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SUMMARY

Introduction

The Fund of International and Regional Roads of the Republic of Macedonia (hereinafter "the Fund") is aiming to implement plans for improvement of the existing road infrastructure. These plans are based upon various statistical information (population, socio-economic development, public infrastructure development status etc.) and data on traffic congestion at various road sections within the country network.

A bottleneck is currently created between two points of the Corridor 10 (the international road E-75) due to the ending of the highway upon its exit from the town of Kumanovo, by the border crossing with Serbia, so called Tabanovce. In addition, technical elements of the existing road (curves, inclination etc.) do not provide appropriate traffic conditions and do not ensure suitable safety standards.

In order to provide smooth traffic movements in the bordering area and enable more propulsive road infrastructure allowing for higher speed and traffic frequency, as well as safety the Fund initiated and financed preparation of the design for the concerned section. The route under question is determined by the ending point of the highway (at its exit from Kumanovo) and the border crossing Tabanovce; the total length of the route is 8.114 km.

The existing road will be kept, serving the traffic in one direction. It will be extended upon its cross section to 11 meters width. Levelling, horizontal contouring and correction of curves is planned for the existing alignment. Scrapes and other roughness will be repaired upon a need to be determined on the spot.

For the traffic conveyed to the opposite direction a new line will be developed. The alignment of the new line will follow the existing route, in the way that longitudinal axis will be parallel and the internal edges will be placed at the same distance; it will be achieved by aligning of the route at correction points to be placed on each 10-20 meters.

The starting and the closing part of the route for both lanes (the existing and extended lane, as well as the new line to be built to convey the traffic for the opposite direction) will join the existing highway upon its ending points.

Legal base

The need to initiate development of a Study on Environmental Impact Assessment (EIA) for the investment projects is being defined in the Art. 76 of the Law On Environment (Official Gazette of the Republic of Macedonia nr. 53/2005, 81/2005), as does the Art. 2 of the Governmental Ordinance on the definition of types of projects and selection criteria upon which the Environmental Impact Assessment (EIA) procedure is carried out (Official Gazette of the Republic of Macedonia Nr. 74 from the 5th of September 2005).

Although the anticipated section of the planned highway is slightly shorter than the minimum length stipulated in the Law (10 km.), the project forming part of the International Network to which the Corridor 10 belongs has been appreciated and its importance for ensuring an efficient transportation as well as undisturbed transit through Macedonia had prevailed; therefore the responsible environmental authority requested undertaking of environmental impact analyses, following national regulations on the content and the procedure, towards obtaining of an approval of the EIA Study as a precondition for the start-up of the project implementation.

The subject of analyses is the corridor along the existing and the new structure, due to the changes which will potentially occur in the sense of environmental, social and economic impacts.

Location

The route in question is located in the northern part of the Republic of Macedonia; the direction of the alignment is north-south, starting with the border crossing Tabanovce and ending with the termination of the existing highway at its exit from the town of Kumanovo.

Reference to distinctive points of the alignment is made through quoting of distances relative to the point 0+00 km, which is settled for the crossing with the border. The route begins at the point marked

as 1+00 km and passing through the valley of river Konjarska via crossing and adjoining several settlements as well as areas of diverse land use comes to the point of conjunction with the existing highway, thus ending at the section 8+146 km.

Route

Regarded section of the existing road to be converted into a highway is placed in a river valley which in terms of its morphological shape is uneven and formed by hilly bulges replaced subsequently by depressions, thus downgrading throughout the entire alignment from 460 to 330 metres above sea level. The subsoil structure is mainly consistent, without dramatic changes, except for the part of the route passing through an area built of volcanic rocks. Dominant landscape type is the agricultural land, in which dispersed settlements have been nested; The valley of river Konjarska is the most significant ecosystem along the route.

The environmental typology is represented by meadow and bush vegetation; forests have been completely destructed upon spreading of settlements and agricultural land. Along the temporary water flows (streams and brooks) distinctive vegetation upon the transition between the terrestrial to aquatic ecosystems appears.

Along the section between the villages of Tabanovce and Recica the crops are in relatively good condition. Wheat crops are dominant, while corn is rarely grown. Fruit and vegetable patches can be found in private yards only, no orchards or plantation of vegetables have been grown in the wider area. Vineyards are characteristic for the area of Kumanovo, but although the climate and other conditions are suitable, this agricultural activity is not present in the area of the alignment.

Intersections with other linear infrastructure

Most significant engineering undertakings aimed to overcome barriers for other linear infrastructure are the following:

- a bridge over the river Konjarska 23 m liong is planned;
- an overpass to enable undisturbed local transport to the village of Recica is foreseen
- an underpass to be constructed beneath the highway will allow for the local transport to the village of Tabanovce.

Ducts and pipes

In order to ensure drainage of the adjoining terrain, 24 ducts in total will be placed under the planned alignment, out of which:

- 16 concrete pipe ducts Ø400 - 1000 mm
- one reinforced concrete duct with opening of 2 meters,
- concrete ducts as follows: two with opening (diameter) of 3 meters, three with openings of 4 meters and two with openings of 5 meters.

Existing concrete parabolic ducts which are placed on km 4+072, 4+868 and 7+174 km (all with a diameter of 1.5 meters) will be extended for the length of the highway cross section, to allow for their undisturbed connection with the existing irrigation system.

Regulation of water flows

Regulation of water courses crossing the alignment, as well as the regulation of the main water course in the valley - Konjarska (Banjka) river is planned for a total length of 424 meters.

The drainage at the Tabanovce interchange and Recica overpass have not been analysed with the project design. This aspect is to be carefully addressed during the development of the detailed design.

Tabanovce interchange

Exit and entrance ramps attached to the highway start with curve elements with radiuses from 250 to 500 meters. Attachments to the crossing road are created with surface intersections; defficency of these crossroads is the radius of curves not exceeding 8,00 meters, which prevents turnings of lorries with trailers.

The length between the entering and exiting the highway is not specified with the project design. The road at the entrance ramps is 5.50 meters wide, while its planum extends up to 7.5 meters.
The ramp which is getting at a critical distance from houses in the village of Tabanovce is supported by a wall which is 28 meters ling and 3-4 meters high.

Transversal connection to Tabanovce
Transversal connection to the village of Tabanovce is also technically inappropriate. Main problem is caused by the passage over the regulated river Konjarska (Banjka); this technical and physical limitation is forcing application of steep gradient up to 10% and sharp curve, which in turn reduces visibility.
This crossing with existing linear infrastructure is regarded as a potentially dangerous. Only relieving factor is the low frequency of traffic.

Overpass for connection to Recica
This connection is located at 5+670.86 km, or at the same location of the currently existing overpass. Building of a new overpass is anticipated and demolition of the existing one. It is required to pass over the extended existing lane and the new lane of the highway. With its construction connection of the villages of Recica, Vaksince, the pig farm (which is one of biggest in the area), Lower and Upper Konjare and others will be allowed.

Underground linear infrastructure
There is a coaxial cable placed in the ground under the alignment, which needs to be dislocated. The cable is not shown in the design. Also, it is not planned for replacement of the cable, hence it would conflict with the legal obligations to revert the changes of any conditions as to the previous state.

Implementation technology
The existing road will be kept, serving the traffic in one direction. It will be extended upon its cross section to 11 meters width. Levelling, horizontal contouring and correction of curves is planned for the existing alignment. Scrapes and other roughness will be repaired upon a need to be determined on the spot.
For the traffic conveyed to the opposite direction a new line will be developed. The alignment of the new line will follow the existing route, in the way that longitudinal axis will be parallel and the internal edges will be placed at the same distance; it will be achieved by aligning of the route at correction points to be placed on each 10-20 meters.
The starting and the closing part of the route for both lines (the existing and extended line, as well as the new line to be built to convey the traffic for the opposite direction) will join the existing highway.
According to the design, ten horizontal curves are anticipated (three symmetrical and seven unsymmetrical with different radiuses). As for the other technical parameters of importance for the engineering design, most of the alignment will be built over embankments and for a limited part cuts will have to be implemented. Maximum height of the embankment is foreseen as 9.5 meters (section between km 1 + 866 and 2 + 347); cuts are significantly lower (max. height up to 3.6 meters); the inclination of the slopes of both-embankments and cuts will be 1:2.

Roadway
In the design it is foreseen that the roadway will have to be reconstructed and extended through implementing the following measures:
- extension of the existing alignment on its right side up to 11 meters;
- rehabilitation of the existing road through correction of inclinations and radiuses of curves, aiming to improve safety, enable better propulsion and grater speed;
- between the existing and the new alignment a green buffer will be implemented;
- in parallel with the existing lane a new motorway 11 meters wide will be constructed.

The new section of the highway thus closing the gap between two endings of the existing highway will consist of two parallel motorways, each divided in two traffic lanes for one direction - 3.75 meters and

the third - as stopping lane - 2.5 meters wide. The project design complies with the national technical standards for motorways.

Drainage

Regulation for the river Banjka is he major undertaking to facilitate drainage and overcome the barrier to be created by the project for the natural runoff through the slopes adjacent to the planned highway. The regulation is dimensioned for a hundred years water flow (estimated at 85 m^3/s). The construction of the regulation is 424 meters long and it consists of a concrete coastal intervention which is wide enough to allow big water passing without a danger for the bridge. The bridge will be built over the river bed regulation approximately 11 meters high. To facilitate construction works for the bridge and the river bed regulation, the river will be temporarily deviated from its natural course, which does not require extensive engineering works, due to the low water flow. The river will be directed to the nearest stream for which underpass beneath the existing road has been already built.

Apart from the river regulation, small temporary waterways should be allowed to pass under the motorways. In the project design such passages are required at km 2 + 875, km 3 + 740 and km 5 + 670.

Another consideration regarding drainage is the technical solution for the conveying of storm water getting in contact with the motorway surface at certain parts of the analyzed highways section. Such example is the interchange Tabanovce, but also other overpasses from which storm water should be carefully collected and drained over the adjoined terrain. The interchange Tabanovce is taken as a dominant auxiliary structure, while the analyses of the storm water draining presented in the project design can be summarized as follows: the interchange is build over a crease created by the natural drainage of the storm water. Drainage of the runoff according to the project is forced through a duct to be canalled under the interchange ramps. Ramps themselves are declined in their cross section direction towards the inner and shorter edge, which part of the motorway is equipped by a peripheral duct. Drainage ducts of all ramp's surfaces will join at the point of km. 2+000, to be further discharged in the river Banjka. In the project design technical description it is stated that drained motorway surface is reasonably small, traffic frequency insignificant, and therefore there is no treatment foreseen for the collected storm water from the interchange Tabanovce prior to its discharge in the river Banjka.

Cuts, Embankments, and soil extraction sites

To embed the alignment in the real environment certain adjustments to the landscape are to be made. In order to achieve appropriate technical standards for the alignment (radiuses of curves, cross-section and transversal inclination etc.) According to the engineering the motorway body will be mainly placed over embankments, while a limited part will be lined in cuts. Mass balance will be applied, thus the surplus of soil from cuts will be used for embankments.

Description of the baseline environmental conditions

Soil

There a distinction can be made for soil in flat areas, depressions, valleys created by permanent and temporary water courses from one hand and hills and hilly terrain on the other. In the alluvium created by deposits transported by the river Banjka (Konjarska river) soil possesses high cadastre class (II-III); Meadows are also formed by fertile soil which is valued as II predominantly and rarely III cadastre class. Major agricultural irrigated area is mainly spread westward from the alignment, although there are fields under crops shaping the area between the settlements eastwards as well. The irrigation system continues on the eastern site across the alignment, but with a limited extent. Hilly terrains are either under degraded forest vegetation, cover by bushes, or used for crops like corn and other live-stock breeding food.

It is important to mention the historical pollution of soil in the area of Lipkovska river, more precisely the pollution of its alluvial sediments with heavy metals originating from the former production of antimony and arsenic ore concentrates in the mine complex of “Lojane”. There is another "hotspot"

created from the storage of the ore concentrates near the railway. Alluvial sediments are widely spread along the river Lipkovska and having in mind the presence of heavy metals emitted from the complex “Lojane” a risk for use of groundwater residing in the alluvium for water supply of the population is anticipated.
A UNDP financed project is considering most feasible closure / rehabilitation options, including also the removal of polluted soil and imbedding of clean sand and gravel in created pits. There aren't any common points between the project and historical "hotspot".

