible discharging of sanitary, technical and storm water, etc.

The risk for pollution of surface water, during construction, is possible along the whole motorway alignment, and particularly during occurring the storm water in spring and autumn, on the locations where the intermittent streams are intersected by the motorway i.e. ~ km 2+200; km 3+600; ~ km 3+900; km ~4+300, km ~ 4+ 700; km 6+000; km 6+400; km 7+600; km ~ 8+200; ~ 8+700; ~ km 9+200. Performance of construction activities in the south part of the alignment may cause direct impact on Vrazanska River, particularly at km 11+300 where the alignment intersects the river and construction of new bridge is predicted. During the construction of the bridge, as direct impact a water accumulation may occur if the bridge's pillars are built in the riverbed. The indirect effect of construction of the bridge will be accumulation of sediments and larger parts upstream of the wings of the bridges, which may cause a change in the flow and the way of deposition. The intensity of the impact will depend on number and size of the wings of the bridges located inside the waterbed. Construction of the bridge on Vrazanska River may cause changes in river flow (if the construction activity is performed when the river has flow), changes in the morphology of river bed and banks, as well as flooding of surrounding land. Construction activity at Vrazanska River which is tributary of river Lepenec may affect the water of Lepenec.

In addition, the intermittent stream Morav dol, at km 3+900, may be affected as a result of transport and disposal of surplus excavated soil materials on the proposed disposal area.

Although the motorway alignment and Lepenec River are not intersected, there is a possibility the Lepenec River to be affected by the construction activity trough transfer of pollution from the intermittent streams on the location when the river passes very close to the alignment.

At this phase of the project development, the hydrogeological investigation are not performed. Only geotechnical investigations has been conducted (in 2021) and the level of groundwater at some bareholes has been registered and presented in the Chapter 3.3.6.

Regarding the hydro-geological phenomena it is predicted that there will be an impact on shallow groundwater resources due to a combination of the lowering of the water table and subsurface infrastructure acting as a barrier to or altering groundwater flow. However shallow groundwater deposits in areas out with the permanent physical footprint of the motorway structures will be re-established and maintained through surface water runoff and infiltration. Shallow ground waters are finding in clastic (alluvial, colluvial and riverine) sediments and weathered rocks, while in amphibolitic schists, gneiss and clay they were much deeper or totally absent. Another thing is that during the seasons the ground water level is very changeable. Thus, the drilling shows that during the spring and early summer (March-June), ground waters are shallow, contrary to late summer (August). As a result of this, the following chainages are identified with shallow groundwater level (from 5 m up to 10 m depth): km 2+238 (Bridge left), km 2+240 (Bridge right), km 2+288 (Bridge left), km 3+280 (Bridge right), km 4+320 (embankment right), km 4+680 (underpass), km 9+700 (underpass), km 10+280 (underpass), km 10+510,8 (underpass) and km 11+840 (underpass).

Construction activity may cause localized change of the groundwater level and drainage direction around the tunnels, bridge pillars, embankments etc. Inappropriate construction works which include, deep excavation, spillage, mining, etc. may cause disturbance of the ground water table and to affect the existing wells in the industrial zone where almost all of the facilities have their own wells for water supply. At the chainage km 3+900 where the disposal area is proposed to be located, no evidence of ground water has been registered with the performed depth of 15 m.

5.2.4.2 Operational phase

Surface water emission sources in the operational phase are traffic activities and emissions generated as a result of traffic, accidents, motorway maintenance (regular and in winter period), structures on a tool station, irregular maintenance of the drainage system on the motorway, etc.

One of the main risks for the occurrence of negative impacts on the hydrology, surface waters as well as on the stability of the future motorway may be caused in a case of inadequate dimensioning of the bridges (the stability of the structure to sustain high waters and floods) and drainage systems in accordance with the hydrological characteristics of the project area of influence, probability of occurrence of large waters and floods, etc.

Constructed motorway will contribute to increased surface runoff. Improper dimensioning and maintenance of the drainage of the motorway for large quantities of storm water can cause soil erosion or flooding, as well as risks to traffic safety. Inadequate drainage of the proposed storage area for surplus excavated materials may disrupt the stability of the storage area and to cause adverse impact on storm water.

Storm water may be contaminated with rinsing deposited sediment from the air, oil, grease, suspended materials and other pollutants released from vehicles. The different types of loads that will be transported can be a source of water pollution due to the potential leakage or accidental spillage of hazardous substances (e.g. fuels, solvents, acids, bases, etc.). Possible adverse impacts may be expected in case of some accidents on the motorway on locations close to surface water bodies (intermittent streams).

Discharging of storm water from drainage systems without treatment may cause water and soil pollution (if not treated in oil separator), increasing the muddiness or impairment of the quality and flow of the recipients as well as long-term change of the local groundwater drainage.

During the operation of the motorway, plants and weeds along the alignment should be cleaned for safety reasons and space maintenance. This is usually done using mechanical and chemical methods (using different herbicides). The most popular is the chemical treatment, which is also the most efficient (more space can be treated in a shorter time), but it is a potential source of water pollution, both surface and groundwater. The use of different types of herbicides can cause adverse effects on surface and storm waters.

5.2.4.3 Assessment of impacts

Surface and ground water											
Impact source	**Impact nature**	**Time of appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Magnitude**	**Sensitivity**	**Significance**	**Mitigation measures**
Construction phase											
Surface water											
Impacts on quantity and quality of surface waters as a result of: Removal of vegetation, deep excavation, construction of the motorway and its structures, storage and handling of excavated soil, materials and waste, incidental leaking of chemicals, fuels, lubricants, soil erosion, presence of the machinery, washing up the equipment and mechanisation near/within water body, possible discharging of sanitary, technical and storm water	Negative	Immediate/ Delayed	Direct/Indirect	Local	Short term	Likely	Reversible	Moderate	Moderate	Moderate	Yes
Ground water											
Impacts on quantity and quality of ground waters as a result of: Deep excavation, construction of the motorway and its structures, storage and handling of excavated soil, materials and waste, incidental leaking of chemicals, fuels, lubricants, soil erosion, presence of the machinery	Negative	Immediate/ Delayed	Direct/Indirect	Local	Short term	Likely	Reversible	Moderate	Moderate	Moderate	Yes
Operational phase											
Surface water											
Impacts on quantity and quality of surface waters as a result of: Traffic, accidents, motorway maintenance (regular and in winter period), structures on a	Negative	Immediate/ Delayed	Direct/Indirect	Location	Long term	Likely	Reversible/	Moderate	Moderate	Moderate	Yes

tool station, irregular maintenance of the drainage system on the motorway											
Ground Water											
Impacts on quantity and quality of ground waters as a result of: Traffic, accidents, motorway maintenance (regular and in winter period), structures on a tool station, irregular maintenance of the drainage system on the motorway	Negative	Immediate/ Delayed	Direct/Indirect	Location	Long term	Likely	Reversible	Moderate	Minor	Minor	Yes

5.2.5 Air Quality

The proposed project for construction of the motorway may cause impact on the existing air quality environment in the area during the construction and operational phase.

The alignment passes close (in parallel) to the existing motorway Skopje-Border with Kosovo, on the on the northwest side of City of Skopje. The air quality in the project area depends on the air quality of the town of Skopje, activities in the existing economic zone in the Municipality Chucer Sandevo (which is closed to the road alignment), existing motorway and the influence by the neighbouring Country-Kosovo and ongoing economic activities close to the border.

In case of a large timespan (more than one year) between preparation of the ESIA study and start of construction works, up-to-date information on air quality in the project areas will be needed to determine baseline conditions

5.2.5.1 Construction phase

The construction phase of the proposed project includes activities such as excavation, blasting, construction of alignment with all associate structures, storage and transport activity of materials and waste etc. All these activities are associated with emissions of fugitive dust from material handling and movement of vehicles and exhaust gasses from vehicles and construction machines. The outcome of the assessment of potential effects from fugitive dust and exhaust emissions is a prediction of the risk of impacts during the construction phase. The risk will depend on the scale of earthworks, construction and paving activities, and the number of construction vehicles to be used.

The construction activities will generate dust and combustion gases from fuel powered machinery, asphalt plants and vehicles (PM_{10}, $PM_{2,5}$, CO_2, NOx, PAH[57], SO_2).

Dust is usually generated from earth movements, wheels of trucks and machinery travelling on unpaved roads, loading, unloading and transport of soil, aggregate, concrete, asphalt, wind erosion from exposed surfaces, and crushing plants.

The construction camps, if set up for the workers, could be additional source of air emissions, particularly in winter, heating systems or camp fires for heating with wood.

The area on which air quality impacts are expected is usually not large. It extends some 100 to 150 m on each side of the motorway axis. It may be more in case of high concentration of equipment working simultaneously.

It is anticipated that the associated construction operations will extend over a period of 24 – 30 months.

According to the project area and the report on material and earthworks volumes, particulate air emissions have been calculated based on a combination of the emission factors published in the emission Estimation techniques for mining (version 3.1 of January 2012)[58] and cement (version 2.1 of April 2008)[59].

The following assumptions were made in order to estimate emissions of TSP and PM_{10}:

- Night time construction activities will not be allowed. The operations will be carried out 16 hours a day, 6 days per week.
- 30 m^3 dumpers will be used for transportation and unload the materials.
- The hauling time for dumpers is 4 hours and the hauling distance is 2.7 km.

Using these data, the particulate emissions have been calculated for all the construction sites of the motorway. Due to different site lengths and type of activities, the overall emissions and emission rates will differ. A summary of the calculated air particulate emissions from earthworks and materials handling is given in the **Table 85**.

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57 Polycyclic aromatic hydrocarbons
58 www.npi.gov.au/system/files/resources/7e04163a-12ba-6864-d19a-fp7d960aae58/files/mining.pdf
59 www.npi.gov.au/system/files/resources/6c9f88a4-55a7-f7f4-7528-44621b78f612/files/cement.pdf

Table 85 Overall particulate emissions from earthworks and materials handling during the motorway construction

	TSP			PM10		
	min	max	avg	min	max	avg
kg/day	0.140	21.800	18.000	0.064	9.909	8.182
kg/km	0.016	8.898	0.720	0.007	4.044	0.327
g/s	0.005	0.380	0.250	0.002	0.173	0.114

Combustion emissions from earthworks and material transportation have been estimated by applying a combination of emission factors developed by USFEMA based on USEPA 2005 Emission factors[60] and EMEP/EEA, 2007. These factors are shown in the **Table 86**.

Time of use of the equipment has been assessed based on the BoQ given in the Material report spreadsheet and the calculated combustion emissions from equipment operation.

Table 86 Combustion emission factors for construction equipment

Type of Construction Equipment	Emission Factors						
	VOC	CO	NOx	PM-10	PM-2.5	SO2	CO2
	g/hp-h						
Water Truck	0.44	2.07	5.49	0.41	0.4	0.74	536
Diesel Road Compactors	0.37	1.48	4.9	0.34	0.33	0.74	536.2
Diesel Dump Truck	0.44	2.07	5.49	0.41	0.4	0.74	536
Diesel Excavator	0.34	1.3	4.6	0.32	0.31	0.74	536.3
Diesel Cement mixer	0.61	2.32	7.28	0.48	0.47	0.73	529.7
Diesel Bull Dozers	0.36	1.38	4.76	0.33	0.32	0.74	536.3
Diesel Front End Loaders	0.38	1.55	5	0.35	0.34	0.74	536.2
Diesel Fork Lifts	1.98	7.76	8.56	1.39	1.35	0.95	690.8
Diesel Generator Set	1.21	3.76	5.97	0.73	0.71	0.81	587.3

Table 87 Emissions from internal combustion machines throughout the construction phase

Type of Construction Equipment	Exhaust emissions (kg)						
	VOC	CO	NOx	PM-10	PM-2.5	SO_2	CO_2
Water Truck	28.512	134.136	355.752	26.568	25.92	47.952	34732.8
Diesel Road Compactors	24.05	96.2	318.5	22.1	21.45	48.1	34853
Diesel Dump Truck	3960	18630	49410	3690	3600	6660	4824000
Diesel Excavator	408	1560	5520	384	372	888	643560
Diesel Cement Mixers	263.52	1002.24	3144.96	207.36	203.04	315.36	228830.4
Diesel Bull Dozers	259.2	993.6	3427.2	237.6	230.4	532.8	386136
Diesel Front End Loaders	61.56	251.1	810	56.7	55.08	119.88	86864.4
Diesel Fork Lifts	133.65	523.8	577.8	93.825	91.125	64.125	46629
Total	**5138.492**	**23191.08**	**63564.21**	**4718.153**	**4599.015**	**8676.217**	**6285606**

60 www.fema.gov/media-library-data/20130726-1711-25045-6430/appendix_d.pdf

The proposed project area is almost entirely away from human settlements. There are very few weekend houses, commercial and auxiliary buildings along the project site as shown in **Table 88.**

Table 88 Potential sensitive receptors along the proposed motorway branch

Parcel No.	Easting (NCS)	Northing (NCS)	Distance from end of nearest lane (m)	Remark
3403	7527656	4663040	14	Not entered in the national register
224/2	7527680	4662886	44	54 m^2 (G+1)
272/2	7528083	4662360	25	Not registered
223	7527662	4662783	124	
221	7527721	4662747	98	
224/4	7527667	4662814	102	Not registered
270/2	7528083	4662382	23	Not registered
3080	7528351	4661741	80	
3475	7529171	4659701	65	Commercial building
1281	7529237	4659704	34	Warehouse
3196/1	7531316	4657433	168	Warehouse
3196/2	7531367	4657391	151	Warehouse

None of the above mentioned receptors is considered a highly sensitive one. Therefore, the sensitivity of receptors can be considered minor.

Since the area of the proposed project is about 2 km from the border with Kosovo and the air impact of particulate emissions is limited to some 150 m from the project site, no cross border impact is expected.

Having in mind the extent of the project site, the time required to complete the construction of the motorway and estimated air emissions during the construction phase, the magnitude of the air quality impact of the proposed project in its construction phase is considered moderate.

5.2.5.2 Operational phase

The operation of the proposed motorway may have an effect of decreasing the number of vehicles using the existing road. On the other hand, it will result in air emissions of its own. Therefore, as the worst scenario, only the impact of the new motorway traffic will be assessed. The assessment of potential air quality effects due to the operation of the proposed project predicts the significance of the impact at existing receptors as a result of air emissions from future traffic on the motorway.

The air emission rates are determined by factors such as number and kind of vehicles, power of the vehicles, traveling velocity, type of fuel and conditions of the road.

AADT (Annual Average Daily Traffic) has been modeled for Hani I Elezit – Stenkovec motorway by Mott McDonald IPF Consortium"[61] based on data collected from 2005 onwards (**Table 89**). 2014 was taken as a base year.

Table 89 Modeled annual average daily traffic (AADT) for the period 2014 - 2045 [62]

Year	Vehicles/day	Passenger cars	Light cargo vehicles	Heavy cargo vehicles	Busses
2014	4053	3502	264	256	31
2020	7066	6036	638	364	28
2030	14655	12020	1898	680	57
2040	25164	21643	2440	977	104
2045	32510	27637	3361	1379	133

[61]Traffic Study Report – WB9-MKD-TRA-01 Infrastructure Projects Facility for Western Balkans"
[62] Traffic Study Report – WB9-MKD-TRA-01 Infrastructure Projects Facility for Western Balkans

Traffic is not evenly spread over time and significant differences may appear in different months, days and hours in the day.

AADT does not deal with fluctuations with time. Data from automatic counters, however, reveal significant differences in traffic flow by months in 2019, 2020 and 2021. Higher frequency is detected in autumn and winter. Traffic differences between weekdays and weekends are very small except in January and February, presented in table below.

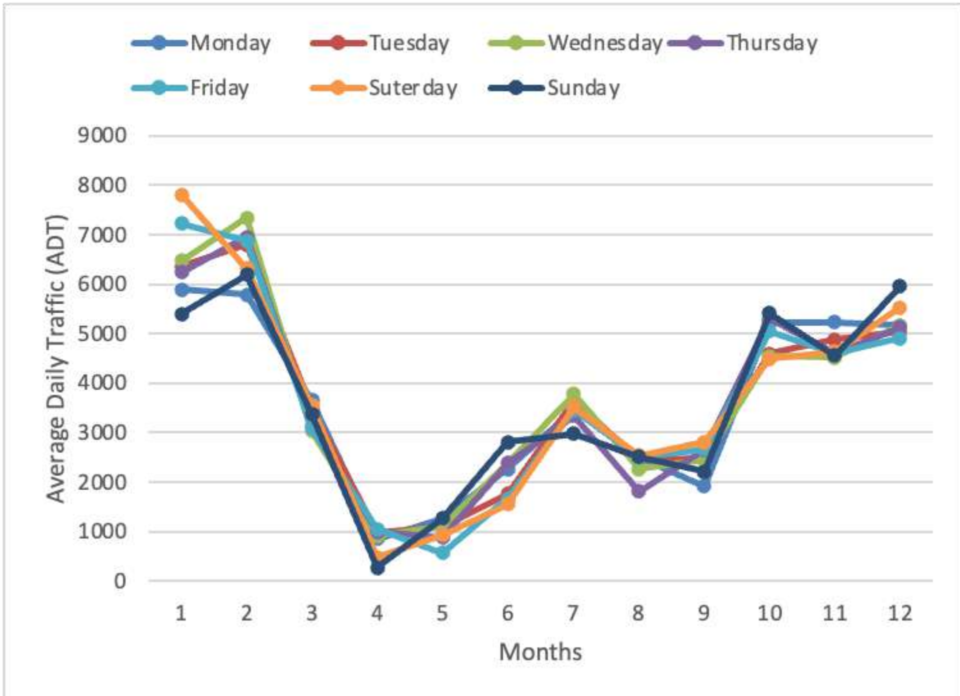

Figure 140 Traffic flow distribution by months and days of the week in 2019 – 2021[63]

The principle factors affecting traffic air emissions and their impact on air quality are:

- Fuel consumption due to type of vehicles, their age and maintenance;
- Vehicle speed and its variations (acceleration/deceleration);
- Use of brakes;
- Air movement and dispersion conditions;
- Tunnels management.

Table 90, shows the emission factors for different kinds of vehicles in 2030, 2040 and 2045 based on the German factors published in the Handbook of Emission Factors for Road Transport (HBEFA)[64] with an addition of PM10 and PM2.5 due to brake and tire wear taken from the UK National Atmospheric Emissions Inventory (NAEI)[65].

Table 90 Air emission factors for paved road traffic (Source: HBEFA and NAEI)[66]

	Vehicle	Emission factors (g/veh.km)		
		2030	2040	2045
Buss	CO	0.326	0.223	0.212
	HC	0.030	0.021	0.020
	NOx	1.565	1.299	1.276

[63] Source: Public Enterprise for State Roads
[64] https://www.hbefa.net/e/index.html
[65] https://naei.beis.gov.uk/data/ef-all
[66] HBEFA and NAEI

	PM10	0.022	0.018	0.015
	PM2.5	0.018	0.015	0.012
HT	CO	0.229	0.199	0.194
	HC	0.022	0.020	0.020
	NOx	1.144	1.130	1.120
	PM10	0.019	0.018	0.018
	PM2.5	0.016	0.015	0.015
LT	CO	0.395	0.383	0.378
	HC	0.030	0.030	0.029
	NOx	0.247	0.126	0.110
	PM10	0.027	0.027	0.027
	PM2.5	0.022	0.022	0.022
PC	CO	0.930	0.626	0.528
	HC	0.103	0.086	0.079
	NOx	0.173	0.073	0.056
	PM10	0.006	0.005	0.005
	PM2.5	0.005	0.004	0.004

Based on these values emissions in units of g/s were calculated. The real emissions might be underestimated to a certain extent as the Macedonian fleet is couple of years older compared to the German one. The results are given in the **Table 91**.

Table 91 Average air emissions from traffic on the Blace - Stenkovec motorway

Pollutant	Emission Rates (g/s)		
	2030	2040	2045
CO	2.072	2.471	2.187
HC	0.195	0.269	0.290
NOx	0.994	0.651	0.483
PM10	0.019	0.025	0.030
PM2.5	0.016	0.021	0.025

The same receptors affected during the construction phase of the proposed project will be exposed to air emissions in its operation phase. The new alignment is not far away from the existing one, but it moves away from some receptors and gets closer to others thus creating small differences in air quality.

Traffic on the new motorway will certainly result in emissions into air. The "Do nothing" option, however, would result in even higher emissions assuming the same traffic growth rate, primarily due to inevitable increased queuing of vehicles because of the capacity of the existing road. Therefore, the overall air quality impact of the proposed project is expected to be slightly positive. The impact of traffic emissions to air quality will be limited to a very narrow area along the new motorway, that is why it is consider as a minor one.

5.2.5.3 Assessment of impacts

Air quality											
Impact source	**Impact nature**	**Time of appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Magnitude**	**Sensitivity**	**Significance**	**Mitigation measures**
Construction phase											
Adverse impacts on ambient air quality as a result of: Construction activities and use of construction mechanization that generate dust, exhaust gases, VOC	Negative	Immediate	Direct	Location	Short term	Certain	Reversible	Moderate	Moderate	Moderate	Yes
Operation phase											
Adverse impacts on ambient air quality as a result of traffic along the motorway	Negative	Immediate	Direct	Local	Long term	Certain	Reversible	Moderate	Minor	Minor	Yes

5.2.6 Climate change - Project implementation impacts on climate change

An assessment of greenhouse gas emissions in both the construction and the operational phase of the project have been carried out, taking into account the national and European legislation (the EIA Directive 2014/52/EU[67]), guidance and policy documents including the EBRD Protocol for assessment of Green House Gas Emissions[68] and the IEMA 2017 Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance[69].

Decommissioning of the motorway may result in significant GHG emissions, but it will happen too far into the future and beyond our knowledge of future technology and possible emissions when such an activity will take place. Therefore, decommissioning activities have been scoped out of this assessment.

5.2.6.1 Construction phase

Every activity in the process of road construction is related to certain GHG emissions. All the elements relevant for GHG assessment have been taken into account except those that are considered to have minor or negligible contribution to total GHG emissions or no data were available for. Such elements include: disposal of waste other than excavated soil disposal; land use change; ventilation in tunnels; maintenance activities; lighting.

The present assessment is focused on those activities that may have a significant effect during the construction of the motorway. The **Table 92** shows the elements taken into consideration for this assessment.

Table 92 Elements taken into account for GHG emissions assessment

Lifecycle Phase	Sources of emissions
Construction	
Raw materials procurement stage (raw material supply, transport and manufacture)	Emissions related to extraction and manufacturing of materials
Construction stage	Fuel/energy consumption by transportation of construction materials etc.

All environmental media which are vulnerable to climate change such as air, water, soil, biodiversity (flora, fauna and habitats) and social aspects (population, infrastructures, cultural and archeological sites) identified in the project area of influence are assessed as sensitive receptors.

A universal database for the sourcing of GHG emission factors is not available, but the Highways England Carbon Emissions Calculation Tool[70] was found most helpful for the purpose of assessing GHG emissions during the construction phase of the project. In addition, a range of other databases and calculation tools were taken into consideration, including the ICE Inventory of Carbon and Energy[71] database. Estimated GHG emissions resulting from the proposed project construction are shown in the **Table 93**.

The predicted emission values are pretty high primarily due to the amount of concrete required for construction of a number of tunnels, bridges and culverts.

Some elements such as transportation of workers to and from construction site, heating and lighting of construction site premises, business trips, waste disposal etc. are not included due to lack of

[67] Directive 2014/52/EU ; https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32014L0052
[68] EBRD Protocol for assessment of Green House Gas Emissions https://www.ebrd.com/documents/admin/ebrd-protocol-for-assessment-of-greenhouse-gas-emissions.pdf
[69] IEMA 2017: Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance https://www.iaia.org/pdf/wab/EIA%20Guide_GHG%20Assessment%20and%20Significance_IEMA_16May17.pdf
[70] Carbon emission calculation tool: Highways England - GOV UK, https://www.gov.uk/government/publications/carbon-tool
[71] https://circularecology.com/embodied-carbon-footprint-database.html

reliable data. An estimation, however have been made based on the estimated project value and the average size of an appropriate construction site.

The following additional assumptions and limitations have been made for the GHG emissions assessment:

- The construction phase will take 3 years;
- GHG construction emissions will be equally spread over 3 years;
- The type and quantities of materials are indicative, based on data received from the design team before the final design has been done.

Table 93 Estimated GHG emissions in the construction phase of the project

Material	Embodied emissions (tCO_{2eq})	Transport emissions (tCO_{2eq})	Total (tCO_{2eq})
Earthworks	5169.6	1793	6962.6
Geotextile	1441.7	35	1476.7
Concrete	18520	689.3	19583.3
Aggregate	14029	397	14426
Asphalt	13677	297	13974
Emulsion	855	31	886
Total	**53692.3**	**3242.3**	**56934.6**

There are no current threshold values against which the significance of GHG emissions could be determined. Therefore, the significance of the proposed project GHG emissions have been assigned based on their magnitude, guidance documents and professional judgement.

The IEMA (17) EIA guidance suggests the assessed project GHG to be placed in context with the national emission data both global and sector specific (transport).

The Third Biannual Report on Climate Changes of the Republic of North Macedonia [72] issued in 2020 is the most recent one. Total GHG emissions and those arising from the transport section are shown in the **Table 94**.

Table 94 Total and sector specific GHG emissions in North Macedonia (2016)

Category	GHG Emissions (Kt CO2eq/year)
Total national emissions	10111
Transport Emissions	2026.7

Assuming same level of national GHG emissions over a period of three years and evenly spread GHG emissions from the project, the share of GHG emissions is presented bellow.

Table 95 Project GHG emissions compared to 3 year National emissions

Category	National emissions (Kt CO_{2eq})	Project emissions (Kt CO_{2eq})
Total national emissions	30333	(0.19%) 56.934

[72] Third Biannual Report on Climate Changes of the Republic of North Macedonia (2020), Ministry of Environment & Physical Planning (Mac), pp 19, https://klimatskipromeni.mk/data/rest/file/download/4ac8bf221efbbd35f29503df33c5d9071c047e98ebc446dcd4761d801ee518da.pdf

Transport Emissions (19.94% of national emissions)	6080	(0.94%) 56.934

5.2.6.2 Operational phase

Use of the motorway (traffic activities) will be by far the biggest source of GHG emission during the operational phase of the project. Minor emissions will result from regular maintenance, repairs, lighting etc. but due to lack of data and their insignificance, these emissions have not been incorporated in the assessment.

All environmental media which are vulnerable to climate change such as air, water, soil, biodiversity (flora, fauna and habitats) and social aspects (population, infrastructures, cultural and archeological sites) identified in the project area of influence are assessed as sensitive receptors.

Greenhouse gas emissions in the projects operational phase have been calculated based on the traffic volume forecast in the Feasibility study[73] prepared in 2016.

A number of databases were taken into consideration for retrieving GHG emission factors from, including Highways England Carbon Emissions Calculation Tool, the ICE Inventory of Carbon and Energy and the UNFCCC GHG Emissions Calculator ver01.3[74]. Eventually, emission factors from the latter were used in calculations. 2045 is the last forecast year in the Feasibility Study. As the three-year Project construction is intended to start in 2022, 2026 could be the first year in operation, which indicate 2086 as the end of life year of the project. Due to lack of data on traffic capacity of the proposed project, the traffic volume was limited to that of 2045.

GHG emissions from traffic still taking place on the existing road, during the operational phase of the proposed project, has been taken into account.

The project impact on the environment is the difference of GHG emissions before and after project implementation. The **Table 96** shows predicted emissions in both scenarios and their difference.

Table 96 Traffic GHG emissions

Scenario	GHG emissions (t CO_{2eq}/year)			
	2026	**2030**	**2040**	**2045**
Implemented Project	11,521.11	14,565.13	23,005.24	29,891.14
Do Nothing	7,596.32	9,100.80	14,900.46	19,371.94
Difference	**3,924.80**	**5,464.33**	**8,104.78**	**10,519.20**

The most up to date data on North Macedonia GHG emissions have been found in the Third Biannual Report on Climate Changes of Macedonia (2020) where the last reported year is 2016. Since 2026 (opening year of the Project) is closest to the reported one, this has been put in context with the National GHG emissions.

Table 97 Operational phase Project emissions in context of National GHG emissions

Category	National emissions (Kt CO_{2eq})	Project emissions (Kt CO_{2eq})

[73] Feasibility Study Report WB – MKD – TRA – 01 Infrastructure Projects Facility for Western Balkans, 2016
[74]Greenhouse Gas (GHG) emissions Calculator - UNFCCC
https://www.google.com/search?q=greenhouse+gas+emission+calculator+ver+01.3&client=firefox-b-d&channel=trow5&biw=1920&bih=927&ei=_HiNYbPsJsmbkwXNyZrQAw&oq=greenhouse+gas+emission+calculator+ver+01.3&gs_lcp=Cgxnd3Mtd2l6LXNlcnAQDEoECEEYAVC1CVi1CWDDUGgBcAB4AIABnAGIAZwBkgEDMC4xmAEAoAEBwAEB&sclient=gws-wiz-serp&ved=0ahUKEwiz2vOaj5H0AhXJzaQKHc2kBjo4PBDh1QMIDQ

Total national emissions	10111	(0.039 %) 3.925
Transport Emissions (19.94% of national emissions)	2097	(0.19 %) 3.925

5.2.6.3 Assessment of impacts

Project implementation impacts on climate change											
Impact source	**Impact nature**	**Time of appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Magnitude**	**Sensitivity**	**Significance**	**Mitigation measures**
Construction phase											
Increased GHG emissions, related to extraction and manufacturing of materials and fuel/energy consumption by transportation of construction materials	Negative	Delayed	Direct	Regional	Short term	Certain	Reversible	Minor	Moderate	Minor	Yes
Operational phase											
Increased GHG emissions as a result of operation of motorway	Negative	Delayed	Direct	Regional	Long term	Certain	Reversible	Minor	Moderate	Minor	Yes

5.2.7 Climate change impacts on project implementation

5.2.7.1 Construction phase

The impacts caused by climate change, will mainly come from possible temperature changes, the occurrence of long-lasting drought periods, strong torrential rains and floods, increased frequency and power of wind, sudden heavy snowstorms and the appearance of more frosty days. The changes and projections of this parameters are presented in Climate Resilience Report presented in Annex 11 of this ESIA study. Based on the projections for climate change presented in the report, risk assessment on identified assets from climate change projections for the future period has been conducted.

According to the dynamic plan of the Public Enterprise for State Roads (PESR), the project is planned to be started in the 4th quartile of 2022. The construction of the motorway is planned to be realized in period of 3 years with possible extension of 1 year.

The following sources of emission were taken into consideration in order to assess the climate change impacts on project implementation: annual temperature data for the region; annual precipitation data for the region; intensive rainfalls in the region; floods; droughts; landslides, forest fires history.

The climate change projections (sources of emission) for assessment of the climate change impacts on the project in construction phase were taken for the period 2025 year (central year for 2011 – 2040).

In the construction phase the most vulnerable receptors i.e. assets from climate change impacts on the project activities are:

- Construction site including access roads to it;
- Storage of materials and waste;
- Construction mechanization, equipment and vehicles;
- Work force.

In order to assess the impacts, the risk assessment on each identified assets has to be done. The risk assessment consists of few steps i.e.: assessing exposure, assessing sensitivity, vulnerability assessment. In the table below is presented exposure matrix of the identified assets in construction phase:

Table 98 Exposure matrix for construction phase

Phase	Assets/location	Extreme heat	Mean heat	Drought	Mean rainfall	Storms/extreme rainfall
Construction phase	Construction site including access roads	1	x	x	x	1
	Storage of materials and waste	2	X	x	x	2
	Construction mechanization, equipment and vehicles	1	X	x	x	2
	Work force	1	x	x	x	x

X = No or negligible exposure now and/or in the future, 1 = Low exposure now and/or in the future, 2 = Medium exposure now and/or in the future, 3 = High exposure now and/or in the future

In order to assess the vulnerability of the project to climate changes, despite of exposure matrix, sensitivity matrix is also needed to be established. Sensitivity is the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. Sensitivity can be assessed using:

- Recent and historical events;
- Geographical location;

- Condition and design life of defined assets.

There are 4 levels of sensitivity i.e. negligible, low, medium and high. On the table below is presented each sensitivity level with its description related to infrastructure.

Table 99 Sensitivity scale

Level of sensitivity		**Description of Sensitivity Level to Infrastructure**
3	High	Permanent or extensive damage requiring extensive repair
2	Medium	Widespread infrastructure damage and service disruption requiring moderate repairs. Partial damage to local infrastructure
1	Low	Localized infrastructure service disruption. No permanent damage. Some minor restoration work required.
0	Negligible	No infrastructure service disruption or damage.

Through combining the exposure and sensitivity ratings, it is possible to identify whether the asset is vulnerable, to what degree, and to which climate variables. Assets having high exposure and sensitivity will have a higher vulnerability to the climate variable than those with a low exposure and low sensitivity. Those with low vulnerability to the climate variable are less likely to require adaptation strategies to be put in place to protect them. The Vulnerability Matrix shown in the table below provides how exposure and sensitivity can be used to determine overall vulnerability level.

Table 100 Vulnerability matrix

Exposure	**Sensitivity**		
	Low	Medium	High
High	4 (medium)	5 (high)	6 (extreme)
Medium	3 (low)	4 (medium)	5 (high)
Low	2 (very low)	3 (low)	4 (medium)

According to the vulnerability matrix presented above, for the purpose of the project, vulnerability level for each defined assets in construction phase was assessed. In the following table is presented the obtained vulnerability level for construction phase of the project.