Soil and biological production
The agricultural areas under wheat crops produce in average 2t/ha; meadows in the alluvium produce to 4-6 t/ha; orchards give 10-15 t/ha while the hill parts which are not operated provide annual grass production of 400-600 kg/ha. This is about an average biological productivity of soil, which should be kept, or improved via various agricultural measures. Local population drives agricultural production and land operation upon legacy of predecessors while no modern techniques are applied, neither education of agricultural producers take place. It might be suitable for growing of organic products, therefore the impacts from the highway should be minimized, in order to preserve conditions which are favourable for ecologically clean agricultural production.

Geology
Pliocenic sediments are dominant geological environment; they are represented by series of sands and clay as well as by series of sands and gravels, composing mostly the local base of quarter series.
Along the analysed alignment the only site which deserves due attention in terms of its geological characteristics is the area around the village Tabanovce; in this area it is possible to penetrate with excavations in marbles. This environment is very sensitive concerning its porosity, water permeability and difficult conditions for excavations. To avoid entrance with construction works in marble series it is highly recommended to invest into more serious geological investigations around the village of Tabanovce; otherwise, if decided to continue works in marble, its categorization concerning complexity of excavation works should be made.
Regarding the regional seismological-tectonic aspects entire route lays within the Vardar seismic zone; Skopje epicentre area is striking due to the huge destructive effects of earthquakes which happened in the past, especially the one dating from 1963. The intensity of this earthquake was determined at 9 and magnitude of 6.1 degree; material damages were estimated at 15 % of the total national production in Yugoslavia in this year.
Due to the specific rock structure and the subsoil character erosion is not considered to be a problem, However, for steep and high cuts (the most higher cut is not exceeding 3,5 meters according to the design) might require measures for erosion control. If the drainage is properly dealt with even high and steep cuts should not be a threat for erosion or land sliding.

Water
Hydrographical network in the area of the route is represented by the catchment area of Konjarska river, being a right tributary of river Pcinja; both inflow in Vardar and form part of its northern basin. The area is not abundant with water; however, water supply of most settlements is being solved currently via capping of local springs, having yield of about 25l/sec. Some limited part of population is supplied by potable water from wells.

Surface water quality
Along the alignment the river of Banjka represents the most important surface water course. It follows the alignment almost in parallel since the beginning of the route at the border-crossing Tabanovce; In spring this river becomes torrential, especially in the area of the village of Tabanovce, where, due to the morphological conditions, at km. 3+000, its stream may rise. At this point, as a result of the change of its character, the river is changing its name into Tabanovacka river; with receiving more inflows from

tributaries in the area, the river is for a third time changing its name (and character) into Konjarska river.
The water courses have been subject to classification concerning its current and anticipated quality. According to the Regulation on categorization of water bodies (Official Gazette of the Republic of Macedonia, Nr.18/99) the river Banjka is to be in II category, while the Konjarska river (due to the discharge of wastewater originating from the pig farm) is worsening, thus it is allowed to be maintained in the range of the III category. It must be noted that there is no sewerage in any of settlements located along the project route and leaking from (mostly permeable) septic tanks is present in the underground.

Groundwater
The level of underground water varies; water table depends on the thickness of the underground collectors composed mainly by alluvial and other kind of porous sediments, as well as upon the distribution of solid rocks and clay being regarded as isolators.
The aquifer embedded in the alluvium created by deposits of the Tabanovacka river dictates relatively high water table (at 3 meters under the ground); in the winter periods (when there are more intensive rainfalls causing increased soil moisture) at certain depressions (which are present mainly westward from the alignment) water appears on the surface; these temporary wetlands are naturally drained in spring.
In the hilly terrain water table is at 10 meters under the ground (justification to this statement are depth of tube wells of 15-20 meters under the ground; these wells have been constructed and used by local population for water supply. No record for artesic groundwater (under pressure) exists in the area.
According to the national development strategy the total amount of groundwater in the Republic of Macedonia is estimated at 940h10^6 m^3/yr which represents 18,3 % of the total water resources (5,147h10^6 m^3/yr). This is an important indication for the significance of this natural resource.

Monitoring of the Surface Water Quality
The quality of surface water is monitored through a network of measurement points (stations) which is under the responsibility of the State Office for hydro metrological works; in addition the Ministry of Environment and Physical Planning maintains a separate network of automatic measurement stations which are located along the Vardar River, and have been obtained as a result of a donation. Measurements concerning the quality of the groundwater which are used for water supply are conducted by the State institute of health protection. It must be noted that the monitoring operations are rather scattered and no clear distinction between the authorities of certain, currently overlapping, national bodies is made. In turn, financing of the monitoring of surface and ground water bodies is not streamlined, thus creating devastation of the existing monitoring stations and reducing of their number via abandoning of stations which are located in upper parts of the river courses, and keeping only stations set at the exit of rivers from settlements, in order to measure effects of urban waste water effluents.

The upper stream of Banjka (Tabanovacka) river doesn't receive waste waters, so even if this river section is not permanently monitored, it can be concluded that the river water quality does not exceed the II class, as being stipulated in the Regulation; furthermore it is valid even for the low water flow season, while it improves he quality to the I class in the period of intense rainfalls.
In the area of the village of Lojane the river might receive polluted effluents, due to the drainage as well as leakages from the storage area of antimony and arsenic ore concentrates; they in contact with precipitations could form solutions or chemical compounds. In addition, the agricultural land in this area is operated by using artificial fertilisers and pesticides. Although the above described area is distanced for about 4-6 km. from the new lane to be constructed, it is analyzed in the view of the environmental carrying capacity; namely, any additional pollution in the area would influence the balance and contribute to significant worsening of the environmental conditions as well as threatening of public health.

The section of the alignment which is approaching the valley of Kumanovo in terms of environmental conditions exhibits the influence of its urban agglomeration. However, Kumanovo is not regarded as polluted area comparably to other towns of similar size. Apart from some water supply problems in the past, waste water is collected and directed to a new Waste Water Treatment Plant (WWTP). It started up its operation recently; The project design was financed by EBRD (Municipal Environmental Action Plans - MEAP), while the construction was funded by a Swiss Agency, which manages an earmarked annual budget to finance wastewater management projects in Macedonia. Further analyses will show if this WWTP may serve regional purposes (to treat wastewater from neighbouring settlements), or these villages located along the alignment will not qualify as agglomerations and therefore sewerage will not be a requirement for them. It is to be determined by nationally adopted strategic water management plans and legal documents.

Ambient air

The alignment is passing through unpopulated areas, where no industrial plants are located. Heating is on wood, but these individual fireboxes are diffuse and active in a limited season. The only source of pollution are exhaust gasses from vehicles (2000 vehicles a day in average, out of which 20% are trucks and other heavy transportation means)

Natural aeration of the windy flat area is emphasized, which contributes to dispersal of any pollution.

Flood and Erosion

The area is characterized by low erosion category (IV) which is owed to the specific geological composition, low slope gradients and limited amount of precipitations.(average of 508mm a year) No significant floods appear in the area.

Biological characteristics

According to the climate-vegetation-soil features, the area belongs to the natural horizontal belt of oak forests, with transits to the belt of oak blagun; Vegetation receives characteristics of a modified sub Mediterranean climate. The ecosystem of Coccifero-Carpinetum orientalis is composed by xeric and thermofilic species. Due to long drought periods in summer, the mesofilic component in the floristic composition is nearly eliminated. Conditions are favourable for appearance of coniferous and other types of periwinkle vegetation. As remnants from the past period when the anthropogenic impacts were not as outstanding as they are at present, periwinkle vegetation appears in diverse degradation stadiums; most often it is met as pseudomaceae, which are differentiated from real Mediterranean maceae by richness of deciduous woods and scrubs.

Cultural factors

The area is characterized by relatively low population density; the population is generating revenues mainly in the primary (production) sector, using own agricultural parcels. The fragmentation of the agricultural parcels prevents intensive use of the agricultural machinery and therefore increase of the soil productivity is limited whatever melioration techniques are applied.

The qualification structure is extremely inappropriate, while the compulsory education is most common level obtained; the age and gender structure is stable. Migrations are low, but daily traveling from home to the working place is frequent, due to jobs of local population living in villages created in Kumanovo.

Water supply and wastewater disposal infrastructure

Communal infrastructure is underdeveloped. Although bigger settlements are equipped with water supply network (using mainly resources of groundwater), there are parts, or even entire villages without suitable water supply, using own wells for this purpose. Quality of potable water should be monitored by the State Office of Health Protection, and, in certain cases, by the utility providing the service. Fortunately, springs used for water supply are distanced from the route, since they are mostly located in hilly terrains.

There is no collection of wastewater in the area of the alignment. Septic tanks are used by the population. Some areas enter into the alluvium of the river Banjka, thus leaking from permeable septic tanks is possible and therefore penetration of nitrates into the ground. Population density is below 100 people on square kilometre, rendering leakage from tanks almost negligible, considering the impact of pollution of the ground. There are remains of old Turkish sewage system in old buildings. These systems are below any standards and it is necessary to replace and modernize it..
Highway will most probably attract construction of industries, warehouses, supermarkets, petrol stations etc. Lack of sanitation in the area could be limitation for the installation of these structures. Planning measures should be applied to integrate new and existing structures, to make best use of available infrastructure, as well as to plan efficient technical solutions for water and wastewater management issues. The fact that there is no bigger settlement along the highway route, is limitation factor in finding new sources of water supply. Alluvium in the Konjarska river is the only promising aquifer in the area.

Transport network
The wider area is covered by developed network of local roads; the coincides with the international road E-75. On East and West from the route local roads connecting the settlements are spread. Most of local roads are not paved.
Railway is placed westward from the alignment, at various distances from the route.
Paths used in farmlands are also of importance for the project.
Local road network shall not be disturbed nor it will be possible to create barriers for connection of the villages; therefore certain junctions will be realized - interchange, overpass, underpass etc.

Power supply
Southward from the border crossing there is a 110kV overhead line for transmission of electrical power. There will be need of building substations for the rising needs: lighting, WWTPs, new structures to be built along the highway etc. For the development needs gas should be considered an alternative since the gas pipeline from Republic of Bulgaria on its way to Skopje may be branched near Kumanovo, on its sothern border.

Quality of the cultivated landscape
The hillside landscape without dominant vertical, predominant agricultural land use, lack of cultivated forests (woods grouped in small areas along the river flows) doesn't represent important landscape with particular value. Of only importance is the riverside landscape, whose ecosystem needs to be revitalized because of the danger from polluted river downstream (Recica, pig farm etc.).
The quality of a landscape can contribute to creation of economic enterprises or support its creation, especially in the fields of recreation and tourism, or when certain measure are undertaken to attract activities in certain region. Especially attractive are the rural, mountainous and riverside areas. The interest is enhanced depending on the quality and preservation of the landscape; sustainable landscape management should be fostered, since in the area recreational issues, crafts and cultural heritage can be promoted.

Environmental Impacts
The potential impacts have been described by way of the specific alterations expected for each component of the environment. A certain factor may impact more than a single environmental component.

Impacts during construction
The major potential impacts for the duration of the construction phase are as follows:

- Disruption of the quality of the air (through harmful emissions from mobile sources of pollution) and thought the emission of dust particles;
- Decrease in water quality;

- Changes in the quality of the soil - disruption of its physical-mechanical characteristics, compressing, loss of natural humidity etc.
- Loss of vegetation or change in the structure of the vegetation;
- Destruction of the natural habitat of the fauna, or a decrease in the quality of the habitat
- Disturbing (by noise, use of mechanization etc.) of the fauna, especially of the smaller species
- Landscape alterations
- Impacts upon the social sphere due to the presence of workers during construction
- Changes in the economical tendencies initiated by the investments in the construction of the objects
- Economical decline due to the investments in construction

Air pollution and harmful noise

Presence of heavy machinery and running of various kinds of vehicles and equipment at different construction stages and sites will inevitably generate exhaust gasses and dust. It will also be a source of harmful noise, especially when the alignment approaches close to the residential areas. Bearing in mind the limited period required for construction and relatively short route, these impacts are not considered significant.

Endangered wildlife

In the immediate area within the corridor of the highway there aren't any protected vegetation (flora) and animal (fauna) species.

Biotopes which are created in the riverbeds and their coastal areas will be endangered in case of clearance of vegetations for the purposes of the regulation of the rivers and other water streams.

During the construction of the highway Kumanovo Tabanovce the upper soil layer will be removed together with the surface low vegetation.

There will be no need for clearance of the tree vegetation in forests and fields, except for a limited area along the river bed of the Konjarska River, at the section where the river is passing from the left to the right site of the alignment and goes in parallel with the route (0+500m by 2+000m). The unique clear-cut of high vegetation is necessary for the construction of the highway nearby the riverbed of the Konjarska river upon the exit from the village of Tabanvce on the right side (2+000); at this point a hilly terrain is changing into a flat agricultural area under an irrigation system.

Construction waste and other debris

Apart from the debris and the construction and demolition (latter waste will be generated due to the destruction of the overpass for Recica).which will be disposed off in accordance with the project design to a defined location, the solid waste generated by the workforce, the containers for the construction materials (barrels, bags, other packaging) are also tagged for disposal;

The additives, oils and fuel falls under the category of harmful waste, and it should be death with special care and in accordance with law.

Cultural issues

Project implementation will require dislocation of cemeteries used by population of village Recica. It is not known if for the purposes of the construction the entire area should be removed. Nevertheless, this impact will affect local cultural tradition. It is considered an important impact to deal with in negotiation with local population.

As presented in the baseline situation, the area is rich with cultural heritage. Monuments under special protection regime are distanced from any construction undertaking. However, during construction it may appear that some valuable cultural artefacts are covered ion the ground. Therefore it is suggested to pay attention to this potential impact.

<u>Impacts during operation</u>

Pollution with harmful noise

Bearing in mind the configuration of the terrain and distribution of populated areas which are distanced from the alignment, noise should not represent a major impact. However, the alignment at the point of its passing through the village of Tabanovce is critically approaching to individual houses and week-end houses. Also the junction of the highway with the local road towards Tabanovce could create problems with noise, due to the vicinity of the nearby houses.

Air pollution

Exhaust gasses which will be emitted from the traffic will cause concentrations of polluters in the ambient air. Bearing in mind the baseline situation which shows relatively clean air, no further worsening is expected. The terrain is open, natural ventilation is suitable for easy dispersion of air pollution, therefore this impact is not considered very significant.

Endangered wildlife

Concerning the aquatic ecosystems, the most important is the river ecosystem of the river Konjarka, which, even at present, is very vulnerable. Its regeneration capacity is relatively limited, thus it could not be regenerated without removing the causes for its disturbed quality.
Regulated river bed is planned according to the design as a rigid concrete structure. It influents the transitional flora and fauna and the communication between the terrestrial and aquatic ecosystem.
Barriers which will be created by the motorway body for migration of species are another impact to be considered.

Storm water drainage from the highway surface

The storm water is drained freely by gravity (following the longitudinal as well as cross section slopes) from the asphalt surface of the highway towards the river courses. Partially, it is infiltrated in the soil and potentially in groundwater. Substances which may be found in such rinsing water will have organic and inorganic compounds: heavy metals and mineral oils could be contained. The analyses show that the technical measures to be applied in accordance with the detailed design, will control the drainage of the storm water and prevent pollution of watercourses and groundwater. Therefore this impact is not considered significant.

Soil pollution

Main sources which cause pollution of the soil are the aero sediments and the storm water drained from the highway paved area. Within the sediments composition there will be solid particles (originating from diesel engines) sulphates, nitrates and aerosol sediments (aerosol may be acidic, due to the reaction of sulphuric, nitrogen and carbon oxides with the storm water).
Agricultural land which is located nearby the alignment (predominantly grain, pastures, meadows and abandoned land) at a distance of 50m. could be polluted by the substances contained in the aero sediment and drained storm water. The agricultural plants may be also disturbed in terms of their quality by the pollution whose penetration may appear through the roots; such pollution substances (aero sediments) may penetrate through the plant reproduction organs as well.

Hazards

A special kind of jeopardy for the agricultural land accidental fire appearance is considered (especially in summer conditions) as well as technical accidents connected with transport of hazardous liquids and their spillages. The vegetation is endangered, as well as the crops, which, if dry, contribute to the propagation of the fire.

It may be noted that the construction works cause more significant impacts, (although with a temporary character), than the impacts which appear during the exploitation of the highway.

Measures to be applied

Mitigation of impacts during construction

Air pollution and harmful noise
Considering the temporary character of this impact there are no measures foreseen. Dust control as usual procedure at construction sites is recommended.

Endangered wildlife
After the clearance of the tree vegetation at the section where the river is passing from the left to the right site of the alignment (0+500m by 2+000m) and the clear-cut of high vegetation for the construction of the highway nearby the riverbed of the Konjarska river upon the exit from the village of Tabanvce on the right side (2+000) the following measure will apply:

- Removal of the vegetation, inventory of the removed vegetation, its appropriate temporary storage and bringing back of the local vegetation at appropriate locations

To mitigate the impact for the transitional flora and fauna created by the concrete regulation of the river Banjka, it is recommended to apply natural material (stone, crashed rock etc.) and avoid hard concrete structures)

Construction waste and other debris
To reduce earth material for disposal mass balance (use of soil surplus for embankments and closure and reclamation of disposal sites) will be applied. By the project technical design this amount is estimated as 93.496 m^3; there will be need for additional 183.288 m^3 which will be taken from predetermined quarries (two in total). They are purposefully selected at the ending points of the existing highway, or in the area of the start-up operations of the construction site. The first one is located in so called “Adzi Pepe” area, on km 8+500 and the second site is situated in the so-called Trgoviste area on km 3+ 650; the latter is marked in the project design as a dumpsite for demolition and construction waste, after the termination of excavations. It is estimated that about 21.541 m^3 construction-demolition waste will be disposed off in the pit to be created by the excavations for provision of soil material to construct embankments.
It is proposed to appoint a waste manager who will take care about the demolition waste, especially for the part which possesses hazardous characteristics. Contracts will licensed companies for removal of hazardous waste will have to be made.

Cultural issues
An important consideration should be put upon the measure of a cultural character, such as the removal/dislocation of the cemeteries used by the population of the village of Recica. This activity will require coordinated action in cooperation with the local population, towards respecting of local traditional values.
Private land (mainly under agricultural production) will be taken away (expropriated) for the pur[pses of the project implementation. Compensation measures will be negotiated with the local population upon the early stages.
Careful design of the compensation site for the local cemeteries for the population of the village of Recica is to be implemented, in agreement with local population.
Protection of the archaeological sites and supervision of construction works approaching to the protected areas by the personnel of the Agency for protection of the cultural heritage is recommended.

Socio-economic issues and benefits
Construction works bring certain positive socio-economic impacts. For the implementation of the complete construction works there will be a need to recruit about 50 unqualified persons, which will be present at the construction site during the shift only, so additional buildings for accommodation of workers will not be required. Local population could be considered to respond to these employment

needs, however some qualified staff will be required for the engineering and supervision works, which should be recruited from Kumanovo and other more densely populated areas.

General recommendation:
The site should be returned in its original state. It means that dumpsites need to be reclaimed; temporary structures should be removed as well. Maintenance of the irrigation system and its revitalization if needed is crucial.

Impacts during operation

Pollution with harmful noise

To mitigate impacts concerning noise and air pollution in the area of Tabanpvce retention walls in the area of Tabanovce are foreseen
Their concrete position, height and design is to be determined with the detailed design

Air pollution

It is proposed to revitalize vegetation as a buffer along the alignment, at sections surrounded by high quality agricultural land.

Endangered wildlife

To mitigate the barrier impact and allow for undisturbed migration of species clearance of riverbeds and other watercourses to provide passing of water through the underpasses and prevent flood is foreseen. Due to the relatively frequent breaks of the motorway body due to ducts and other passages created for drainage of the surroundings, no additional measures are required. Windscreens created by tree lines in the field need to be maintained and revitalized if during the construction parts should have been removed. Maintenance of coastal vegetation is recommended as well.

Storm water drainage from the highway surface

No retention wells, ponds or any other kind of technical measures are foreseen. This impact is not considered significant, under the assumption that the drainage of motorway is constructed in accordance with the design.

Socio-economic issues and benefits

Increased traffic and creation of conditions for appearance of industry and services will contribute to the generation of new (permanent) employments and improvement of the local population lifestyle

Conclusion

If the proposed measures will be applied, there should not be considered any significant impacts originating from the construction and exploitation phases of the highway.
It is proposed to the client and to the national and local organs in charge, as well as to the concerned public, to undertake the preparatory works for the implementation of the project.

Potential Impacts/Issues	Mitigation Measures	Implementation Schedule	Responsibility for implementation	Responsibility for supervision	Monitoring indicators	Type and Frequency of monitoring and reporting.
			Impacts during construction			
Air pollution and harmful noise	Monitoring of air quality in Tabanovce	Once a year in winter	Fund for International and regional roads	Ministry of Environment and Physical Planning (MEPP)	Thresholds for polluters in the Law and subsequent regulations	Annual report to MEPP
Endangered wildlife	Removal, inventory and bring back original vegetation close to its habitat	After finishing of the construction	Construction company	Fund for International and regional roads	Number, type and age of plants, trees, shrubs brought back on site	Records annexed to the report on construction works
Construction waste and debris	Appointment of a waste manager during construction	Continuously during construction works	Construction company	Fund for International and regional roads; MEPP	Identification forms and transport lists kept and updated	Records annexed to the report on construction works
Cultural issues	Compensation with local population	Prior to start up of construction	Fund for International and regional roads;	Ministry of Finance	Previously commonly applied compensation measures	Report by the Fund to the Ministry of Finance
Socio-economic benefits	Employments (seasonal)	During construction	Construction company	n/a	Number of workers	n/a

Impacts during operation

Potential Impacts/Issues	Mitigation Measures	Implementation Schedule	Responsibility for implementation	Responsibility for supervision	Monitoring indicators	Type and Frequency of monitoring and reporting.
Noise	Retention walls around Tabanovce	During construction	Fund for International and regional roads;	MEPP	Noise thresholds in the Laws and subsequent legislation	n/a
Air pollution	Vegetation buggers along high quality agricultural land	Immediately after construction	Fund for International and regional roads	Ministry of Agriculture, forestry and water economy	Concentrations of air sediment polluters in soil	n/a
Endangered wildlife	– Vegetation control under bridges, underpasses and ducts – Maintenance of coastal vegetation	Once a year, in autumn	Fund for International and regional roads	Ministry of Agriculture, forestry and water economy	Quantity of removed biomass	n/a
Storm water drainage from motorway surface	Monitoring of quality of effluent	Once a year, in summer (low river flow)	Fund for International and regional roads	MEPP	Thresholds for water polluters in the Law and subsequent regulations	MEPP
Socio-economic benefits	Industry, trade development	Project implementation	Private entrepreneurs	n/a	Purchasing power of population	n/a
Nazards	Plan for Hazard Management	Project implementation	Fund for International and regional roads	MEPP	Number of accidents and hazards	Annual reporting to MEPP (Law on Environment)

1 DESCRIPTION, OBJECTIVE AND JUSTIFICATION FOR THE PROJECT IMPLEMENTATION

Legal base for development of Studies on environmental impact assessment toewards implementing certain private and public projects

The need to initiate development of a Study on Environmental Impact Assessment (EIA) for the investment projects is being defined in the Art. 76 of the Law On Environment (Official Gazette of the Republic of Macedonia nr. 53/2005, 81/2005), as does the Art. 2 of the Governmental Ordinance on the definition of types of projects and selection criteria upon which the Environmental Impact Assessment (EIA) procedure is carried out (Official Gazette of the Republic of Macedonia Nr. 74 from the 5th of September 2005). Namely, in the Annex 1 of the Ordinance, the types of projects for which an EIA procedure is obligatory (e.g. screening, scoping, access of the public to environmental information and public participation in the decision making) have been precisely listed. In addition, the criteria to assess the need for initiation of an EIA procedure for projects which are not in the Annex, but for any reason may cause environmental impacts have been defined as well, accompanied by a list (Annex II) of projects for which the evaluation throughout the use of these criteria is obligatory.