Table 101 Vulnerability assessment for construction phase of the motorway A4

Assets	Climate change	Exposure	Sensitivity	Vulnerability
Construction site including access roads	Extreme heat	Medium	Medium	Medium
	Mean heat	Low	Negligible	Very low
	Drought	Negligible	Negligible	Very low
	Main rainfall	Low	Negligible	Very low
	Storms/extreme rainfall	High	Medium	High
Storage of materials and waste	Extreme heat	Medium	Medium	Medium
	Mean heat	Medium	Negligible	Low
	Drought	Medium	Negligible	Low
	Main rainfall	Low	Negligible	Very low
	Storms/extreme rainfall	High	Medium	High
Construction mechanization, equipment and vehicles	Extreme heat	Medium	Low	Low
	Mean heat	Low	Negligible	Very low
	Drought	Negligible	Negligible	Very low
	Main rainfall	Negligible	Negligible	Very low
	Storms/extreme rainfall	High	Low	Medium

Work force	Extreme heat	Medium	Low	Low
	Mean heat	Low	Negligible	Very low
	Drought	Negligible	Negligible	Very low
	Main rainfall	Low	Negligible	Very low
	Storms/extreme rainfall	Low	Low	Very low

Based on the established vulnerability assessment, assessment and prioritization of risk is the next step to be conducted in order to identify where the most significant risks are expected to occur and which adaption measures need to be applied and when. The risk assessment consists of assessing impact probability and assessing impact severity. The definition of each risk level is presented in the following table.

Table 102 Risk categories and responses

Level of risk	Definition
Extreme ≥ 20	• Extreme risks demand urgent attention at the most senior level and cannot be simply accepted as a part of routine operations without executive sanction. • These risks are not acceptable without treatment
High ≥ 12	• High risks are the most severe that can be accepted as a part of routine operations without executive sanction but they are to be the responsibility of the most senior operational management and reported upon at the executive level. • These risks are not acceptable without treatment.
Medium ≥ 5	• Medium risks can be expected to form part of routine operations but they will be explicitly assigned to relevant managers for action, maintained under review and reported upon at the senior management level. • These risks are possibly acceptable without treatment.
Low < 5	• Low risks will be maintained under review but it is expected that existing controls will be sufficient and no further action will be required to treat them unless they become more severe. • These risks are can be acceptable without treatment.

On the following table is presented the risk score of construction of the motorway A4 Blace – Skopje (Stenkovec).

Table 103 Risk score of defined assets in construction phase of the motorway

Assets	Climate change	Probability score	Severity Score	Risk Score
Construction site including access roads	Extreme heat	3	2	**6**
	Storms/extreme rainfall	2	3	**6**
Storage of materials and waste	Extreme heat	3	1	**3**
	Storms/extreme rainfall	2	3	**6**
Construction mechanization, equipment and vehicles	Storms/extreme rainfall	2	2	**4**

Based on the performed risk assessment for the future motorway A4 Blace – Skopje (Stenkovec) as a result of climate change projections, identification of impacts and adaptation measures for each risk and impact needs to be proposed. The construction site which includes access roads in the construction phase will be exposed mostly on extreme heat and storms/extreme rainfall. As a result of this following impacts are expected:

- Drying and cracking of construction land;
- Forest fires may occur;
- Extreme heat can limit construction activities, which may increase the cost and duration of construction and maintaining activities.

- Accumulation of water or complete flooding of the construction site and the access to it;
- Excess erosion and sedimentation, landslides activation.

Storage of materials and waste will be exposed also on extreme heat and storms/extreme rainfalls. As a result to that the following impacts are expected:

- Risk of fires as a result of storage of flammable substances on construction site;
- Flooding of the stored material;
- Drainage of the piles of temporary stored excavated material.

Construction mechanization, equipment and vehicles will be exposed on storms/extreme rainfall and extreme heat/fires and following impacts are expected:

- Reduce visibility for the drivers of vehicles;
- Ignition of equipment containing hazardous substances;
- Damage of construction equipment (melting);
- Turning the ground into mud which poses its own risks to the health and safety of site workers which are operating the mechanization.

5.2.7.2 Operational phase

In order to assess the climate change impacts on project implementation, the following sources of emission were taken into consideration: annual temperature data for the region; annual precipitation data for the region; intensive rainfalls in the region; floods; droughts; landslides.

For operational phase the climate change projections were taken for the period up to 2075 if it is assume that the lifespan of the motorway is 50 years.

In the operational phase the most vulnerable receptors i.e. assets from climate change impacts on the project activities are: alignment of the motorway A4; tunnels; bridges; underpasses; retaining walls; culverts.

In order to assess the impacts, the risk assessment on each identified assets has to be done. The risk assessment consists of few steps i.e.: assessing exposure, assessing sensitivity, vulnerability assessment. In the table below is presented exposure matrix of the identified assets in operational phase:

Table 104 Exposure matrix for operational phase

Phase	Assets/location	Extreme heat			Mean heat			Drought			Mean rainfall			Storms/extreme rainfall		
		2050	2075	2100	2050	2075	2100	2050	2075	2100	2050	2075	2100	2050	2075	2100
Operational phase	Alignment of the motorway A4	1	2	3	1	2	3	1	2	3	1	2	3	1	3	3
	Tunnels	x	1	1	x	x	1	x	x	1	x	1	1	x	1	1
	Bridges	1	2	2	x	1	2	x	x	1	1	2	3	1	2	3
	Underpasses	x	x	1	x	x	1	x	x	x	x	2	2	1	2	2
	Retaining walls	x	x	1	x	x	1	x	x	x	x	1	2	1	2	2
	Culverts	x	x	1	x	x	1	x	x	x	1	2	2	1	2	2

X = No or negligible exposure now and/or in the future, 1 = Low exposure now and/or in the future, 2 = Medium exposure now and/or in the future, 3 = High exposure now and/or in the future

Through combining the exposure and sensitivity ratings presented, it is possible to identify whether the asset is vulnerable, to what degree, and to which climate variables. Assets having high exposure and sensitivity will have a higher vulnerability to the climate variable than those with a low exposure and low sensitivity. Those with low vulnerability to the climate variable are less likely to require adaptation strategies to be put in place to protect them. According to the vulnerability matrix presented above, for the purpose of the project, vulnerability level for each defined assets in operational phase was assessed. In the following table is presented the obtained vulnerability level for operational phase of the project.

Table 105 Vulnerability assessment for operational phase of the motorway A4

Assets	Climate change	Year	Exposure	Sensitivity	Vulnerability
Alignment of the motorway A4	Extreme heat	2050	Low	Low	Very low
		2075	Medium	Medium	Medium
		2100	High	Medium	High
	Mean heat	2050	Low	Negligible	Very low
		2075	Medium	Medium	Medium
		2100	High	Medium	High
	Drought	2050	Low	Low	Very low
		2075	Medium	Low	Low
		2100	High	Low	Medium
	Main rainfall	2050	Low	Low	Very low
		2075	Medium	Low	Low
		2100	High	Low	Medium
	Storms/extreme rainfall	2050	Low	Low	Very low
		2075	High	Medium	High
		2100	High	Medium	High
Tunnels	Extreme heat	2050	Negligible	Negligible	Very low
		2075	Low	Low	Very low
		2100	Low	Low	Very low
	Mean heat	2050	Negligible	Negligible	Very low
		2075	Low	Low	Very low
		2100	Low	Low	Very low
	Drought	2050	Negligible	Negligible	Very low
		2075	Negligible	Negligible	Very low
		2100	Low	Low	Very low
	Main rainfall	2050	Negligible	Negligible	Very low
		2075	Low	Low	Very low
		2100	Low	Low	Very low
	Storms/extreme rainfall	2050	Negligible	Low	Very low
		2075	Low	Low	Very low
		2100	Low	Medium	Low
Bridges	Extreme heat	2050	Low	Low	Very low
		2075	Medium	Medium	Medium
		2100	Medium	High	High
	Mean heat	2050	Negligible	Low	Very low

Assets	Climate change	Year	Exposure	Sensitivity	Vulnerability
		2075	Low	Low	Very low
		2100	Medium	Medium	Medium
	Drought	2050	Negligible	Negligible	Very low
		2075	Negligible	Negligible	Very low
		2100	Low	Low	Very low
	Main rainfall	2050	Low	Low	Very low
		2075	Medium	Low	Low
		2100	High	Medium	High
	Storms/extreme rainfall	2050	Low	Low	Low
		2075	Medium	Medium	Medium
		2100	High	Medium	High
Underpasses	Extreme heat	2050	Negligible	Low	Very low
		2075	Negligible	Low	Very low
		2100	Low	Medium	Low
	Mean heat	2050	Negligible	Negligible	Very low
		2075	Negligible	Low	Very low
		2100	Low	Low	Low
	Drought	2050	Negligible	Negligible	Very low
		2075	Negligible	Low	Very low
		2100	Negligible	Low	Very low
	Main rainfall	2050	Negligible	Low	Very low
		2075	Medium	Low	Low
		2100	Medium	Low	Low
	Storms/extreme rainfall	2050	Low	Low	Low
		2075	Medium	Low	Low
		2100	Medium	Medium	Medium
Retaining walls	Extreme heat	2050	Negligible	Low	Very low
		2075	Negligible	Low	Very low
		2100	Low	Medium	Low
	Mean heat	2050	Negligible	Low	Very low
		2075	Negligible	Low	Very low
		2100	Low	Low	Low
	Drought	2050	Negligible	Negligible	Very low
		2075	Negligible	Low	Very low
		2100	Negligible	Low	Very low
	Main rainfall	2050	Negligible	Low	Very low
		2075	Low	Low	Low
		2100	Medium	Low	Low
	Storms/extreme rainfall	2050	Low	Low	Low
		2075	Medium	Low	Medium

Assets	Climate change	Year	Exposure	Sensitivity	Vulnerability
		2100	Medium	Medium	Medium
Culverts	Extreme heat	2050	Negligible	Negligible	Very low
		2075	Negligible	Low	Very low
		2100	Low	Low	Low
	Mean heat	2050	Negligible	Negligible	Very low
		2075	Negligible	Low	Very low
		2100	Low	Low	Low
	Drought	2050	Negligible	Negligible	Very low
		2075	Negligible	Low	Very low
		2100	Negligible	Low	Very low
	Main rainfall	2050	Low	Low	Low
		2075	Medium	Low	Low
		2100	Medium	Low	Low
	Storms/extreme rainfall	2050	Low	Low	Low
		2075	Medium	Low	Low
		2100	Medium	Medium	Medium

Based on the established vulnerability assessment, assessment and prioritization of risk is the next step to be conducted in order to identify where the most significant risks are expected to occur and which adaption measures need to be applied and when. The risk assessment consists of assessing impact probability and assessing impact severity. The definition of each risk level is presented in the following table.

Table 106 Risk categories and responses

Level of risk	Definition
Extreme ≥ 20	• Extreme risks demand urgent attention at the most senior level and cannot be simply accepted as a part of routine operations without executive sanction. • These risks are not acceptable without treatment
High ≥ 12	• High risks are the most severe that can be accepted as a part of routine operations without executive sanction but they are to be the responsibility of the most senior operational management and reported upon at the executive level. • These risks are not acceptable without treatment.
Medium ≥ 5	• Medium risks can be expected to form part of routine operations but they will be explicitly assigned to relevant managers for action, maintained under review and reported upon at the senior management level. • These risks are possibly acceptable without treatment.
Low < 5	• Low risks will be maintained under review but it is expected that existing controls will be sufficient and no further action will be required to treat them unless they become more severe. • These risks are can be acceptable without treatment.

On the following table is presented the risk score of operational of the motorway A4 Blace – Skopje (Stenkovec).

Table 107 Risk score of defined assets in operational phase of the motorway

Assets	Climate change	Year	Probability/Scores	Severity Score	Risk Score
Alignment of the motorway A4	Extreme heat	2075	4	2	**8**
		2100	4	3	**12**
	Mean heat	2075	5	1	**5**
		2100	4	2	**8**

Assets	Climate change	Year	Probability/Scores	Severity Score	Risk Score
	Drought	2100	4	1	**4**
	Main rainfall	2100	4	1	**4**
	Storms/extreme rainfall	2075	4	2	**8**
		2100	4	3	**12**
Bridges	Extreme heat	2075	3	2	**6**
		2100	4	3	**12**
	Mean heat	2100	4	2	**8**
	Main rainfall	2100	4	2	**8**
	Storms/extreme rainfall	2075	4	2	**8**
		2100	4	3	**12**
Underpasses	Storms/extreme rainfall	2075	3	2	**6**
		2100	3	2	**6**
Culverts	Storms/extreme rainfall	2100	3	2	**6**

Based on the performed risk assessment for the future motorway A4 Blace – Skopje (Stenkovec) as a result of climate change projections, identification of impacts and adaptation measures for each risk and impact needs to be proposed.

The alignment of the motorway A4 in the operational phase will be exposed mostly on extreme heat and storms/extreme rainfall. As a result of this, following impacts are expected:

- Higher temperatures and solar radiation can increase the rate of degradation of pavements leading to higher maintenance costs;
- Increase of GHG emissions;
- Softening and expansion of pavements which can lead to rutting and pavement cracking;
- Disruption to traffic flows and destroyed vehicles as a result of damage of the alignment;
- Rapidly spreading fires along the alignment can lead to car fires, and injury or even death of road users;
- Flooding of the road and surface damage.

Bridges will be exposed also on extreme heat and storms/extreme rainfalls. As a result to that the following impacts are expected:

- Demolition of pillars.

The underpasses will be exposed on storms/extreme rainfall and following impacts are expected:

- Demolition of underpasses and closure of underpass with vegetation and stones.

The retaining walls will be exposed on extreme heat and storms/extreme rainfalls. As a result to that the following impacts are expected:

- Drying the vegetation which will result with destabilization of the slope and cracking the retaining walls as a result of increased rainfalls.

The culverts in operational phase will be exposed on storms/extreme rainfalls. As a result of this events, the following impacts are expected:

- Closure of culverts with vegetation and stones.

5.2.8 Noise and vibrations

The effect of noise depends on the intensity, duration and frequency of the sound as well as the sensitivity of the receptor. The lowest sound that can be heard is 0 dB (a sound pressure of 20 mPa), but the threshold depends on the frequency of noise and the condition (usually age) of the listener. Noise is most annoying at a frequency range between 2 kHz ÷ 5 kHz. Typically, receptors are grouped by sensitivity and an acceptable noise level applied. Table below shows outdoor noise limits in the Republic of North Macedonia for different location types:

Table 108 Limit noise levels in areas outside urban locations from Article 6 of the Rulebook on limit values of noise in the environment (Official Gazette of the Republic of Macedonia No. 147/08)

Types of Location	Noise level (dBA)		
	Ld (07 – 19 h)	Le (19 – 23 h)	Ln (23 – 07 h)
Locations exposed to intensive road traffic	60	55	50
Locations exposed to intensive rail traffic	65	60	55
Locations exposed to air traffic	65	65	65
Locations with intensive industrial activities	70	70	70
Quiet locations outside settlements	40	35	35

The IFC[75]/World Bank EHS[76] guidelines criteria differ in grouping types of noise locations. The noise impact according to IFC/WB EHS Guidelines - Environmental Noise Management[77] should not exceed the levels presented in the **Table 109** or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

Table 109 Noise limit values according to IFC/WB EHS guidelines

Location/ Time	Criteria 1 hour L_{Aeq} in dB(A)	
	Daytime (07:00 – 22:00)	Night time (22.00- 07:00)
Residential, institutional, educational	55	45
Industrial, Commercial	70	70

According to the World Health Organization's (WHO) Environmental Noise Guidelines for the European Region[78], 40 dB (Lnight, outside), can be considered a health-based limit value of the night noise guidelines necessary to protect the public, including most of the vulnerable groups such as children, the chronically ill and the elderly, from the adverse health effects of night noise. Where this is not feasible, an interim target of 55 dB $L_{night,\ outside}$ is recommended.

The gap between the recommended target and interim noise values has been significantly reduced for road traffic in the Environmental Noise Guidelines for the European Region[79]. The updated recommendations are to reduce road noise level below 53 dB L_{den} and 45 dB L_n. Assuming a 15 hour daytime slice, the resulting daytime noise level is 52.4 dB(A) L_d.

In case of a large timespan (more than one year) between preparation of the ESIA study and start of construction works, up-to-date information on ambient noise levels in the project areas will be needed to determine baseline conditions.

[75] International financial corporation
[76] Environmental health and safety
[77] https://www.ifc.org/wps/wcm/connect/4a4db1c5-ee97-43ba-99dd-8b120b22ea32/1-7%2BNoise.pdf?MOD=AJPERES&CVID=ls4XYBw
[78] https://www.euro.who.int/__data/assets/pdf_file/0017/43316/E92845.pdf
[79] https://www.euro.who.int/__data/assets/pdf_file/0008/383921/noise-guidelines-eng.pdf

5.2.8.1 Construction phase

Every road construction activity is related to noise and vibration generation, starting with removal of vegetation and ending up with horizontal and vertical signalisation. Construction noise and vibrations are generated by the machinery being used and operations such as blasting, earth moving, compacting etc.

The magnitude of the noise and vibration impact from the outdoor construction equipment will depend on:

- Construction machinery, transportation vehicles and related equipment's emission levels;
- The machinery that is used at the same time in a single area; and
- Distance between the source and the sensitive receptors.

Average noise levels from construction equipment commonly used in road construction projects is shown in the **Table 110** assuming that the equipment in line with the European requirements outlined in Directive 200/14/EC.

Table 110 Noise from construction equipment (15 m from the source)

Construction noise source	Noise level (dBA) at 15 m from source	Construction noise source	Noise level (dBA) at 15 m from source
Air compressor	81	Impact drill	101
Backhoe	80	Sonic drill	96
Pneumatic drill	88	Pneumatic tools	85
Truck	88	Pump	76
Compactor	82	Saw	90
Concrete mixer truck	85	Rock drill	98
Concrete pump truck	82	Roller	74
Concrete compactor	76	Chain saw	76
Fixed crane	88	Shaker	83
Mobile crane	83	Scraper	89
Bulldozer	85	Shovel	82
Generator	81	Jogger	77
Grader	85	Cutter	84
Pneumatic hammer	85	Front end loader	85

The procedure, which is recommended for assessing the impact of vibration from construction activities in humans and buildings, includes assessment of damage based on the selection of the equipment to be used, the appropriate reference level of vibration and their spread depending on the distance, based on the average values from numerous measurements of different types of construction machines. The following table gives an overview of the main sources of vibration from construction mechanization.

Table 111 Source of vibration from construction machinery and equipment (PPV-max value of particle velocity)

Mechanization		PPV at 25 ft (in/s)	Normalized $L_V^{\dagger}$ at 25 ft
Placement of stakes Impact compaction	Upper threshold	1.518	112
	Normal	0.644	104
Pole placement	Upper threshold	0.734	105

Pneumatic compaction	Normal	0.170	93
Excavators with retractible bucket	For soil	0.008	66
	For rocks	0.017	75
Vibratory roller		0.210	94
Hydraulic backhoe loader (with auxiliary hammer)		0.089	87
Rotational drill		0.089	87
Dump truck		0.076	86
Pneumatic hammer		0.035	79
† RMS speed in decibels (VdB)1 micro-inch/second			

The proposed motorway is located well away from inhabited areas. There are only a few storehouses, barns, auxiliary and weekend houses as outlined above.

Noise and vibration levels will increase in the project area during the construction of the proposed project. This will have a negative effect although very few people living or working in the field will be affected.

Due to the distance of about 2 km from the border with Kosovo, the moving character of construction works and construction noise levels, no cross border impact is expected.

The magnitude of noise impact will change over time during construction. For a short period of time, drilling, blasting and excavating, a high magnitude is expected. Noise from the rest of the construction activities will be generated with lower magnitude than while blasting and exaction activities. In absence of sensitive receptors, the noise impact loses its significance.

5.2.8.2 Operational phase

Detailed noise modeling was not needed for the entire area of this project, because of the lack of sensitive receptors. For certain locations, however, modeling was carried out in order to determine the extent of noise impact. The noise modeling has been carried out with SoundPlan Essential software.

The traffic on the motorway will generate noise and vibrations. Traffic noise and vibration impact depends on:

- Traffic flow,
- Type and velocity of vehicles,
- Distance and height difference from the source and
- Road conditions (type of pavement, slope etc.)

Traffic flow is not steady. It varies with time on monthly, daily and hourly basis. According to the automatic traffic counters, there are significant differences among monthly traffic flowrates. However, no significant differences were noticed between weekdays and weekends.

In 2020 hourly traffic flowrate varied during the day from 77 to 524 vehicles. Considering the same ratio of vehicle types and the expected traffic in the future, the maximum hourly traffic flows for 2030, 2040 and 2045 were calculated.

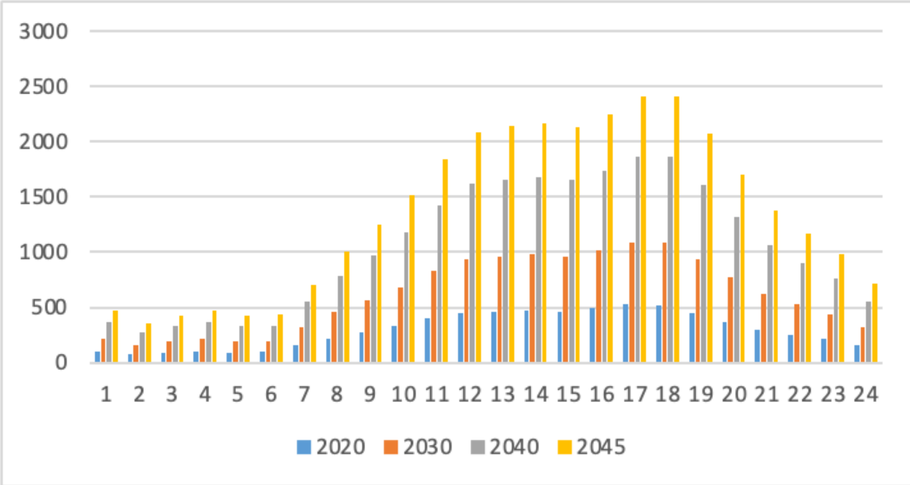

Figure 141 Maximum hourly traffic flow distribution in 24 hours

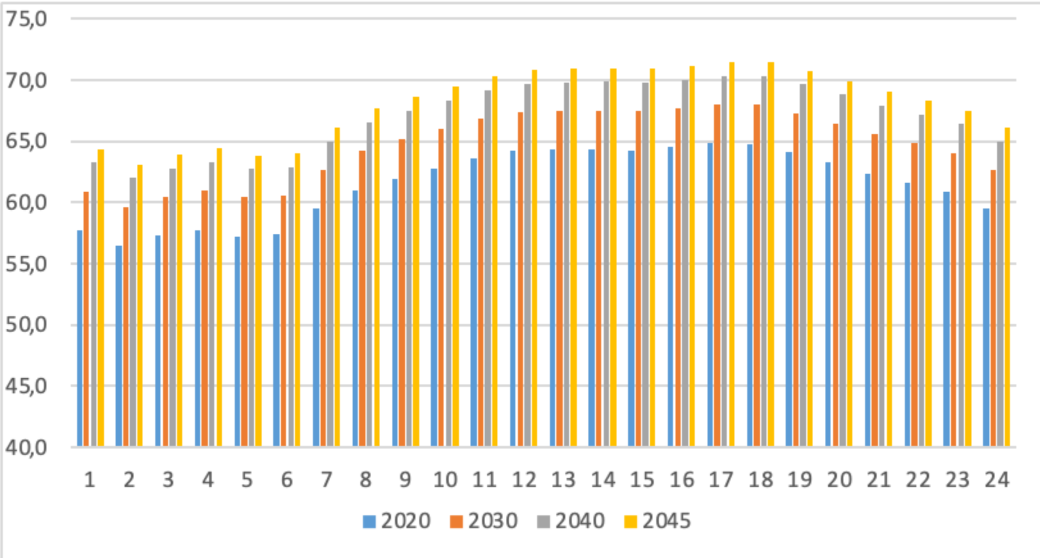

Figure 142 Hourly distribution of traffic noise levels

The predicted hourly traffic flow in the three time slices, based on data for previous years, is shown in the **Table 112**.

Table 112 Predicted hourly traffic flow in one direction

Year	Traffic flow (vehicles/hour)		
	Day	Evening	Night
2020	211	142	54
2030	436	293	112
2040	750	506	193
2045	868	650	250

There are very few sensitive receptors along the future motorway. Most of the buildings are industrial or commercial facilities such as storehouses, barns, concrete mixing plants, stone crushing plants etc. A couple of houses are present near km 3+850 and a few more around km 4+650.

The effect of traffic noise from the proposed project has been assessed at several rather small areas by applying the RLS 90 standard and the SoundPlan Essential software package.

Based on the traffic density, sound levels at reference distance of 25 m[80] have been determined. The resulted values are shown in the **Table 113**.

Table 113 Sound levels at reference distance of 25 m

Year	Noise level – dB(A)		
	$L_{25(D)}$	$L_{25(E)}$	$L_{25(N)}$
2020	62.97	61.26	57.1
2030	66.14	64.42	60.24
2040	68.49	66.77	62.6
2045	69.6	67.88	63.71

Based on the data on traffic density and the configuration of the terrain, traffic noise levels have been calculated for three areas containing sensitive receptors.

The results indicate that, at the nearest properties, the noise levels caused by the road traffic on the proposed motorway exceed the limit values prescribed in the Rulebook on the use of noise indicators, additional noise indicators, the method of noise measurement and assessment methods with indicators for noise in the environment.

The most affected receptor is a small weekend house around km 3+850, only 16 meters away from the motorway. Another potentially sensitive receptor is located close to km 4+650. Finally, there is a farm and a couple of houses close to km 9+250. Traffic noise levels have been calculated for the above areas showing that at some points the noise level limits set up by the law will be exceeded.

The figures below show the extent of day, evening and night limit noise levels as well as tabulated noise levels for receptors with conflict (exceedance) for 2030 at two locations (km 3+590 to 4+150 and 4+525 to 4+750 respectively). A single point map with the noise limit lines for the area between km 9+700 and 9+570, obtained as a result of the limited modeling performed, is shown in the following figures.

80 25 m is the distance between the properties (houses, buildings) to the centerline of the nearest traffic lane

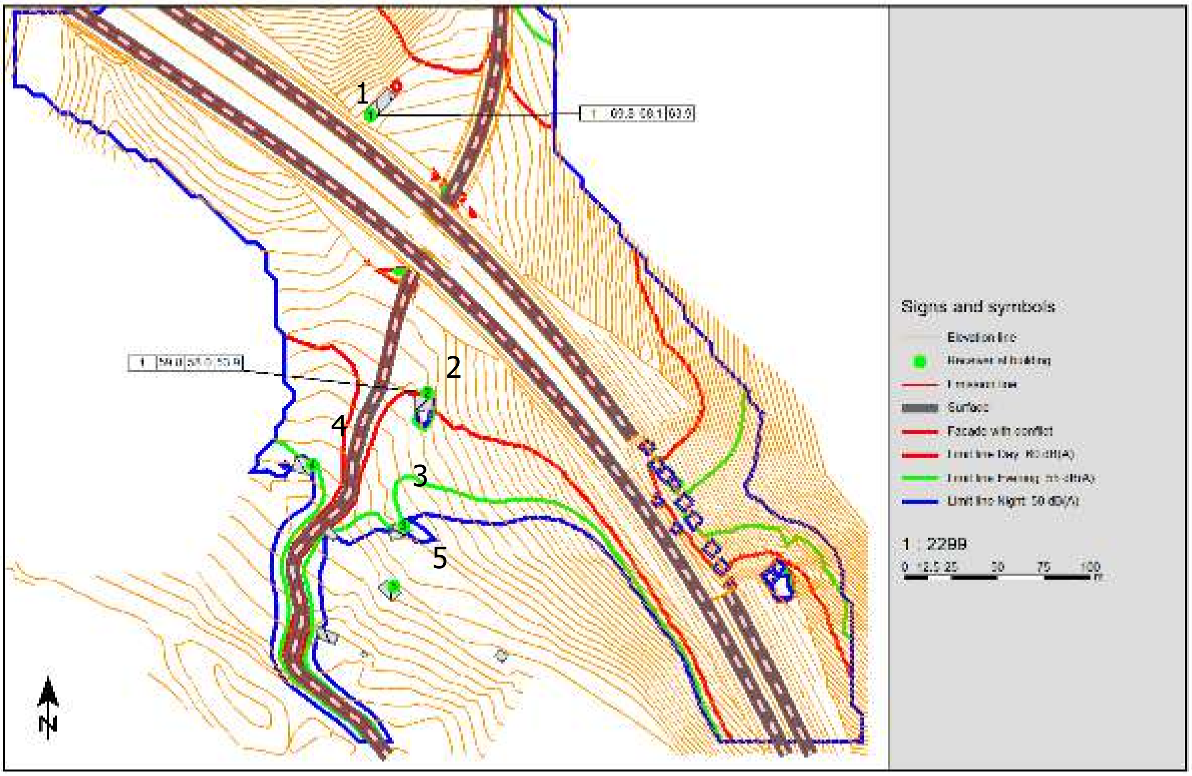

Figure 143 Single point map with limit lines between stationing 3+590 and 4+150 for 2030 (*numbers are assigned to receptors*)

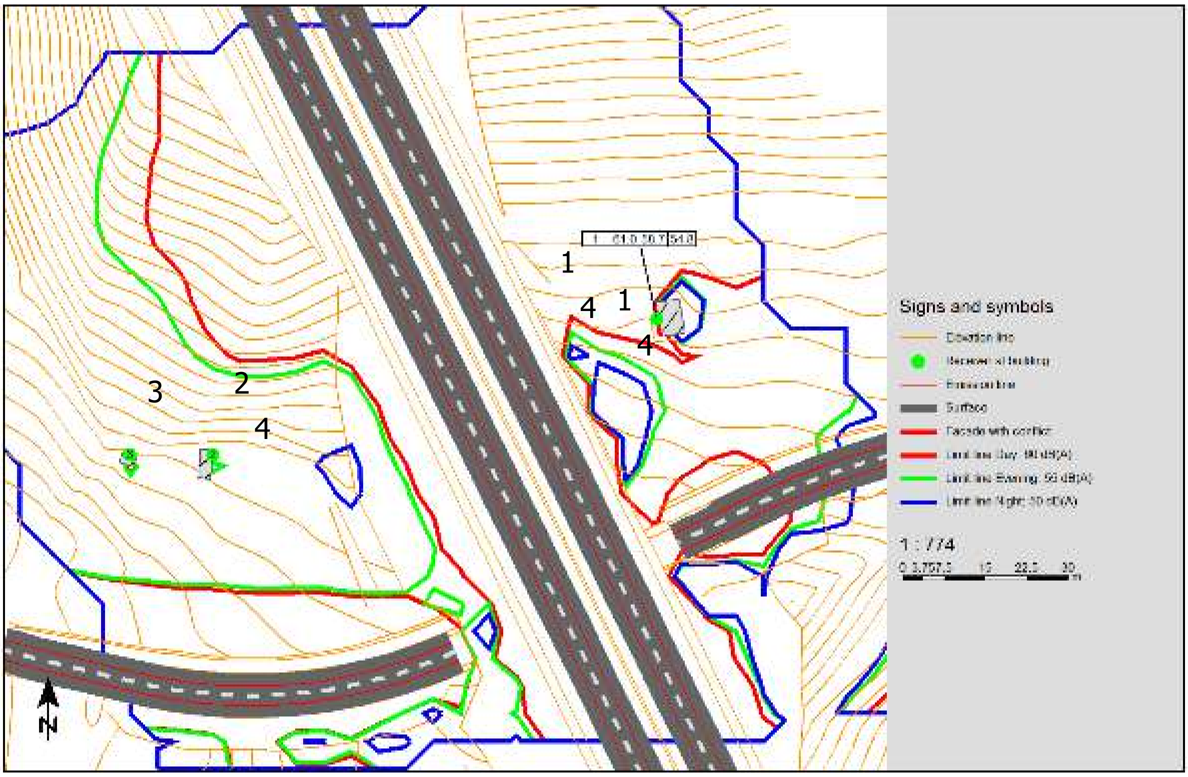

Figure 144 Single point map with limit lines between stationing km 4+150 and km 4+525 (numbers are assigned to receptors)

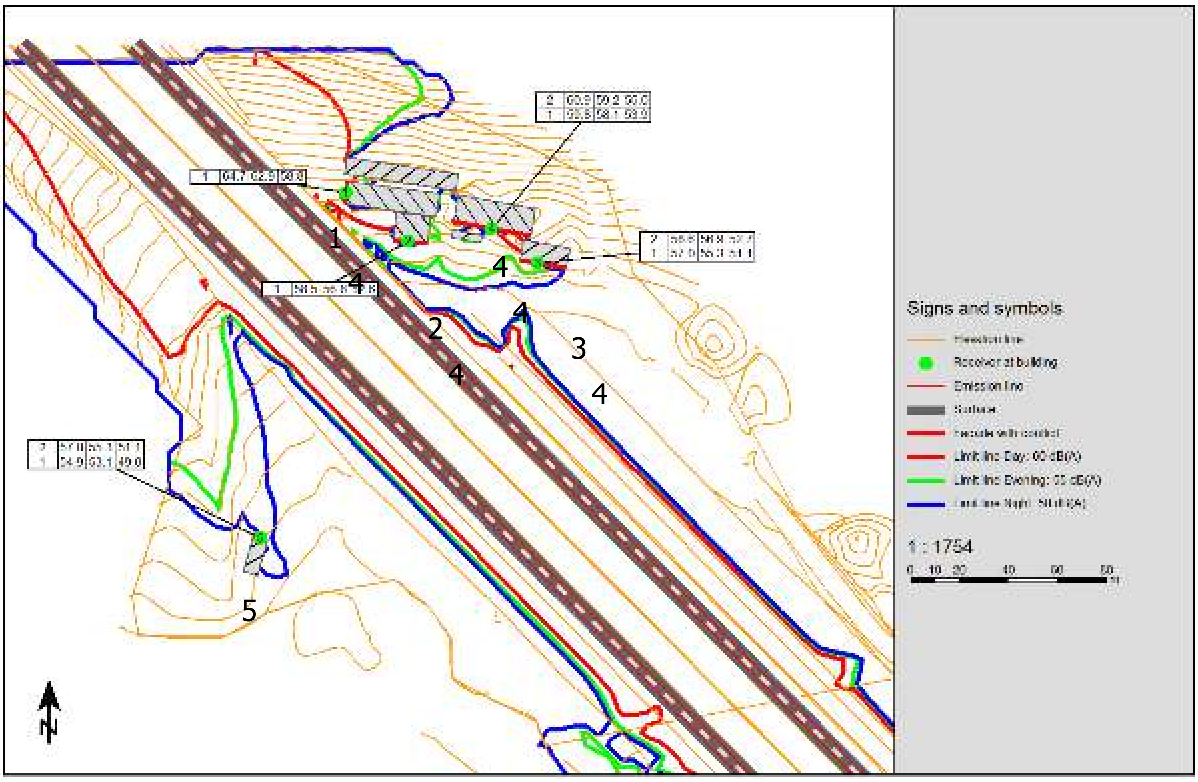

Figure 145 Single point map with limit lines between stationing km 9+250 and km 9+750 (numbers are assigned to receptors)

In the operational phase are expected also vibration impacts as a result of the movement of the vehicles along the alignment. Due to the fact that the road alignment will be new, with implemented GIP for construction of motorways and adaption to climate change measures, the vibration impacts as a result of movement of vehicles along the alignment are negligible.