In the paragraph 7 of the Annex 1 of the Ordinance it is determined that EIA Study is mandatory for development of highways, new roads with four or more lanes, levelling and/or extension of existing roads with two or less lanes providing for total four or more lanes, in case if that re-aligned or extended sections are 10 km long or more, in continuum.

Other relevant regulations

The Ordinance for regulating the procedure for caring out environmental impact assessment (Annex 3 from the Law on Environment, Articles 78, 80 line 5, 81 line 2, 84, 90 line 4, 93 line 3 and 94 line 3 stipulates:

- The content of notification of the project implementation intention (according to the Article 80 of the Law on Environment)
- Procedure for determining the necessity of environmental impact assessment Study
- The content of the environmental impact assessment study
- The procedure for informing the public and public participation
- The content of publishing of:
    - Notification of intent of project implementation
    - Decision of environmental impact assessment study
    - Decision of approval of environmental impact assessment study.

The relevant authority in the area of Environment, based on the project is obliged to check:

- the extent of the project;
- technical-technological concept of the project;
- cumulative interaction with other undergoing projects or projects planned;
- natural wealth exploration;
- creation of waste and waste waters (type and amount, presence of harmful materials and substances etc.)
- pollution and discomforts;
- risks of accidents and disasters, from substances, materials or technologies used and/or other types of environment degradation.

According to the Ordinance in force, the Study will cover the following elements:

- description of the project along with information on location, character and extent of the project (building a highway and amount of land necessary);
- description of the environment and its location medias;
- record and description of the natural, cultural and historical heritage and land marks (description of certain types of land marks along the route of the anticipated highway).
- Measurements and evaluation of the type and amount of emissions and assessment of the expected amounts of emissions especially air and waste water emissions, solid waste and other information important to evaluate bigger effects on the environment;

- In defining goals to ensure public participation in decision making in project implementation, the Study contains an annex which describes the project in non-technical language, the measurements selected to decrease the most important effect or to avoid any effects on the environment.

The stated legislation is fully consisted with the Directive 85/337/EEC from June 27, 1985 of impact assessments from public and private investment projects on the environment, in aim to present information to the decision making authorities which will make decision upon its implementation evaluating the level of endangerment of certain mediums, public health and flora and fauna.

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1.1 Project description

The Project for which it is required to develop an Environmental Impact Study is a section of the international corridor E-75 (forming part of the Corridor 10). It represents an artery passing through the country in north-west direction along the valley of the most important water course -the Vardar River. Apart from the East-West transportation corridor (Corridor 8, connecting the neighbouring countries Bulgarija, Macedonia and Albania), this corridor is regarded as most important development axis, since it enables connection of Macedonia with the developed European countries from the north, as well as provides exit to the Aegean Sea in the South, through Greece. Completion of the highway in its full length is considered a priority, which is supported by the fact that the Government intends to obtain EU pre-accession funds (IPA) to finalize a very difficult section in technical and engineering terms of this corridor.

This project covers a section starting from the border crossing Tabanovce and ending at the point where the existing highway is terminated at its leaving the town of Kumanovo, in total length of 8.34 km. The Project Initiator (the Fund of international and regional roads) has financed development of the design and currently intends to obtain funds for the project implementation. Among prospective sources of funds is the World Bank, which would offer a loan to finance the project.

Design implies an extension of the existing alignment over its cross section up to 11 metres width (to serve one traffic direction) and development of a new lane to be aligned in parallel, (with the same width). In this way the existing bottleneck created due to the break of the existing highway between the points with locations as described above will be overcome, thus providing for safe transport, higher speed and frequencies.

Although the anticipated section of the planned highway is slightly shorter than the minimum length stipulated in the Law, the project forming part of the International Network to which the Corridor 10 belongs has been appreciated and its importance for ensuring an efficient transportation as well as undisturbed transit through Macedonia had prevailed; therefore the responsible environmental authority requested undertaking of environmental impact analyses. It is mandatory to follow national regulations concerning the Study content and the EIA procedure (as described in the previous sub-chapter). In the scope of the project initiation phase, an approval of the EIA Study by the Ministry of Environment and Physical Planning constitutes a pre-condition for obtaining construction permits and start-up the project implementation

Bearing in mind the opportunity to finance the project from international sources, consultants carried out a brief check against the World Bank's requirements concerning Environmental Assessment. In their Operational Policy (OP 4.01 from January 1999) it is stated that "the Bank undertakes environmental screening of each proposed project to determine the appropriate extent and type of EA. The Bank classifies the proposed project into one of four categories, depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts". Considering the character of the analyzed project which represents an extension of the existing road alignment via widening of the existing lane and its rehabilitation (to convey traffic in one direction) as well as constructing a separate lane to serve the opposite direction in which way a conversion of the road into a highways is planned, consultants reserve the right to classify the project into the category B. Namely, 'a proposed project is classified as Category B if its potential adverse environmental

impacts on human populations or environmentally important areas—including wetlands, forests, grasslands, and other natural habitats—are less adverse than those of Category A projects. These impacts are site-specific; few if any of them are irreversible; and in most cases mitigatory measures can be designed more readily than for Category A projects. The scope of EA for a Category B project may vary from project to project, but it is narrower than that of Category A EA. Like Category A EA, it examines the project's potential negative and positive environmental impacts and recommends any measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and improve environmental performance".

Cross-border communities are most often significantly poorer if compared with the population in the country and their average purchasing power. Therefore this project is aimed to improve the transportation network in the crossing-border area, thus fostering economic activities. It is clear that building of reliable transportation network will create better conditions for regional and local economic development, but environmental impacts which may occur in terms of change of the land use pattern, occupation of space, air pollution, harmful noise, loss of habitats etc. must not be neglected. This Study will attempt to identify most significant environmental impacts within the corridor of the planned project and propose some cost-effective mitigation measures. Avoidance of impacts for this project is almost impossible, due to the absence of more than one design alternatives; consultants analyze the only technical proposal and its design trying to diminish these environmental impacts for which both technical and biological undertakings could co0ntribute to the improvement of the environmental conditions and public health in general. .

1.2. Location

The location of the route in question is in the northern part of the Republic of Macedonia, from the border crossing Tabanovce to the city of Kumanovo. The first part of the route begins with the existing highway on the border crossing Tabanovce (1+00 km) through the valley of river Konjarska, to the point of conjunction with the existing highway, the section 8+146 km.

1.3 Route

The section Tabanovce-Kumanovo (highway E-75) is part of the regional road M-1 from km 0 + 764.69 to km 8 + 388.43 in total length of 8 km.
The corridor of the road is in valley with morphological changes of heights and depressions of altitude of 330-460 above sea level. The natural structure of the land is consistent in its path except the part of the route that leads through volcanic rocks area. Dominant landscape is valley region of agriculture soil in populated area of mostly rarely populated villages. The valley of river Konjarska is the most significant ecosystem along the route.

The ecological conditions are mostly represented by grass and low vegetation, forestry vegetation when forming the agricultural land was completely destroyed; on the section Tabanovce – Recica the crops are in relatively good conditions; on the valleys on the temporary water flows there is distinctive vegetation on the crossing from land to water ecosystems, while on the wider area by the highway there are wheat crops and fruit and vegetable crops are non-existing. There is no underground water in the area.

1.4 Intersection of the route with other regional and interstate infrastructure

1.4.1 Bridges

It is anticipated to have bridge on the river Konjarska in length of 23 m; overpass on the crossing of river Recica and underpass for exit to Tabanovce.

1.4.2 Duct

There are in total 24 ducts, 16 concrete pipe ducts Ø400 - 1000 mm and one iron-concrete duct with opening of 2 meters, two ducts with opening of 3 meters, three ducts with openings of 4 meters and two ducts with openings of 5 meters.
There is extension on existing concrete parabolic ducts with opening of 1.5 meters on km 4+072; 4+868 and on 7+174 km which are for conjunction with the irrigation system.

1.4.3 Regulation of water flows

The regulation is in length of 424 meters. The drainage at the Tabanovce interchange and Recica crossing are not solved, so this should be carefully monitored.

1.4.4 Tabanovce interchange

The conjunction ramps are connected with curve elements with radius of 250 to 500 meters. The entrance to the parallel road is through crossroads with minimal turns of 8 meters which is not a suitable solution for turning of truck with cart. The length of the enter and exit points is not specified with the project. The road at the enter ramps is 5.5 meter wide and at the subgrade 7.5 meters.
In the ramp IV due to protection of the existing houses there will be a support wall in length of 28 meters and in height of 3 and 4 meters.

1.4.5 Parallel connection (passage) to Tabanovce

The parallel road connection to Tabanovce, due to the current limitation is pretty forced. In general, it satisfies the implemented border crossing elements. The levelling solution due to the crossing over the regulation of the Banjska river is unsuitable, where there is convex curve and obeisance in upsurge of 10 % and fall of 10 % and it has difficult visibility. The road construction for the parallel connection is the same as in the ramps (35+8+5).

1.4.6 Road passage Recica

This passage is located on 5+670.86 km from the currently existing overpass. Building of a new overpass is anticipated and demolition of the old one. This will connect the traffic with the villages of Recica, Vaksince, pig farm lower and upper Konjare and others.

1.4.7 Intersection with temporary and permanent water flows.

Everywhere where there is duct on the existing road, it will be extended or rebuild under the new road or if the existing is damaged from something, totally new will be build under the two new roads. The existing concrete parabolic ducts with openings of 1.5 m and km 4+072; 4+ 868 and on km 7 + 174 which are used by the irrigation system.
Along the basic route total of 24 ducts are planned – 16 concrete with ø 400 do ø 1.000 mm and 8 iron-concrete one with opening 2 m, two with opening 3 m, three with opening of 4 m and two with opening 5 meters.

1.4.8 Underground infrastructure

There is underground coaxial cable which needs to be dislocated. The cable is not shown in the situation and in the profiles. There is no data for any other infrastructural system.

The route is on a land with irrigation system and it interconnects with these pipes on: 4 + 072 and km 7 + 174.

1.5 Implementation technology

The existing road will be kept, serving the traffic in one direction. It will be extended upon its cross section to 11 meters width. Levelling, horizontal contouring and correction of curves is planned for the existing alignment. Scrapes and other roughness will be repaired upon a need to be determined on the spot.
For the traffic conveyed to the opposite direction a new line will be developed. The alignment of the new line will follow the existing route, in the way that longitudinal axis will be parallel and the internal edges will be placed at the same distance; it will be achieved by aligning of the route at correction points to be placed on each 10-20 meters.
The starting and the closing part of the route for both lines (the existing and extended line, as well as the new line to be built to convey the traffic for the opposite direction) will join the existing highway.
According to the design, ten horizontal curves are anticipated (three symmetrical and seven unsymmetrical with different radiuses). As for the other technical parameters of importance for the engineering design, most of the alignment will be built over embankments and for a limited part cuts will have to be implemented. Maximum height of the embankment is foreseen as 9.5 meters (section between km 1 + 866 and 2 + 347); cuts are significantly lower (max. height up to 3.6 meters); the inclination of the slopes of both-embankments and cuts will be 1:2.

1.5.1 Roadway

It is anticipated that the roadway will be extended on the right side, or the two lanes from the existing road will be extended up to 11 meters after which there will be green zone and additional 11 meter of asphalt surface with which there will be two traffic lanes in both directions and with one lane for stopping on each. The traffic lanes will be in standard width of 3.75 meters while the stopping lanes will be 2.5 meters in width.

The dimensioning of the road construction is done and it's concluded the following structure and layer dimensions will be followed:

- improved base	d=30 cm
- bottom base	d=40 cm
- upper base	d=13 cm
- road cover AB	d=6 cm

The body of the newly projected section of the highway is mostly placed on embankment (around 186.000 m3) and excavation of 98.000 m3. The hacks will be with smaller depth to 3.6 meters. The maximum height of the rampart is at km 1 + 866 to 2 + 347 and height of 9.5 meters. The incidence on the curves and hacks are 1:2.