5.2.8.3 Assessment of impacts

Noise and vibrations											
Impact source	**Impact nature**	**Time of appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Magnitude**	**Sensitivity**	**Significance**	**Mitigation measures**
Construction phase											
Increased noise and vibration as a result of construction activities (drilling, blasting, earth moving, compacting) and use/movement of construction mechanization	Negative	Immediate	Direct	Local	Short - term	Certain	Reversible	Moderate	Moderate	Moderate	Yes
Operational phase											
Increased noise as a result of operation and maintenance of the motorway	Negative	Immediate	Direct	Local	Long term	Certain	Reversible	Moderate	Moderate	Moderate	Yes
Increased vibration as a result of operation and maintenance of the motorway	Negative	Immediate	Direct	Local	Long term	Certain	Reversible	Negligible	Negligible	Negligible	No

5.2.9 Waste

5.2.9.1 Construction phase

In the construction phase different types of waste will be generated as a result of the preparation of site, construction activities of the motorway, structures and infrastructures, use of mechanisation and equipment, arrangement of workers. The waste will be generated as a result of:

- clearing the sites and removal of vegetation along the alignment;
- earthworks, concrete works, asphalt work, blasting, welding;
- use of equipment, mechanization and vehicles and their maintenance;
- transport, handling and use of different types of materials;
- unwanted leaks;
- sludge as a result of possible pre-treatment/treatment of waste water (technical waste water and storm water);
- presence of workers, etc.

These activities will generate different types of hazardous, non-hazardous waste, such as:

- surplus excavated soil;
- biodegradable waste (grass, trees and shrubs from the process of clearing of the locations);
- packaging waste;
- waste oil, fuel, chemicals;
- filters, adsorbents, wiping towels;
- contaminated soil as a result of unwanted leaks;
- waste from welding;
- waste from blasting;
- electronic and electrical waste;
- waste from maintenance of equipment, mechanisation and vehicles,

municipal waste, etc. On the basis of the above it can be concluded that as a result of the construction activities, different types of hazardous waste will be generated such as: contaminated soil (from unwanted leakages), packaging waste from hazardous materials, electronic and electrical waste, waste from maintenance of the equipment and mechanization, contaminated absorbent materials and other types of construction waste that belongs in the category for hazardous waste in accordance with their characteristics.

The following table shows the types of waste expected to be generated in the construction phase of the project activity, in accordance with the List of Waste Types ("Official Gazette of the Republic of Macedonia" No. 100/05).

Table 114 List of types of waste and method of treatment

No.	Type of waste	Number of the List of waste types
02 - Waste from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing		
	Waste from agriculture, horticulture, aquaculture, forestry, hunting and fishing	**02 01**
1	Waste from forest exploitation	02 01 07
2	Other waste	02 01 99
08 - Waste from PFTP (production, formulation, packaging, transportation) and use of coatings		

	(paints, varnishes and glass enamels), adhesives, sealants and printing inks	
	Waste from PFTPU (production, formulation, packaging, transportation, use) and removal of paints and varnishes	**08 01**
1	Waste paints and varnishes containing organic solvents or other hazardous substances	08 01 11*
2	Waste paints and varnishes different than those mentioned in 08 01 11	08 01 12
	Waste from PFTPU (production, formulation, packaging, transportation, us) of adhesive and seals, including waterproof products	**08 04**
1	Waste adhesive and seals containing organic solvents or other hazardous substances	08 04 09*
2	Waste adhesive and seals different than those mentioned in 08 04 09	08 04 10
	12 - Forming waste and physical and mechanical surface treatment of metals and plastics	
1	**Welding waste**	**12 01 13**
	13 Waste oils and liquid fuels	
1	Waste hydraulic oils	13 01
2	Waste motor and transmission oils and lubricants	13 02
3	Waste from liquid fuels	13 07
	15-Packaging waste, absorbents, wipes, filter materials and protective clothing not otherwise specified	
1	Packaging (including packaging separated from municipal waste)	15 01
2	Absorbents, filter materials, wiping cloth and protective clothing	15 02
	16- Waste not otherwise specified	
	Used vehicles of various modes of transport (including rolling stock), waste disassembly of used vehicles and maintenance of vehicles (except 13, 14, 16 06 and 16 08)	**16 01**
1	Used tires from vehicles	16 01 03
2	Used vehicles*	16 01 04*
3	Oil filters*	16 01 07*
	Waste from electric and electronic equipment	**16 02**
4	Transformers and capacitors containing PHB*	16 02 09*
5	Hazardous komponenets taken from waste equipment*	16 02 15*
6	Komponenets taken from waste equipment differen from those in 16 02 15	16 02 16
	Waste from explosives	**16 04**
7	Other waste explosives*	16 04 03*
	Batteries and accumulators	**16 06**
8	Lead accumulators*	16 06 01*
9	Nickel-cadmium batteries*	16 06 02*
10	Alkaline batteries	16 06 04
	17 – Waste from building and demolition	
	Concrete, bricks, tiles and ceramics	**17 01**
1	Concrete	17 01 01
2	Bricks	17 01 02
3	Tiles and ceramics	17 01 03
4	Mixtures or special fractions of concrete, bricks, ceramics or ceramics containing dangerous substances	17 01 06 *[81]
5	Mixtures or special fractions of concrete, fractions of concrete, bricks, tiles or ceramics other than those in 17 01 06	17 01 07
	Wood, glass, plastic	**17 02**
1	Wood	17 02 01
2	Glass	17 02 02
3	Plastic	17 02 03
4	Glass, plastic and wood containing or contaminated with hazardous substances	17 02 04 *
	Bituminous mixtures, coal tar and tar products	**17 03**
1	Bituminous mixtures containing tar	17 03 01 *
2	Bituminous mixtures mentioned in 17 03 01	17 03 02

[81] (star) – dangerous waste according the list of waste types

3	Tar and products containing tar	17 03 03 *
	Metals (including their alloys)	**17 04**
	Earth Material (including excavated soil from contaminated sites), rocks and excavated soil	**17 05**
1	Earth and stones containing dangerous substances	17 05 03 *
2	Earth and stones mentioned in 17 05 03	17 05 04
3	Excavated soil and stones containing dangerous substances	17 05 05 *
4	Excavated soil not mentioned in 17 05 05	17 05 06
	Plaster-based building materials	**17 08**
	Other construction and demolition waste	**17 09**
20-Municipal waste (household waste and similar commercial, industrial and administrative waste) including selected waste fractions		
1	Separately collected fractions	20 01
2	Garden waste and park waste	20 02
3	Other municipal waste	20 03

** Hazardous waste according the List of waste types*

Taking into consideration the scope of the proposed project activities and quantities and types of generated waste, no proper waste management (collection, separation, storage, reuse, recycling, transport and landfilling) may cause adverse impact on the environment. The receptors which will be impacted by the improper waste management in construction phase are the environmental media i.e. air, water, dry water beds, soil, surrounded flora and fauna, habitats and the surrounded landscape.

At this phase of the project, one location for disposal of excavated earth material was determined close to chainage km 3+900. This location was taken into consideration in 2002 during the preparation of the project for construction of the motorway by the company Granitproekt. The designer team has reviewed the data for the location and has increased the surface area in order the estimated quantites of excavated earth material to be fully deposited on the deposited site.. Due to the fact that almost 20 years has been passed since the last geo-mechanical investigation, new investigations has to be conducted within the preparation of the Detailed Design. The possible impact on the environment that may arise as a result of usage of these areas will depend on geological and hydrogeological characteristics of the areas as well as the types of waste that will be stored/landfilled.

Construction and demolition waste, besides inert waste, which contains fractions which are classified as hazardous waste and are not storage on proper way within the project area or others chosen areas, may cause adverse impact on the environmental media.

On the basis of all mentioned above it can be concluded that storage and disposal of the waste as well as transport of waste, if it is not managed appropriately will have adverse impacts on the quality of air, soil, surface and groundwater bodies, landscape and biodiversity receptors, as well as local population and workers.

5.2.9.2 Operational phase

Different fractions of waste will be generated during the operational phase as a result of the following activities:

- maintenance of the motorway;
- operation of the pay tool station;
- transport of passengers and goods.

In fact, the types of waste that will be generated during the operational phase are the following:

- biodegradable waste (grass, trees and shrubs from road maintenance);
- mixed municipal waste;
- sediment from the sediments;
- lubricant waste oils;
- maintenance waste (asphalt, electrical equipment);
- packaging waste, absorbents;

- contaminated soil from unwanted leaks;
- Waste from dead animals etc.

The dynamics of generating these types of waste is related to the maintenance of the motorway and the frequency of passengers. The types of waste expected to be generated in the operational phase (in accordance with the List of Waste Types) are shown in the following table.

Table 115 List of waste types

No.	Type of waste	Waste list number
02 - Waste from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing		
	Waste from agriculture, horticulture, aquaculture, forestry, hunting and fishing	**02 01**
1	Waste from forest exploitation	02 01 07
2	Other waste	02 01 99
13 Waste oils and liquid fuels		
1	Waste hydraulic oils	13 01
2	Waste motor and transmission oils and lubricants	13 02
15- Packaging waste, absorbents, wipes, filters and protective clothing not otherwise specified		
1	Packaging (including packaging separated from municipal waste)	15 01
2	Absorbents, filter materials, wiping cloth and protective clothing	15 02
16 - Wastes not otherwise specified		
17 - Waste from building and demolition		
	Earth material (including excavated soil from contaminated sites), rocks and excavated soil	**17 05**
1	Earth and stones containing dangerous substances	17 05 03 *
2	Earth and stones mentioned in 17 05 03	17 05 04
3	Excavated soil and stones containing dangerous substances	17 05 05 *
4	Excavated soil 17 05 05	17 05 06
19 – Waste from the instalations for treatment of waste, instalations for waste water treatment outside of the place of generation and preparation of drinking water and water for industrial use		
	Waste from wastewater treatment plants which is not specified differently	**19 08**
1	Mixtures of lubricants and oils from separating oils from water	19 08 10*
20-Municipal waste (household waste and similar commercial, industrial and administrative waste) including selected waste fractions		
1	Separately collected fractions	20 01
2	Garden waste and park waste	20 02
3	Waste of electrical and electronic equipment	20 01 35 *
4	Waste of electrical and electronic equipment not mentioned in 20 01 21, 20 01 23 and 20 01 35	20 01 36
5	Sewage cleaning waste	20 03 06

** Hazardous waste according the List of waste types*

Improper handling and management of waste generated can cause impacts on the environment. The receptors which will be impacted by the improper waste management in operational phase are the environmental media i.e. air, water, soil, surrounded flora and fauna, habitats and the surrounded landscape. The same may be affected as a result of: odor from the biodegradation of the remove vegetation; increased dust emissions; detoriation of the landscape and biodiversity as a result of not collection of generated waste etc.

5.2.9.3 Assessment of impacts

Waste											
Impact source	**Impact nature**	**Time of appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Magnitude**	**Sensitivity**	**Significance**	**Mitigation measures**
Construction phase											
Inadequate waste management (collection, separation, storage, reuse, recycling, transport and landfilling) will have adverse impacts on air, water, dry water beds, soil, surrounded flora and fauna, habitats and the surrounded landscape	Negative	Immediate/Delayed	Direct	Location	Short – term	Certain	Reversible/Irreversible	Moderate	Minor	Minor	Yes
Operational phase											
Collection and storage of waste	Negative	Immediate/Delayed	Direct	Location	Long-term	Likely	Reversible/Irreversible	Minor	Negligible	Negligible	No

5.2.10 Safe use and management of hazardous substances and materials

5.2.10.1 Construction phase

During the construction phase as a result of predicted construction activities different types of hazardous materials and substances will be used. In the Preliminary Design, which is the basis for preparation of the ESIA study, there is a lack of data about the substances and materials which will be used in the construction phase. According to the experience and available practices fuel, oils, pressurized gases, additives for preparation of construction material mixtures, colours, different insulators materials etc. will be used. The possible leakage of hazardous materials and waste may occur as a result of:

- Places and warehouses for temporary storage of hazardous materials and hazardous waste are not adequate for their purposes;
- Collection vessels are not adequate for their purpose;
- Vessels for storage of hazardous materials are not cover and there is an evaporation;
- Absence of secondary containment system for collection of possible leakage and spill prevention kits;
- Impairment of the storage reservoirs and vessels for storage of hazardous substances;
- Incidental leaking during collision of vehicles, particularly during transport of hazardous substances;
- Spillage during transferring and refueling;
- No regular maintenance of equipment, mechanization and vehicles; etc.

Hazardous materials are substances and mixtures which, due to their physical and chemical properties, can cause damage on the environment and human health and safety during construction work, in case of no proper management that may result with possible leakage, generation of dust, fire, explosion, etc. Inadequate storage and handling of hazardous materials and waste, use of equipment and mechanization and transport activities may cause leakage, dust emission etc.

Beside incident and damages on the environmental media that may be caused by possible leakage, inadequate storage and management of the hazardous materials, the hazardous materials may cause the appearance of fires and explosions as a result of their flammability and explosiveness. On the basis on above mentioned it may concluded that possible risk and damages that may be caused by hazardous materials on the environment and community, mainly may be caused by the human factors as a result of not applying appropriate protective measures, no good housekeeping, negligence, intentional infliction of damages etc. But it should also be mentioned that these side effects can be caused as a result of natural disasters such as floods, earthquakes, fires caused by third parties, etc.

The possible risk on the environment will depend on the causes of occurrence of impacts, sensitivity of locations and receptors, type and quantity of leaked materials, scope of the affected areas as a result of: possible leaking, fire or explosion, time of intervention etc. Incidental leaking, occurrences of a fire or explosion may cause serious adverse impacts on the environment.

The receptors which will be impacted by the improper use and management of hazardous substances and materials in construction phase are the environmental media i.e. air, water, soil, surrounded flora and fauna, habitats and the surrounded landscape as well as community.

5.2.10.2 Operational phase

In this phase as a result of the operation and maintenance of the motorway and its structures, different hazardous materials and substances will be transported and used. Transport of hazardous materials in packaged and unpackaged form, which poses a potential risk of release/leakage in the environment in case of accidents, may be expected. During the operational phase, hazardous materials as fuel, oils, lubricants, chemicals, etc. will be used for the mechanization which will be engaged for maintenance of the motorway and its structures, as well as maintenance of vegetation with herbicides, etc. Transport of hazardous materials may cause fires and explosions and leakage/dispersion of explosive and/or flammable materials.

In general, during the maintenance and repairing of the alignment and structures will be used the similar hazardous materials as were mentioned during the contraction phase.

The receptors, which may be impacted by the improper use and management of hazardous substances and materials in operational phase, are the environmental media i.e. air, water, soil, surrounded flora and fauna, habitats and the surrounded landscape as well as community.

5.2.10.3 Assessment of impacts

Safe use and management of hazardous substances and materials											
Impact source	**Impact nature**	**Time of appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Magnitude**	**Sensitivity**	**Significance**	**Mitigation measures**
Construction phase											
Damage on the environment and human health and safety during construction work, in case of no proper management that may result with possible leakage, generation of dust, fire, explosion, etc.	Negative	Immediate	Direct	Location to local	Short-term and medium term	Likely	Reversible	Moderate	Moderate	Moderate	Yes
Operational phase											
Release/leakage in the environment in case of accidents as a result of transport of hazardous materials in packaged and unpackaged form	Negative	Immediate/ delayed	Direct	Location to local	Long-term	Likely	Reversible/ irreversible	Minor	Moderate	Minor	Yes
Transport of hazardous materials may cause fires and explosions and leakage/dispersion of explosive and/or flammable materials.	Negative	Immediate	Direct	Location to local	Long-term	Likely	Reversible/ irreversible	Minor	Moderate	Minor	Yes
Extensive use of herbicides may impact soil and water quality	Negative	Immediate/ delayed	Direct	Location to local	Long-term	Likely	Reversible/ irreversible	Minor	Moderate	Minor	Yes

5.2.11 Biodiversity (flora, fauna, ecosystems and natural protected areas)

The impact on biodiversity components are presented separately for construction and operational phase. All of the biodiversity components were considered as receptors of the impacts: habitats and species of flora and fauna. There are no protected areas in the defined project influence area that will be affected the motorway construction and operation.

5.2.11.1 Construction phase

The impacts on biodiversity from the construction of the motorway are various and specific depending on the biodiversity features (ecosystems, habitats, and species), their coverage and sensitivity. Within and close to the project area there are not any protected areas. The overall biodiversity values and their sensitivity was supported by the conducted seasonal monitoring. During the construction phase, area dominantly covered by hill pastures (with or without shrubs) as well as some degraded oak forests will be impacted from the construction activities. In the southern parts of the alignment, agricultural and commercial area will be affected. It crosses one small fragment of degraded riparian belt along Vrazanska River. In the project area can be registered low or medium sensitive habitats. No high sensitive habitats will be impacted with the construction activities. In the northern part of the alignment, a potential bio-corridor is presented which requires habitats restoration in order to improve its functions. Primary mitigation is already incorporated into the Preliminary design (e.g. create wildlife crossings (tunnels, culverts, underpasses) to minimize the fragmentation effect enabling wild animals to cross the motorway. This was achieved during the analyses of the alternatives as primary mitigation ('mitigation through design'). As already mentioned, the design already includes bridges and tunnels i.e. permeable structures with length of 2829 m (left branch) and 2586 m (right branch) as well as 10 underpasses which are already embedded in the design. Hill pastures which are used for cattle grazing (sheep, cows) will be affected as a result of construction of the motorway.

Sensitivity of natural, seminatural and anthropogenic habitats was assessed according to the described methodology. The results are presented on table below. There are no vhs (very high sensitive) habitats in the analysed motorway corridor. In total, three habitats were assessed as **hs**: Riparian willow-poplar woodland, Rivers (epipotamal habitats) and meadows. Furthermore, five habitats were assessed as **ms** and the rest of 10 habitats as **ls**.

Table 116 Estimation of sensitivity for different ecosystems, biotopes, sites and localities in the motorway Blace-Stenkovec corridor area

HABITATS	Habitat Directive	Rare communities in Macedonia	Well preserved natural communities	Presence of species on IUCN Red List	Presence of species important for Europe	Presence of threatened birds	Presence of endemic species	Biocorridor function	Landscape value	Economic value	Erosion prevention	Pollution prevention value	SUM	Sensitivity
Thermophilous oak forests	1	0	1	1	1	1	1	2	2	2	2	1	15	**ms**
Degraded thermophilous oak forests	0	0	0	1	1	1	0	1	1	1	1	1	8	**ls**
Hill pastures	3	0	1	1	1	1	1	0	1	1	1	1	12	**ms**
Hill Pastures with sparse shrubs	3	0	1	1	2	2	1	1	1	1	1	1	15	**ms**
Riparian willow-poplar woodland	3	1	1	2	2	2	0	2	2	1	2	2	20	**hs**
Riparian willow shrubs' stand	2	1	1	1	1	1	0	1	2	1	1	1	13	**ms**
Riparian willow-poplar belts	2	0	1	2	2	2	0	1	2	1	1	1	15	**ms**
Riparian scrub communities -	3	2	1	1	1	1	0	1	2	0	1	1	14	**ms**

Tamaris shrubland													
Rivers- epipotamal habitats	2	0	2	1	1	1	1	3	3	2	1	2	19	**hs**
Intermittent streams - ravines	2	0	1	1	1	0	1	1	1	1	0	0	9	**ls**
Abandoned agricultural land	0	0	0	0	0	1	0	1	1	1	1	1	6	**ls**
Fields and acres	0	0	0	0	0	1	0	0	1	3	1	1	7	**ls**
Orchards and vineyards	0	0	0	0	0	0	0	1	2	3	1	1	8	**ls**
Meadows	3	2	2	1	1	1	1	1	2	3	1	1	19	**hs**
Small broadleaf plantations	0	0	0	0	0	0	0	1	1	1	1	1	5	**ls**
Fallow land	0	0	0	0	0	0	0	0	0	0	1	1	2	**ls**
Rural habitats	0	0	0	1	1	0	0	0	3	3	1	0	9	**ls**
Industrial site	0	0	0	0	0	0	0	0	0	3	0	0	3	**ls**
Man-made structures	0	0	0	0	0	0	0	0	0	1	0	0	1	**ls**

Legend: ls-low sensitive; ms-medium sensitive; hs – high sensitive

The sensitivity of habitats is presented in the following map. Dominance of ls and ms habitats can be seen from the map.

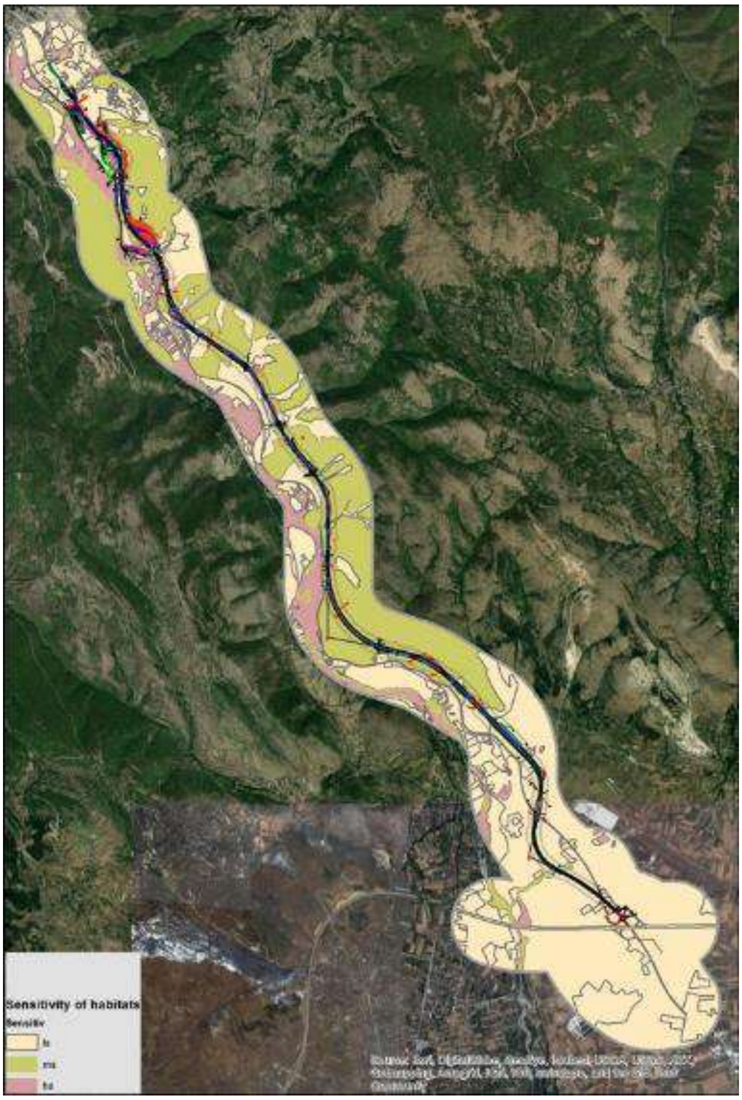

Figure 146 Habitat sensitivity map in the Blace-Stenkovec motorway corridor

The principle potential impacts on the biodiversity receptors, during the construction phase of the motorway include:

- Loss of terrestrial habitats - direct destruction and alteration of habitats – due to land take requirements (including main road, access roads and the auxiliary structures). Due to its irreversibility this is considered as the key impact on the biodiversity. It relates to forested areas, riparian habitats, grasslands, pastures, fields, etc. The largest area that will be lost belongs to hill pasture with shrubs (21.42 ha). Additionally, very small (insignificant) surface of Pubescent thermophyllous oak forest will be removed for a disposal site.

Table 117 Estimation of the loss of natural and seminatural terrestrial habitats[82]

Habitats	Area (ha)
Coniferous plantations	2.09
Degraded xerothermophillous oak forest	4.64
Hill pasture	6.82
Hill pasture with sparse shrubs	21.42

- Loss of terrestrial flora and fauna. Decrease in plant and animal populations due to habitat fragmentation effects, forest cut, collisions and destruction of nests, burrows, and other animal sheltering/breeding structures;

- Disturbance of species (breeding, foraging, roosting) due to the presence of workers and construction works (noise, vibrations) by machinery and vehicles in the area which may cause disturbance of animals and their temporary migration in the neighbouring areas. Animals will be disturbed due to the presence of workers and machinery during the whole construction phase. The construction noise generated during the vegetation clearance and the construction of access roads as well as vehicular access would likely disturb and displace some species – mammals in general. During the breeding season, disturbance effects would be greater in open areas where workers and machinery would be visible from a wider area. The animals will leave their natural habitats and places where they live, but upon construction activities completion, it is expected that they would return back. The construction of the motorway may also cause interruptions in the breeding cycle (clutch loss) and decrease in the breeding success of the birds breeding along the wider area of the highway corridor.

- Illegal hunting/accidental killing of animals by workers. Road kills may occur which is associated especially with mammals, reptiles and amphibians as well as invertebrate fauna. However, provided that good construction practice and management actions for road safety (e.g., speed limit) during construction of the Project are provided and implemented, the impacts will be reduced and mitigated

- Introduction of alien species: During the construction phase introduction of alien species may be a result of spread of seeds of alien species by workers and machinery.

- Dust deposition during construction has the potential to lead to changes to plant communities;

- Changes in aquatic habitats due to pollution and eutrofication (e.g., material storage, spoil and waste disposal) especialy in a case of Vrazanska River and some of the existing intermitten streams;

- Sedimentation and pollution/eutrofication of the intermittent streams and river Vrazanska, as a result of possible input of construction debris from concrete or other building materials, as well as expected erosion of solid and soluble material (mud, dirt, clay) into the water when construction activities are performed near or in the river bed and storm run-off from areas cleared of vegetation or otherwise made bare. Increase in turbidity of surface water and

[82] The area of the habitats was estimated in a buffer of 10 m from both side of each lane of the projected motorway. Its width range from 40 to 60 m depending on the position of the lanes (adjacent or distanced).

disruption of the waterbed may be caused by deposition of sediments from soil erosion due to construction works and storm water runoff. Inappropriate construction waste management during the construction phase could cause some temporary disturbance to the flow regime or interrupt the river flow, even completely destroy the small and narrow streams.

- Mortality of hydrobionts as a result of water pollution/eutroficationfrom spills of vehicles and construction machinery, in particular oils and lubricants, the impact which can occur if the construction activities will be happened in very rainy season and close to the intermittent streams.

The proposed location for disposal area is situated mainly within agricultural land, but also covers very small area of thermophyllous oak forest (part of it degraded). These habitats have low to medium sensitivity (none of them have high sensitivity or very high sensitivity).

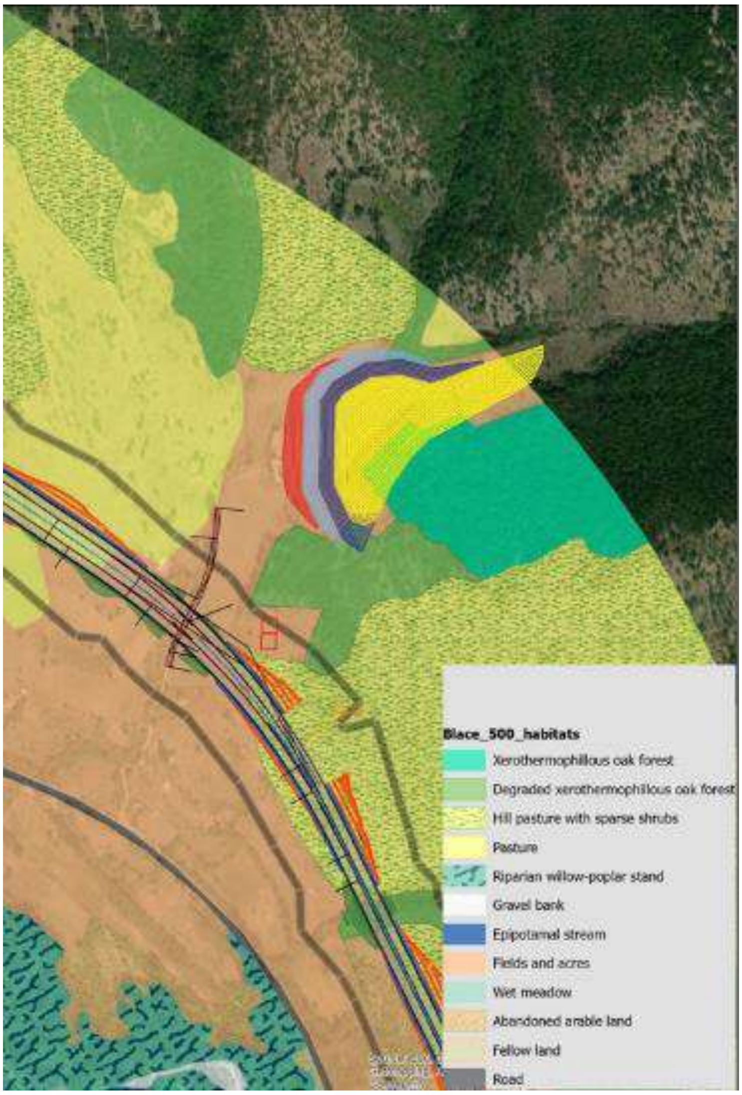

Figure 147 Location of disposal area correlated with the presented habitats

- **Assessment of impacts on critical habitats and priority biodiversity features during the construction phase**

The impacts assessment on key biodiversity features during the construction phase is presented in the following tables, separately for habitats and species.

Table 118 Impact assessment on critical habitatis and priority biodiversity features

Feature	Habitats	Impacts

PBF	3260 Watercourses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation	This habitat refers to river Lepenec and associated vegetation of different species of Ranunculus, Potamogeton, Alisma, etc. The projected motorway does not cross river Lepenec at any point. However, it approaches river Lepenec at the following points: 21.345904, 42.092212 (65 m at closest distance from the closest lane); 21.338456 42.104997 (150m at closest distance). At this point the existing asphalt road is closer to the river. We expect no direct impact during the construction phase on the habitat 3260 i.e. no herb riparian vegetation will be affected.
CH	*6220 Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea	Direct impact is expected since the projected motorway passes through some of the patches with hill pastures, but mostly through the less-representative variant of "hill pastures with shrubs". The area to be permanently lost is 6.82 ha for "hill pastures" and 21.42 ha for "hill pastures with shrubs". This area is about 9% of the total area of hill pastures in the analyzed corridor. Compared to the national coverage of this habitat (although not known) is negligible.
PBF	92A0 *Salix alba* and *Populus alba galleries*	Similar to 3260. The motorway corridor does not cross any of the patches with this habitat. No direct impact is expected.

Table 119 Impact assessment on species that trigger critical habitatis and priority biodiversity features

Feature	Species	Impacts
PBF	Brown Bear *(Ursus arctos)*	Loss of habitats, disturbance
PBF	Eurasian otter (*Lutra lutra)*	No direct impact on the species is expected as there will not be construction works near the river Lepenec.
PBF	European turtle dove (*Streptopelia turtur)*	Loss of habitat, disturbance
	Common kingfisher (*Alcedo atthis)*	Potential noise disturbance might cause a smaller number of wintering birds at the Lepenec river, water pollution might decrease the available fish on which feeds this species
	Levant sparrowhawk (*Accipiter brevipes)*	Disturbance from the surroing construction activities might force one of the pairs from this bird species to change its breeding location.
PBF	Herman tortoise (*Testudo hermanni)*	Moderate impact. Habitat destruction and modification. Loss of resource, but not affecting integrity, partial loss of/damage to key characteristics, features or elements.
PBF	Greek tortoise *(Testudo graeca)*	Moderate impact. Habitat destruction and modification. Loss of resource, but not affecting integrity, partial loss of/damage to key characteristics, features or elements.
PBF	Fire belly toad *(Bombina variegate_*	Moderate impact. Habitat destruction and modification. Loss of resource, but not affecting integrity, partial loss of/damage to key characteristics, features or elements.

5.2.11.2 Operational phase

Main activities in operational phase that will affect the biodiversity components are the following:

- Fencing of the motorway which will decrease the permeability and movement of animals;
- Traffic that may cause mortality of animals;
- Air, water and soil pollution;
- Occurrence of wild fires, especially forest fires.

The most sensitive receptors in the operational phase are the species of fauna, especially mammals, reptiles and amphibians. The vegetation along the motorway may be susceptible to the pollution caused by the traffic.

In the operational phase of the motorway the following impacts are identified:

- Fragmentation of habitats and obstructing animals to move freely across their home ranges or to disperse;
- Inadequate maintenance of vegetation along the motorway;
- Incidental leaks can cause impacts on the presented biodiversity;
- Occurrence of fires will cause more serious impacts on vegetation;
- Increased mortality of the animals due to collision with vehicles. Animal collisions can be expected due to the increased presence of food (scrap) and other dead animals. Bird species may be victims of collision with vehicles ("road kills"), and this will mostly affect small passerine birds and some non-passerines (Owls, Nightjars, Bee Eaters etc.). The following mammal species will be also threatened: northern white-breasted hedgehog (*Erinaceus roumanicus*), stone marten (*Martes foina*, badger (*Meles meles*) etc.;
- Disturbance due to increased noise and vibrations.

- **Assessment of impacts on critical habitats and priority biodiversity features during operational phase**

The impacts assessment on key biodiversity features during the operational phase is presented in the following tables, separately for habitats and species.

Table 120 Impact assessment on critical habitatis and priority biodiversity features during operational phase

Feature	Habitats	Impacts
PBF	3260 Watercourses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation	As already mentioned, the projected motorway does not cross river Lepenec at any point, although it approaches river Lepenec at two points. We expect no direct impact during the operational phase on the habitat 3260 i.e. no herb riparian vegetation will be affected. However, pollution impact on the water of river Lepenec should be taken into consideration.
CH	*6220 Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea	The following impacts from the motorway operation should be expected: fragmentation of the habitat (to be mitigated by animals passages), air and soil pollution, waste disposal, etc.
PBF	92A0 *Salix alba* and *Populus alba galleries*	Similar to 3260. No direct impact is expected but pollution (air, water, soil) should be taken into consideration

Table 121 Impact assessment on species that trigger critical habitatis and priority biodiversity features

Feature	Species	Impacts
PBF	Brown bear *(Ursus arctos)*	Fragmentation of habitats, animal mortality due to collision with vehicles.
PBF	Eurasian otter (*Lutra lutra)*	No direct impact on the species is expected.
PBF	European turtle dove (*Strpetopelia turtur)*	Loss of suitable breeding habitat and mortality caused by collision
PBF	Common kingfisher (*Alcedo atthis)*	No direct impact on the species is expected
PBF	Levant sparrowhawk (*Accipiter brevipes)*	Given the current situation (nest site of this species are close to the existing road), no significant impact is expected

PBF	Herman tortoise (*Testudo hermanni)*	Moderate impact. Habitat destruction and modification. Loss of resource, but not affecting integrity, partial loss of/damage to key characteristics, features or elements.
PBF	*Testudo graeca*	Moderate impact. Habitat destruction and modification. Loss of resource, but not affecting integrity, partial loss of/damage to key characteristics, features or elements.
PBF	Fire belly toad *(Bombina variegata)*	Moderate impact. Habitat destruction and modification. Loss of resource, but not affecting integrity, partial loss of/damage to key characteristics, features or elements.

5.2.11.3 Assessment of impacts

Biodiversity (flora, fauna, ecosystems and natural protected areas)											
Impact source	**Impact nature**	**Time of appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Magnitude**	**Sensitivity**	**Significance**	**Mitigation measures**
Construction phase											
Loss of terrestrial habitats	negative	immediate	direct	Area	short term	certain	irreversible	Moderate	Moderate	Moderate	yes
Loss of terrestrial flora and fauna	negative	immediate	direct	Area	short term	certain	irreversible	Moderate	Moderate	Moderate	yes
Disturbance of species	negative	immediate	direct	Area	short term	certain	reversible	minor	moderate	Minor	yes
Illegal hunting/accidental killing of animals by workers	negative	immediate	direct	Location	Temporary	Unlikely	irreversible	minor	moderate	Minor	yes
Introduction of alien species	negative	immediate	direct	Area	Temporary	Unlikely	reversible	minor	moderate	Minor	yes
Dust deposition	negative	immediate	direct	Area	short term	certain	reversible	minor	moderate	Minor	yes
Changes in aquatic habitats (sedimentation, Pollution and eutrophication of streams)	negative	immediate	direct	Area	short term	Likely	reversible	minor	moderate	Minor	yes
Mortality of hydrobionts	negative	immediate	direct	Area	short term	Likely	reversible	minor	moderate	Minor	yes

Biodiversity (flora, fauna, ecosystems and natural protected areas)											
Impact source	**Impact nature**	**Time of appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Magnitude**	**Sensitivity**	**Significance**	**Mitigation measures**
Operational phase											
Fragmentation of habitats	negative	immediate	direct	area	long term	Highly likely	irreversible	moderate	moderate	Moderate	yes
Inadequate maintenance of vegetation	negative	immediate	direct	area	long term	certain	irreversible	minor	moderate	Minor	yes
Incidental leaks	negative	immediate	direct	Location	long term	Unlikely	irreversible	moderate	minor	Minor	yes
Occurrence of fires	negative	immediate	direct	Location	long term	Unlikely	irreversible	moderate	minor	Minor	yes
Animal mortality due to collisions	negative	immediate	direct	Location	long term	Highly likely	irreversible	moderate	minor	Minor	yes

5.2.12 Landscape and visual aspects

5.2.12.1 Construction phase

The introduction of the new structure in the landscape will inevitably lead to changes in the visual aspects of the landscapes. The construction works and associated temporary facilities will also have impact on the visual aspects.

During the construction phase, the activities and facilities within the motorway are considered as key sources of the direct temporary physical and visual change to the landscape. Therefore, impacts may result from the construction materials and equipment. In addition, impacts may result from vegetation removal and soil removal/excavation/stockpiling as well as from material storage and waste or spoil temporary disposal. Auxiliary facilities (e.g. worker camp, storage areas) may also cause temporary impact to the landscape.

5.2.12.2 Operational phase

In the operational phase of the motorway, the impacts on the landscape will be associated with the new corridor and the structures along the alignment. The alignment is projected in an area with already medium values of visual landscape. The new road will introduce new elements into the landscape (asphalt road, bridges, tunnels, etc.). With implementation of the project there will be bridges with total length of 312 m (left branch) and 801 m (right branch) and tunnels with total length of 2509 m (left branch) and 1785 m (right branch) i.e. total length of permeable structures of 2829 m (left branch) and 2586 m (right branch). Furthermore, 10 underpasses are embedded in the road design. Thus, the permeability of the motorway is satisfactory, especially in the Lepenec river gorge. The fragmentation effect is treated in the elaboration of impacts on habitats.

One has to bear in mind that the landscape visual aspects of the area are already severely altered by the existing road and the number of industrial facilities along river Lepenec. However, the visual aspects of the area will be certainly affected due to the introduction of new structures in the area. Cuts and covers are one of the principal components that affect the visual aspects of the landscape, especially as sources of erosion. These are in length of 362 m (left branch) and 156m (right branch).

5.2.12.3 Assessment of impacts

Landscape and visual aspects											
Impact source	**Impact nature**	**Time of appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Magnitude**	**Sensitivity**	**Significance**	**Mitigation measures**
Construction phase											
Visual changes of the landscape	Negative	Immediate	Direct	Area	short term	Certain	Irreversible	Moderate	Minor	Minor	Yes
Operational phase											
Visual aspects	Negative	Immediate	Direct	Area	long term	Certain	Irreversible	Moderate	Minor	Minor	Yes

5.2.13 Forests and forestry

5.2.13.1 Construction phase

Construction activities on the motorway A4 will cause direct and indirect damage or destruction of parts of forest plantations, their reconstruction, meadows, pastures and forest lands in the project area. In addition to the construction activities for the construction of the motorway, the construction of access roads and other auxiliary infrastructure and facilities will cause additional negative impact on the forests and forestry.

For the implementation of the project activities, certain parts under the forest will be affected, due to which the trees will have to be cut down. With the necessary expropriation and conversion of the land from forest to construction, certain production areas will be permanently lost, which will negatively affect the forest management and the preservation of the forest fund. Forest plantations, meadows, pastures and forest lands in the project area are considered as sensitive receptors. In addition, the construction activities will contribute to a certain loss of wood mass from the pubescent (downy) oak (*Quercus pubescens* Willd.) and white hornbeam (*Carpinus orientalis* Mill.) forests included in the *Querco - Carpinetum orientalis macedonicum* Rud.1939 ap. Ht.1946. forest community. Removal of forest vegetation may cause erosion processes in the soil, as well.

It can be concluded that the construction activities within the project can cause negative impacts on forests as a natural resource and forestry, as a result of permanent loss of forest area, loss of wood mass and loss of natural regeneration, which may be direct, indirect and cumulative, to occur immediately and with irreversible effect.

The main potential impacts on the forests during the construction phase of the motorway include:

- Loss of forest area - construction activities will irreversibly cause loss of certain forest area.
- Loss of certain number of trees and decreased carbon sequestration capacity – the removal of certain number of trees in construction phase will decrease the carbon sequestration capacity as it is related with the number of these at certain area.
- Loss of wood mass – the removal of trees of the forest area will lead to irreversible loss of wood mass.
- Loss of natural regeneration – construction activities and loss of certain forest area will cause loss of the natural regeneration of forests in the project area.
- Possibility for occurrence of erosion processes – all construction activities taken in areas with minimal tree coverage may result in occurrence of erosion processes and loss of topsoil.
- Dust deposition - during construction dust deposition may cause physiological weakening and decrease of the increment of the forest vegetation

In general, the construction activities in the deforested and bare landed project area may cause instability of the soil layers as a result of the use of heavy construction machinery. In addition to the permanent loss of fertile forest soil in the project area, certain damage will be done with the application of heavy construction machinery that will contribute to its compaction, and thus damage.

5.2.13.2 Operational phase

The use of the motorway can cause negative impacts on forests and forestry and forest ecosystems respectively, as a result of motorway maintenance, increased risk of forest fires, unwanted leaks etc.

Forest plantations, meadows, pastures and forest lands in the project area are considered as sensitive receptors.

The maintenance of the route of the motorway will mean clearing of the natural regeneration of the forests in the immediate vicinity (protection belt), which will prevent, i.e. reduce the potential of the forest for regeneration.

In the operational phase of the motorway, increased passenger and vehicles flow increase the possibility of forest fires, most often caused by negligent passengers, as well as other incidental events that may cause negative impacts on forest plantations.

5.2.13.3 Assessment of impacts

Forests and forestry											
Impact source	**Impact nature**	**Time of appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Magnitude**	**Sensitivity**	**Significance**	**Mitigation measures**
Construction phase											
Loss of forest area	Negative	Immediate	Direct	Area	Long term	Certain	Irreversible	Moderate	Minor	Minor	Yes
Loss of certain number of trees and decreased carbon sequestration capacity	Negative	Immediate	Direct/Indirect	Area	Long term	Certain	Irreversible	Moderate	Minor	Minor	No
Loss of wood mass	Negative	Immediate	Direct	Area	Long term	Certain	Irreversible	Moderate	Minor	Minor	No
Loss of natural regeneration	Negative	Immediate	Direct	Area	Medium term	Certain	Irreversible	Moderate	Minor	Minor	Yes
Possibility for occurrence of erosion processes	Negative	Immediate	Direct	Area	Short term	Likely	Irreversible	Moderate	Minor	Minor	Yes
Dust deposition	Negative	Immediate	Direct	Area	Short term	Likely	Reversible	Minor	Negligible	Negligible	No

Forests and forestry											
Impact source	**Impact nature**	**Time of appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Magnitude**	**Sensitivity**	**Significance**	**Mitigation measures**
Operational phase											
Motorway maintenance	Negative	Delayed	Direct	Area	Long term	Likely	Reversible	Minor	Moderate	Minor	Yes
Forest fires	Negative	Delayed	Direct	Area	Long term	Certain	Irreversible	Moderate	Minor	Minor	Yes
Leaks/pollution	Negative	Delayed	Direct	Location	Long term	Likely	Reversible	Moderate	Minor	Minor	Yes

5.3 Social impact assessment

5.3.1 Positive social and socio-economic impacts

5.3.1.1 Construction phase

Implementation of the Project directly and indirectly will contribute to the economic development of the Municipality of Chucher-Sandevo. It is expected increased engagement of local mining and transport companies as a supplier for the contractor during the construction of the motorway. Furthermore, there will be increased level of local employment and financial benefits for the local population.

On the basis on above, it could be concluded that implementation of the project during construction will cause:

- Increased engagement of local mining and transport companies as a supplier for the operator for construction of the motorway;
- Positive development of the local road network near and around the part of the industrial zone Vizebgovo that belongs to this municipality;
- Increased local employment.

5.3.1.2 Operational phase

Implementation of the Project, directly and indirectly, will contribute to the economic development of the country, i.e. it will allow connecting to Corridor VIII, which is one of the main preconditions for further development of national transport, businesses, economy etc. The built motorway will provide overall conditions in the area for faster and safer transportation of people and cargo that contribute to the socio-economic development of the region and the country.

Other positive social and socio-economic benefits during operational phase are:

- Some dirt roads passing beneath the motorway in order to reach fields, will be coated with asphalt;
- Traffic safety on the local E4 (E-65) road will be significantly improved (current road is very insecure and in bad condition);
- Travel time towards/from Kosovo will be shorter;
- Increased employments for maintenance of the motorway;
- More companies will approach to the current area (extended economic zone Vizbegovo) to build their production capacities and other facilities due to the improved local road network;
- Improved accessibility for residents of village Blace to the city of Skopje, and accordingly better access to educational, health and social facilities.

5.3.1.3 Assessment of impacts

Social community											
Impact	**Impact nature**	**Time of appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Magnitude**	**Sensitivity**	**Significance**	**Mitigation measures**
Construction phase											
Increased engagement of local mining and transport companies as a supplier for the operator for maintenance of the motorway	Positive	Immediate	Direct	Local	Short-term	Likely	Irreversible	Minor	Low	Low	No
Positive development of the local road network near and around the part of the industrial zone Vizebgovo that belongs to this municipality	Positive	Immediate	Direct	Local	Long-term	Certain	Irreversible	Moderate	Medium	Medium	No
Increased local employment	Positive	Immediate	Direct	Local	Short-term	Highly likely	Reversible	Minor	High	Medium	No
Operational phase											
Some dirt roads passing beneath the motorway in order to reach fields, will be coated with asphalt	Positive	Immediate	Direct	At location	Long-term	Highly likely	Irreversible	Minor	Low	Low	No
Traffic safety on the local E4 (E-65) road will be significantly improved (current road is very insecure and in bad condition)	Positive	Immediate	Direct	National	Long-term	Certain	Irreversible	Moderate	High	Medium	No
Travel time towards/from Kosovo will be shorter	Positive	Immediate	Direct	Cross border	Long-term	Highly likely	Irreversible	Moderate	Minor	Medium	No
Increased employments for maintenance of the motorway	Positive	Delayed	Direct	Regional	Long-term	Certain	Irreversible	Minor	Minor	Low	No
More companies will approach to the current area (extended economic zone Vizbegovo) to build their production capacities and other facilities due to the improved local road network.	Positive	Immediate	Direct	Regional	Long-term	Highly likely	Irreversible	Moderate	Minor	Medium	No
Improved accessibility for residents of village Blace to the city of Skopje, and accordingly better access to educational, health and social facilities.	Positive	Immediate	Direct	Local	Long-term	Likely to occur	Irreversible	Moderate	Low	Medium	No

5.3.2 Community Health,Safety and Security

5.3.2.1 Construction phase

Implementation of the project activities will contribute to the temporary or permanent disruption of the habits of lifestyle and patterns of movement of the property owners, road users, local farmers, and companies.

Construction of the linear infrastructure involves activities that take place in a particular territory, relatively short and narrow in width. As a result of the relatively short length of the motorway, it is possible for the whole route to become a construction site for a certain period of time.

The sensitive receptors are mainly local population and livestock, i.e.:

- Grazing livestock,
- Farmers taking livestock for grazing at the areas where the motorway is planned to be constructed,
- Farmers reaching their fields,
- Other property users,
- Passengers and drivers.

On the basis of the above it can be concluded that during the implementation of the project, possible risks and negative impacts to public safety are possible and related main social impacts can be identified as:

Loss of livestock's lives due to the illegal presence at the construction sites, open pits and tunnel mining area. Possible risks and negative impacts to public (and worker's, particularly) safety can be caused by entrance of unauthorised persons and livestock at the construction site. Livestock (sheep and cattle, and some goats and guard dogs) can enter the construction site, which, by the character of the project will extends to some 10 kilometres, can endanger their live, as well as the lives of the shepherds. Animal considers the area as a grazing location and will continue to behave as such, unless properly guided by the shepherds and guard dogs and change routes of movement.

Decreased general health and safety of the drivers and passengers (E4 road) due to the increase of construction related traffic. Implementation of project activities during construction will cause endangered traffic safety to the local road users, as well as users of the existing international road toward/from Kosovo (A4). Also, due to the nature of the works that are planned to be performed on site, like the use of explosives for tunnels, corrosive, dangerous and flammable materials, during their transport sometimes accidents and incidents occur and commuters can be affected.

Increased number of traffic accidents on the existing E4 (E65) road. Access to the construction sites, transportation of materials, workers and waste may generate a risk of traffic accidents. Construction works, heavy machinery and large transport vehicles and increased intensity and volume of the traffic will affect the normal road traffic regime in the Project area, particularly the main road that leads toward Kosovo. Also, the companies and local farmers who use the current road network in the project footprint to reach fields or business destinations, very often commute with farming mechanisation across the existing A4 road, therefore presenting significant threat to the road commuters.

Annoyance due to the explosions. Foreseen explosions for the purpose of tunnel drilling will not cause disturbance to the daily life of nearby settlements due to the presence of both quarry mines in the municipality (Brazda and Banjani), where the use of explosives is regularly practiced several times throughout the year. Blasts are limited and controlled, and sometimes its noise effects are experienced even in Skopje. Additionally, military uses explosive devices during exercises on the military training facility (shooting range).

At this stage, it is unknown who will be Contractor and what construction techniques will be applied.

Dust and noise emissions generated by the site construction activities also would not present issue to the closest settlements to the project area of influence since noise and dust is already present due to the quarries and sand separation factories installed (next to the river Lepenec) between the closest settlement and the current road and planned motorway.

5.3.2.2 Operational phase

Sensitive receptors during operational phase are:

- Passengers and drivers,
- Livestock grazing near motorway

Decreased traffic safety during operation. Passengers' and drivers' health and safety on the motorway can be endangered by several external factors that do not depend on commuter's behaviour, such as:

- Natural disasters, Possible landslides on the road as a result of soil erosion;
- Presence of livestock and other animals on the motorway by breaching of the protection fence of the Motorway;
- Faults in design (inadequate drainage) and road maintenance, Performing heavy construction activities during maintenance of the motorway;
- Illegal crossings over the motorway;
- Presence of military shooting facility and possible ricochets;
- The possibility of intentional and unwanted leaks that can cause fire, contamination of surface and ground water, soil, pose a threat to human health and material goods, etc.

All conditions listed here can cause traffic accidents, floods, fire and explosions, contamination of environmental media and also pose a threat to traffic safety, as well as to the health and safety of local population, commuters, local transport companies and drivers.

Endangered traffic safety during performing military exercises at the shooting range. In the operational phase of the project, the proximity of the military training shooting range to the motorway (120-150 m from the shooting range) presents minor risk to the motorway commuters (drivers and passengers). Proximity of the military training shooting range in a case of ricochets may endangered health and safety of the drivers and/or passenger.

Figure 148 Military training area (Shooting range)

Figure 149 Proximity of the Military Shooting Range to the Motorway

Figure 150 Proposed view of Shooting Range's and Motorway's embankments and the cattle farm

5.3.2.3 Assessment of impacts

Social community											
Impact	**Impact nature**	**Time of appearance**	**Type**	**Scope**	**Duratio n**	**Probabilit y**	**Reversibilit y**	**Magnitude**	**Sensitivity**	**Significanc e**	**Mitigatio n measures**
Construction phase											
Potential impacts in case of unauthorised access of people and animals to construction sites	Negative	Immediate	Direct	At location	Short-term	Likely	Irreversible	Minor	Minor	Low	Yes
Risk to health and safety of the drivers and passengers (E4 road) due to the increase of construction related traffic (increased number of traffic accidents on the existing E4 (E65) road)	Negative	Immediate	Direct	Area	Short-term	Highly likely	Irreversible	Moderate	Moderate	Medium	Yes
Operational phase											
Traffic safety risks during operation due to illegal crossings over the motorway, etc.	Negative	Delayed	Direct	Local	Long-term	Likely	Irreversible	Minor	Moderate	Low	Yes
Endangered traffic safety during performing military exercises at the shooting range.	Negative	Immediate	Direct	Local	Long Term	Likely	Irreversible	Minor	Moderate	Low	Yes

5.3.3 Labour, Working conditions, Occupational health, Safety and Security

5.3.3.1 Construction phase

Labour and working conditions are a cross-disciplinary area concerned with protecting the safety, health and welfare of people engaged in work or employment.

Due to the strong national legislation and monitoring system in the Labor domain it is not expected adverse impacts in regards of labor discrimination, equal opportunities for workers, and prohibition of child and forced labor to occur.

Labour influx is not expected to be problematic due to the relative distance of the settlements from the project footprint. Workers are not expected to wander around (across the river Lepenec), where the closest settlement to the minor section of the project footprint is located, nor there are orchards or other fields near the project footprint that would attract their attention and initiate their socially unaccepted behaviour.

Importing workers for this project is not expected to occur since the wide project area has potential workforce needed for construction activities. Workers can be transported to the active construction site on a daily base. The project is at a distance of 1 km from first houses that belong to the capital city of the country, Skopje (who accommodates more than 600.000 people). If Contractor decides to bring workers out of wide project area (Skopje region), then he can find accommodation for his/her workers in the city of Skopje which do holds necessary infrastructure for accommodation set in urban settlements (easy to be controlled by the relevant inspection services, if needed). In case the Contractor decides to create Worker's Accommodation Camp, it would surely not affect any local community that neighbours the project area of influence. Hence, at this stage of the project it is still unknown whether the need for workers' accommodation will occur. This will be familiar once the Contractor is being selected and his construction strategy and approach defined.

Furthermore, the Constitution prohibits all forms of forced or compulsory labour. The Criminal Code also prohibits slavery, transportation of enslaved people and forced labour. Labor law defines participation in trade union, working hours, pensions, disabilities, salaries, healthcare and discrimination.

Contractor and its sub-contractors, according to the Macedonian laws on occupational health and safety must take all necessary measures to provide and maintain a safe and healthy workplace taking in account into account inherent risks in its particular sector and specific classes of hazards that may be present. All employers are obliged to implement and monitor all measures taken to ensure acceptable occupational health and safety. There are numerous rulebooks that support main OHS legislation.

Labour risks regarding Gender – Based Violence and Harassment (GBVH), in relation to this project are not expected to occur, although possibility of occurrence should not be ignored. At this moment it is not familiar how many female workers will be engaged, and at what positions.

In addition to the controls on labour, the project footprint is at a grip of governmental institutions who can easily monitor (frequently, if incompliances are registered) the work and respect of implementation of primary and secondary OHS and labor law provisions.

Sensitive receptors during construction phase are:

- Workers engaged by the Contractor and sub-contractor
- Employees
- Female workers

Impacts, in regards of worker's health that are expected to occur and seek mitigation measures, are:

Injuries from attacks of sheep guard dogs to the workers. Due to the construction activities, there will be increased presence of people (workers) at the grazing locations. This state could significantly annoy cattle and sheep guard dogs who might attack human individuals (workers and equipment guards) present on construction site in order to protect the herd.

Decline in health services delivery - Extended time of travel for the Emergency Service to the construction site. Although, the travel time from the first location of social interest (presented on **Figure 121**) to the main City's Hospital is 15-20min (ca.16 km distance), and 8 min to reach location at the end of project, during construction phase this travel can be extended for at least 10 min to reach location I, in case of emergency.

Worker's annoyance due to the presence of shooting exercising and increased personal health risk. The proximity of the military training shooting range (120-150m) from the project footprint, presents minor risk to the workers if ricochet occurs. Noise from the shooting exercises can also be annoying to workers.

Delays in construction works and accidents and incidents occurrence due to the engagement of unskilled and unqualified workers by the contractor and its sub-contractor. Sometimes, contractors do not possess the appropriate qualified workforce for the successful implementation of the project. That's why they often create consortia, or engage other companies who adds their own or someone else's workforce. This, the so-called. borrowed staff, does not always have the necessary training and experience, and it is a potential threat to the project implementation process, as well as to people (colleagues, local population population) as well as to the human environment.

Disabilities created due to the accidents caused by easily flammable, corrosive and explosive materials. Project activities envision drilling tunnels. For this purpose, highly flammable materials, as well as explosives, will be used. Poor handling, as well as poor storage of these easily flammable, corrosive and explosive materials can cause material damage. And above all, it poses a threat to the safety of workers and the environment. Fires and or explosions resulting from ignition of easily flammable, corrosive and explosive materials or gases can lead to loss of property as well as possible injury or fatalities to project workers. Explosions and fires can occur at the storage location, as well as during transport of such materials to and from storage location.

Infection of workforce by Communicable and Vector-Borne diseases. Health related impacts are also likely to occur in locations where construction works take place. The near vicinity of rivers (Lepenec and Vardar), could be home of various vector species that can easily transmit diseases. The presence and severity of coronavirus SARS-CoV (COVID-19) is expected to continue, until proper cure is found. As the number of workers employed by the Project would be relatively high at a certain moment, the risks of communicable diseases transmission at workplace are possible. This refers to the coronavirus SARS-CoV (COVID-19), vector borne diseases and possibly other sexual and other communicable diseases.

Other predictable (due to the unknown contractor and construction method) risks to the labour, occupational safety and health and working conditions to be considered for this project, but not limited to the following, are:

- Potential ignorance on the rights and wellbeing of the Worker's engaged on construction works of this project (not only for the construction workers of the contractor, but sub-contractors as well);
- Lack of PPE provided to and used by the workers by the Contractor;
- Lack of experience to work in road construction sector, and consequently increased risk of accidents;
- Lack of HR policies in the Contractor (sub-contractors);
- Lack of basic professional trainings;
- Risks that Contractor (and subcontractors) may not follow national legislation in relations to worker's rights, HSE and relevant entitlements.
- Inability to voice concern regarding violation of workers' rights.

The risk of accidents or incidental situations related to activities performed on construction sites, may arise as a result of:

- Technical defect of the equipment for work (construction equipment);

- Improper handling of raw materials and auxiliary materials, waste, etc.;
- Car accidents;
- Human error and natural phenomena (earthquakes, floods, etc.).
- Injures from construction machinery such as injuries due to roll-over of equipment and objects falling onto the equipment, collapse of equipment in use due to overloading, and failures due to poor slinging techniques for lifting equipment;
- Injures from physical overexertion, repetitive manual tasks, prolonged standing, or working in awkward position;
- Injures from welding/hot work;
- Extreme working environmental temperature;
- Working in confined spaces (tunnelling) and working on height (viaducts and bridges).

PESR, as a client to IFI's (among which EBRD is the most present) has already implemented policies relevant to EBRD ESP requirements.

5.3.3.2 Operational phase

Sensitive receptors during operational phase are:

- PESR Employees
- Maintenance workers engaged by the Contractor (and sub-contractor)
- Female workers

OHS risks and impacts during the road operation are similar to those in the construction phase, limited to the operational and maintenance activities of the road, which will be occasional and/or involve a limited number of workers.

During the operational phase PESR and maintenance workers will be exposed to risks directly related to activities performed during motorway use and maintenance and at the pay toll. Potential impacts may occur due to the events, but not limited to:

- Falling into trenches;
- Falling from a height;
- Causing injury from handling machinery and tools;
- Exposure to increased dust, exhaust gases and noise emissions;
- Car accidents;
- Exposure to extreme weather working environment.

The risk of accidents or incidental situations in operational phase may arise as a result of:

- Technical defect of the equipment for work for maintenance of the motorway (construction equipment and motorway equipment);
- Improper handling of raw materials and auxiliary materials, waste, etc.;
- Human error and
- Natural phenomena (earthquakes, floods, fire, rockfalls, etc.).

5.3.3.3 Assessment of impacts

Occupational health, safety and security											
Impact	**Impact nature**	**Time of appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Magnitude**	**Sensitivity**	**Significance**	**Mitigation measures**
Construction phase											
Risks for workers' safety related to construction activities (injuries, diseases etc.)	Negative	Immediate	Direct	Location	Short–term	Likely	Reversible	Minor	Moderate	Low	Yes
Extended time of travel for the Emergency Service to the construction site	Negative	Immediate	Direct	Area	Short-term	Likely	Reversible	minor	Moderate	Low	Yes
Operational phase											
Risks for workers' safety related to maintenance/operation activities (injuries, diseases etc.)	Negative	Immediate	Direct	Location	Short–term	Likely	Reversible	Minor	Moderate	Low	Yes

5.3.4 Property, Housing, Communication & Infrastructure

5.3.4.1 Pre-Construction phase

Loss of land and property. Bigger part of the alignment passes through unpopulated areas. The smaller part of the alignment (near the junction with the Skopje Ring Road) affects active agricultural parcels and several companies. No physical displacement of people or businesses is expected, but some minor impact on livelihood could occur, due to the lower level of land/property use.

Land and property acquisition process will occur prior any construction activities take place. The project will acquire agricultural land, some auxiliary objects from few companies and improvised weekend house (see following figure). As a result of this, the land and property owners (and users) will be affected.

At the location **I** there is an improvised weekend house that is rarely visited by its owner. The object is set on private land.

Figure 151 Improvised weekend house to be acquired and dismantled at the location I (see chapter 3.5.5)

At the location **V** a shepherd's house, along with one sheep pen and auxiliary facility, at the km 8+600m, shall be acquired.

Figure 152 Shepard house and sheepfold, along with land beneath the objects, to be acquired

Three sheep pens (see map in **chapter 3.5.5**: I, III, and IV) are set on governmentally owned land, while the single sheep pen set on a privately owned land (see location V on the map in **chapter 3.5.5**) will lose part of its fixed assets.

Figure 153 Sheep pen at location V (see chapter **3.5.5**)

The cattle farm buildings (see location VI on a map in **chapter 3.5.5**) are constructed illegally, on a military land (also in governmental possession).

Figure 154 Foreseen acquisition of land (violet line) next to the cattle farm

Any of the objects that belongs to the cattle farm is also not foreseen to be affected by physical resettlement (expropriation).

Figure 155 Dwelling object at the cattle farm

There are companies that will lose fixed assets (land and storage space). These companies are located at the end of the project footprint, just prior to the roundabout that connects the motorway to the existing Skopje Ring Road and road towards Skopje. Some parts of the land to be expropriated are used as a storage place (for storage of tiles, and gravel used for cement factory), while other parts are used as a parking space (for transport vehicles, mainly).

The following images presents the current and planned situations with companies located at the end of the project footprint.

Figure 156 Affected fixed assets of the companies located at the end of the project footprint

At the moment it was not possible to assess the exact number of used arable fields, hence the procedure for socio-economic survey and census for the purposes of Land Acquisition and Resettlement Plan (LARP) will assess the exact extent of fields being used for growing crops, likewise the exact impacts on how many households solely depend on the livelihood provided by the growing crops or other farming activity. For this project there is a Land Acquisition and Resettlement Framework (LARF) that precedes LARP, and it is created in compliance with EBRD PR5 and PR10. LARP activities will be conducted and completed prior commencement of any construction activity and in compliance with EBRD PR5 and PR10, and GIIP.

No displacement of people will occur, nor objects (house) for permanent dwelling will be expropriated within the planned activities for this project.

5.3.4.2 Construction phase

Temporary occupation of private land is not expected to occur during construction due to the sufficient free available governmentally owned land along within the project area of influence and next to the project footprint.

Loss of peace and space commodity for users of weekend houses and dwellers on cattle farm and potentially induced abandoning of property. Weekend house owners (those who frequently use their property) will lose peaceful and relatively spatially comfort location where their private property, used for enjoyment and relaxation, is located. Additionally, noise, dust and increased number of people and vehicles will be present near their property during construction period. There is one populated object (cattle farm), whose inhabitants will experience decrease of quality of housing, and some 7 (6+1) weekend house objects that will be affected with the loss of commodity of life, during the construction period. These locations are listed in **chapter 3.5.5** as locations: I, II and VI. At the location II the house is possible to lose

Increased time of travel from Skopje to Kosovo, and vice versa. Construction activities will extend the time travel for passengers traveling to/from Kosovo to/from Skopje. It is also expected decreased number of visits to the relatives living in both sides to occur, due to the extended time for travel through active construction sites.

Impeded traffic flow and decreased communication. Increased frequency of vehicles can cause minor traffic congestion or temporary disruption of the regular traffic flow, which may affect local property users, as well as road users sometimes resulting in financial and unplanned costs.