The roadway construction ant the ramps of interchange Tabanovce have the following dimensions:

- lower base from scratch	35 cm
- upper base	8 cm
- road cover AB	5 cm

Other basic features of the anticipated solution for the highway are the following:

- anticipated speed = 100 km/hour

- roadway lanes 2 = 11 meters
- corner lanes 2 = (2x0.35) = 0.7 m
- sidewalk 2x1.2 = 2.4 meters
- subgrade 28 (rampart) 28.9 (hack) m
- separating lane = 4 meters.

Before beginning with exploitation of the material, the land needs to be cleaned from the humus layer and rare vegetation, see annex 60.

1.5.2 Drainage

According to the drainage project the drainage is possible with parallel incidences, along the road incidences, gutter, as well as with drains, channels, drainage protective trench, the anticipated sewage channels and with the ducts. The Project has solution and regulation for the river Banjka. The regulation is dimensioned for one hundred years water flow with 85 m^3/s and in length of 424 meters. With dislocation and regulation of the river bank, a bridge will be built with a hedge of around 11 meters. With the Project for drainage and regulation of river Konjarka and the objects on km 2 + 875, km 3 + 740 i km 5 + 670 there will be a successful drainage. On the highway km 1 + 987.36 the interchange Tabanovce will be built, by the village of Tabanovce which presents four lane interchange type "Rhomb". It will consist of four direct entrance ramps and two secondary junctions located on the passage. For protection of the existing houses a support wall will be built in length of 28 meters and height of 3 to 4 meters.
The location of the interchange is practically in a valley where there is a duct. The parallel incidence of the highway with its orientation also enhances the flow of water. If on considers that it is overpass in question, the drainage needs to function best as the projector took in consideration number of hydro technical solutions. Through duct of km 2 + 000 the water will flow in conduits and canals and the duct over the bridge (on the local road) at the end all the water from the ducts will go into river Banjka. From ecological point it will be especially important that the obeisance of the outer sides of all ramps through the curves on the road will go in the fields. The explanation that those are small narrow areas which will not lead to pollution of the soil during the construction of the road, needs to be examined and if necessary to take precaution steps.
Beside the construction project for the interchange, an illumination project is also made.
The road passage "Recica" located on km 5+670.86, the existing overpass will be used for traffic junction with villages Recica, Vaksince, pig farm, upper and lower Konjare;
For the section, there is a technical documentation: main project with studies of geotechnical research works and geological works and paper on exploration, traffic solution and electrics; revision is conducted on all of them.
In 2002, the interstate and regional Fund conducted measurements with automatic tools on the place 11/A for the number of light and heavy vehicles which pass in day and night time. The results of these measurements are attached in the annexes.

2 DESCRIPTION OF THE ENVIRONMENT

2.1 Land

The soil in the meadow is characterized of value II-III cadastre class and in the hills of quality IV-VI cadastre class. The first are used for meadows and orchards and small part for vegetables (10%) while the hill fields are mainly wheat crops.

The fell area is limiting factor in agriculture, the water supply and the drainage and irrigation systems lead to lack of forests and other types of vegetation. The areas with water, underground water, land for agriculture and populated areas are more valuable.

The landscape is plain without significant topographic marks, dominated by agricultural land. The building of the new highway will take some of the fertile and agricultural land and local paths which serve as routes to the local population to their fields. According to the Study for expropriation it is necessary to expropriate local earthly road which is in km 1+060 to km 2+110 in length of 1.050 meters.

Swamps occur in small area along the banks of river Tabanovacka, where based on the geological composition and under the influences of pedoclimatic conditions, fertile and alluvial soil is formed which when appropriate ameliorative and agro-technical measures are applied, have high agricultural value.

2.1.1 Mineral resources

Alluvial sediments which are found along the flow of Lipkovska river have evident hard metals originating from the mine complex for antimony and arson “Lojane”. Near the location is the ex plant for production of antimony concentrate located at the railroad Tabanovce. The mine is no longer in use and it represents one of the so called hot spots of historical pollution.

2.1.2 Available construction material (findings of sand, gravels and clay)

For making of the embankments the surplus soil material originating from cuts will be used (total of 93.496 m3) and the rest of 183.288 m3 will be taken from quarries and other excavation sites.. These are located in so called “Adzi Pepe” site, which is located before the entrance in Kumanovo on km 8+500 and another one near the site Trgoviste on km 3+ 650 where after the excavation the space will be used for storage of the unneeded materials 21.541 m3. Total of the mineral extraction sites to be used will be 131.000m3 and stored are anticipated to be around 21.500 m3.

2.1.3 Soil and biological production

The agricultural areas which have wheat crops give annual production of 2t/ha; meadows in the alluvial produce to 4-6 t/ha; orchards give 10-15 t/ha while the hill parts which are not worked are with annual grass production of 400-600 kg/ha.
The agricultural areas which have wheat crops give annual production of 2t/ha; meadows in the alluvial produce to 4-6 t/ha; orchards give 10-15 t/ha while the hill parts which are not worked are with annual grass production of 400-600 kg/ha.

2.1.4 Morphology

In a regional sense, the area where the route is, is north of Miladinovci and belongs to the so called Vardar zone. In the frame of this macrostructure is the Kumanovo basin in which western part is the route of the highway. This area is only section of the ex lake phase of development of Skopje-Kumanovo basin, for which the enormous amount of lake sediments are witness.
In the composition of the area there are two distinct lytostratographic units: pliocenic sediments and cvartar sediments.

2.1.5 Geology

In the pliocenic sediments, there are series of sands and clay and series of sands and chalk which also represent local base of cvartar series.
Series of sands and clay are widely found in the Kumanovo valley as well as in this section of it, where one can find small chalk sediments without specific super-positioned feature with narrow crossings and distinctly marked diversity in the granulation.
The series of sand and chalk is also widely found and practically present a final stage of the pliocenic lake phase, which is evident by its domination of chalk. From mineralogical aspect these are composed of the same rocks found in Skopska Crna Gora, represented with quartz, marble, serpentite, and quartzite and similar. The sands in this series are of intercalary type with bigger lenses with similar mineralogical composition.
Further in length of around 1 km are alluvial sediments in the valley of river Lipkovska, composed of diverse granulates chalk and sands.
Next section on the route is in geological ambient from the above described sediments of clay-sand series and it stays the same in the wider surroundings of the border crossing Tabanovce.
On this section attention should be paid to area around the village Tabanovce, where it is possible to come across marbles, which need to be defined in the interest of the investor with detailed examination in categorization when excavating.

According to the representation of rocks in the field, from engineering – geological aspect there can be four groups:

Complex of loosen rocks
Complex of lightly connected rocks
Complex of highly connected (semi rocky) rocks
Complex of highly connected rocks

The complex of loosen rocks consists of sands, dusty-clay soil, found locally and with small depth, found mostly in the river-stream banks and in the depressions they fill. The send is below the clay and dust layer; chalk is inter-layer with previous sand, characterized with good density, building lake basins and contemporary river valleys.
The lightly connected rocks have all kinds of clays, dust and their mixture. The lightly connected rocks are good from aspect of their usage in building rampart. Their stability depends on their density and the coalition of sand and clay fractions. In longer and bigger hacks, their stabily should be questioned and there should be additional protection of the rocks.

The pliocentic layers are characterized by heterogenic granule-metric and litological composition with often changes in horizontal and vertical direction. Generally speaking, these are series of clay, sand, chalk and their transitional types (sandy clay, chalk sands etc).
In function of the above mentioned composition these sediments show great oscillations in context of their waterproof or their hydro collecting potential. Still, the current experiences from hydro-geological

research, the pliocentic sediments are not characterized with high features (up to 5 liters per second) which having in mind the conditions, especially in the villages, is very important data and capacity which can solve some water supply needs.
Alluvial sediments are widely spread along the river Lipkovska and having in mind the present of hard metals from the complex "Lojane" and the previous plant for production of antimony concentrate located at the railroad station Tabanovce, there is a risk in usage of underground waters from the alluvial for water supply of the population.
From regional seism-tectonic aspect the biggest section of the route belongs to the Vardar seismic zone, which in the Skopje epicenter area is mostly marking due to the level of destructive effects of earthquakes, especially the one in 1963. The intensity of this earthquake is 9 and magnitude of 6.1 with much human causality and material damages of 15 % of the total national production in Yugoslavia in those days.

2.1.6 Important and protected geological and geomorphologic forms

This area doesn't have any significant and protected geological and geomorphologic forms. Especially important when paving the route and sensibility in exploration and building should be shown to the alluvial sediment along the Lipkovska river and with the evident distribution of hard metals from the mining complex "Lojane" as well as the ex plant for antimony concentrate located at the railroad station Tabanovce, there is a risk of usage of underground water from the alluvial for water supply for the population.

2.2 Water

Hydrographic network is represented by the flow of Konjarska river and smaller water flows, right tributary of Pcinja, so the route can be element of shaping the area, if there is planning of the landscape through variety of biological and re-cultivating measures.
The hydrological features of the area represented through surface and underground waters and basins include the following elements:

- hydrological regime of surface and underground water, flows and flood
- rainfall, density and atmospheric sediment
- conditions for natural drainage in the area

Relevant factors which influence the quality of waters in the area are:

The level of dissolved oxygen, and the organic pollution.
Saturation of oxygen has important influence on the living world in the aquatorium. The expenditure of oxygen can be caused by natural conditions (speed of the water flow, sun, temperature, climatic conditions) but also from anthropogenic factor – waste waters, soil materials and their transport to the water flows by erosion or infiltration in the underground waters. The microbes that participate in the dissolution of organic materials need the oxygen for their metabolism. The expenditure of oxygen may lead to enhanced concentration of chemically dangerous substances - hydrogen sulfide, methane, amines etc. With drainage of atmospheric waters from the road surface in to the surrounding area and in the water flows, the saturation of oxygen will be disturbed due to the character of organic pollution, burning of oil fuels in the vehicle motors.

Thermal pollution
The sweet water systems have thermal regime to which water species are adapted. The change of temperature can directly endanger water ecosystems. Thermal pollution of the water flows is possible only in certain accident situations, disasters or similar, when there can be fire of big extent which will impact the temperature regime in the water.

Change of pH value and acidification

In the water ecosystems the pH value varies in the seasons, and sometimes during the day. The base natural acidness depends on the chemical composition of the soil substrate from which the banks and river channels are made. Acidification in case of a freeway, can be caused by rainfalls which contain in certain cases sulfur, nitrogen and carbon acid as result of the gases from the vehicles (sulfur dioxide, nitrogen dioxide and carbon dioxide) with water particles. Besides the impact of the acidification of the living world in the waters, it has impact on the dissolution of certain toxic materials in the water. Increased levels of nitrates and phosphates in the water can be reason for their appearance in the underground water, from which most of the population receives its water supply. The health in endangered and one of the most common reason for disease in small children metaloglobinemia (blue babies syndrome) is directly linked with concentration of nitrates.

Sludge
The soil contains organic and non organic particles. They could be washed away by the surface or atmospheric waters. Material suspensions from diverse origin can be transported from the road surface with the atmospheric waters.

Metals
The metals mostly exist in the mineral composition of the soil, so they are washed away by the water flows or the atmospheric water. They are: aluminum, chrome, copper, lead, mercury, zinc. In these area zinc and lead are found in concentration higher than the republic average, which will have negative effect on the capacity of the space to have intoxicating materials such as hard metals.

Pathogenic materials
There are wide spectrum of pathogenic materials that come into the water and the underground waters, through technically imperfect sewage systems or septic such as: viruses, bacteria, microscopic animals and taenia. There is no significant density of the population which could cause serious pollution on the water and the underground waters with pathogenic materials.

In hydrological sense, the route is along Konjarska river, right tributary of river Pcinja. Konjarska river at the section of junction with the new highway has bad quality due to the sewage waters from the pig farm, so the further pollution will be damaging for Konjarska river and for Pcinja further down as well.