Hindered access to land and property. During the construction phase, some local roads intersecting project footprint will be closed (some permanently) and traffic will be diverted through the existing roads, or new short road sections within the project area of influence will be constructed. This activity will cause brief temporary hindered access to the land, other fixed assets and available resources (fields, premises, forest, pastures and other) for the land owners and land users in the project area of influence.

The following images give overview of the proposed solution for enabling access to property and resources (orange color are new roads).

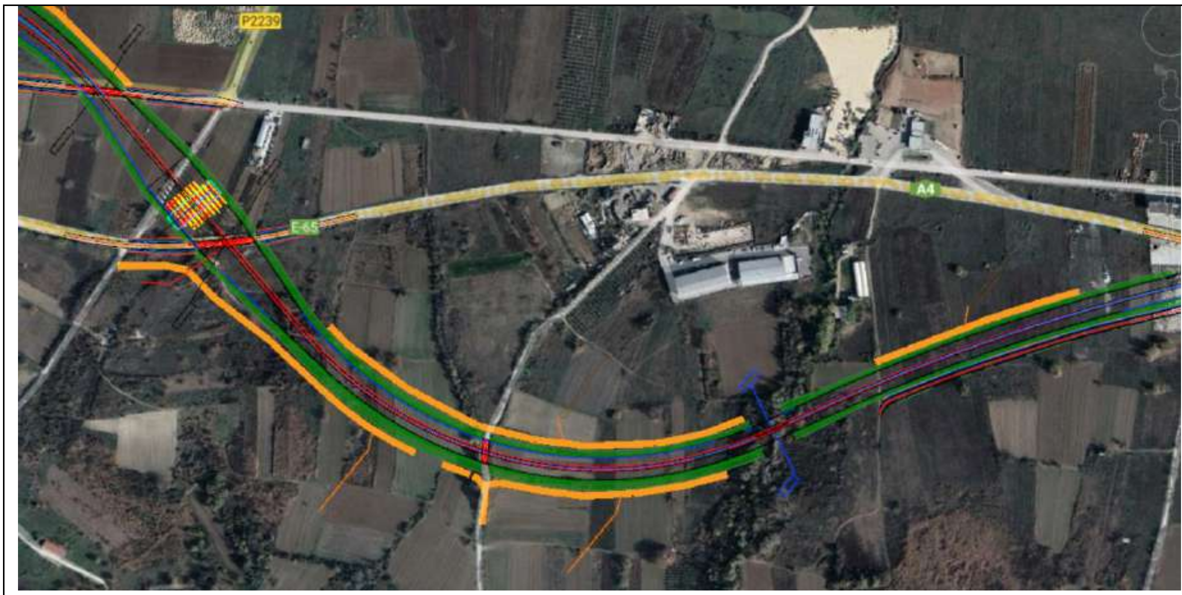

Figure 157 Changes in road network (new access roads are with orange colour) in the project affected area

5.3.4.3 Assessment of impacts

Property, Housing, Communication & Infrastructure											
Impact	**Impact nature**	**Time of appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Magnitude**	**Sensitivity**	**Significance**	**Mitigation measures**
Pre-Construction phase											
Loss of agricultural land and property (weekend houses, cattle farm and commercial/residential auxiliary facilities)	Negative	Immediate	Direct	Area	Long-term	Certain	Irreversible	Minor	Negligible	Low	Yes
Construction phase											
Construction related nuisances (noise, dust, etc.) for nearby local communities (such as businesses located at the ending part of the route or weekend settlement users)	Negative	Immediate	Direct	Location	Long-term	Likely	Reversible	Minor	Minor	Low	Yes
Increased time of travel from Skopje to Kosovo, and vice versa	Negative	Immediate	Direct	Regional	Short-term	Certain	Reversible	Minor	Minor	Low	Yes
Impeded traffic flow and decreased communication	Negative	Immediate	Direct	Area	Short-term	Highly likely	Reversible	Minor	Minor	Low	Yes
Hindered access to land and property dueto traffic diversions	Negative	Immediate	Direct	Location	Short-term	Highly likely	Reversible	Minor	Minor	Low	Yes

5.3.5 Economy, Use of natural resources & Livelihood provision

5.3.5.1 Construction phase

Loss of livelihood/income. The following receptors will experience adverse livelihood provision impacts:

- Farmers growing crops
- Farmers keeping livestock
- Private individuals losing land planned to be used in commercial purposes (selling it to the business, or opening a business)
- Companies losing land planned to be used for commercial aims (construction of commercial facilities and expansion of business).

Loss and/or limitation of access to free natural resources used for keeping livestock. Farmers keeping livestock will lose (have limited, as a better option) access to the free resources available near and at the project footprint. This refers to pastures that belong to the government, but are not in use by the GRNM or private individuals for a long period.

Same is with the free available water resources used for keeping livestock. The water catchments are set high in the local hills and brought to troughs installed next to the sheep pen, by rubber hose. During construction it is expected most of these hoses that bring fresh drinking water to the throughs to be damaged and new one will need to be installed. This refers to locations (see map in the **chapter 3.5.5**) I, III, V and VI.

Figure 158 Trough used for drinking water at location III (see chapter 3.5.5)

Figure 159 Alignment of the Motorway passing near the sheep pen at the location III (orange colour is a new road with underpass that can be used by sheep)

Figure 160 Sheep pen at location IV (see chapter 3.5.5)

Figure 161 Sheep pen at location V (see chapter 3.5.5)- Sheep are freely grazing on the local hills

Small livelihood related impact will occur to the cattle farm, which will actually lose illegally occupied governmental land that is actively used for preparation of the cattle prior sending for grazing onto the local pastures spread on the hills, as well as a hay storage location used during winter times. Owners of the cattle farm will have to reorganize availbale space to accommodate their farming needs.

Figure 162 Cattle at location VI (see chapter 3.5.5)

Loss of income from growing crops. Although project footprint passes through a relatively hilly terrain, hence a part is located in the area of arable land where some parcels are actively used by population in neighbouring settlements and by some companies, for growing crops. It is not expected to see significant livelihood losses to occur as a result of land acquisition process. Better part of the affected privately owned parcels remain unused.

Figure 163 Farmers on the affected fields

At this stage, it is not possible to assess the exact number of used arable fields, and crops grown on it. It is expected, after approval of Infrastructure design for this project, and adoption of Expropriation elaborate and conducted crops and property valuation, LARP to be completed and all relevant information to be available for analysis and proposing adequate compensations/replacement (if any).

Increased operational costs of companies being present throughout the project area of influence. During the construction phase some companies operating throughout the area of influence might experience disruption of daily activities, due to the construction activities. Some roads (see roundabout at the following figure) that these companies use can be temporary closed and the traffic will be redirected to alternative routes, thus disposing companies to additional and unplanned costs (losses), that are not expected to be crucial to distort normal operating of these companies.

The following images presents the potential location where financial implications in business can be experienced due to the construction activities.

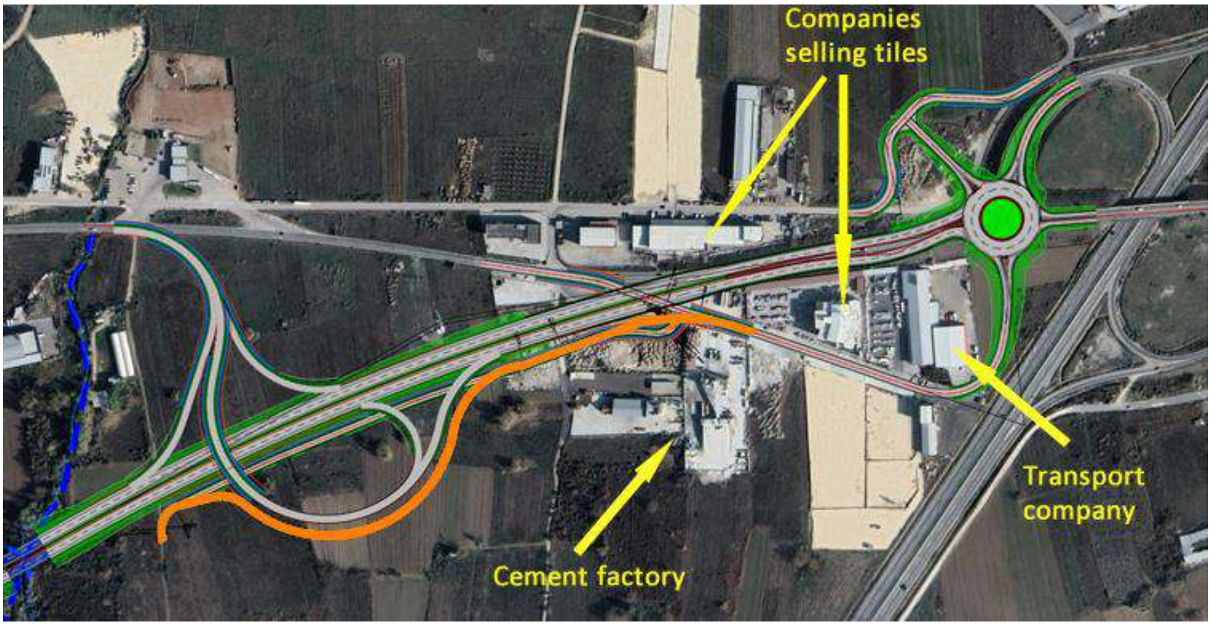

Figure 164 Roundabout (at the end of the project), motorway connection and proposed exit as a complex solution that can temporarily cause financial losses to the companies presented on this figure

5.3.5.2 Operational phase

No social impacts are expected in this phase.

5.3.5.3 Assessment of impacts

Economy, Use of natural resources & Livelihood provision											
Impact	**Impact nature**	**Time of appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Magnitude**	**Sensitivity**	**Significance**	**Mitigation measures**
Construction phase											
Loss and/or limitation of access to free natural resources (pastures and spring water) used for keeping livestock	Negative	Immediate	Direct	Area	Short-term	Certain	Reversible	Minor	Moderate	Low	Yes
Loss of income from growing crops on arable land that will be acquired for Project needs	Negative	Immediate	Direct	Area	Long-term	Highly likely	Irreversible	Minor	Minor	Low	Yes
Temporary income losses for businesses due to construction related disruption	Negative	Immediate	Direct	Area	Short-term	Likely	Reversible	Minor	Minor	Low	Yes

5.3.6 Cultural heritage

5.3.6.1 Construction phase

Based on the available documentation, no cultural heritage has been recorded on the designed road footprint. Close to the border of project influence area at a distance of 600 m is located the cultural heritage site Davina Kula. It is not expected that the construction activities may cause adverse impact on the cultural heritage site Davina Kula.

Given that project area has been populated since ages, during the construction work some accidental disclosure of cultural heritage or objects that have historical value may occur. During the construction work, possible damage and loss of undiscovered archaeological site may occure. Uninformed workers cannot identify and alert on possible chance find. Therefore, it is possible to lose or destroy important undiscovered archaeological locations, together with potentially valuable evidence.

Blace cemetary would not be affected with construction activities.

5.3.6.2 Operational phase

No Cultural Heritage related impacts in operational phase are expected.

5.3.6.3 Assessment of impacts

Cultural heritage											
Impact source	**Impact nature**	**Time of appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Magnitude**	**Sensitivity**	**Significance**	**Mitigation measures**
Construction phase											
Potential damage and loss of undiscovered archaeological site or items	Negative	Immediate	Direct	Local	Long-term	Unlikely	Irreversible	Moderate	Minor	Minor	Yes

5.4 Environmental and social cumulative impacts

5.4.1 Introduction

Changes in the environment caused by the foreseen activities in combination with other past, present or future activities, that are similar to those foreseen in the observed area, have been assessed as cumulative impacts. In general, the cumulative effects relate to impacts that supplement the basic or interactive effects (synergy) in nature, resulting conducting of several activities at a particular time, including the impact caused by the project activity.

The cumulative effects of projects, plans, developments and existing facilities depend on the capacity of the respective environmental receptor to adapt to additional change. Actions that are minor individually may become significant when considered in combination with other major or minor actions, especially if sensitive receptors are affected.

From the submitted project documentation for construction of the motorway A4, as well as the collected data and information for the project areas and its surrounding for the predicted planning activities regarding the urban development and land use in the municipality, it can be concluded that in the vicinity of the project area, where the motorway is located, activities for implementation of the infrastructure projects are predicted. In addition, there are many smaller to medium infrastructures and facilities that already exist and cause impacts on the environment as well as there are some facilities that have already been built and their presence or prolonged effects from the time of their construction may contribute to the occurrence of cumulative impacts.

The construction activities for this Project are estimated to start in the 4th quartile of 2022. The project duration of the construction phase is estimated to three (3) years from the commencement day.

5.4.1.1 Methodology for assessment the significance of cumulative effects

The assessment of the significance of cumulative effects is based on the criteria, presented in the following table:

Table 122 Methodology for assessment of significance of the cumulative effect

Significance of effects		
Significant	**Severe**	Effect on the receptor/resource is irreversible and the decision-maker must take into account
	Major	Effects that are likely to become issues on whether the Project design should be selected
	Moderate	Effects that are unlikely to become issues on whether the project design should be selected, but future work may need improvement on current performance
Not Significant	**Minor**	Effects are locally significant
	Negligible	Effects that are within the receptor's ability to absorb further impact

5.4.2 Overview of the possible sources for cumulative impacts

The identified past, present and reasonably likely to occur projects in the project area of influence and its surroundings that have the potential to cause cumulative effects are presented in the following table. Also the identified associated facility i.e. Subsection 1 is part of the cumulative assessment. This subsection will be finished and in operation when construction of Subsection 2 will start.

Table 123 Identified past, present and reasonably likely to occur projects in the project area of influence

No.	Project	Status
1.	Quarry and separation plant owned by Company Transmet	Existing
2.	Concrete plant owned by Granit and its administrative buildings	Existing
3.	Sand separation plant	Existing
4.	Two sheepfolds	Existing
5.	Two cattle farms and auxiliary objects	Existing
6.	Gas station Diesel	Existing

7.	Sport airport Stenkovec	Existing
8.	Industrial facilities close to interchange Stenkovec	Existing
9.	Motorway A4 subsection 1 (from Blace crossing point to v.Blace)	Existing*
10.	Existing regional road A4	Existing
11.	Local urban-planning documentation for a facility with a purpose E2-Gas station and service centers with accompanying facilities on KP 1283/1, KP 1283/5 and KP 1284	Planned
12.	Local urban-planning documentation for a building with purpose E1 - Infrastructure project for local road, KM Gluvo Brazda	Planned

*The subsection 1 will be in operation when construction work for Subsection 2 will start.

On the following figures are presented the location of the identified projects together with the alignment of the motorway. The projects marked with blue pin are projects which are planning to be implemented and the projects marked with yellow pin are the ones that already exist in the project area of influence. The marking with numbers corresponds with the numbering of the projects in the table above.

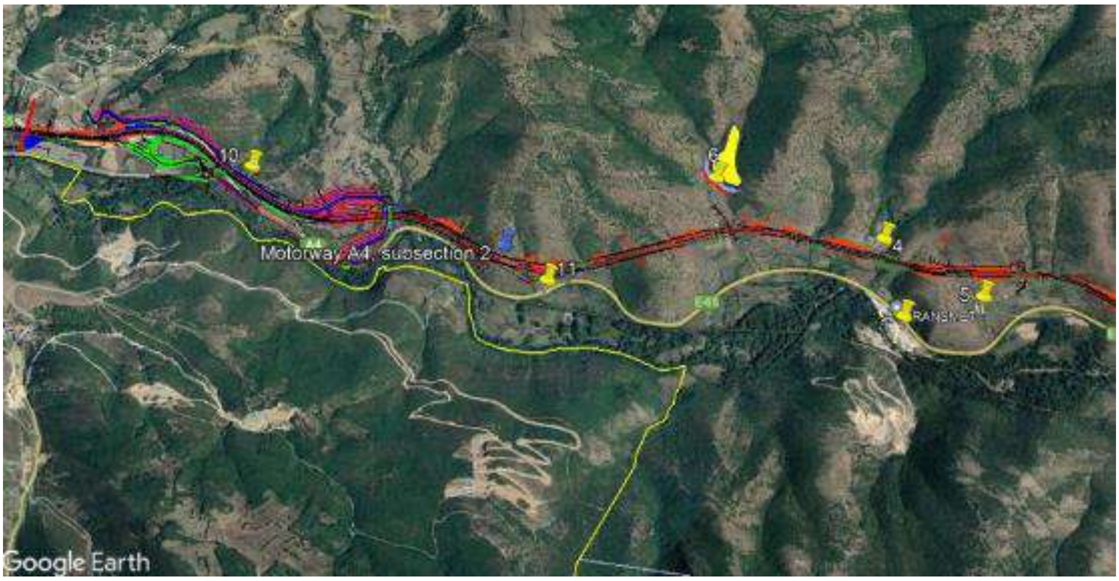

Figure 165 Identified projects from border crossing point to km 5+400

Figure 166 Identified project from km 7+500 to km 10+850

Figure 167 Identified project from km 10+900 to km 12+100

5.4.3 Assessment of potential cumulative impacts

In order to assess the possible cumulative impacts and effects on the environmental media and social aspects, that may be caused by the identified projects, in the table below possible cumulative impacts that may arise for all identified projects in combination with project for construction of the motorway alignment are presented.

Table 124 Source for potential cumulative impacts

No.	Project	Phase	Raw materials	Energy use	Water use	Air quality and climate change	Surface and ground water	Geology and soil	Waste	Noise and vibrations	Biodiversity (flora, fauna, habitats, protected area, forests)	Landscape	Socioeconomic aspects	Community health and safety	Labour related issues	Resettlement (physical and economic) issues
1.	Quarry and separation plant owned by Company Transmet	Operation	√	√	√	√	√	√	√	√	√	√			√	
2.	Concrete plant owned by Granit and its administrative buildings	Operation	√	√	√	√	√	√	√	√	√	√			√	
3.	Sand separation plant	Operation	√	√	√	√	√	√	√	√	√	√			√	
4.	Two sheepfolds	Operation		√	√	√	√	√	√			√				
5.	Two cattle farms and auxiliary objects	Operation		√	√	√	√	√	√			√				
6.	Gas station Diesel	Operation		√	√	√	√	√	√	√		√	√		√	
7.	Sport airport Stenkovec	Operation		√	√	√	√	√	√	√		√		√	√	
8.	Industrial facilities close to interchange Stenkovec	Construction	√	√	√	√	√	√	√	√		√	√	√		√
		Operation		√	√		√		√	√		√	√			
9.	Motorway A4 subsection 1 (from Blace crossing point to v.Blace)	Operation	√	√	√	√	√	√	√	√	√	√	√			
10.	Existing regional road A4	Operation	√	√	√	√	√	√	√	√		√	√			

No.	Project	Phase	Raw materials	Energy use	Water use	Air quality and climate change	Surface and ground water	Geology and soil	Waste	Noise and vibrations	Biodiversity (flora, fauna, habitats, protected area, forests)	Landscape	Socioeconomic aspects	Community health and safety	Labour related issues	Resettlement (physical and economic) issues
11.	Local urban-planning documentation for a facility with a purpose E2-Gas station and service centers with accompanying facilities on KP 1283/1, KP 1283/5 and KP 1284	Construction	√	√	√	√	√	√	√	√		√			√	
		Operation		√	√	√	√	√	√	√		√	√		√	
12.	Local urban-planning documentation for a building with purpose E1 - Infrastructure project for local road, KM Gluvo Brazda	Construction	√	√	√	√	√	√	√	√		√	√	√	√	√
		Operation	√	√	√	√	√	√	√	√		√	√	√	√	√

In the tables below are presented a summary of identified cumulative impacts in construction and operational phase.

Table 125 Summary of cumulative impacts resulting from construction activities and their assessment

Topic	Potential Impacts	Description of potential impacts	Assessment of cumulative impact		
			Magnitude	Sensitivity	Significance
Raw materials	Use of construction raw materials	Implementation of the project for construction of the motorway and all other mention projects foreseen use of natural raw material, such as gravel, sand, soil, as well as material for preparation of concrete, asphalts etc. On the basis of it, it could be concluded that the current implementation of the current project in combination with other project may cause cumulative impacts on the natural raw materials in the affected municipality	Minor	Moderate	**Minor**
Energy use	Use of fuel and electricity	Implementation of the project for construction of the motorway and all other mention projects will need use of energy, such as fuel for mechanization and electricity. Overlapping of the projects may cause interruptions of the energy supply network in the municipality	Minor	Negligible	**Negligible**
Water use	Use of technical and sanitary water	All the mentioned projects, during the construction phase, will use water for technical and sanitary purposes. Technical and sanitary water will be used in all identified projects for construction works (preparation of materials, construction activities, dust suppression, sanitary needs, etc.).	Minor	Minor	**Negligible**
Air quality and climate changes	Emissions of dust, exhaust gasses and GHG	All the projects are releasing air pollutants in the air. The combination of the mentioned activities with the construction of the motorway A4 will increase dust emissions in the area and will increase the transport frequency which will result with increased emission of exhaust gasses in the atmosphere. In addition, the generated GHG from equipment and mechanization and removal of vegetation in the construction phase will contribute to global climate change and microclimate changes in the area.	Moderate	Minor	**Minor**
Noise and vibrations	Increased noise and vibration level	As a result of the engagement of mechanization and vehicles for transport and performance of construction activities, the combination of the above defined projects will increased the noise and vibration level in the project area of influence. As it can be seen from the figure above where the identified	Moderate	Minor	**Minor**

Topic	Potential Impacts	Description of potential impacts	Assessment of cumulative impact		
			Magnitude	Sensitivity	Significance
		projects are presented on Google Earth map, all of the projects are within the borders of the project area of influence.			
Surface and ground water	Deterioration and pollution of surface and ground waters	During construction phase of the motorway there is a potential of pollution of surface and groundwater bodies Almost all of the identified projects in their construction phase, as well as those which are already in operation have negative impacts and emissions in surface and ground water bodies. The impacts may arise as a result of the presence of the workers on site, use of mechanization and vehicles and generation waste water as a result of construction activities. Contamination of groundwater and surface water alos are possible as a result of accidental leakage.. Combination of this activity with other projects identified above may increase the negative impact on the water quality of river Lepenec and Vrazarska River (when there is water flow in the river bed). Also if deep excavations are needed, possible deterioration of the aquifers may occur	Minor	Minor	**Negligible**
Geology and soil	Pollution of soil and deterioration of the geology structures	As a result of construction activities in the above mentioned projects, operation of the sheepfolds and cattle farms, soil contamination is expected. Also contamination of soil is expected as a result of accidental leakage. Impacts on geology are expected in construction projects in combination with the quarry, as a result of deep and big excavations.	Moderate	Minor	**Minor**
Waste	Negative impacts on environmental media and areas	Hazardous, non-hazardous and inert waste will be generated in all phases of the above mentioned projects. Bigger part of the excavated earth material will be reused. For the construction of the motorway A4 only 500.000 m^3 of earth material will be deposited on a landfill already defined and presented in this ESIA. The cumulative impacts may be expected also in generation of selected types of waste (communal, construction, WEEO, batteries and accumulators etc.) which will be handled to companies for recycling and/or disposal.	Moderate	Minor	**Minor**
Biodiversity (flora, fauna, habitats, protected	Loss and fragmentation of habitats as a result of	Impacts on biodiversity are expected only at those projects which are in construction phase. Some habitats will be lost as a	Moderate	Moderate	**Moderate**

Topic	Potential Impacts	Description of potential impacts	Assessment of cumulative impact		
			Magnitude	Sensitivity	Significance
area, forest)	construction activities	result of construction of roads, extension of sand separation plants. No increased cumulative impact is expected on ecosystems of the river Lepenec (aquatic and riparian communities).			
Landscape	Deterioration of visual aspects	The cumulative impacts caused by the construction of the alignment, as well as the construction of all mentioned project will contribute to increasing the significance of the impacts on the visual characteristics of the landscape (as a result of the increased scope and magnitude of the impacts). This impact will be more significant in a case of overlapping of the construction activities. The combination of all projects will contribute to increased cumulative effects on the functionality of the landscape in terms of migration of species.	Moderate	Moderate	**Moderate**
Socio-economic aspects	Impacts on local businesses and workforce	During the construction phase there will be increased level of spending that will be experienced by nearby local businesses and settlements, and accordingly the socio-economic situation is expected to be slightly improved in the area where the projects will be performed during construction phase. If all of the proposed projects included in the cumulative assessment proceed, they will generate increased opportunities for local businesses to increase sales revenue and overall viability through the supply of goods and services. Existing businesses may expand, and new businesses are likely to move to the region at least temporarily to provide services to projects under construction. The employment rate in the area will surely rise, turning the area into desirable location for living and thus generating migration from the rural parts of the country. This may, however, cause inflationary impact on prices which will represent benefit for limited members of the community, but may have negative impact on others making existing living costs slightly expensive compared to the situation prior realization of the projects. Human resources costs are also expecting to rise as a result of higher demand for workforce, particularly qualified	Moderate	Moderate	**Moderate**

Topic	Potential Impacts	Description of potential impacts	Assessment of cumulative impact		
			Magnitude	Sensitivity	Significance
		workforce.			

Table 126 Summary of cumulative impacts resulting from operational activities and their assessment

Topic	Potential Impacts	Description of potential impacts	Assessment of cumulative impact		
			Magnitude	Sensitivity	Significance
Raw materials	Use of raw materials for maintenance	In operational phase raw materials such as gravel, sand, soil, as well as concrete, asphalts etc. will be used for maintenance of the roads and in the plants as a product	Minor	Negligible	**Negligible**
Energy use	Use of fuel and electricity	As energy source for all identified projects fuel and electricity will be used. Use of fuel for mechanization which will be used for maintenance of roads, operation of installation plants and electricity for lightening and operation of the machines in the operational plants and lightening of the motorway	Minor	Minor	**Negligible**
Water use	Use of technical and sanitary water	Sanitary and technical water will be used in all identified projects. Sanitary water will be used for the engaged workers on the construction sites. Technical water will be used for maintenance of the roads, plants, petrol stations, farms etc. Implementation of current project in combination with other project may cause cumulative impacts on the water resources in the affected municipality.	Minor	Minor	**Negligible**
Air quality and climate changes	Emission of air pollutants such as dust, exhaust gases and GHG	The combination of the above mentioned projects will increase dust and exhaust gas emissions into the air as a result of the transportation activities. GHG will be emitted not only from transportation activities but also from the cattle and sheep farm as a result of their operation and maintenance.	Minor	Minor	**Negligible**
Noise and vibrations	Increased noise and vibration level	Transportation activities of vehicles and mechanization will increase the noise level in operational phase. The operation of the concrete, quarry and sand separation plants also will contribute to the increased noise and vibration level in the project area of influence. The intensity will depend on the frequency and time of operation and movement of vehicles.	Minor	Negligible	**Negligible**
Surface and ground water	Pollution of surface and ground water	The operation and maintenance of the projects may result in pollution of surface and groundwater bodies. The pollution may occur as a result of leakage of oil, fuel, liquid substances, improper waste management	Minor	Negligible	**Negligible**

Topic	Potential Impacts	Description of potential impacts	Assessment of cumulative impact		
			Magnitude	Sensitivity	Significance
		etc. from the vehicles which will operate among the roads and mechanization which will be engaged for maintenance of the roads, as well as from the usage of mechanization in industrial zone or in the plants.			
Geology and soil	Pollution of soil and deterioration of the geology structures	Operation of the motorway may cause cumulative impacts on soil as soil erosion, contamination, etc. Soil erosion is expected in case as flash rains and improper management of the structures (drainage systems). Contamination of soil is expected as a result of accidental leakages. From the other projects are not expected impacts on geology only on soil as a result of leakage of oil, fuel, liquid substances, improper waste management etc.	Negligible	Negligible	**Negligible**
Waste	Negative impacts on environmental media and areas	Hazardous, non-hazardous and inert waste will be generated in all phases of the above mentioned projects. In the operational phase of the motorway mainly biodegradable waste will be generated as a result of the maintenance of the alignment. All of the other mentioned projects will generate different type of waste but with less quantity. The cumulative impacts may be expected also in generation of selected types of waste (communal, construction, WEEO, batteries and accumulators etc.) which will be handled to companies for recycling and/or disposal.	Minor	Negligible	**Negligible**
Biodiversity (flora, fauna, habitats, protected area, forest)	Impacts on habitats, flora and fauna	In the operational phase of the project there is a possibility of cumulative impacts on the habitats, flora and fauna. The regional road and the new highway and side roads, can have a cumulative impacts on the fauna, but the same will be lower in relation to the cumulative impacts in construction phase. Impacts are expected in operational phase on habitats and flora as a result of maintenance activities i.e. cleaning and removal of vegetation. Also increase of fragmentation and impediment of the movement of animals is expected, but also increase of the mortality of wild animals from collisions, disturbance etc.	Moderate	Minor	**Minor**
Landscape	Visual aspects	In operational phase the cumulative impacts on the	Minor	Minor	**Negligible**

Topic	Potential Impacts	Description of potential impacts	Assessment of cumulative impact		
			Magnitude	Sensitivity	Significance
		landscape are associated with the new motorway and auxiliary structures in combination with the constructed facilities and structures of the above mentioned projects. The new projects will introduce new elements into the landscape (roads, bridges, tunnels, petrol station, warehouses, industrial facilities etc.)			

A flexible approach to managing cumulative impacts and a good inter-project communication between developers and contractors will be a key to **manage and mitigate the cumulative impacts** which result from implementation of the projects.

6 GREEN ECONOMY TRANSITION POTENTIAL

In accordance with the proposed content of the ESIA the Green Economy transition potential is prepared.
The Green Economy Transition (GET) potential Handbook has been approved by the EBRD in 2018 The objective of GET is to increase the financing of projects that advance the transition to an environmentally sustainable, low-carbon economy, and help prevent economies from being locked into a carbon-intensive, polluting pathway that depletes natural assets.
The EBRD has developed principles and criteria that must be met for projects to qualify for its GET approach. The Bank assesses all new projects in light of how their specific characteristics and circumstances fit with the strategic aims of GET, specifically that they are consistent with its overarching objectives to advance the transition to a green economy, and to prevent economies from being locked into a carbon-intensive pathway. Projects that qualify for GET meet the principles and criteria set out in table below.

Table 127 Qualifying Principles and Criteria for projects through the GET approach

Principle	Criteria	
Granularity	Only clearly defined environmental project activities or components that can be disaggregated from non-environmental activities, as far as reasonably possible, qualify for GET.	√
Environmental benefits	Measurable net total environmental benefits against a baseline	√
Minimum environmental performance and standards	Application of sector-specific best available techniques in EU environmental performance and social standards	√
Multiple environmental benefits	No double counting of financing across multiple environmental benefits	√

6.1 Granularity

The construction of the motorway A4, Skopje - Blace. Section 2: Construction of motorway from Interchange with local road for village Blace (interchange "Blace") to Skopje (Interchange "Stenkovec"), km 2+000 to ~ km 12+250 is defined as multiple stand – alone project under a larger program as defined and presented in the **Chapter 1**.

The overall objective of the Project is to increase transport efficiency and improve traffic safety on Route 6a, as part of the extension of the TEN-T Core Network in the Western Balkans, on Orient/East- Med Corridor. The planned Motorway A4 Skopje – Blace will connect Skopje to Kosovo via Route 6a and the latter to Corridor VIII as part of the extension of the TEN-T Core Network in Western Balkan on the Orient/East-Med Corridor.

6.2 Environmental benefits

As part of this ESIA study assessment of potential environmental and social impacts in all phases of the project was conducted and presented in Chapter 5.
In order to present the GET potential, the environmental benefits needs to be measured. The three main categories for environmental benefits of GET projects and project component activities are:

1. Climate change mitigation (reduction of greenhouse gas emissions)
2. Climate change adaptation (enhancement of climate change resilience)
3. Other environmental benefits.

6.2.1 Climate change mitigation

An assessment of greenhouse gas emissions of the project have been carried out, taking into account the national and European legislation (the EIA Directive 2014/52/EU), guidance and policy documents including the EBRD Protocol for assessment of Green House Gas Emissions and the IEMA 2017

Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance[83].

Greenhouse gas emissions in the project's operational phase have been calculated, based on the traffic volume forecast in the Feasibility study prepared in 2016. Due to lack of data on traffic capacity of the proposed project, the traffic volume was limited to that of 2045. GHG emissions from traffic still taking place on the existing road, during the operational phase of the proposed project, has been taken into account also due to the fact that this road will be used in the future but with less intensitiy. On the following table is presented the annual traffic forecast for Stenkovec – Blace and the existing road and the baseline year 2020.

Table 128 Annual traffic forecast for Stenkovec – Blace and the existing road and the baseline year 2020

Type of vehicles	2020	2026	2030	2040	2045
Stenkovec – Blace new motorway					
PC	6103	10307	13110	20833	26676
LHV	553	834	1022	2440	3361
MHV	84	127	156	277	379
HV	47	62	72	130	226
AV	209	270	310	569	773
BUS	31	52	66	104	133
PC Gen.	410	525	602	810	962
AADT total	**7437**	**12177**	**15337**	**25164**	**32510**
Stenkovec- Blace existing road					
PC	1241	1785	2148	3354	4240
LHV	0	370	617	683	761
MHV	0	0	0	0	0
HV	0	0	0	0	0
AV	0	0	0	0	0
BUS	6	9	11	17	21
AADT total	**1247**	**2164**	**2775**	**4054**	**5022**

Legend: PC – passenger cars; LHV – Light trucks; MHV – Heavy tracks with two axes; HV – Heavy trucks with three axes; AV – Heavy cars with more than 3 axes; BUS – bus; AADT total - Annual average daily traffic

Based on the forecast for the traffic flow, in the following table is presented the estimation of GHG emissions with two scenarios i.e. implementation of the project and "do nothing".

Table 129 Traffic GHG emissions

Scenario	GHG emissions (t CO_{2eq}/year)			
	2026	**2030**	**2040**	**2045**
Implemented Project	11,521.11	14,565.13	23,005.24	29,891.14
Do Nothing	7,596.32	9,100.80	14,900.46	19,371.94
Difference	**3,924.80**	**5,464.33**	**8,104.78**	**10,519.20**

The assessment was carried out for vehicles which are using diesel and gasoline as a source of energy, due to the lack of data on national level for the forecast of traffic with use of different type of fuel including (Gasoline, Oil, Mixture, Gasoline-gas, Electric energy and Alcohol).

Republic of North Macedonia is a non-Annex I country to the UNFCCC, it is also a candidate country for European Union (EU) membership, and thus must adhere to EU Climate and Energy Policy, which actually assumes the commitments of Annex I countries. Few policies are under preparation related to reduction of emissions of GHG especially in transport sector. The following amendments of the

[83] IEMA 2017: Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance
https://www.iaia.org/pdf/wab/EIA%20Guide_GHG%20Assessment%20and%20Significance_IEMA_16May17.pdf

current fee charge aims to shift the environmental charging system to more directly target CO_2 emissions rates in order to encourage consumers to purchase vehicles that emit less CO2. The new fee will increase linearly with the CO_2 emissions rate, and at a higher rate for diesel fuel vehicles compared to gasoline vehicles. The following criteria are proposed to be used to calculate the amount of annual registration environmental fee to be paid:

- CO_2 emission amount
- Vehicle age
- Fuel type

6.2.2 Climate change adaptation

The country has signed the Paris Agreement in September 2016 and delivered the Intended National Determined Contributions (INDCs) to reduce the CO_2 emissions from fossil fuels combustion for 30%, that is, for 36% at a higher level of ambition, by 2030 compared to the business as usual (BAU) scenario. The Macedonian Parliament adopted the Law on ratification of the Paris agreement in 2017. It is important to underline that the objective of the Republic of Macedonia is to incorporate as much as possible the reporting principles accepted by the European Union (EU) member states (as a candidate country for full membership into the EU), going far beyond reporting requirements as developing non-Annex I country under the UNFCCC. This project is aligned with the requirements and adaptation goals prescribed in the Paris Agreement with proposal of adaptation and resilience measures for construction and operational phase. Due to that, within this ESIA study, Climate resilience report has been prepared (Annex 11). The main aim of this Climate resilience report is to ensure and enhance the resilience of the proposed construction of the new motorway A4 Blace – Skopje (Stenkovec) to the effects of climate change and extreme weather events. The construction and operation of the motorway is designed to be resilient to the future projected climate changes for the country. Risk assessment for each phase has been conducted in order to give more appropriate adaptation and resilience measures. The risk assessment consists of few steps i.e.: assessing exposure, assessing sensitivity, vulnerability assessment. Based on the established vulnerability assessment, assessment and prioritization of risk was conducted in order to identify where the most significant risks are expected to occur and which adaption measures need to be applied and when. The risk assessment consists of assessing impact probability and assessing impact severity.

The prescribed measures in the Climate resilience report and in the **chapter 5.2.7** needs to be implemented in order the project to be adopted and resilient on a future climate change projections for the region.

6.2.3 Other environmental benefits

Despite of the climate change mitigation and adaptation measures, this Project itself has other environmental benefits. On the following table are presented the benefits on each environmental media and area as a result of the implementation and operation of the motorway and the disadvantages in case of do nothing scenario.

Table 130 Benefit and disadvantages in case of implementation of the project and do nothing

No.	Environmental media and area	Do nothing	Implementation
1.	Air quality and climate change	Increase emission of dust, exhaust gasses and GHG as a result of increased traffic on the road, traffic jams etc.	Reduced dispersion of pollutants as a result of free traffic on the motorway, no traffic jams and availability of more vehicles to use the motorway as well as installation of charging station for electric vehicles which will increase the flow of this type of vehicles in the project area
2.	Surface and ground water	Free discharge of pollutants in the soil and surface and ground water bodies without any treatment as a result of leakages and incidents	Constructed and installed drainage infrastructure and oil captures for collection of storm water on the motorway and eliminate waste oils
3.	Soil	Possible risks of landslides	Reduced risks of landslides with stabilization of slopes

		and soil pollution	and construction of retaining walls and avoidance of soil contamination as a result of constructed drainage infrastructure and installed oil captures
4.	Biodiversity	Increasing the number of mortality of animals due to the lack of fencing and corridors for movement of the animals	Reduced number of mortality of animals as a result of installation of fence on the motorway, construction of tunnels, underpasses and high bridges for movement of animals etc.

6.3 Minimum environmental performance and standards

This ESIA study has been prepared according to the Environmental and Social Policy (2019) of EBRD. EBRD has adopted a comprehensive set of specific Performance Requirements (PRs), as part of Environmental and Social Policy (EBRD, 2019). This ESIA study covered a range of key areas of environmental and social impacts, occupational and public health and safety, resettlement and other issues and actions involved in the construction and operation of the motorway.

The identification of the physical, biological and social environment for the identified project footprint and project area of influence is presented in **Chapter 2.7** and is correlated with the appropriate PRs.

The Detailed Design of the motorway will be prepared in accordance with the prescribed environmental and social mitigation measures, which are in compliance with the applicable regulatory requirements (National legislation, EU standards and regulations, EBRD policy, International treaties and conventions) as prescribed in Annex 4 and good international industrial practice (GIIP).

7 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

The Environmental and Social Management Plan (ESMP) defines the impacts that may arise from the realization of the project activity, proposes measures to avoid or mitigate the negative impacts, gives clear responsibilities to the Contractor and PESR on how to manage and monitor the proposed environmental and social measures. Within this ESMP presented below key performance indicators (KPI) for each proposed measure are presented in order to facilitate to the Contractor, Supervisor, PESR and Inspection body easily to check the successful implementation of the proposed measures. The plan describes the identified environmental and social impacts caused by the implementation of the Project's activities and proposed measures for mitigation which needs to be implemented in due time and by relevant bodies/entities.

The reason for preparing ESMP is to identify any potential adverse environmental and social impacts resulting from the implementation of the project activity, to propose mitigation measures, along with corrective measures if there is an adverse impact or an unforeseen level of impact, as well as establishing a system of accountability monitoring and reporting during implementation of the proposed measures. The ESMP is linked with the **Chapter 5** (Associated and potential impacts) of this ESIA Study.

7.1 Purpose of the ESMP

The purposes of the ESMP are:

- To provide practical and feasible plans for environmental and social management, which will be in accordance with national, EU and EBRD requirements;
- To provide sufficient resources in the budget of the project, so the scope of activities related to (ESMP), in accordance with the significance of the impacts of the Project;
- To provide integrated planning framework that will allow comprehensive monitoring and control over the possible negative impacts during the construction and operational phases;
- To ensure the commitment of the authorities for future implementation of mitigation measures, according to a defined timetable and monitoring;
- To provide relevant information to the public about the phases of project management in an environmentally sound manner;
- To provide feedback for continuous application and improvement of environmental performance;
- To provide a response/solution to the changes that occurred during the implementation of the project that were not taken into account in the ESIA;
- To provide a platform/bases for reaction/solutions to unforeseen events.

Prior to starting of construction phase the Contractor will prepare Construction Environmental and Social Management Plan (CESMP), which will include/upgrade the mitigation measures and good construction practices prescribed in the ESIA. The CESMP will contain the following sub-plans:

- Site Rehabilitation Management Plan (SRMP)
- Topsoil Management Plan (TMP)
- Emergency Preparedness and Response Plan (EPRP)
- Soil and Erosion Management Plan (SEMP)
- River Crossing Management Plan (RCMP)
- Waste Management Plan (WMP)
- Hazardous Materials and Leak Control Management Plan (HMLCMP)
- Water Monitoring plan (WMP)
- Air Quality Management Plan (AQMP)
- Emergency Resilience Plan (ERP)
- Construction Waste Management Plan (CWMP)
- Plan for Evacuation and Rescue in Emergency Situations (PERES)
- Biodiversity Management Plan (BMP)
- Vegetation Removal Management Plan (VRMP) (which includes Afforestation activities)

- Rehabilitation and Landscaping Plan (RLP)
- Community Health and Safety Management Plan (CHSMP)
- Traffic Management Plan (TMP)
- Occupational Safety and Health Plan (OSH)
- Local Employment and Procurement Plan

The CEMSP will be implemented by the Contractor and supervised by the Supervision Engineer and PESR.

Prior to starting the operational phase, the PESR will prepare Operational Environmental and Social Management Plan (OESMP), which will include/upgrade the mitigation measures and good construction practices prescribed in the ESIA. In addition, the OESMP will contain the following sub-plans:

- Operational Soil Monitoring Plan (OSMP)
- Emergency Preparedness and Response Plan (EPRP)
- Effluent Monitoring Plan (EMP)
- Operational Stakeholder Engagement Plan (OSEP)
- Rehabilitation and Landscaping Plan (RLP)
- Community Health and Safety Management Plan (CHSMP)
- Occupational Health an Safety Plan (OHSP)

The OEMSP will be implemented by the PESR.

7.2 Funding for implementation of the actions defined in the ESMP

The financial resources, required for the implementation of the ESMP in the construction phase, will be envisaged in the Project Implementation Budget and will be the subject to requests and proper allocation during the tender phase of the project.

The maintenance of the motorway, all the accompanying structures, the equipment, ensuring the safety of the transport of passengers and goods and the implementation of the actions defined in the ESMP during the operational phase of the motorway, shall be implemented with the funds provided by Operator (PESR).

7.3 Management of residual impacts

Residual impacts are impacts that remain even after the implementation of the mitigation measures. The same are identified and elaborated in the chapter Mitigation measures. If the implementation of the proposed mitigation measures will not result with expected benefits, the Contractor (in the construction phase) and PESR (in the operational phase) will design and implement additional measures, which are described in the mentioned chapter, but not limited on it (it depends of the conditions at the time of occurrence of the residual impacts).

At the current moment all of the residual impacts couldn't be predicted precisely, that why the future Contractor and the PESR should take into account possibility of occurrence such impacts and make a proper calculation in the budget of each phase of the project development.

In the table below is presented the ESMP, i.e. the mitigation measures that should be implemented during all phases of the project, their purpose, responsibility for implementation of measures, cost, time for implementation as well as monitoring of implementation of the measures and indicators that will confirm successful implementation of proposed measures.

Table 131 Environmental and social management plan

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
Resource efficiency						
Pre-construction phase						
– Increased energy use for road and tunnels lighting purposes	– Ensure that Lighting and Electrical Design for roads and tunnels contains energy saving measures and equipment (e.g. Specifying high frequency ballasts, LED and lower wattage lamps can deliver quick savings of over 20 % together with greater lamp durability). Consider using solar powering.	To develop energy efficient lighting system	Design preparation included in the cost of the overall design	Designer	Revision of the Design to be done by the competent and licenced company	Prepared and revised Lighting and Electrical Design
Operational phase						
– Increased energy use for road and tunnels lighting purposes	– Keeping record of electricity consumption – Regular maintenance of the lighting system using energy efficient equipment	To ensure energy efficient operation of the lighting system	Depending on the maintenance needs	PESR to transfer responsibility to the company responsible for the road maintenance	Electricity consumption rates	Electricity consumption rates
Geology and geomorphology						
Pre-construction phase						
– Lack of information on the stability of the terrain for the construction and operational phase; – Lack of information on hydrogeology of the area (on direction of movement and speed of ground water).	– Perform geological, geo-mechanical and hydrogeological investigations for the alignment and the disposal area; – Based on the results of investigation works include following measures in the design: o The embankments' construction methodology and the suitability of the materials for the body, the subgrade and improvement (remediation) layer should conform to the material specifications and the quality control guidelines; o In case the surface ground	Avoiding impacts of motorway construction on the land stability and ground waters, as well as ensuring stability of the motorway structures through appropriate reinforcement and risk of	The cost will be defined in the phase of preparation of program of investigation works	PESR to prepare tender documents and Contractors to implement investigation works and modelling.	PESR to monitor implementation of works and revise the final outputs	Reports by supervision on revising the investigation reports and results. Modelling results.

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	inclination is significant, the foundation of the embankments should be done in anchorage steps and therefore the soil improvement layer should be spread in partial layers; o All the embankments along the alignment with height h>8.00m are proposed to be constructed with materials QS2 and an improvement layer of 0.30cm at the base of the measurement should be placed. The stability of these embankments must be checked on the base of the appropriate calculations. o A top soil layer of 30 cm in thickness must preferably be placed and vegetated on the 2:3 embankment slopes. The method of the vegetation scheme, that will define the type and density of plants and means of application, will be the subject of a separate plantation design; o Propose engineering measures to ensure stability of structures under impact of groundwater. – Perform rock fall modelling for the section passing through the Lepenec gorge to understand the risk for the motorway construction and use and decide on the stability engineering measures	damage				
Construction phase						

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
– Activation of landslides and rock-falls, during the construction of the motorway and accessible roads; – Slide and fall of excavated material on the cuts and embankments on the motorway, on the access roads and on disposal site; – Local changes of the slopes, intensity of erosion and deposition	– During the construction camp planning development avoid occupying the areas/specifically sensitive locations or zones on the following chainages: km 3+000, km 3+600, km 5+300 and km 7+800 where steep slopes in the Lepenec gorge are presented; the well close to km 10+000 used for irrigation purposes and the riparian vegetation along River Lepenec; – Adhering to recommended measures and standards for construction engineering and the execution of works according to the project documentation; – It is recommended that the highest embankment sections should be properly instrumented and monitored during the construction of the project. The monitoring results should be systematically evaluated, in order to promptly diagnose any potential problems and take the appropriate remedial measures; – Develop the **Site Rehabilitation Management Plan (SRMP)** and include it in the **Construction Environmental and Social Management Plan (CESMP).** SRMP will describe baseline conditions of the site and describe strategy, implementation and monitoring of rehabilitation measures to ensure stability of slopes and re-vegetation of affected areas. Upon completion of works implement the measures from the SRMP.	Avoiding impacts of motorway construction on the land stability and ground waters, as well as ensuring stability of the motorway structures through appropriate reinforcement and risk of damage	The cost shall be included in the total construction costs;	PESR to transfer responsibility for preparation of SRMP and their implementation to the Contractor through tender documents and contractual agreement. Contractor to implement all measures.	Revision of SRMP by the Engineering Supervison. Weekly to monthly monitoring by the Engineering Supervision in order to control the contractor's work	SRMP prepared, reviewed and approved by the supervising engineer. Number of Construction Dairy logs on stability issues.

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
Operational phase						
– Local changes of the slopes, intensity of erosion and deposition	– Develop the **Operational Environmental and Social Management Plan (OESMP)** and include in it the following measures to implement: ○ regular control and maintenance of the condition of the motorway drainage system to prevent impact on erosive sliding of the soil or flooding, ○ monitoring of slopes, in particular after strong rains for identification of possible traces of erosion (landslides, rockfalls, rock weathering); – Maintaining the vegetation and if necessary, increasing the area with vegetation.	Avoiding negative impacts of land instability on motorway structures	PESR Budget	PESR or PESR to transfer responsibility to maintenance contractor.	Monitoring by the State and municipal inspection body if the prescribed measures are implemented	Records from the inspection (if any).
Soil						
Construction phase						
– Soil erosion – Soil contamination – Soil compaction	– Develop and implement **Topsoil Management Plan (TMP) and Soil and Erosion Management Plan (SEMP),** as a part of **Construction Environmental and Social Management Plan (CESMP).** – The TMP shall describe topsoil stripping procedures and rules, topsoil stripping depth and volumes, topsoil stripping supervision, transportation and stockpiling requirements, stockpile location, topsoil stockpile design, stockpile management, erosion hazard and erosion control, runoff drainage/diversion, soil protection	Reducing and avoiding negative impacts on soil	Costs borne by the Contractor	PESR to transfer the responsibility to Contractor though tender documents and contractual agreement	Revision of TMP and SEMP by the Engineering Supervision. Weekly to monthly monitoring by the Engineering Supervision in order to control the contractor's work	TMP and SEMP prepared, reviewed and approved by the Supervising Engineer. Number of Construction Dairy logs on negative impacts on soil.

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	measures at the storage area, maintenance of the stockpile and topsoil application procedure. TMP shall also include procedures for management of contaminated soil. – Ensure good planning of the material balance per sections, i.e. reuse of the excess soil resulting from cut and fill and tunnels drilling. – Implement the same measures as under *Geology and geomorphology* Measures to be included in TMP (and therefore CESMP) are at least the following: *Removal of top soil:* – The topsoil should be properly removed, before the construction begins, to be stored and used after the completion of the construction activities, for the purpose of re-cultivation and stabilization of the slopes according to the recommendations in the Detail Design; – The removed soil heaps to be stabilized or covered (with textile) and to be temporary stored in places located away from the river banks or erosion-prone sites; – During the manipulation of the soil (excavation, transport, storage), special attention should be given to the soil moisture level, i.e. the soil should not be either very dry or very moist; *Soil and erosion Management Plan should cover, but not limited to the following mitigation measures:* – Drainage of the formation width to					

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	be done with ditches and gutters set along the alignment which at certain points will drain into the watercourses; – Dewatering of sites located above the cut slopes to be done with gutters located above the slopes, as well as slope downward gutters that will drain into the ditches. In case of longer slopes, contour gutters in order to break the flow of waters at the slope and redirecting to the existing drains; – Mitigation measures at the temporary storage and deposit sites: The temporary measures are represented with different types of covers as well as grassing, while the permanent measures are applied after the finishing of construction activities with biotechnical stabilization of slopes; – If necessary, install and maintain control measures for erosion and sedimentation along the construction sites and access roads; – Upon completion of construction implement SRMP: restoration of work area to its previous condition; ripping of compacted soils, landscaping and re-vegetation as appropriate; – Progressive rehabilitation and stabilization of disturbed ground surfaces in order to reduce erosion; – Removal of bulk earth material, as soon as possible. *Soil contamination:* – Washing of equipment and vehicles					

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	to be done only at special sites designed to avoid soil and groundwater contamination; – Washing out of concrete mixer and pumps on site is not allowed; – The storage and handling of fuels should be a rigorously controlled process that includes taking measures for prevention of soil contamination. The fuelling of the machines and generators should be done at least 50 m from watercourses, channels or wells; – Containers with chemicals, fuels and oils should be stored in suitable containers at a location designated for that purpose, provided with a waterproof surface; – Provision and application of equipment/vessels for evacuation of possible leaks of fuels, oils and chemicals, their regular inspection and maintenance; – Mandatory use of sawdust, sand or other absorbent material in case of accidental leakage of fuel, oil and other chemicals; – The machines should be parked at appropriately envisaged and arranged sites (camps) that fulfil the necessary requirements for soil protection (accidental leaks of fuel and oil); – Implementation of appropriate waste management, in accordance with the legal prescriptions and requirements; – In case of soil contamination with accidentally spilled fuels, oils,					

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	chemicals, the contaminated soil sample should be removed and treated as a hazardous waste; – Full implementation of the Emergency Prepardness and Response Plan; – Preventive and control measures include: proper planning of the time of transport of hazardous materials in order to minimize the risk to the community (for example, limiting the transport of hazardous materials to some routes); construction of protective barriers and other technical measures (drainage) at sensitive locations (near water resources, settlements, etc.) and implementation of emergency notification systems and evacuation procedures; – Compliance with the measures from the Soil and Erosion Management Plan, Waste Management Plan, Hazardous Materials and Leak Control Management Plan. – Implement the same measures as under *Water* and *Waste* sections. *Soil compaction:* – The movement of heavy machinery should be limited in the construction site and access roads; – Mechanization and technology that causes minimal tremors and harmful impacts that can lead to soil compaction (and indirectly can interfere with the spring water regime in the scope of the corridor and downstream) should be used during motorway construction.					

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
Operational phase						
Soil contamination	– Develop and implement the **operational soil monitoring plan** and include it in the **Operational Environmental and Social Management Plan (OESMP).** In the OESMP, make connection between implementation of measures under the Water and Waste section with prevention of soil contamination. – Develop and implement the **Emergency Preparedness and Response Plan (EPRP)** based on a hazard analysis including the nature, consequence and probability of accidents. The plan shall provide details of procedures, responsibilities, resources, documentation and reporting requirements, training provisions for relevant staff, etc. to avoid spills of hazardous substances and to effectively respond to such incidents.	Reducing and avoiding negative impacts on soil	Costs included in maintenance costs.	PESR or PESR to transfer responsibility to maintenance contractor.	Implementation of measures from OESMP and EPRP. Performing soil monitoring in line with the plan in the OESMP and ESIA **Table 132**.	Internal reports and supporting documents on implementation of measures from OESMP and EPRP.
Hydrology, surface and ground water						
Pre-construction phase						
– Inadequate design solutions to mitigate impact on waters	– Include all recommendation in the design officially issued by the Public Enterprise "Vodovod and kanalizacija", Skopje (No. 1302-26667/2 from 15.07.2021), Ministry of environment and spatial planning – Water Department (No.11-3335/4 from 09.08.2021) and Municipality of Chucher Sandevo (No. 11-769/2 from 02.08.2021) related to implementation of appropriate	Provide engineering solutions for control of water pollution and ensure baseline data on water quality to be used for comparison in	Included in the design costs	PESR to obtain permits and consents and organise baseline water quality measurements. Designer to develop engineering solutions for water protection.	Engineering supervision to revise developed designs and approve structures for water protection. Water quality parameters as specified in ESIA. Supervision Engineer to	Consents obtained Design of Hydro-Engineering structures revised and approved Water Quality Monitoring Report prepared.

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	measures for protection of the III zone – wider protection zone of the well area Nerezi – Lepenec as well as protection of water body within the project area; – Obtaining water management consent; – Design hydro- engineering structures based on detailed information and data related to hydrological, meteorological conditions and climate changes scenarios for the project area that will provide protection of the motorway from natural disasters such as floods; – Ensure that each bridge that is crossing river beds have oil separators and sedimentation traps; – Ensure that the construction camp is designed in a way to have all appropriate water and sanitary facilities for which appropriate consents are obtained from authorities; – Perform baseline monitoring of water quality in Vrazanska River (in the period when there is water in the river spring/autumn) and River Lepenec (and possible other water bodies) according to the water monitoring plan included in the CESMP. The obtained result should be used as a reference values for comparison with future possible changes caused by the construction works. The measuring points, frequency and monitoring parameters are defined in Chapter 8	the later stages of the project.		Contractor to ensure water and sanitation facilities in the Consuruction Camp Organisation Plan	approve Construction Camp Organisation Plan.	Construction Camp Organisation Plan prepared.

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	Monitoring Plan under Emissions in surface and groundwater (Preconstruction phase).					
Construction phase						
– Impacts on the quality and quantity on surface and ground waters as a result of: Removal of vegetation, deep excavation, construction of the motorway and its structures, storage and handling of excavated soil, materials and waste, incidental leaking of chemicals, fuels, lubricants, soil erosion, presence of the machinery, washing up the equipment and mechanisation near/within water body, possible discharging of sanitary, technical and storm water	– Development on **River Crossing Management Plan (RCMP)** and include it in the **Construction Environmental and Social Management Plan (CESMP)**. The RCMP shall o Outline the key policies, legislation and standards relating to surface water protection; o Define roles and responsibilities; o Outline actions and measures necessary for the effective management of water crossings; o Cover both accidental and intended impacts due to water crossings; o Detail specific control measures to be implemented by the Contractor and its contractors (and subcontractors); o Incorporate the requirements of the ESIA findings, international standards, national legislation, Lenders requirements and Project-specific construction permits; o Considers the Contractor's general approach to water crossings management procedures and	Reduction of impacts on surface and ground water during construction of the motorway	Included in the contractors costs	PESR to transfer responsibility to the Contractor through tender documents and contractual agreement. Engineer Licenced company for monitoring	Implementation of measures from CESMP including RCMP and water pollution control measures to be controlled by Engineering Supervision during weekly to monthly site visit checks. Performing water monitoring in line with the plan in the CESMP water monitoring plan.	Water quality monitoring reports. Monthly Supervision Reports and Construction Dairy daily logs on water management supervision.

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	methodologies *Note: The construction activities on bridges to be carried out in dry season, i.e. scheduling of construction to low-rainfall season/low-flow periods);* – Develop water pollution control measures and include them in the **Construction Environmental and Social Management Plan (CESMP)** including, but not limited to: o Freely and uncontrolled discharging of waste water (sanitary, technical or storm water) is forbidden; o Performance of construction activities within/or near water body as well location with high level of ground water to be performed in accordance with the obtained permits and opinions issued by relevant authorities; o Removal of vegetation should be done as much as to provide sufficient space for work and strictly control in order to be prevent occurrence of erosion and creation of sediment; o Application of control measures for erosion and sedimentation, through setting up of temporary drainage systems for removal of waters that will arise in the construction side; o Setting up appropriate drainage system on locations used for temporary storage of materials and waste, particularly surplus					

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	excavated soil and inert material; ○ Minimize the possibility of sediment discharge (muddy water) into watercourses during construction activities that take place within the riverbed; ○ If there is a risk of discharge of high quantity of sediment into watercourses, to install clarifiers (sediment traps); ○ The possible dewatering of the excavated ditches, holes etc. (where there is occurrence of groundwater or accumulated surface runoff) to be discharged in a controlled manner , i.e. in a way that will minimize the physical impacts on the recipient; ○ Worker camps, mobile toilets and septic tanks should be placed on a distance larger than 100 m from the drainage infrastructure or water body and regularly emptied and maintained by a certified company; ○ Temporary land-take (including access roads, worker camps, etc.) should be set away minimum 50 m from river bed, wherever possible; ○ Servicing or maintenance of the equipment and mechanisation or any kind of fuelling is not allowed at a distance larger than 100 m from drainage systems and water body;					

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	○ Washing out of the equipment and vehicle, particularly concrete equipment and mixers that contain concrete with alkali cement or cement residues is not allowed on site as well as in the rivers or in their vicinity; ○ Regular maintenance of the equipment, mechanisation and vehicles in order to prevent unwanted leakage; ○ Storage of fuel, oils, fats and chemicals to be done in an appropriate tanks and containers, placed in warehouses, secured with waterproof floors with provided leachate collection system, located away from the drainage system, water body and areas where high ground water are identified; ○ Presence of fuel, oils and chemicals on site should be present in small quantity only for a daily use and their storage to be at a distance more than 100 m from drainage systems and water body and areas where high ground water are identified; ○ Spill prevention kits and absorbent materials should be present in a sufficient quantities on site as well as in a warehouses; ○ Implementation of the prescribed measures for protection of the wider 3rd zone in the well area Nerezi-Lepenec					

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	i.e.: Exploitation of sand, stone and land use in a manner and scope that endangers natural values, quality, quantity and regime of surface and groundwater is prohibited, direct discharge of wastewater into open watercourses is prohibited, disposal and disposal of waste materials and garbage outside organized, secured and controlled landfills is prohibited and release of oils, acids and other harmful, dangerous and radioactive substances is prohibited; – Develop a **water monitoring plan** and include it in the **CESMP**. Perform regular monitoring of water quality in Vrazanska River (in the period when there is water in the river spring/autumn) and River Lepenec (and possible other water bodies) according to the water monitoring plan included in the CESMP and when the constuction works are nearby the flows. – Implementation of same measures as under the *Waste* section.					
Operational phase						
– Impacts on quantity and quality of surface and ground waters as a result of: Traffic, accidents,	– Develop **Operational Environmental and Social Management Plan (OESMP)** and include water pollution control measures such as but not limited to: ○ Regular control and maintenance of the drainage systems along the roads and on the bridges in	Reducing the impacts on surface and ground water contamination during operation and maintenance	Operational Environmental and Social Management Plan planned in the PESR Budget	PERS to transfer responsibility to Contractor through the contractual agreement	Procedures for operation of the sanitary and drainage facilities. Monitoring of effluent discharge in line with the OESMP and the Water Permit.	Procedures for operation and maintenance of sanitary and drainage facilities set up. Procedures for emergency

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
motorway maintenance (regular and in winter period), structures on a tool station, irregular maintenance of the drainage system on the motorway	order to avoid clogging with waste and sediment; o Regular control and cleaning of sediment's traps and oil separators, in order to be provide efficiently treat storm water before discharging it to the recipient; o The canals and culverts must not be filled with waste, sludge and vegetation; o When maintaining vegetation, avoid chemical treatment of weeds and vegetation in order to prevent water pollution; o Make connection with application of waste management measures, as well as application of soil erosion protection measures that lead to the prevention of water pollution. – Develop and implement a **effluent monitoring plan** in line with the water permit. Include the plan in OESMP. – Develop and implement Operational **Emergency Preparedness and Response Plan** to act in case of traffic accidents with high risk of pollution	of the motorway			Setting up preparedness and response procedures in line with the EPRP	preparedness and response set up. Effluent quality in line with the national regulations for effluent discharge. Annual report on effluent quality submitted to relevant ministry. No spills affecting water quality.
Ambient air quality						
Pre-construction phase						
– In case of a large timespan (more than one year) between preparation of the ESIA study	– Repeat the analysis of air quality in the project area, possibly in two seasons (summer and winter).	Minimize the impacts on air quality in construction phase	Cost the air measurements included in the Contractor's BoQ;	PESR or PESR to transfer the responsibility to the Contractor as per contractual agreement	Checking if the air quality monitoring is performed	Environmental baseline report on air quality prepared

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
and start of construction works, up-to-date information on air quality in the project areas will be needed to determine baseline conditions						
Construction phase						
– Adverse impacts on ambient air quality as a result of: construction activities and use of construction mechanization that generate dust, exhaust gases, VOC	– The CESMP is to include **Air Quality Management Plan** (AQMP). The AQMP shall contain: ○ identification of all air emission sources including motorway construction activities, concrete and asphalt production facilities, sourcing and transport of construction materials, and other emissions generating facilities, ○ identification of all types of emission from each source, ○ details of mitigation measures for each source, ○ specific location and schedule where such measures shall be implemented to minimise impacts to sensitive receptors due to the presence construction work ○ Monitoring and reporting in accordance with Table 133 in the ESIA. Specific mitigation measures to be	Controlling and minimize the impacts on air quality in construction phase	Air Quality Management Plan Included in Construction costs;	PESR to transfer the responsibility to Contractor through tender documents and contractual agreement Licenced company for monitoring	Engineer supervision of the Contractor's work based on CESMP (AQMP): weekly visual inspections throughout the construction phase to monitor the implementation and effectiveness of prescribed mitigation measures. Records should be kept of these visual inspections and submitted in the monthly reports prepared by the external supervising engineer. Air quality parameters as defined in the ESIA, **Table 132**	AQMP prepared, reviewed and approved by the Supervising Engineer. Weekly to monthly report by the Engineering Supervision; No community grievances raised relating to construction dust.

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	included in AQMP shall include but will not be limited to: – Covering the borrow pits (if new are opened for the purpose of the motorway), landfill sites, and slopes with suitable vegetation at the end of the construction activities in order to minimize particulate matter air emissions. – Dust from construction activities, implement the schedule of active wetting of soil on the corridor when the unfavourable weather conditions are present (presence of wind, low humidity) and emission-intensive activities are taking place on the corridor according. – Ensure proper state of maintenance machinery and vehicles to minimise air emissions. – Undertake immediate repairs of any malfunctioning construction vehicles and equipment. – Wherever possible, use electrically powered equipment rather than gas or diesel-powered equipment. – Trucks used for transporting materials to and from the site will be covered with canvas tarpaulins.					
Operational phase						
– Adverse impacts on ambient air quality as a result of the traffic along the motorway	– Regular monitoring of air quality to take place at sensitive receptors and grievances, when raised, will be dealt with according to the Operational Stakeholder Engagement Plan; – Conducting monitoring of the air quality in accordance with the Table	Controlling and minimize the impacts on air quality in operational phase	Operational costs for the air measurements;	PESR and Contractor (in case of reconstruction activities), or PESR to include in the contractual agreement	Standard set of parameters to include CO, SO_2, O_3, NO, NO_2, NO_x, PM_{10} and $PM_{2.5}$. Checking if Air quality measurements have been performed by	Report from performed air quality measurements by PESR;

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	133 in the ESIA. – In case that monitoring indicates increased pollution of ambient air caused by traffic around the sensitive receivers, implement construction of natural of artificial barriers to protect the receptors. If this is not sufficient protection or these species cannot grow on the Project area, artificial barriers are also acceptable, e.g. noise barriers also prevent spread of air pollution, and their efficiency depends on their height. – In case of reconstruction activities, conduct measures for construction phase				PESR	
Project impacts on climate change						
Pre-construction phase						
– Same as under air quality in the pre-construction phase.	– Same as under air quality in the pre-construction phase.	Same as under air quality in the pre-construction phase.	Same as under air quality in the pre-construction phase.	Same as under air quality in the pre-construction phase.	Same as under air quality in the pre-construction phase.	Same as under air quality in the pre-construction phase.
Construction phase						
– Increased GHG emissions related to extraction and manufacturing of materials and fuel/energy consumption by transportation of construction materials	– Selected contractors should have incorporated a commitment to reduce GHG emissions in their environmental policies; Include climate change mitigation measures in the CESMP: – Use construction materials with lower carbon footprint wherever possible, such as cold mixed asphalt, asphalt with lower content of bitumen; – Decrease number of trips by optimizing material transporting	Reducing the impacts on climate change	Construction costs	PESR to transfer the responsibility to the Contractor through tender documents and contractual agreement	Weekly monitoring by the Engineering Supervision in order to control the contractor's work	Weekly to monthly report by the Engineering Supervision; No records on eventual environmental disasters (which would lead to GHG emissions) caused by the project.