2.2.1 Surface water

Only water along the route is river Banjska which has character of rainfall river n the valley of Tabanovce where it changes the name into Tabanovacka river which by the village of upper Konjare changes its name once again into Konjarka. Banjka river is of class II, Lipkovska river from the pig farm to the village of upper Konjare to Lipkovska river is class III by the Decree for water classification (Official Gazette number 18/99).
Hydrological parameters are presented through the following generated data for the hydrological parameters for the following hydrological stations:

Hydrological stations:

Station	upstream	downstream	distance	area	geog. latitude	geog. longtitude
ST 040 Kumanovo Lip.	Lipkovska	Kumanovska	10	212	42^{o} 08' 24”	21^{o} 45' 31”
STO41Kumanovo	Konjarka	Kumanovska	/	135	42^{o} 09' 16”	21^{o} 43' 21”
ST042 Dobrosane	Kumanovska	Lipkovska	1	/	/	/

Anticipated low level of flow based on the minimal annual registered flow

Station ST 035 Katlanovska Banja River Pcinja

Interval m^3/s

years	5	10	20	25	50	100
extreme	0,82	0,42	0,25	0,13	0,00	0,00
normal	0,73	0,38	0,27	0,2	0,14	0,11
	0,7	0,38	0,27	0,21	0,16	0,14

Conditions in the hydrological stations

Station	location	Available data		conditions	installed	period	
		H	Q			from	to
ST 040 Kumanovo Lip.	Lipkovska	+	+	bad	1948	1965	1975
ST041Kumanovo	Konjarka	+	+	good	1962	1963	1996
ST042 Dobrosane	Kumanovo	+	+	Non functioning	1969	1970	1996

2.2.2 Groundwater

The level of underground water varies depending on the sea level, width of the collector in the alluvial environment and distribution of waterproof environments or isolators.

Litological composition of the alluvial area by the Tabanovacka river allows appearance of underground waters in depth of 3 meters, and in the winter periods (when there are rainfalls and increase humidity of the soil) there is water on the soil surface which is naturally drained in spring. The hills area has underground water on depth of 10 meters (wells on depth of 15-20 meters). There is no record of artery waters.

According to the national development strategy the total amount of underground water in Republic of Macedonia is estimated to $940h10^6$ m^3/yr which represents 18,3 % of the water resources ($5,147h10^6$ m^3/yr).

Water source 10^6 m^3/yr

number	Examined wells	river	Geological time	geological aquifer	Geochemical type
A32	Челопек	Pcinja	Alluvial	Sand and chalk	Calcium - bicarbonate
A33	Ginovci				
A34	Dragomanci		Alluvial	Sand and chalk	Calcium - bicarbonate
A35	Pcinja		Alluvial	Sand and chalk	Calcium - bicarbonate

number	Examined wells	river	Geological time	geological aquifer	Geochemical type
A36 A37	Sredno Konjare Katlanovo		Alluvial dialluvial	Sand and chalk Sand and chalk	Calcium - bicarbonate Calcium - bicarbonate
			Alluvial	Sand and chalk	Calcium - bicarbonate
			Alluvial	Sand and chalk	Magnesium - bicarbonate

2.2.3 Water quality (analysis of chemical, physical and biological parameters)

2.2.3.1 Quality of surface water

The quality of surface water is measured as part of the network sustained by the State directorate for hydro metrological matters and Ministry of environment. Certain measurements, especially the quality of the underground waters which are user in the water supply as conducted by the State institute of health protection.

The results of the measurements are published partially or completely and posted on the web site of the Ministry of environment.
Unfortunately, the size and the number of measurement sites are reduced in the past years, so one can't speak of holistic monitoring which will be foundation of planning activities for protection and improvement of the quality of surface and underground waters.

Hydrological stations:

Station	upstream	downstream	distance	area	geog. latitude	geog. longtitude
ST 040 Kumanovo Lip.	Lipkovska	Kumanovska	10	212	42° 08' 24"	21° 45' 31"
STO41Kumanovo	Konjarka	Kumanovska	/	135	42° 09' 16"	21° 43' 21"
ST042 Dobrosane	Kumanovska	Lipkovska	1	/	/	/

The upper stream of Tabanovacka river doesn't have waste waters, so even if this place is not covered by permanent monitoring of the quality of the water, it can be concluded that the river is classified as quality of II class in the period of decreased flow and class I in the period of intense rainfall. Expected pollution is possible with drainage of the waters in the vicinity of village Lojane, whose population uses more artificial muck and chemical protective measurements as agricultural and technological means in the agriculture.
From aspect of level of endangerment of pollution of the environment and its basic components, Kumanovo valley is in less polluted areas in the country, mostly because of the industrial capacities and their usage.

2.2.3.2 Quality of the ground waters

These waters usually contain calcium, magnesium, sodium, iron, manganese and cilium. Anions are mostly carbonates, hydrogen-carbonates, (bicarbonates), sulphates, chlorides and nitrates.

The following table has the Macedonian maximum allowed concentrations value of the drinking water compared with those of the World Health Organization.

Parameter	Unit	Macedonian	WHO
pH		6,5-9,5	6,5-8,5
abstruness		2,4	5,
ammonium	Mg/l	0,1	1,5 as aammonia
nitrate	Mg/l	10,0	50,0 as nitrate
nitrite	Mg/l	0,005	3,0 as nitrite
sulfate	Mg/l	200,0	250,0
chloride	Mg/l	200,0	250,0
iron	Mg/l	0,3	0,3
manganese	Mg/l	0,05	0,1
chrome	Mg/l	0,05	0,5
arsenic	Mg/l	0,05	0,1
lead	Mg/l	0,05	0,1
mercury	Mg/l	0,001	0,001
cadmium	Mg/l	0,005	0,003
selen	Mg/l	0,01	0,01
phluor	Mg/l	1,5	1,5
phenol	μr/l	1,0	1-10
threecholrephenol	μr/l	1,0	2-300
bicholrephenol	μr/l	-	0,3-40
chloroform	μr/l	30,0	200
threecholrethylen	μr/l	30,0	70
tetracholrethylen	μr/l	10,0	40
DDT	μr/l	1,0	2
Aldrin and dialdrin	μr/l	0,03	0,03
lyndane	μr/l	3	2
2,4D	μr/l	40,0	30
cholredyn	μr/l	0,03	0,02
Alpha radioactivity	Blj/l	0,11	0,01
Beta radioactivity	Blj/l	1,0	1,0

Geochemical features and quality of underground waters

number	Examined wells	river	Geologi-cal time	geological aquifer	Geochemical type
A32	Челопек	Pcinja	Alluvial	Sand and chalk	Calcium - bicarbonate
A33	Ginovci				
A34	Dragomanci		Alluvial	Sand and chalk	Calcium - bicarbonate
A35	Pcinja		Alluvial	Sand and chalk	Calcium - bicarbonate
A36	Sredno Konjare		Alluvial	Sand and chalk	Calcium - bicarbonate

A37	Katlanovo		dilluvial	Sand and chalk	Calcium - bicarbonate

2.3 Ambient air

The alignment is passing through unpopulated areas, without industrial plants being known as sources of emissions of polluting matters in the atmosphere; in addition, the natural aeration of the open and flat area (constant wind blows) contribute to the fact that the ambient air is considered as relatively clear.

2.3.1 Quality of the ambient air (particles, gases, dust etc.)

The only contaminator of the air are exhaust fumes from the vehicles (according to the data of the Fund of Regional roads and Highways, the traffic on the existing regional road is estimated at around 2000 vehicles running per day, out of which about 20% are heavy vehicles). Due to the previously mentioned alignment features, the dust hardly ever appears in the air.
For determining the condition with the quality of the air, measurements are conducted on four measurement points along the route and for the basic parameters CO, SO_2 and NO_2 which are emitted from the motors. The measurement points are determined near the points which are considered to have largest contamination of air: village Tabanovce, due to the speed limit, two gas stations and vehicle staying in one place and passage and crossing Recica due to the large number of vehicles. The measurements are done with the digital instrument *TESTO 300 XL*, and the results are as follows:

mg/m^3

	v. Tabanovce 2 km	Gas station. MAKBENZ 3 km	Passage Recica	Gas station REDOIL 7 km	MDK
CO	0,0	0,1	0,5	0,1	3
SO_2	0,05	0,08	0,02	0,011	0,5
NO_2	0,03	0,04	0,06	0,09	0,085

From the table it can be seen that the concentration of carbon dioxide, sulfur dioxide and nitrogen dioxide in all four measurement points are within MDK values according to the Law for protection of air pollution (Official Gazette, number 20/1974).

2.4 Climate

Distribution of polluting materials among others is also influenced by the meteorological features which also impact the climate changes. Emission and level of polluting materials are in function of the following climate elements:

- air temperatures
- air circulation
- atmospheric sediment
- water and air humidity
- light and insolaration

Kumanovo valley is at the end where the warm air circulation from the Augean sea are felt in the valleys of the rivers Vardar and Pcinja and represents separate thermal region with significant valley character on the temperature regime. It is characteristic to note the fluctuation of absolute extreme temperatures and fluctuation of average monthly temperatures. The absolute temperature fluctuation is $67,1^0$C and the average annual temperature fluctuation is 22.8 ^{0}C.

The absolute minimum temperature is -35.6^{0}C and is measured on January 13, 1985. Average icy period lasts for 170 days with middle autumn date October 21 and mid spring day April 10.
Vegetation period with mid daily temperature of 5 ^{0}C lasts from March 5 to November 27 and from 10 ^{0}C from April 3 to October 29, and according to these there are conditions for freezing of agriculture crops in the autumn and spring icing.
The warmth of the soil in the summer months leads to high air temperatures.
The absolute maximum temperatures was 42.4 ^{0}C noted in July 1988. The high value of the heat regime is manifested in summer and tropic days with average of 117 summer and 53 tropical days.
The temperature inversions in the air are present in all months of the year and mostly in the winter, in anticyclone weather situations, when the valley is the coldest and in height the temperature is higher.
The lowest temperature of the soil is in January with average of 1.4 ^{0}C and highest in July with average of 24.3 ^{0}C, and annual fluctuation of 22.9^{0}C.
According to this, these valleys have insignificant Mediterranean influence which gives specific local climate, strictly influenced by the valley topography.
Significant ecological repercussion of the temperature regime is the icing period during the plants vegetation and the high temperatures with negative impact on the physiological functions of humans and plants' development.

In the region the average rainfall is 515mm which by amount and frequency do not meet the needs of the agriculture. The average annual rainfalls are between 300mm and 714mm.
May is month with most rain of 61mm, than November with 52mm and least rain falls in August 30mm and July with 33mm.
The monthly average days with rain are least in August with minimum of 1.8mm and highest in May with 125mm.
Of the total average days with falls, only 17% are snow falls, limited to the three winter months and average annual days with snow cover are 25.
Drought periods occur in average 13 times per year and mostly in summer and autumn with 56% and 44% in winter and spring. The longest drought period was 80 days, recorded in 1961 in summer autumn period.
The average annual solar radiation in these two valleys is 2102 hours or 6 hours per day in average, with maximum in July, 10 hours per day and minimum in December with only 2 hours per day.
The average dowdiness is 5.5 tenths, largest in January in average of 7.4 and least in August 3.1 in average. In average there are 105 cloudy days and only 69 clear sky days which indicate increased dowdiness in this valley.
The biggest humidity is in the months of November, December and January with 82-84% and least humidity in July and August with average of 57%.

Fog appears from October to March. The annual average is 27 days with fog, but there are cases from 6 to 54 days with fog.
Like in the other regions in the country, rime appears in the early morning hours from September to May, with maximum in December with average of 11.6 days.
Dominant wind is the north wind with average annual appearance of 331‰ with average speed of 3.1 m/sec and maximum speed of 26.4 m/sec. Northwest wind is second in appearance with average of 105 ‰ with average annual speed of 1.8 m/sec and maximum speed of 18.9 m/sec. The west wind blow with average of 13‰ and annual average speed of 1.7 m/sec. Southeast wind appears in May, December and January with average speed of 2m/sec and the east wind blows mostly in spring and summer with sped of 2.5m/sec.
Days without wind mostly appear in October to January with 520$^0/_{00}$, and most windy are spring months and July with quiet days of 328-347$^0/_{00}$.
The subject area has intense natural ventilation which serves as positive ecological factor in cleaning the atmosphere.