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	vehicles; – Switching off the vehicles and construction machinery whenever not in operation rather than idling.					
Operational phase						
– Increased GHG emissions as a result of operation of motorway	Include climate change mitigation measures in the OESMP: - Use the best practice-efficient approach to maintenance and refurbishment; – Be adequately equipped for fast and effective repair; – Implement re-cultivation and restoration activities; – Encourage drivers with motivational messages on electronic displays to maintain a consistent speed of 100-110 km/h for the benefit of reducing GHG emissions.	Reducing the impacts on climate change	Operational costs	PESR	Monitoring by the PESR on the implementation of mitigation measures	Implemented messages on speed control Re-cultivation and restoration activities implemented Report on the performed measures by the PESR
Climate change impacts on project						
Pre-construction phase						
– Availability of documents and baseline data to monitor climate change impacts on the project, as well as and structures/equipment to avoid impacts of climate change on the project	– Development of **Emergency Resilience Plan (ERP)** as a part of CESMP – Review of the Preliminary Design and Main Design to evaluate design measures and materials specification in light of the anticipated climate change forecasts and projections over the lifetime of the Project, as follows: - Expected increased rainfall should be taken into account while designing slopes, retention walls and tunnel portals in order to prevent possible landslides; - Confirm capability of current	Reducing and avoiding climate change impact on construction work, mechanization and equipment	Construction costs	PESR to transfer the responsibility to Contractor through tender documents and contractual agreement	Engineering Supervision to review Preliminary and Main Design to include measures to increase climate resilience Prepared ERP and control mitigation measures included, as a part of CESMP	Preliminary and Main Design reviewed and approved by the Engineer Supervision EPRP prepared, reviewed and approved by the Supervision Engineer Control mitigation measures to avoid climate change impacts on the

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	heat-resistant road and track materials and if necessary use more heat tolerant binders and materials; - Use lighter color paving materials (i.e. concrete) or reflective coatings for asphalts; - Consider constructing dams, reservoirs and retaining ponds to buffer the water, flood walls to protect the road from flooding, temporary flood barriers along road; - Usage of corrosion-resistant or waterproof materials (adapting different pavement mixture design can improve resistance to water damage – compared with concrete pavement; asphalt pavement material is generally less resistant to water damage). Implement control mitigation measures to avoid climate change impacts on project activities in construction phase, as a part of CESMP: - Install ventilation systems in ground facilities; - Provide special heat-resistance containers for flammable substances; - Provide channels and pipelines on the construction site to collect water in case of extreme rainfall; - Install drainage system for collection of storm water and torrential flows from the bigger catchment areas, i.e.					project included in the CESMP.

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	installation of open channels, pipelines and culverts; - Build reservoirs and retaining ponds to buffer the water; - Cleaning out watercourses and structures of flood prone areas ahead of predicted heavy rainfall.					
			Construction phase			
– Drying and cracking of construction land; – Forest fires may occur; – Extreme heat can limit construction activities, which may increase the cost and duration of construction and maintaining activities; – Accumulation of water or complete flooding of the construction site and the access to it; – Excess erosion and sedimentation, landslides activation; – Risk of fires as a	Include climate change mitigation measures in the CESMP: In case of extreme heat, mean heat or droughts: – Stopping the work during extreme temperatures according to the recommendations by the governmental institutions; – Supply the construction site with sufficient technical water; – Regularly control the state of fires in the project area by visual inspection and monitoring of news in local media; – Store flammable materials in special heat-resistance containers; – Improved coverage of fire-fighting equipment; In case of main rainfall and storm or extreme rainfall: – In case of noticeable wetting of the terrain in the lowest zones, make culverts in places to drain the accumulated waters; – In case of noticeable torrential flow of water from larger catchment areas, collect and channel water through temporary or permanent channels and pipelines;	Reduction of climate change impacts on construction work, mechanization and equipment	Construction costs	Contractor Engineer	Daily visual inspection of construction site by Engineering Supervision Checking the storage of hazardous substances Collected storm water through temporary or permanent channels and pipelines	Weekly reports and records by the Supervision Engineer on visual inspection Reports on the delivery and storage of flammable substances Reports of the supervising engineer on the implementation of fire protection activities on the construction site No records on eventual natural hazards which may affect the project.

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
result of storage of flammable substances on construction site; – Flooding of stored material; – Drainage of the piles of temporary stored excavated material; – Reduce visibility for the drivers of vehicles; – Ignition of equipment containing hazardous substances; – Damage of construction equipment (melting); – Turning the ground into mud which poses its own risks to the health and safety of site workers which are operating the mechanization	– Using water capture and storage systems; – Review capacity of pump equipment; – Stopping the work during intensive rainfalls; – Parking the mechanization and equipment on stable terrains.					
Operational phase						
– Higher temperatures	Include climate change mitigation measures in the OESMP:	Reduction of climate change	Operational costs;	PESR or PESR to transfer the	Evidence of prepared Operational Emergency	Operational Emergency

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
and solar radiation can increase the rate of degradation of pavements leading to higher maintenance costs; – Increase of GHG emissions; – Softening and expansion of pavements which can lead to rutting and pavement cracking; – Disruption to traffic flows and destroyed vehicles as a result of damage of the alignment; – Rapidly spreading fires along the alignment can lead to car fires, and injury or even death of road users; – Flooding of the road and surface damage; – Degradation of the material	*For the alignment of the motorway the following mitigation measures are proposed:* – Maintain and implement vegetation management practices that minimize fire risk; – Tree planting to reduce run-off rates across a catchment; – Prepare **Operational Emergency Preparedness and Response Plan**; – Control water leakage, to prevent its disappearance in extremely dry periods, which can cause land subsidence; – Restrict the movement of vehicles transporting dangerous substances during periods of high temperatures; – Establish an appropriate program of regular control maintenance and inspection of road infrastructure; – Regularly control the state of fires in the project area by visual inspection and monitoring of news in local media; – Install fire extinguishers in tunnels. *For protection of underpasses and bridges the following mitigation measures are proposed:* – Regular cleaning and removal of vegetation; – Tree planting to reduce run-off rates across a catchment. *Mitigation measures for protection of the retaining walls and bridges are the following:* – Maintenance of the planted vegetation on slopes;	impacts on the motorway		responsibility to the sub-contractor per Contractual Agreement	Preparedness and Response Plan	Preparedness and Response Plan prepared Percentage of reforested and re-cultivated area. Inspection reports Traffic reports Evidence of the performed verification of the correctness of the drainage system, as well as regular maintenance and control of road infrastructure Number of drainage system blockages per year

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
(concrete, wood); – Flooding and undermining of supporting structures; – Demolition of pillars; – Demolition of underpasses; – Closure of underpass with vegetation and stones; – Drying the vegetation which will result with destabilization of the slope; – Cracking the retaining walls as a result of increased rainfalls; – Closure of culverts with vegetation and stones.	– Maintain and implement vegetation management practices that minimize fire risk; – Drainage of road embankment for fast lowering of groundwater table after flood retreats; – Use vegetation for improving slope stability and erosion protection; – Use geo-synthetics for improving slope stability and erosion protection. *In order to reduce the negative impacts on culverts and tunnels the following mitigation measures are proposed:* – Inspect and clean drainage systems regularly; – Keeping the road drainage in good condition; – Prevent the clogging of pipes/culverts on connecting roads; – Control water leakage, to prevent its disappearance in extremely dry periods, which can cause land subsidence; – Restrict the movement of vehicles transporting dangerous substances during periods of high temperatures; – Install fire extinguishers in tunnels; – In case of least fire danger, divert traffic.					
Noise and vibrations						
Pre-construction phase						
– In case of a large timespan (more than one year) between preparation of	– In case of large timespan, repeat the analysis of ambient noise in the project area; – In the Detail Design should be taken into consideration proposed	Reducing the impacts from increased noise and vibration levels	Designing costs;	PESR or PESR to transfer the responsibility to the Contractor as per contractual	Checking if the ambient noise levels measurement are performed;	Environmental baseline report on ambient noise levels prepared

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
the ESIA study and start of construction works, up-to-date information on ambient noise levels in the project areas will be needed to determine baseline conditions – Some preparatory works should be done to avoid negative impact in construction and operational phase	mitigation measures for reduction of noise, generated during the operational phase of the project. All proposed measure that will contribute to reduction of the noise to be applied as much as possible. In order to protect the few sensitive receptors along the motorway, noise barriers should be constructed at several locations i.e. on km 3+805; km 3+828; km 3+870; km 4+610; km 4+631; km 9+128; km 9+168; *The noise barriers should meet the following characteristics:* – Have a sound absorption coefficient of at least 8 dB (A) (EN 1793-1); – The aerial sound insulation under direct conditions of the sound field shall not be less than 28 dB(A) (Class D3 EN 1793-6); – To resist atmospheric influences (temperatures from -30 to + 70 ° C, humidity and wind); – To be resistant to the dynamic force of snow when removed by snow-plow from the pavement (EN 1794-1); – Be resistant to impacts of stones and scrap (Class 3 - EN 1794-2); – To be water-resistant to salt and the effect of combustion gases; – To be resistant to fire (class 3 - EN 1794-2); – Be resistant to the cumulative effects of the above factors; – To have a long life of exploitation and low maintenance costs; – In order to protect the landscape, it should be a color in keeping with			agreement	Checking if noise barriers are included in the Detailed Design	Revised and approved Detailed Design by Engineering Supervision and obtained construction permit

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	the landscape; – If transparent sound barriers are chosen, they should have clear warning signs for birds.					
Construction phase						
– Increased noise and vibration as a result of construction activities (drilling, blasting, earth moving, compacting) – Increased noise and vibration as a result of movement of mechanization and vehicles	Include noise control measures in the CESMP: – Installation of operational noise barriers as early as possible in order to be functional in construction phase; – Include noise control measures in the CESMP to avoid the exceeding of permitted values in accordance with the Law on protection against noise in the environment, such as: o restriction of works to day-time only (period of day: 06:00 to 22:00, period of night: 22:00 to 06:00), o on unpaved roads, maximum speed of vehicles should be restricted to 20 km/h to minimise load-rattle, o haul routes should avoid passing dwellings at distances closer than ten metres, o equipment and machinery to be shut down when not in use, o in case of noise increase complaints by residents, simultaneous use of machines that generate noise over 70 dB should be limited and all noise complaints shall be investigated, o all equipment and vehicles will be maintained in good working	Reducing the impacts from increased noise and vibration	Construction costs;	Contractor, PESR to transfer the responsibility to the Contractor as per Contractual Agreement Licenced company for monitoring	Weekly site walkover by Engineering Supervision to consider if noise mitigations being appropriately implemented. Noise mitigation measures are included in the CESMP. Monitoring of noise levels are performed.	Noise control measures implemented and recorded as implemented in monthly reports prepared by the Engineering Supervision. Records on performed noise levels measurements during construction activities. No noise related complaints received. Equipment maintenance and repair program implemented. Noise barriers installed and Engineering revision approved the installation.

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	order - implement a regular equipment maintenance and repair program, o machines and vehicles to be used in construction activities must have use/operation permits, o monitoring upon complaints during the construction phase of the Project. – Conducting monitoring on noise during construction phase in accordance with the Table 133 in the ESIA.					
	Operational phase					
– Increased noise and vibration as a result of operation and maintenance of the motorway	Include noise control measures in the OESMP: – It is possible that the traffic intensity during motorway use will be higher than originally planned. If this would be the case, perform control measurements of the noise level along the complete motorway length annually, during the first three years of the operation of the motorway, in order to determine the noise emission level. If the allowed levels were exceeded, additional protection measures must be planned in the form of additional noise protection barriers, preserving the road and the tarmac in a good condition, pavement curtain which absorbs noise, green belts etc. – Maintenance and replacement of the noise barrier along the alignment in case broken parts are present. – Noise monitoring upon complaints	Reducing the impacts from increased noise and vibration	Operational costs;	Contractor, or PESR to include in the Contractual Agreement	Periodical monitoring of the ambient noise in accordance with the provisions of Environmental Permit. Conducting regular maintenance of noise barriers	Report on performed noise measurements; Report on performed maintenance activities; No complaints received.

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	during the operation phase of the Project.					
Waste						
Pre-construction phase						
– Inadequate planning of waste disposal	– Decide on the locations for temporary storage and permanent disposal of surplus of excavated land and other construction waste. **Develop required design documents** and obtain necessary permits; – Develop **Construction Waste Management Plan (CWMP)** to address methods for handling and disposal of spoil and other types of construction waste; – Prepare the **Waste Management Plan (WMP)** that will address management options for communal waste and other special waste categories that are generated in the construction camp including both hazardous and no-hazardous waste.	Adequate planning of waste management in the pre-construction phase	The cost of design documents to be determined based on the number of disposal locations	PESR to transfer responsibility to the Contractor	Design documents reviewed and approved by Engineering Supervision. WMP and CWMP reviewed and approved by the Engineering Supervison. All approvals for the disposal locations have been obtained.	Copies of the permits Monthly monitoring reports by Engineering Supervision on implementation of waste management measures.
Construction phase						
– Inadequate waste management (collection, separation, storage, reuse, recycling, transport and landfilling) will have adverse impacts on air, water, dry water beds, soil, surrounded flora	– Contractor to nominate a Waste Manager on site who will promote and maintain sound condition for waste management during performance of the project activities; – Singing agreements with licensed companies for collection, transport and treatment of waste for all types of generated waste (hazardous, non-hazardous); – Full implementation of the measures that will arise from the WMP and CWMP;	Reducing impacts as a result of improper waste management	Included in the construction costs	Contractor Engineer	Records of generated waste during construction phase; Weekly to monthly monitoring by the Supervision in order to control the contractor's work on managing the waste in line with WMP and CWMP.	Proofs of communal waste and special waste categories from the construction camp transferred to licenced operators for further disposal. Monthly supervision report on soil disposal practices including Construction Dairy

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
and fauna, habitats and the surrounded landscape	– Besides the proposed location, if the Contractor asses that there is a need for new locations for storage or disposal of generated waste, it is recommended to propose locations which should be approved by the Supervisor and Investor and to provide all required permits/agreements for their use.					logs.
Operational phase						
– Collection and storage of waste	– Develop the measures related to waste management in the operations/maintenance phase and include them in the OESMP. Identify waste types generated during the maintenance of the road section and handling method.	To adequately manage the waste in the operational phase and during maintenance activities	Included in the operational/maintenance costs	PESR to develop OESMP PESR to transfer responsibility for waste management to maintenance contractor regarding the waste generated during maintenance activities.	Records of generated waste during the maintenance phase PESR to monitor implementation of OESMP measures	Proofs of waste being transfered to licenced operators for further disposal
Safe use and management of hazardous substances						
Pre-construction phase						
– Damage on the environment and human health and safety in case of inadequate management that may result with possible leakage, generation of dust, fire,	– Preparation of **Hazardous Materials and Leak Control Management Plan**; – Preparation of **Plan for Evacuation and Rescue in Emergency Situations** in accordance with the Law on Protection and Rescue ("Official Gazette of RM" no. 93/12, 41/14, 71/16, 106/16, 83/18); – Preparation of notification procedure (form) in case of emergency.	Reducing and avoiding negative impacts on environment and health	Designing costs	PERS to transfer responsibility for preparation of the Plans to the Contractor	Engineering supervision to review and approve Hazardous Materials and Leak Control Management Plan and Plan for Evacuation and Rescue in Emergency Situations, Notification procedure (form) in case of emergency and all	Revised Detailed Design and obtained construction permit; Prepared Hazardous Materials and Leak Control Management Plan, Plan for evacuation and rescue in emergency

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
explosion, etc.					required documentation proposed for waste management has been prepared.	situations; Notification procedure (form) in case of emergency and all required documentation proposed for waste management and approved by Supervision
Construction phase						
– Damage on the environment and human health and safety during construction work, in case of no proper management that may result with possible leakage, generation of dust, fire, explosion, etc.	Implementation of measures that will arise from the prepared **Hazardous Materials and Leak Control Management Plan** and **Plan for evacuation and rescue in emergency situations** including but not limited to: ○ Prevent storage of hazardous materials, refuelling, servicing or maintenance of the equipment within 100 m of drainages, water courses, alluvial soil or erosive soils, wetlands or other sensitive environmental resources. If these activities have to be done at the construction sites, all precautionary measures shall be taken to prevent leaks or spills from reaching the soil or nearby water courses; ○ All hazardous material accepted by the Contractor and entering on the construction should be properly identified	Reducing and avoiding negative impacts on environment and health in the construction phase	Construction costs	Contractor	Daily monitoring implementation of the measures by responsible person from the Contractor. Weekly monitoring by the Supervision in order to control the contractor's work.	Daily reports and records by the Contractor; No community grievances and no records of eventual environmental pollution.

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	and labelled; ○ Safe storage of hazardous materials and hazardous waste in the warehouses and along the construction sites should be provided; ○ Storage area must be marked and fenced and unauthorized access should not be allowed; ○ Manner of storage of hazardous materials should be performed in accordance with their properties defined in the Safety Data Sheet that should be provided by the producer of materials; ○ Storage of hazardous materials and waste should be performed separately; ○ Hazardous materials should not be exposed to temperatures at which they could ignite (flammability limits) or explode (explosive limits); ○ Secondary system containment system around the storage tanks for collection of leachate should be provided; ○ Flammable liquids should be transported in an appropriate safety-carrying container. Compressed gas cylinders must be set in an upright position, regulators and cylinders caps should be removed on place; ○ Leaks spill up and spill prevention kits should be					

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	present on storage areas and construction sites; o Good housekeeping practices for hazardous materials should be implemented; o Preventive and regular maintenance of all dispense vessels and containers, pipes and other elements should be implemented; o Regular-routine/Daily checks in the hazardous materials storage area to be performed by responsible person; o Regular maintenance of the equipment, mechanisation and vehicles should be provided; o Appropriate safety equipment in case of fire, explosion, leakage should be provided; – Training of workers involved in handling the hazardous materials and hazardous waste should be provided as well as the training should be provide for all arranged workers about possible hazards and harmful effects of chemicals/hazardous substances					
Operational phase						
– Release/leakage in the environment in case of accidents as a result of transport of hazardous	– Implementing the measures for fire protection proposed during designing phase in order to avoid possible risk of fire of hazardous materials; – Usage of herbicides for vegetation management should be avoid as much as possible, or to avoid excess	Reducing and avoiding negative impacts on environment and social aspects	Included in the operational costs	PESR	Record of implementation of proposed measures.	Records of any accidents and proof of appropriate handling of the released material.

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
materials in packaged and unpackaged form; – Transport of hazardous materials may cause fires and explosions and leakage/dispersion of explosive and/or flammable materials. – Extensive use of herbicides may impact soil and water quality	use of herbicides. – The herbicides should be provided for manufactured under license, registered and approved by an appropriate authority; – Only herbicides that are labelled in accordance with international standards and norms should be used; – Handling and application should be in accordance with the SDS (Safety Data Sheet) and recommendation for its usage, i.e. maximum recommended dosage for treatment; – Herbicide application should be based on criteria (e.g. field observations, weather data, time of treatment, and dosage) with use of a herbicide logbook to record data; – Application practices should be designed to reduce unintentional drift or runoff; – Herbicide application equipment should be maintained and calibrated in accordance with manufacturers" recommendations; – Untreated buffer zones or strips should be established along water sources, rivers, streams, ponds, lakes, and ditches to help protect water resources; – Training of workers involved in handling the hazardous materials and hazardous waste should be provided, etc.					
Biodiversity (flora, fauna, ecosystems and natural protected areas)						
Pre-construction phase						

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
– Negative impacts on flora, fauna, ecosystems caused by inadequate planning and preparation of works	*Mitigation measures that should be implemented in the further phases of Detailed Design development:* - wildlife crossings (tunnels, culverts, underpasses) already incorporated in the project design must not be changed to minimize the fragmentation effect enabling wild animals to cross the motorway; - supporting structures for bridges should be built outside of permanent rivers beds. - construction on intermittent streams should take place in dry season. *Mitigation measures that should be implemented by the Contractor, prior starting of the construction activities:* – Preparation of **Biodiversity Management Plan (BMP)**; – Preparation of **Vegetation Removal Management Plan (which includes Afforestation activities);** – Ensuring both of these plans are harmonized with each other and other plans to be developed as sub-plans within CESMP; – BMP must include compensation measures in order to secure no net loss of the identified Priority biodiversity features (PBFs) and net gain of Critical Habitats (CH). Only one important habitat (considered as critical habitat) will be directly affected: *6220 Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea. In the habitat map	Reducing the negative impacts on biodiversity	Designing and construction costs	Designer and Contractor	Checking if the wildlife crossings are incorporated in the Detailed Design Checking if the, Biodiversity Monitoring Plan and Vegetation Removal and Management Plan has been prepared Checking if water quality analysis of Vrazanska River has been conducted	Detailed Design and construction permit in line with recommendations regarding wildlife crossings and bridge structures Prepared Biodiversity Monitoring Plan and Vegetation Removal and Management Plan and approved by Supervisor Report for conducted water quality analysis of Vrazanska River

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	it is named “Hill pasture” (67.15 ha) and “Hill pasture with sparse shrubs” (241.3 ha). The latter is overgrown by shrubs of different species in the area (*Paliurus spina-christi, Quercus pubescens*, etc.) and does not represent typical habitat 6220. However, it is not possible to avoid this habitat since it is spread along the whole gorge of river Lepenec. As a consequence a compensation measure has to be proposed. The compensation measure should concern improvement of the important habitat 92A0 *Salix alba* and *Populus alba* galleries (riparian habitats). The BMP should list afforestation activities and revitalization of riparian habitats, improvement of their connectivity, cleaning of deposited waste, and eradication of alien species of the surface area the same or larger than the affected one. The area of unavoidable loss must be precisely calculated during the development of BMP taking work camps, access roads, parking lots etc. into consideration; – Avoiding installation of worker camps and parking lots for heavy vehicles near the sensitive locations and sensitive habitats (see Habitat sensitivity map in the Blace-Stenkovec motorway corridor); – Monitoring of the water quality in Vrazanska River, based on the algae, macroinvertebrate community and physical-chemical parameters in					

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	order to follow the impact in construction phase. Monitoring activity should be performed during the wet (rainy) period when the river will have regular (even minimal) flow. Measuring points, sample rate and monitoring parameters are defined in Environmental Monitoring Plan.					
Construction phase						
– Loss of terrestrial habitats – Loss of terrestrial flora and fauna – Disturbance of species – Illegal hunting/accidental killing of animals by workers – Introduction of alien species – Dust deposition – Changes in aquatic habitats (sedimentation, pollution and eutrophication of streams) – Mortality of hydrobionts	*Mitigation measures that should be implemented by the Contractor:* – Full implementation of the measures prescribed in the Detailed Design, Biodiversity Management Plan and Vegetation Removal Management Plan (which includes afforestation activities); – Measures of good construction practice e.g. avoid important and sensitive habitats such as alluvial terrains, avoid destruction of natural habitats, avoid temporal occupation and destruction of adjacent land; sound storage of hazardous substances (oil, fuel, etc.), provide fire-protection measures and equipment/vehicle (no construction machinery within the construction sites), provide spill-kits in construction and transport vehicles, sound material and waste management practices, measures to reduce air emissions, noise and vibrations, etc.; – Temporary land-take (including access roads, worker camps, etc.) would include adequate areas of	Reducing the negative impacts on biodiversity	Construction costs	Contractor	Checking if water quality analysis of Vrazanska River (if there is a water flow) and Lepenec River have been conducted Daily monitoring by responsible person from the Contractor in order to monitor the successful implementation of the measures Weekly monitoring by the Supervision in order to control the contractor's work	Report for conducted water quality analysis on Vrazanska River (if the measurements are done) and Lepenec River Monthly reports and records by the Contractor

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	land set away from sensitive biodiversity areas; – Construction of access roads should avoid the riparian habitats (Willow and poplar woodlands) as well as hill pastures (to the extent possible). Attention should be paid to riparian habitats (no-go areas) at the following riparian sites: 21.344711, 42.088961 and 21.322070 42.120404; – Undertake education of workers to eliminate illegal hunting, accidental killing and/or collection of animals/plants; – Actions to ensure contaminated materials are identified, isolated and removed to appropriate landfill to avoid any impacts on the biodiversity; – Excavated soils and fine sediments should be adequately fenced to stop disposal in the riverbeds through erosion and storm water runoff at the following sites: 21.322834 42.121370; 21.332588 42.111111; 21.334528 42.110057; 21.339359 42.103925; 21.346029 42.093918; 21.346146 42.090658; 21.353175 42.081159; 21.364262 42.076850; 21.370653 42.071914; 21.377377 42.058321; – Leaks and spills from construction equipment and vehicles should be prevented by regular inspection and reparation of vehicles which operate					

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	near project area waters and by cleaning equipment prior to operation; – Sanitary facilities should be provided at work sites in the construction camp for preventing sanitary waste release in the environment; – Implement the measures from the Waste management plan (especially regarding the waste that may be potentially used for food by wild animals, carcasses, etc., educate workers about the plan, and have the necessary equipment for its implementation); – The waste material (concrete, iron, rocks etc.) and spoil accidentally deposited, should be immediately removed from riparian and aquatic habitats; – Control and eradication of invasive alien species; – A site-wide ban on workers bringing vegetation or soil from outside the site area to prevent dispersion of non-native invasive species; – All vehicles and equipment must be washed down before entering the sensitive sites in or near riparian habitats to prevent introduction and/or spread of invasive alien plants; – Reduce the use of herbicides as much as possible to avoid their persistence in the environment and negative impacts to autochthonous flora in project area; – Wetting of soil and plants should be done regularly in order to prevent					

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	deposition of thick dust layers on top of plants as much as possible; – Visual monitoring of the whole construction phase in order to make sure that all measures are properly applied; – Water quality analysis of Vrazanska River and Lepenec River by authorized laboratory in order to assess the ecological status of the Rivers on locations presented in the chapter 9.					
Operational phase						
– Fragmentation of habitats – Inadequate maintenance of vegetation – Incidental leaks – Occurrence of fires – Animal mortality due to collisions	*Mitigation measures that should be implemented by PESR* to eliminate or mitigate potential operational risks: – Maintenance of the wildlife crossings (tunnels, culverts, underpasses); – Adequate maintenance of drainage structures and oil separators to ensure their efficiency regarding the pollution prevention; – Establish sound waste management, including removal of food and carcasses from the motorway, in order to minimise attractiveness to animals and prevent collisions with vehicles; – Monitoring and maintenance of the fence of the motorway in order to avoid animal collisions with vehicles; – Application of soil, water and air protection measures; – Application of measures to prevent the occurrence of fires and other incidents; – Regular maintenance of the vegetation along the motorway;	Reducing the negative impacts on biodiversity	Operational costs	PESR	Monitoring by the State and municipal inspectorates after the prescribed measures are implemented each season after the completion of construction works Monitoring of invasive plant species Monitoring of afforestation and revegetation success; Monitoring of road-kills (number, species and localities)	Records from the inspections

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	avoid utilization of pesticides; – Recultivate the construction waste landfill by autochthonous species.					
Landscape and visual aspects						
Pre-construction phase						
– Visual changes of the landscape	– Preparation of the **Rehabilitation and Landscaping Plan** in construction and operation phase, to address measures for mitigation of the visual and landscape effects.	Reducing the negative impacts on visual aspects	Construction costs	PESR Permit from the PE "National Forest' Contractor for construction phase and PESR for operational phase	Checking if the Rehabilitation and Landscaping Plan has been prepared	Prepared Rehabilitation and Landscaping Plan and approved by Supervision
Construction phase						
– Visual changes of the landscape	Principal strategy during the construction phase to mitigate the impacts, as far as practicable and to the extent possible, includes undertaking of construction works such as: – Full implementation of the Rehabilitation and Landscaping Plan-construction phase part; – Measures to retain and protect vegetation/trees during construction; – Replanting of erosion-prone areas to be conducted by indigenous plant species; – Screen the temporary construction buildings, fencing and facilities by solid fences; – Establish sound spoil and waste management system, cleaning the construction site after the construction works.	Reducing the negative impacts on visual aspects	Construction costs for Remediation of land/trees alonge the alighment	Contractor	Weekly monitoring by responsible person from the Contractor in order to monitor the successful implementation of the measures Weekly monitoring by the Supervision in order to control the contractor's work	Implemented Rehabilitation and Landscaping Plan Weekly reports and records by the Contractor
Operational phase						
– Visual aspects	– Preparation and full implementation	Reducing the	Operational costs	PESR	Monitoring by the State	Implemented

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	of the **Rehabilitation and Landscaping Plan-operation phase part**; – Regular maintenance of underpasses and fences; – Retention of natural vegetation, where practicable; – All embankments and slopes are to be re-vegetated and maintenance of vegetation to be ensured; – In addition to replanting vegetation on embankments, tree berms should be established in key places where the cuttings are high and invasive; – Design and construct rest/parking areas along the motorway in accordance with aesthetics of the surrounding; – Continuous removal of rock debris from slopes, dales and ravines and replanting of vegetation.	negative impacts on visual aspects			and municipal inspection body if the prescribed measures are implemented	Rehabilitation and Landscaping Plan Records from the inspections
Forests						
Pre-construction phase						
– Impact on identified forest in the area	*Mitigation measures that should be implemented by the Contractor, prior starting of the construction activities:* – Preparation of Biodiversity Management Plan and Vegetation Management Removal Plan (which includes afforestation activities).	Reduce and avoid impacts on forests	Construction costs	Contractor Engineer	Checking if the Vegetation Management and Removal Plan has been prepared prior to construction	Prepared Forest Vegetation Management and Removal Plan and approved by Supervisor
Construction phase						
– Loss of forest area – Loss of certain number of trees and decreased carbon sequestration	– Full implementation of the measures from the Vegetation Management Removal Plan (which includes afforestation activities); – Avoiding construction work near the willow and poplar riparian forests; – Undertake education of workers to	Reduce and avoid impacts on forests	Construction costs	Contractor Engineer	Daily monitoring during works near or in woodlands by responsible person from the Contractor in order to monitor the successful	Weekly reports and records by the Contractor

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
capacity – Loss of wood mass – Loss of natural regeneration – Possibility for occurrence of erosion processes – Dust deposition	eliminate possibility for occurrence of forest fires; – Minimization of areas affected by construction activities and minimization of logging, in order to reduce damage to forests; – The construction of access roads, if possible, to be planned and performed in places where there is no forest or in parts where it is degraded; – Timely implementation of expropriation procedures and fair compensation for lost ownership of private forest owners and forest land; – Partial landscaping of the land, as well as afforestation of certain areas where construction is completed, in order to partially offset the negative impacts and reduce the risk of erosion processes, restoration of natural balance, ecosystem processes and dynamics of the habitats; – Wetting of soil and plants near construction in order to prevent substantial dust deposition on plants; – Implementation of measures to reduce negative impacts on biodiversity, air, soil, etc.				implementation of the measures Weekly monitoring by the Supervision in order to control the contractor's work	
Operational phase						
– Motorway maintenance – Forest fires, – Leaks/pollution	– Implementation of the measures from the Vegetation Management Removal Plan (which includes afforestation activities); – Preventive measures to reduce the	Reduce and avoid impacts on forests	Operational costs	PESR	Monitoring by the State and municipal inspection body if the prescribed measures are implemented	Records from the inspections (if any)

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	danger of forest fires by timely clearing of vegetation along the motorway and maintaining the protective zone along the motorway; – Installation of appropriate signalization for possible danger of forest fires; – Maintenance of land along the motorway, in order to protect against landslides and to protect against erosion; – Establish sound waste management; – Application of forest protection and regeneration measures.					
Community Health, Safety and Security						
Construction phase						
– Potential impacts in case of unauthorised access of people and animals to construction sites – Risks to health and safety of the drivers and passengers (E4 road) due to the increase of construction related traffic (increased number of traffic accidents on the existing E4	*Mitigation measures that should be implemented prior commencement of any construction activities by the Contractor:* – Establishing a fenced safety zone around construction zones and facilities – Preparation of **Community Health and Safety Management Plan (CHSMP);** – Preparation of **Traffic Management Plan (TMP) ;** – Preparation of **Emergency Preparedness and Response Plan – EPRP** (including emergency response and recovery/clean up procedures) in consultation with the relevant local authorities and emergency services	Care for health, safety and security of people transiting through project area of influence or users of affected property; Care for health, safety and security of commuters, drivers and passengers; Minimizing potential damages to property and human and	Construction costs.	Contractor in cooperation with Local Authorities: Municipality and Traffic Police; Contractor in cooperation with local authorities	Contractor to develop quarterly reports on implementation of CHSMP, TMP and EPRP activities. PESR to check and approve CHSMP, TMP and ERPR, and monitor its implementation; PESR to monitor implementation of measures. Contractor to report to PESR; Contractor to report to PESR quarterly on stakeholder engagement activities conducting on construction site.	Implementation of CHSMP; Complete Implementation of TMP; Complete Implementation of EPRP; Number of submitted and closed grievances.