Because of the listed regime of winds, average high temperatures and low rainfalls, there is significant vaporization from the free water surface. It is in average of 962mm to 1m2 annually and the vegetation is 852mm or 98% of the total annual potential vaporization. It is clear that there is a need to compensate the water deficit for the agriculture to ensure high crops.

2.5 Processes

The physical-geographical features are accountable for possible processes which may have negative interaction with the newly built object, during the construction as well as after the exploitation.

2.5.1 Flood

The relatively small size of Tabanovacka river, the valley-hill character and the geological composition of the soil, even in extremely heavy rainfalls do not produce floods. Floods are very rare with exception of the 50 year waters which flood the narrow river banks.

2.5.2 Erosion

The area is characterized with low level of erosion (category IV) which is due to the geological composition, narrow field and type and amount of rainfalls (annual average of 508mm, with average maximum in May and average minimum in August). There are no significant floods in the area.

2.5.2.1 Soil permeability

The surface soil layers on the hills found on the location have relatively small water permeability, with coefficient of filtration around 10^{-7}-10^{-3} cm/sec.

2.5.3 Geo-mechanical features

According to the geo-mechanical features of the rocks, the ground weight ability is around 2.0-3.0 kg/cm^2 which represents appropriate building foundation for linear infrastructure and construction objects with medium height (from 4-6 floor heights).
The sand-clay composition, the coefficient of filtration and the resistance compose the soil to medium values which allows application of usual technical and technological solutions when building the construction objects.
The altitude above sea level (highest 490), the openness of the space, southwest exposure and long lasting insolarization allow only brief period of icing, which occurs from December to middle March, with average days of temperatures below zero of 82 days. The number of snow days is also relatively low, with annual average of 20 days.
The appearance of small umber of days with maximum temperature below zero (11 days per year), high percentage of sunny days in the winter period (around 450 sunny hours) and relatively low cloudiness make the formation of thick ice difficult, and easy to melt. From the above mentioned reasons, the ice doesn't cause significant erosion process of the soil, the rocks and doesn't have destructive effect upon the construction materials.

2.5.4 Stability of the slopes (sliding)

The area has small narrowing of 5^o and there are no register soil sliding, so the hills are stabile in geological sense.

2.5.5 Seismic risk

The area belongs to the Vardar zone, formed with the Alps orogenesys, and the sedimentation of the structures is formed in the lake phase of the pliocenic. According to the engineering-geological features, the area is build from rocks with permanent physical and mechanical features, which compared with the object time lasting, will not show any significant changes due to outer influences nor human impact.
According to the current seismological activities, the area is characterized with seismology up to 8^{o} (maximum expected intensity). Because of this, the area is considered to have inappropriate engineering-geological conditions as seismically sensitive environment.

2.6 Biological features

According to the climate-vegetation-soil features, the area belongs to the area of oak forests, to the oak blagun to be more precise which is characterized with modified sub Mediterranean climate features. The climate vegetation present is Coccifero-Carpinetum orientalis in which there are xeric and thermofilic species which are in correlation with the described climate conditions. Because of the long drought periods in the summer, the mesofilic component in the floristic composition is nearly eliminated. This feature leads to appearance of evergreen vegetation. These appear in diverse degradation stadiums, but most often as psevdomaceae which are different from the Mediterranean macae due to the rich forests and bushes. These ours psevdomacae mostly have hard leaves types and from the woods – oak, blagun and white gaber.

2.6.1 Flora

The vertical composition of the vegetation is composed by the following types:
- the highest floors are oak trees;
- lower floor white gaber, griper and many other bushes;
- lower plants whose most significant representatives are listed below.

Because of the intensive usage of the land for fields, orchards, winery and meadows, there is limited game present. Exception is the swam area, where the constant presence of water in long periods during the year allows presence of swam fauna.

This environment is thermo-folic and xeric and all around has basic features and alike physiology and ecology. More significant representatives are the following:

Quercus pubescens
Fraxninus ornus
Cornus mas
Silene viridiflora
Cyclamen neapolitanum
Ranunculus psilostashys
Syphytum bulbosum
Tamus comunis
Carpinus orientalis
Acer monspessulanum
Evoymus verucosa
Iris sintenisii
Lithospermum purpureo coeruleum
Saxifraga buldifera

Geranium sanguineum and others.

The listed date of the vegetation structure is important to asses the possible impacts on destroying rare or endangered and endemic species during the construction works.

2.6.2 Fauna

The wider area is pleasant for development of grasshoppers, lizards, serpents and small number of mammals. From other game in natural environment there are wild pigeons, struck, hawk, crow, magpie etc. Their presence along the route is very important, because of their participation in the food chain and in the destruction of many insects that destroy the crops.

2.7 Crops

The social economic conditions of the area characterized with small density of the population, population mostly enterprising in the primary sector on individual fields. The quality of the soil has potential for high productivity (first and bigger part of the route is in second cadastre class), but because of the lack of larger private fields, and fields divided on bigger distances, the production is smaller than the potential of the quality of the soil. The education of the population is low, dominating population with primary education only; the age and sex population are balanced, which indicates that the villages along the route will not experience any migration processes which is mostly because the proximity with Kumanovo, where most of the population satisfied their needs (employment, supplies, education, culture etc.). Most of the population is employed in Kumanovo. The water supply on the border crossing is solved with underground water from wells, near the railroad station Tabanovce and the abandon mine of chrome in the mine Lojane. The pipeline is in longitudinal section of -f 5/4 and it meets the minimum needs for sanitary waters.

2.7.1 Land use

The agricultural land dominate is the structure of land used, than the settlements with accompanying public function of tertiary character, agro industry (pig farm), and other object from service and other enterprises. The settlements are urbanized according to the urban planning documentation which is planned and implemented by the municipality of Kumanovo.

2.7.1.1 Forestry

Along the route there are degrading forest communities, on very limited area on the left side of the river Konjarska, near the village Tabanovce. The land is in private property so the forestry has no precondition for development on a wider national interest. The limited land under forest vegetation is not planned and organized, and it has types and plants typical for riverside vegetation.

2.7.1.2 Recreation

Besides the valley of river Konjarska, where there is certain number of individual houses for weekend-housing, there are no significant recreational sites or attractive areas. If there are investments in certain sub structures for development of tourist capacities, it will be possible to develop this economic branch, having in mind the proximity with the border crossing.

2.7.1.3 Quality of the cultivated landscape

The hillside landscape without dominant vertical, usage of the land for agriculture, lack of forestry (wood vegetation grouped in small areas along the river flows) doesn't represent important landscape

with particular value. Of only importance is the riverside landscape, whose ecosystem needs to be revitalized because of the danger from polluted water from the river.
The quality of a landscape can assist in creation of economic enterprises or support its creation, especially in the fields of recreation and tourism, or when certain measure are undertaken to attract activities in certain region. Especially attractive are the rural, mountain and riverside areas. The interest is enhanced depending on the quality and preservation of the landscape and it should develop in sustainable landscape management.

2.7.1.4 Historical and archaeological areas and structures

Monuments of culture according to the Institute for preservation of historical heritage in Republic of Macedonia are the following:

- registered cultural monuments;
- evident cultural monuments;
- archaeological findings, or any traces of human settlements which are evidence of the eras or civilizations, from which excavations are main source of scientifically information;
- monumental buildings, settlements or architectonic complexes or areas or building area which have special cultural meaning, and which are protected, and included in the contemporary development in amount allowed by the character of the protection;
- individual (architectonic monuments) architectonic works of special cultural meaning with their protected surroundings, or the location to which they belong and are protected to preserve their origin and to provide appropriate conservation, restoration and revitalization.

Near by the route of the newly planned highway are the following archeological sites:

- Archeological site “Nad padina” from pre-historic age
- Archeological site “Padalishte” from pre-historic age
- Archeological site “Bazine” from Roman period
- Archeological site “Micinski vodenici” from Middle Ages
- Archeological site “Crkvishte” from Middle Ages
- Archeological site “Dabinka - Anishte” from late Middle Ages
- Kodza Mehmed bej mosque, from XVII century

On the very location, there are no significant archaeological findings, with exception of the mosque Kodza Mehmed bej, which is near the riverside of river Konjarska on 1 km of the south border of the border crossing Tabanovce. It is deserted object for which it is necessary to have revitalization and restoration in case the Institute for protection of cultural monuments assesses that the object is of public interest.
These are all object not of national but local to regional importance. Still, the culture is studied and promoted through many evidence and witnesses and each of these objects may be tourist attraction. Having that in mind, when paving the route, its construction and in the exploitation circumstances, the treatment of these objects must be as prescribed by the standards of the relevant Institute.

2.8 Cultural status

2.8.1 Existing infrastructure on the location

Near the village Tabanovce there are two bus stops in both directions and un-asphalted exits from the regional road which go into the village streets, but it is not allowed to cross it. For crossing from one side to other with car or agricultural equipment the locals used the passage under the interstate road which serves as drainage for the atmospheric waters to river Banjska (Konjarka). At Recica there is interchange with overpass for entrance and exit to the interstate road and it is the only acceptable

crossing of this section. On many places of the section there are paths which are used for exit from the fields for agricultural mechanization, tractors etc.
Parallel with the interstate road is the old road Kumanovo – Vranje which is still functioning and it connects the villages of the right side of the interstate from Kumanovo to Republic of Serbia.

2.8.2 Transport network

The wider area is covered by developed network of local roads and on the route itself is the international road E-75 which is on the same route with the anticipated interstate road M. On east and west of the location there are local earthly roads which connect the near by settlements. The railroad passes in parallel with the location on changeable distances in south direction.
Local road network can't be disturbed nor it is possible to create barriers in connection of the villages, and therefore certain junctions will be realized. On the other hand, for building the overpass a ramparts will be needed or when building the underpass for parts of the newly build route in rampart, with certain harmful impact on the environment (new quantities of earthly material, construction of concrete works).

Counted and anticipated vehicles from 1999 to 2025 on the section Tabanovce – Kumanovo

Year	Light vehicles average/day	heavy vehicles average/day	total vehicles average/day
1999	1444	400	1844
2000	1520	421	1941
2001	1087	392	1479
2002	913	330	1243
2006	2280	631	2911
2010	2327	788	3115
2015	3380	980	4360
2025	5080	1470	6550

2.8.3 Solid waste management

The production of solid waste is estimated to 160 kg/yr/person for the rural areas. The largest section of the produced waste is organic bio-degradation waste, which will be most likely used by the population for the agricultural fields, as food for the domestic animals etc. so the real quantity of solid waste in these villages where the inhabitants are mostly working in agriculture is significantly smaller. The solid waste which will came out of the construction of the highway, during the construction and afterwards in the exploitation phase, will overpass these amounts and it will be necessary to deal with the issues of generated solid waste very carefully. Problem might be organization of collection and transport system for the waste, because there is no system in place except for the urban parts of the Republic. The transport of the waste from the highway needs to be organized together with the waste collection from the villages taking in consideration the possibilities of recycling certain sections of the waste, which could be driven to Drisla, after the implementation of the second phase (recycling and objects for recycling).

2.8.4 Water supply infrastructure

The area is poor with flows of the underground waters except near the Konjarska river, so the population is supplied with water from dig and drilled wells whose depth varies from 1 to 4 meters in the alluvial of Konjarska river from 6-10 in the valley to 15-20 in the hills area.

The construction of the highway will attract higher frequency and flow of people and goods, so it will be necessary to solve the issue of water supply along the highway route to improve the living quality and to create conditions for road construction (certain parts of the building technology requires new supplies of water) as well as for the advance construction of other object of different enterprises (because of the improved communication conditions there can be an increase in interest for investment in economic objects on the agriculture fields, service enterprises, motels, restaurants and other objects).
There are no conditions for water supply of larger capacities (industry). On the other hand the scarce water supplies, the surface and underground eater are valuable treasure, which preservation is one of the priorities in implementation of certain protective measurements.
There is no sewage system in the villages so the waste waters are drained in septic. There are remains of old Turkish sewage system used by older objects. But this is really old system below any standards and it is necessary to abandon this system for drainage of the waste waters. The area is with density of below 100 people on square meter, which decreases the dimension of pollution of the underground waters from these waste waters. Still with construction of the highway and increased frequency of vehicles in this area, the drainage of the atmospheric waters of the road surface will be considered as direct polluters of the underground water. The location of services necessary for the highway and building of those will also be a problem of waste waters because there is no canal network. It is recommended that these objects are located near the villages after they receive sewage systems and other water supply systems.
For the construction needs, certain technological processes and phases will require larger amounts of water. The fact that there is no bigger settlement along the highway route, is limitation factor in finding the new sources of water supply. In the existing conditions of water supply in the area scarce with water it will be necessary to transport water with tanks from Kumanovo and Skopje, or to construct new water supply systems through digging or drilling wells (for constructing new objects). Alluvial in the Konjarska river is the only place with surface water source.