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
(E65) road)		livestock lives; Uninterrupted realization of planned stakeholder engagement activities and minimizing the risk of opposition to the project by PAPs				
Operational phase						
– Traffic safety risks during operation due to illegal crossings over the motorway, etc. – Endangered traffic safety during performing military exercises at the shooting range.	*Mitigation measures that should be implemented by PESR:* – Conducting regular control and maintenance of traffic signalization; – Conducting regular inspection and maintenance of the fence along the motorway in order to reduce the risks of illegal crossing of the population, wildlife and livestock, as well as the number of accidents. – Implementation of **Emergency Preparedness and Response Plan (EPRP)** during operation, **Community Health and Safety Management Plan (CHSMP)** during operation and EPRP. CHSMP and EPRP must be in compliance with EBRD ESP, and particularly with PR1, PR4 and PR10. – It is also important PESR to establish regular communication with the Army, so to get regular updates on when Army is planning to perform shooting exercises so PESR can timely inform all road users. Some	Care for health, safety and security of road users: drivers, passengers and PESR and maintenance company's workers Road users' safety and security	Operational costs	PESR	PESR to publish EPRP, TMP and CHSMP online; Semi-annual control on traffic signalization and protection fence; PESR to check on implementation of CHSP	Plans are prepared and implemented; Documented checks and controls on signalization and fence; Documented communication among PESR and army, as well as preformed activities

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	300-500m prior to the shooting range (for each direction), PESR to install traffic information signal that will indicate (with traffic light green/red) active shooting exercise nearby conducted at the moment, by the military. This will give information to the current road users regarding potential risk to the health and safety of the drivers and passengers due to the use of explosive materials near the motorway (100-150 m).					
Labour, Working conditions, Occupational health, Safety and Security						
Construction phase						
– Risks for workers' safety related to construction activities (injuries, diseases etc.) – Extended ime of travel for the Emergency Service to the construction site	*Mitigation measures that should be implemented prior commencement of construction activities and during construction phase by the Contractor are listed below:* – Contractor must create and implement relevant **labour and working conditions policies** (all in compliance with national Labour law and its bylaws and EBRD PR2), such as: a) Company's HR Policy b) Non-discrimination and Equal Opportunities Policy c) Policy against GBVH (including procedure for reporting and responding to GBVH[84]) d) Policy against Child and Forced Labour e) Occupational Health and	Protection of worker's rights and securing social, pension and health insurance for engaged Contractor and sub-contractor's workers; Protect workers' health and safety	Construction costs	Contractor in cooperation with local employment agency	PESR to check and approve Policies and monitor their implementation; Continuous monitoring of implementation by receiving semi-annual reports on status of engaged workers PESR to check if the OHSP has been prepared; Daily monitoring by responsible person from the Contractor in order to monitor the successful implementation of the measures; Weekly monitoring by the Supervision in	Completed documents; Workers to put signature for received, understood and agreed each document; Prepared policies and plan, approved by Supervisor; Daily reports and records by the Contractor; Provided first aid kits and PPE to all workers;

[84] https://toolkit.cdcgroup.com/wp-content/uploads/2020/12/Addressing-Gender-Based-Violence-and-Harassment-Emerging-Good-Practice-for-the-Private-Sector.pdf

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	Safety Plan during construction f) Grievance Mechanism for engaged workers on this project during construction phase g) Code of Conduct (for all workers, including those of sub-contractors) – All these policies should be shared with Contractor's and sub-contractors' workers engaged on this project, in a language understandable to the workers, and documents should be signed by each engaged worker on this project (including sub-contractors' workers engaged on this project). – It is necessary for Contractor to engage independent consulting company that will perform Compliance Assessment of Contractor's HR & other labour related policies with national labour law and bylaws and PR2 requirements, as well to demonstrate efforts of elimination of these gaps prior commencement of any construction or civil works. – All personnel engaged in the construction of the proposed project, regardless of the level of contracting/subcontracting, will need to be entitled with full social, pension and medical insurance. – It is necessary for the Contractor to organize: • Professional trainings for all workers engaged on the project,				order to control the contractor's work Visual check of existence and presence on site by responsible monitoring entities Monitoring officers to check and compare lists of engaged workers and those who received First aid training.	Lists with workers that passed the training; Documented Minutes of meetings; Lists with workers that passed the training; Target of 100% to be achieved and maintained during the whole construction period; Lists with workers that passed the training. OHS statistics reported monthly by the Contractor.

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	even those of subcontractors. • Create Workers' Accommodation Management Plan, in case if such need occurs. Working conditions and work camp (if deemed required) during whole construction period will need to be set in compliance with relevant national labour legislation and GIIP. The accommodation for workers will comply with relevant Macedonian standards and EBRD requirements and shall be appropriate and be clean, safe and, at a minimum, meet the basic needs of workers: provision of minimum amounts of space for each worker; provision of sanitary, laundry and cooking facilities and potable water; provision of fire safety and safety from or other hazards; provision of first aid and medical facilities; and heating and ventilation. • The Contractor will be requested to develop a Local Employment and Procurement Plan, thus favour local workers, (from affected municipality and Skopje region), and ensure equal opportunities are provided to men and women in terms of employment. A target of at least 40% of local workers is to be adopted by the Project, and implemented by the Contractor(s). • Contractor must provide set of					

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	measures against COVID-19 in accordance with EBRD recommendations[85] and national requirements[86], and seek their implementation by his sub-contractors, but also monitor its implementation. • Contractor will be required to have a written contract with their workers materially consistent with objective of EBRD PR2, in particular about child and forced labour. Nonetheless, the contractor will be required in the contract to commit against the use of forced labour, and PIU staff in charge of contractor supervision will monitor and report the absence of forced labour. PIU staff in charge of contractor supervision will monitor and report the compliance with relevant national law or EBRD PR2. Contractor and his sub-contractors, will be required to develop and implement written management procedures related to labour, including procedures to establish and maintain a safe working environment as per requirements of EBRD PR2. *In regards of GBVH, the contractor must organize annual training to its employees*					

[85] https://www.ebrd.com/covid19-labour-requirements.pdf
[86] https://koronavirus.gov.mk/

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	on GBVH, and this training must also embrace sub-contractors' workers engaged on this project. **Occupational health and safety:** ○ The Contractor shall prepare an **Occupational Safety and Health Plan (OHSP),** perform health examinations of workers and provide personal protective equipment. ○ OHSP to include provisions regarding: ○ Actions to ensure full compliance in every project development stage with the national labour legislation and EU Directives for OHS; ○ Conduct job and task-specific hazard analysis and controls for all activities; ○ Fencing the construction site; ○ Provision of PPE, requirements for use of PPE, and enforcement of PPE use. Mandatory use of personal equipment; ○ Emergency prevention and preparedness and response arrangements; ○ Safety training for all personnel covering hazards and safety protocols of their jobs; ○ Review and approval of contractor OHS plans by PIU; ○ Oversight of Contractor(s) OHS implementation, including mandatory reporting; ○ Recording incident statistics, including total work hours, lost time incidents, major injuries,					

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	fatalities, etc. ○ Compliance with the legislation in the field of labour relations and protection at work and EBRD PR2; ○ Implementations of measures provided for in the risk management plans and measures; ○ All contractors and their subcontractors will be required to develop and implement written management procedures related to labour, including procedures to establish and maintain a safe working environment as per requirements of PR2. All contractors will be required under the Environmental and Social Action Plan (ESAP) to ensure workers will use basic safety gears, receive basic safety training and other preventive actions as provided in the Occupational Health and Safety Plan (OHSP); ○ Engaged workers must be educated on COVID-19 pandemic and symptoms, and undergo regular health checks in accordance with WHO recommendations. Protection measures against COVID-19 are mandatory for all workers,					

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	including those of sub-contractors[87]. ○ Contractor must establish and maintain communication (during the lifetime of the construction phase) between his responsible staff (Construction Site Manager/s) and closest emergency service in Skopje. ○ Contractor must provide training in Frist Aid to all project-engaged workers, even those of the sub-contractors. – Contractor to provide first aid kits to each team lieder and all locations where night guards will be located (in case of dog attacks and injuries during performing works).					
Operational phase						
– Risks for workers' safety related to maintenance/operation activities (injuries, diseases etc.)	*Mitigation measures that should be implemented by the PESR and road maintenance company engaged by PESR:* **Labour and Working Conditions** – PESR to make available and maintain Grievance Mechanism for its workers, as well as workers engaged on road maintenance. – PESR must require from the maintenance company on this motorway to comply with EBRD ESP. Also, this company must establish OHS plan for the operational phase. Policy and procedure for reporting and responding to GBVH from the construction phase shall be valid in	Maintain compliance with international standards and protection of workers' rights	Operational costs	PESR and road maintenance company	Monitoring by the relevant governmental inspection body; Visual check of document adequacy by PESR	Grievance mechanism for PESR workers established and communicated to workers; OHS Plan and EPRP for operation developed; Records from the inspection (if any); Lists with workers that passed the

[87] https://www.ebrd.com/covid19-workplace.pdf

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	the operational phase, as well. It can be updated by PESR, in accordance with GIIP. **Occupational health and safety** – Perform activities to ensure full compliance in project with the national labour legislation and EU Directives for OHS and PR4. – Provide Traffic Safety Measures training for the PESR employees on all maintenance workers. – In case of construction activities during maintenance, implement measures set in this document that refer to construction phase. – PESR to maintain EPRP during operational phase, and demand from the maintenance company to implement it, and act in accordance with it.					OHS training
Property, Housing, Communication & Infrastructure						
Pre-construction phase						
– Loss of agricultural land and property (weekend houses, cattle farm and commercial/residential auxiliary facilities)	– Develop and fully implement LARP (based on the developed LARF) – Establish Grievance Redress Mechanism (GRM) prior to commencement of expropriation process as defined in LARF. This GRM should be kept active during the construction period in case some affected land owner/user raise claims. GRM must be promoted among affected land and property owners during consultations held with them (for LARP purposes) and prior to commencement of the expropriation process.	Full compliance with PR 5	LARP development and implementation	PESR	Internal and external monitoring of land acquisition process in line with LARF/LARP provisions Monthly review of external grievances by LARP Implementation Unit (LIU)	LARP Implementation Unit (LIU) established in line with LARF LARP developed and approved by PESR and EBRD LARP implemented prior to any works; reports on implementation submitted to EBRD

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
						GRM in place; GRM communicated to PAP (to be documented through consultation reports)
Construction phase						
– Construction related nuisances (noise, dust, etc.) for nearby local communities (such as businesses located at the ending part of the route or weekend settlement users) – Increased time of travel from Skopje to Kosovo, and vice versa – Impeded traffic flow and decreased communication – Hindered access to land and property due to traffic diversions	Contractor and PESR to inform affected communities about planned construction works as foreseen in SEP: - information boards to be installed by the Contractor next to the roads that serve as entry/exit roads to/from the project area of influence and lead toward project's neighbouring settlements; - Grievance Leaflet and Form to be available on construction site in both Macedonian and Albanian in printed forms; - Grievance Leaflet to be hung on the construction site bulletin board - Two weeks prior to start of works, PESR to publicise information about the extent, timing and duration of planned construction works, and any expected disruptions and inconveniences via its website and social media platforms, and to ensure that such information is publicised on the website of the municipality - During construction works, Contractor to send semi-monthly updates to PESR and PESR to publicise this information via its website and municipality website. Traffic related measures addressed above	Minimize construction related disturbances to nearby local communities and minimize community grievances	Construction costs	Contractor and PESR Engineer Munissipality of Cucer Sandevo	Monitoring of Contractor's compliance with SEP provisions by PIU member responsible person for SEP implementation	SEP provisions all implemented: - Information boards set up by Contractor - 2 weeks prior to works, information on planned works publicised by PESR and municipality on their websites - Every 2 weeks during works, updated information on on-going works publicised by PESR and municipality on their websites - Grievance leaflet visibly hung on construction site, and printed grievance form available at site

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	under 'Community Health, Safety and Security'.					
Economy, Use of natural resources & Livelihood provision						
Construction phase						
– Loss and/or limitation of access to free natural resources (pastures and spring water) used for keeping livestock – Loss of income from growing crops on arable land that will be acquired for Project needs – Temporary income losses for businesses due to construction related disruption	– For all economic displacement impacts, develop and fully implement LARP provisions, as elaborated above under the Property item of this ESMP; – For access to free water resources, Contractor to liaise with sheep pens owners, at the very beginning of the construction phase, in order to find quick and sustainable solution for continuous supply of water in case rubber hoses used for delivery of fresh drinking water to cattle/sheep are damaged – through replacement of these hoses by the Contractor. – For access to pastureland, Contractor to give accent and priority in construction to underpasses, which is supposed to serve as a passage to the pastures for livestock. – PESR to keep active GRM in case someone raises claim for incurred costs due to impeded access to property or destination (for companies).	Minimize threat for incurred economic losses	Construction costs	PESR and Contractor	Internal and external monitoring of land acquisition process in line with LARF/LARP provisions Contractor to create Minutes of Meetings with sheep pen owners on access to water resources Monitoring by PESR of construction of underpasses for animals Monthly review of external grievances by LARP Implementation Unit (LIU) Visibility check	Minutes of meetings between Contractor and sheep pen owners sent to PESR Prepared and published Grievance Redress Mechanism Compensation for all losses provided through LARP implementation; reports on implementation submitted to EBRD
Cultural heritage						
Pre-construction phase						
– Potential damage and loss of undiscovered archaeological site or items	*Mitigation measures that should be implemented prior to starting of the construction activities by the Contractor:* – The Contractor shall be obligated to develop a "chance-find" procedure and to comply with national legislation and EBRD PR8 on protection of cultural heritage. The	Prevent damage to undiscovered cultural heritage	Construction costs	Contractor Engineer	Verification by PESR that the Contractor has developed a "chance-find" procedure prior to works	Developed "chance-find" procedure and shared with EBRD Record of Contractor's workers' training on the topic

Impacts	Proposed measures for impact mitigation	Purpose	Costs	Responsibility	Monitoring	KPI
	chance find procedure should include provisions on: how and when cultural heritage authorities will be notified in case of chance finds; ceasing of operations and securing the area of finds; maintenance of discovered site or items until authorities arrive; and notifying PESR. – Workers need to be trained in the use of these procedures.					
Construction phase						
– Potential damage and loss of undiscovered archaeological site or items	*Mitigation measures that should be implemented by the Contractor:* – If site or items of archaeological significance are found during the performance of construction works, the work Contractor must implement the chance find procedure.	Prevent damage to undiscovered cultural heritage	Construction costs	Contractor Engineer	Verification by PESR that the Contractor is implementing the "chance-find" procedure in case of any chance finds during works	Implementation of "chance-find" procedure documented

8 MONITORING PLAN OF IMPACTS ON THE ENVIRONMENTAL AND SOCIAL COMPONENT

The monitoring plan aims to assess the degree of project implementation and the effects of implementing mitigation measures in all project's phases (pre-construction, construction and operational). In the monitoring programme is included the responsibility of each party, when the measure should be monitored and the costs for their implementation.

On the table below is presented a monitoring plan for monitoring of the emissions in the defined project area of influence. The monitoring plan refers only to those measures prescribed in the pre-construction, construction and operation phase, which parameters can be examined according to the ISO methods for measurement and compared with the applicable emission limit values.

The testing laboratories which will be engaged to conduct the measurements should be authorized and accredited according to ISO 17025.

Table 132 Monitoring plan

Receptor/Parameter to be monitored	Where?	How?	When?	Why?	Responsibility
Pre-Construction phase					
Ambient air quality	**MV1:** 42°4'53.72"N 21°20'49.95"E **MV2:** 42°6'16.65"N 21°20'4.65"E	• Performing measurements of PM_{10}, $PM_{2,5}$, CO_2, NOx, VOC, PAH, SO_2	Before starting with construction activities	In case of a large timespan (more than one year) between preparation of the ESIA study and start of construction works	Contractor
Construction phase					
Ambient air quality	**MV1:** 42°4'53.72"N 21°20'49.95"E **MV2:** 42°6'16.65"N 21°20'4.65"E	• Performing measurements of PM_{10}, $PM_{2,5}$, CO_2, NOx, VOC, PAH, SO_2	Ones in construction phase when construction activities will take place on the identified locations	To present if construction activities have an impact on quality of ambient air	Contractor
Operational phase					
Ambient air quality	**MV1:** 42°4'53.72"N 21°20'49.95"E **MV2:** 42°6'16.65"N 21°20'4.65"E	• Performing measurements of PM_{10}, $PM_{2,5}$, CO_2, NOx, VOC, PAH, SO_2	Operational phase	To present if operation of the motorway has an impact on quality of ambient air; Grievances are raised by local community	PESR
Operational phase					
Soil	Along the alignment and Project area of invluence	Laboratory analisies of soil for the following parameters: pH, conductivity, oil and grasce, physical-chemical analisies, organic and inorganic components and heavy metals	In case of accidental leackage	Soil protection	PESR
Pre – construction phase					
Surface and ground waters	**Vrazanska River** Measuring points at:	• Analysis by accredited laboratory according ISO 17025 for the following	Before commencement	To determine the status of the water	Contractor

Receptor/Parameter to be monitored	Where?	How?	When?	Why?	Responsibility
	42° 3'30.76"N and 21°22'15.81"E (at km 11+300) Intermittent streams defined in chapter 3.3.5.1 HidrologyHydrology	parameters: Algae – Phytobenthos, Invertebrate, Alkalinity_CaCO3, BOD5, Ca2+, Cd, Cl-, Co, CO2_free, COD_Mn, COD_Mn_Kmn, Colour_Pt, Conductivity, oil and grease, mineral oil, total phenols, TOC, total PAH, Cr_VI, Cu, DO, DO_sat, Dried residue_filtrable, Dried residue_non-filtrable, Fe, Fixed residue_filtrable, Fixed residue_non-filtrable, Hardness_carbonate_CaCO3, Hardness_carbonate_odH, Hardness_non carbonate_CaCO3, Hardness_non-arbonate_odH, Hardness_total_CaCO3, Hardness_total_odH, HCO3-, K+, Mg2+, Mn, Na+, NH4_N, Ni, NO2_N, NO3_N, OH-, Pb, pH, PO4, Redox, Residue volatile_filtrable, Residue volatile_non-filtrable, SO4_2-, SS_Mineral, SS_Organic, SS_Total, T_air, T_water, Turbidity_NTU, Turbidity_SiO2, Zn	with construction activities during the raining periods when there is minimum flow in the river	in River Vrazanska and other intermittent streams	
Construction phase					
Surface and ground waters	**Vrazanska River** Measuring points at: 42° 3'30.76"N and 21°22'15.81"E (at km 11+300) Intermittent streams defined in chapter 3.3.5.1 Hidrology	• Analysis by accredited laboratory according ISO 17025 for the following parameters: Algae – Phytobenthos, Invertebrate, Alkalinity_CaCO3, BOD5, Ca2+, Cd, Cl-, Co, CO2_free, COD_Mn, COD_Mn_Kmn, Colour_Pt, Conductivity, oil and grease, mineral oil, total phenols, TOC, total PAH, Cr_VI, Cu, DO, DO_sat, Dried residue_filtrable, Dried residue_non-filtrable, Fe, Fixed residue_filtrable, Fixed residue_non-filtrable, Hardness_carbonate_CaCO3, Hardness_carbonate_odH,	Before starting construction activities and during constuction phase in Vrazanska River (in the period when there is water in the river spring/autumn)	To determine the status of the water in River Vrazanska and intermittent streams and to present if construction activities have impact on the water in rivers	Contractor Authorised laboratory to implement the requirements and do monitoring. Supervison Engineer PESR to oversee

Receptor/Parameter to be monitored	Where?	How?	When?	Why?	Responsibility
		Hardness_non carbonate_CaCO3, Hardness_non-arbonate_odH, Hardness_total_CaCO3, Hardness_total_odH, HCO3-, K+, Mg2+, Mn, Na+, NH4_N, Ni, NO2_N, NO3_N, OH-, Pb, pH, PO4, Redox, Residue volatile_filtrable, Residue volatile_non-filtrable, SO4_2-, SS_Mineral, SS_Organic, SS_Total, T_air, T_water, Turbidity_NTU, Turbidity_SiO2, Zn			
	River Lepenec: Measuring point Lepenec – Mouth MP2	• Analysis by accredited laboratory according ISO 17025 for the following parameters: Algae – Phytobenthos, Invertebrate, Alkalinity_CaCO3, BOD5, Ca2+, Cd, Cl-, Co, CO2_free, COD_Mn, COD_Mn_Kmn, Colour_Pt, Conductivity, oil and grease, mineral oil, total phenols, TOC, total PAH, Cr_VI, Cu, DO, DO_sat, Dried residue_filtrable, Dried residue_non-filtrable, Fe, Fixed residue_filtrable, Fixed residue_non-filtrable, Hardness_carbonate_CaCO3, Hardness_carbonate_odH, Hardness_non carbonate_CaCO3, Hardness_non-arbonate_odH, Hardness_total_CaCO3, Hardness_total_odH, HCO3-, K+, Mg2+, Mn, Na+, NH4_N, Ni, NO2_N, NO3_N, OH-, Pb, pH, PO4, Redox, Residue volatile_filtrable, Residue volatile_non-filtrable, SO4_2-, SS_Mineral, SS_Organic, SS_Total, T_air, T_water, Turbidity_NTU, Turbidity_SiO2, Zn	Before starting construction activities and during constuction phase in River Lepenec (and possible other water bodies) according to the water monitoring plan included in the CESMP and when the constuction works are nearby the flows.	To determine if construction activities have an impact on the water in river Lepenec;	Contractor
Operational phase					
Surface and ground	Discharge point of the oil and	• Analysis by accredited laboratory	Ones in	To determine the	

Receptor/Parameter to be monitored	Where?	How?	When?	Why?	Responsibility
waters	grease separators defined in the Detailed Design	according ISO 17025 for the following parameters: Alkalinity_CaCO3, BOD5, Ca2+, Cd, Cl-, Co, COD_Mn, COD_Mn_Kmn, Colour_Pt, Conductivity, oil and grease, mineral oil, total phenols, TOC, total PAH, Cr_VI, Cu, DO, DO_sat, Dried residue_filtrable, Dried residue_non-filtrable, Fe, Fixed residue_filtrable, Fixed residue_non-filtrable, Hardness_carbonate_CaCO3, Hardness_carbonate_odH, Hardness_non carbonate_CaCO3, Hardness_non-arbonate_odH, Hardness_total_CaCO3, Hardness_total_odH, HCO3-, K+, Mg2+, Mn, Na+, NH4_N, Ni, NO2_N, NO3_N, OH-, Pb, pH, PO4, Redox, Residue volatile_filtrable, Residue volatile_non-filtrable, SO4_2-, SS_Mineral, SS_Organic, SS_Total, T_air, T_water, Turbidity_NTU, Turbidity_SiO2, Zn	operational phase and in case of extreme rainfalls	status of the water in River Lepenec and to present if the separators are maintained accordingly	PESR
Pre-Construction phase					
Noise	**MP1:** 42° 4'20.54"N 21°22'3.35"E **MP2:** 42° 4'26.21"N 21°21'52.81"E **MP3:** 42° 4'52.28"N 21°20'51.28"E MP4: 42°6'16.65"N 21°20'4.85"E **MP5:** 42° 6'38.75"N 21°19'46.94"E	• On site measurements of Laeq by accredited laboratory	Before starting with construction activities	In case of a large timespan (more than one year) between preparation of the ESIA study and start of construction works	Contractor

Receptor/Parameter to be monitored	Where?	How?	When?	Why?	Responsibility
	MP6: 42° 3'28.49"N 21°21'57.04"E **MP7:** 42° 3'23.35"N 21°22'39.78"E				
Construction phase					
Noise	**MP1:** 42° 4'20.54"N 21°22'3.35"E **MP2:** 42° 4'26.21"N 21°21'52.81"E **MP3:** 42° 4'52.28"N 21°20'51.28"E MP4: 42°6'16.65"N 21°20'4.85"E **MP5:** 42° 6'38.75"N 21°19'46.94"E **MP6:** 42° 3'28.49"N 21°21'57.04"E **MP7:** 42° 3'23.35"N 21°22'39.78"E	• On site measurements of Laeq by accredited laboratory	Ones in construction phase when construction activities will take place on the identified locations	To determine if construction activities have an increased noise level in environment	Contractor
Operational phase					
Noise	**MP1:** 42° 4'20.54"N 21°22'3.35"E **MP2:** 42° 4'26.21"N 21°21'52.81"E **MP3:** 42° 4'52.28"N 21°20'51.28"E	• On site measurements of Laeq by accredited laboratory	Once during operational phase	To determine if operation of the motorway has an increased noise level in environment	PESR

Receptor/Parameter to be monitored	Where?	How?	When?	Why?	Responsibility
	MP4: 42°6'16.65"N 21°20'4.85"E **MP5:** 42° 6'38.75"N 21°19'46.94"E **MP6:** 42° 3'28.49"N 21°21'57.04"E **MP7:** 42° 3'23.35"N 21°22'39.78"E				
Construction phase					
Biodiversity	Suitable bear habitats in the first few km of the section	• Visual monitoring transect surveys and reporting (engagement of expert for mammals)	Every two months (2 days per month), during the construction phase in period from March to October	To monitor the bear presence and movement in the area and to monitor the implementation of the proposed mitigation measures	Contractor
	EAAA	• Common bird monitoring per breeding season	During construction phase in breeding season (March – June)	To access and monitor the impact on the common bird population trends	Contractor
	Suitable habitats and reproductive centres for amphibians along the whole alignment	• Transect surveying and reproductive sites monitoring for amphibians	During construction phase, once per month (March, April, May, June and September)	To determine migratory routes; To determine reproductive centres; To obtain data of the population size and abundance of the species; To identify possible direct threats and propose measures	Contractor

Receptor/Parameter to be monitored	Where?	How?	When?	Why?	Responsibility
	Suitable habitats for reptiles along the whole alignment	• Transect surveying monitoring for reptiles	Once per month (in March, April, May, June and September)	To obtain data of the population size and abundance of the species; To identify possible threats and propose measures.	Contractor
			Operational phase		
Biodiversity	Area around the bridges /tunnels within the bear habitat	• Visual monitoring and reporting	During operational phase in period from March to October	Monitor the bear population; Monitor the implementation of the mitigation measures.	PESR
	EAAA	• Common bird monitoring	2 breeding seasons (March – June) from the start of the operational phase	Monitor the impact on the common bird population trends	PESR

Receptor/Parameter to be monitored	Where?	How?	When?	Why?	Cost	Responsibility
Pre-construction phase						
Establishment of Grievance Redress Mechanism	Online and at the premises of Legal department office	Checking if the Grievance Redress Mechanism has been prepared	Before selection of Contractor and commencement with construction activities	Minimisation of adverse resettlement impacts, on land and material assets acquisition		PESR and Supervision
Construction phase						
Community Health and Safety Management Plan	• Contractor office; • Construction site	• Visual control in order to check successful implementation of the proposed organization; • Check whether the prescribed measures in Community Health and Safety Management Plan are implemented	Construction phase	Protect and promote safety and health of the community. Care for health and safety of the drivers and passengers		Contractor Engineer
Traffic Management Plan	• Contractor office; • Construction site	• Visual control on site in order to check successful implementation of the proposed traffic organization; • Check whether the prescribed measures in Traffic Management Plan are implemented	Construction phase	Protect and promote safety and health of the community. Care for health and safety of the drivers and passengers		Contractor Engineer
Implementation of relevant labour and working conditions policies: a) Company's HR Policy b) Non-discrimination and Equal Opportunities Policy c) Policy against GBVH (including procedure for reporting and responding to GBVH)	•Contractor office; •Construction site; •Document check •Online-Contractor's website	• Visual control of documents. • Check website to see whether the documents are available online • Control of implementation of Policies and Plans • Checking if the Grievance Mechanism is implementing continuously; • Checking if all engaged workers have signed written contracts and Code of Conduct; • Checking if all engaged workers have PPE;	Construction phase	Compliance with EBRD ESP PR's		External auditor engaged by Contractor, responsible to PESR

Receptor/Parameter to be monitored	Where?	How?	When?	Why?	Cost	Responsibility
d) Policy against Child and Forced Labour e) Occupational Health and Safety Plan during construction f) Grievance Mechanism for engaged workers on this project during construction phase g) Code of Conduct (for all workers, including those of sub-contractors)		• Checking if procedure for reporting and responding to GVBH has been established and it's functional. • Contractor to engage external auditor to assess the validity of the Plans and Policies who will report to PESR • Checking if all needed documentation and procedures for all contractors and sub-contractors has been prepared and implemented; • Checking if the prescribed mitigation measures in OHS plan are implemented; • Checking the Report and MoM from performed training of workers for COVID-19;				
Conduct Compliance Assessment of Contractor's HR & other labour related policies with national labour law and bylaws and PR2 requirements	•Contractor office; •Construction site; •Document check •Online-Contractor's website …	• Contractor to engage external consulting company to monitor implementation of Plans and Policies, who will report to PESR, and be paid by Contractor, upon PESR approval for each agreed action.	Construction phase	Compliance with EBRD ESP PR's and national legislation		External auditor engaged by Contractor, responsible to PESR
Trainings to all project-engaged workers, even those of the sub-contractors in: - First Aid - Safety training for all personnel covering hazards and safety protocols of their jobs - Professional trainings	• On site • Documents	• Checking reports and attendance lists from performed professional trainings.	Construction phase	Improvement of worker's efficiency		PESR od external auditor Contractor Engineer

Receptor/Parameter to be monitored	Where?	How?	When?	Why?	Cost	Responsibility
Local Employment and Procurement Plan (40% of workers to be from municipality or Skopje region)	• Documents • Contractor's offices	• Checking if Local Recruitment Plan has been prepared and implemented	Construction phase	Implementation of measures that should support local economy		PESR Contractor Engineer
Workers' Accommodation Management Plan	• On site	• Checking if Workers' Accommodation Plan has been prepared (if needed); • Checking if the working conditions and working camp is according to the proposed measures	Construction phase	Compliance with EBRD ESP PR's		Contractor, controlled by Supervision

9 IDENTIFIED TECHNICAL GAPS DURING THE DEVELOPMENT OF THE ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY

During the preparation of the Environmental Impact Assessment Study for *"Construction of motorway from Interchange with local road for village Blace (interchange "Blace") to Skopje (Interchange "Stenkovec"), km 2+000 to ~km 12+250,* the ESIA team has faced with lack of technical data, in order to provide a more detailed description of the Project activities. An overview of the lack of data, consequences are presented in the following table:

Table 133 Identified lack of technical data

Issue	Description
Project documentation (geology data)	For preparation of the project (preliminary and detail design) should be conducted geotechnical investigation. The same were finalised in January 2020 and only limited data are presented in this ESIA Study.
Project documentation (ground water)	Hydrogeological investigations have not been performed within the Preliminary Design and were not subject for analysis according to the ToR. As a result of this, the impacts are assessed on the base of opinions collected by the relevant institutions and geotechnical investigation at the site of the different structures-information about the water level.
Project documentation (use of materials)	The ESIA study was prepared on the basis of the draft Preliminary design. Information and layouts were provided by the Designers, but still missing data related to the type and quantities of materials that should be used in construction phase; manner of their supply, locations on borrow pits, quarries, concrete batching plants, locations for the storage of materials, water supplying, electricity supplying, wastewater management, etc. As a result of this, the impacts are assessed more general.
Project documentation (use of equipment and mechanisation)	Missing data related to number and type of vehicles, equipment and construction mechanization, manner of their maintenance, routes for transport of materials and waste. As a result of this, assessment of some impacts was done more general.
Project documentation (labor force)	Missing data related to labor force, i.e. the number of engaged workers, work camp sites, work shifts, etc. which resulted in a more general definition of possible impacts and measures to be applied.
Opinions from relevant institutions	Missing response on submitted letter for issuing information sent by the PESR to the Ministry of Interior Affair related to trend of projections of fuel/energy what will be used for vehicles in the period of 30 year which is required for preparation of chapter GET.

10 REFERENCES

- Conceptual Design for Interchange Stenkovec-Blace Border Crossing Point (12.5 km), 2021;
- Preliminary Assessment of Environmental and Social Impacts of the Proposed Alternatives (MCA), February, 2021;
- Draft Preliminary Design for the alignment for Section 2: Construction of motorway from Interchange with local road for village Blace (interchange “Blace”) to Skopje (Interchange “Stenkovec”), km 2+000 to ~ km 12+250, from 2021;
- Detailed Design for Subsection 1 interchange Blace border-crossing length of 3 km;
- Elaborate for environmental protection for the construction of subsection 1: Upgrading of the existing road A4 from BC "Blace" to Blace village to a highway level and construction of part of the highway with interchange to local road to village Blace”, July, 2019;
- Infrastructure project for construction of A4 motorway, section BCP "Blace" - Skopje (interchange "Stenkovec"), Subsection 1 - Expansion of the existing road A4 from BCP "Blace" to village Blace to the level of the motorway and construction of part of motorway with junction for connection with a local road to the village Blace - Municipality of Cucer Sandevo (km 0 + 085 - 2 + 213, January, 2020;
- Technical assistance preparation of climate resilience design guidelines for the Public Enterprise for State Roads in North Macedonia, July 2019;
- Decree on the limit values of concentrations and types of polluting substances in the ambient air and alarm thresholds, deadlines for complying with the limit values, tolerance margins for the limit values, target values and long term goals (“Official Gazette of Republic of Macedonia” No.50/05);
- Hydro meteorological Institute of Kosovo https://airqualitykosova.rks-gov.net/en/reports-for-the-monitoring-stations;
- MOEPP Monthly reports,2020, https://air.moepp.gov.mk/?page_id=290;
- skopje@pulse.eco;
- https://home.openweathermap.org/history_bulks
- https://www.moepp.gov.mk/wp-content/uploads/2014/09/Pravilnik%20za%20granicni%20vrednosti%20na%20nivoto%20na%20bucava%20vo%20zivotnata%20sredina.pdf;
- Third National communication to the UNFCCC;
- Macedonian third biennial update report on climate change, August 2020;
- Technical assistance preparation of climate resilience design guidelines for the Public Enterprise for State Roads in North Macedonia, July 2019;
- Draft Law and Long-term Strategy on Climate Action;
- SEA Climate Strategy;
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