2.8.5 Electric power network

On the existing route of the interstate road there are no elements or objects that have increased needs of electrical power. With construction of the highway, during its building and afterwards in the exploitation these needs will increase. Part of these needs will be met with usage of electrical power but part will need to be supplied from other types of fuel (mostly liquid for the needs of the technology of highway construction and maintenance of equipment). Southward from the border crossing there is conduit of 110kb for transport of electrical power. There will be need of building substations for the newly aroused needs, mostly for the illumination, and eventually for power of the cleaning equipment for the waste waters (if there is such need) and for the new objects along the highway. In intensifying the development of the area gas could be considered as renewable power source for which there are preconditions on the corridor route, where the gas pipeline from Republic of Bulgaria.

3. IMPACTS ON THE ENVIRONMENT

3.1 Most common impact upon building and exploitation of highways

Making the route is no doubt great challenge to the projector if he insists on using element which will satisfy the parameters and also preserve the natural ambient or the landscape. Big loss is considered to be cutting forests and vegetation for the needs of the technical elements of road construction.
In the beginning, it is common to neglect small paths or water streams, but every usage of materials other than the prescribed will lead to misbalance of the natural relations of the morph – esthetic features. The largest leaks are when forming the path of the road as these surfaces are incompletely or insufficiently shaped. Planting trees, grass or bushes is usually neglected or is inappropriately implemented.
The projected places for waste management usually end up as garbage spots. When defining these points there is quick agreement between the projector and the contractor or the agreements are not followed.
In estimating the categories of land at the excavations, usually they are wrongly estimated in the category and amount of material and rarely are they re cultivated.
Quarries rising along the road during the construction are not real potential danger because the construction of certain section is the real danger for the environment. Biggest and real treat of quarries is if they remain active after beginning of road exploitation and then they are not ecologically secured.
The road construction disturbs the environment because of the noise from the mining and construction machines, creation of dust, destroying land, forests lakes etc.
Geo-technical eco risk most commonly present is the general risk and the task of the researches must be to asses the amount of this risk and to determine its acceptable level. But because the general risk in road construction is not defined in quantity (amount of pollution and degradation allowed) the geo-technical risk can't be stated in quantity but one can only state the hazards which are possibility of exposure to negative impacts which could lead to damage or risk.
When building roads the following types of hazards to the natural environment appear:

- changes in the morphological features
- process of surface dissolution, erosion etc.
- possible changes in the regime of underground water and surface water flows
- possibility of larger pollution of the geological environment due to the accidents in transport of harmful materials and permanent micro pollution
- changes of the geological environment due to the changes in the biodiversity, microclimate changes etc.

3.2 European requirements for environmental impact assessment study

The procedure for determining the amount and importance of impacts on the environment from installing objects which with emissions influence changes in the ecosystem is defined in the Directive 97/11/EC. This procedure is about collection, analysis and presentation of information on the location and the character of the installation in aim to assess the type and amount of anticipated impact on the environment. According to the previously elaborated information about the conditions of the environment on the location and the production technology of bio diesel, analytic assessment is conducted to asses the global impacts using the guidance from the Union in aim to establish pros and cons on the investment related to the planned structure.

Issues to take into consid-iration:	**Yes/No (Brief description)**	**Will this have significant impact? Yes/No/Why?**
1. Will the object construction cause any physical changes of the area (topography, land usage, water flows' changes etc.)?	Yes. Building this section of the high-way will cause interventions on the water topography and hydrological regime (regulation of the river Konjarka)	No negative impact. There will be regulation of the water flow of river Konjarka for possible water floods.
2. When building the object, will there be usage of natural resources as soil, water materials and energy or especially non renewable and/or rare resources?	Yes. The location is taking parts of agricultural fields, but not usage of any rare resources; water con-sumption is minimal.	No negative impact.
3. Will the object functioning request usage, storage, transport and handling of materials which might be harmful for the human health and the environment?	Yes. There is detailed description of the materials to be used in the proc-ess.	Yes. With careful manipulation according to the project documentation, these impacts can be brought to minimum.
4. Will the object produce solid waste when building, exploitation or stopping?	Yes. Part of the waste which will be produced when building the section will be garbage and it will be appropriately disposed.	Yes. The amounts are minimal and when handled properly, the impact will be minimal.
5. Will the object emit toxic and dangerous substances in the air?	Yes. The vehicles emit toxic gases.	The impact is minimal due to the increased flaw power of the section.
6. Will the object be source of noise, vibration or light, heat energy or electromagnetic radiation?	Yes. During the construction there will be impact from the heavy con-struction machinery (noise and vibration) and afterwards only noise from the vehicles.	The impact is minimal.
7. Will the object present risk for soil pollution and pollution of underground waters from emission of toxic material?	No.	The impact will be minimal due to the resistance of the section and usage of lead free fuels.
8. Is there a risk of accidents during construction of the object which might endanger human health or the envi-ronment?	Yes. The risk of accidents is described in details.	Yes. With applying all of the protec-tive measurements, the impact is minimal.
9. Will the object construction result in social changes, demographic changes, traditional way of living, employment level?	Yes. Each investment results in positive impact on the social life.	Yes. The positive impact is with limited effect.

10. Is there any other important factor which might impact the environment and for which there might be influence on the anticipated activities?	No.	No impact.
11. Are there area or locations around this location which is protected internationally, locally or nationally because of their ecological, cultural or other value and upon which the object might have an impact?	No. The location is along an existing road, surrounded by individual fields of low cadastre class.	No impact. The location has no landscape or cultural value.
12. Are there areas on or around the location which are sensitive due to their ecology like swamps, water flows, riversides, mountain or forests which might be impacted by the object?	Yes. The alluvial around river Konjarka is sensitive due to the limiter water supply in the summer period and the decreased capacity as receiver of waste waters.	Yes. Having in mind the limited amount of waste water this impact is important.
13. Are there area around the location which are used by protected, important species of flora or fauna for instance for breeding, rest, hibernation, migration which might be impacted by the object?	No. There is no record of researched biotypes of endangered species. The listed species don't habitat along the route.	No impact.
14. Are there features of high landscape value which might be impacted by the object?	No.	No impact
15. Are there any recreation or other public objects near by?	No.	No impact
16. Are there traffic routes on or around the location which have high frequency of traffic or could cause other environmental impact?	Yes. The route is on the existing route M-1	No impact
17. Is the object on a location easily visible from visual points?	Yes.	No impact.
18. Are there on the location or around it areas characteristic for their historical or cultural value and which might be impacted by the object?	No.	No impact

19. Is the object located on previously not used area which might cause losses of vegetation or other natural wealth?	No.	No impact
20. Is the land around the location already in use for something else like houses, gardens, other private property, industry, trade, recreation, open public space, agriculture, forestry, tourism, mines or quarries which might be impacted by this object?	Yes. There are village graveyards which need to be dislocated.	The impact is minimal because only small number of graves needs to be dislocated.
21. Are there planes for further usage of the land on and around the location which might be impacted by the object?	No. The location has been urbanized.	No impact
22. Are there on or around the route densely populated locations?	No. The route goes only through village Tabanovce with 200 houses but doesn't influence any other object.	No impact
23. Are there near the location sensitive objects (like schools, hospitals etc) which might be impacted by the object?	No. There are no neighboring locations to the object.	No impact
24. Are there on or around the object area with concentration of polluting elements above the maximum limit which might have cumulative effects on project implementation?	No.	No impact
25. Are there on or around the location areas with high seismological activity, zones of unfavourable climate (temperature inversions, for floods etc.)?	No.	No impact

In the further text there is detailed overview of the impacts during the construction and exploitation of the structure.

Criteria	**Indicator**	**Data needed to evaluate the alternatives**
Noise	Density of population in the	Traffic density

Criteria	Indicator	Data needed to evaluate the alternatives
	area of noise endangerment (>55 dB)	
Air pollution	Density of population in the in the emission zone over maximum allowed concentrations (SO_2, CO, Nox, Pb)	Type of transport means, frequency, gas consumption, metrological conditions, orography
Usage of un-renewable energetic sources	Consumption of oil derivates, electrical power	Public transport, objects of public sector, other bigger consumers
Land occupation	Area needed for the structure and auxiliary components	Topographic features, type of roads, bigger mound, bridges
Traffic safety	Route features, visibility, icing, drainage of atmospheric waters	Number of accidents
Traffic safety	Route features, visibility, icing, drainage of atmospheric waters	Number of accidents
Integration in the surroundings	Population density	Land usage intension
Social segregation and alienation	Ending traditional neighboring relations	Social evaluation of terminated contacts, existing crime and stress
Esthetic modeling	Destroying and degradation of important land marks	Devaluation of important natural land marks, natural and cultural heritage

3.3 Environmental impacts during construction

The potential impacts have been described by way of the specific alterations expected for each component of the environment. A certain factor may impact more than a single environmental component. The major potential impacts for the duration of the construction phase are as follows:

- Disruption of the quality of the air (through harmful emissions from mobile sources of polution) and throught the emission of dust particles;
- Decrease in water quality;
- Changes in the quality of the soil - disruption of its physical-mechanical characteristics, compressing, loss of natural humidity etc.
- Loss of vegetation or change in the structure of the vegetation;
- Destruction of the natural habitat of the fauna, or a decrease in the quality of the habitat
- Disturbing (by noise, use of mechanization etc.) of the fauna, especially of the smaller species
- Landscape alterations
- Impacts upon the social sphere due to the presence of workers during construction
- Changes in the economical tendencies initiated by the investments in the construction of the objects
- Economical decline due to the investments in construction

3.3.1 Possible pollution during excavation works and road alignment

Construction will directly impact the environment during the preparatory works, excavation works, concrete works, asphalt paving; and especially the process of disposing of earth material from the excavation works; locations of bases, warehouses for construction and auxiliary materials as well as fuel will be chosen; for the uninterrupted movement of traffic detours will need to be set, which will impact traffic safety; the impact corridor will be expanded due to the need for access roads for the mechanization, which will be abandoned after the completion of the sections of the road.
The following phases fall under the category of preparatory works for the construction of the new highway:

- Pre-works- in the sense of previously settling any property issues that may arise during expropriation, dislocation of certain objects, cemeteries (e.g. the cemetery used by the population of the Rechica village within the road's corridor) clearing of the terrain, installation of the required mechanization
- construction of temporary access roads
- Earth works - excavations, embankments, supporting walls, redirection of the river flow for the purposes of constructing a bridge

3.3.1.1 Accessibility of the location for the purpose of preparatory construction works

The existing highway will be used on occasion for the transport of heavy-duty construction machinery and construction materials to the sections of the new widening of the road, as well as for transporting waste materials, (from the excavation works, vegetation clearing, construction waste etc.) For the aforementioned reasons, traffic conditions will be exacerbated, which will be partially solved by detouring the vehicles during the different stages of the highway construction. On one side of the highway, earth access ramps will be raised, with a width of 3.5 m. for the purpose of manipulating with the construction machinery, human resources and construction materials on individual parts of the route.
The fuel-carrying-vehicle frequency and their lingering on the spot, (especially during the pouring of the fuel), maintenance of the construction mechanization etc. pose a latent threat to maintaining soil quality, surface and ground waters etc. in case of various spills and accidents.

3.3.1.2 Description of materials designated for dislocation or disposal

Disposal of the construction waste should be done at a location conceived for that purpose (there is no technically equipped landfill that can be used for that purpose). The auxiliary construction objects (warehouses for the storage of construction materials, tools, fuel and similar auxiliary objects), which will be used for the duration of the highway construction will be required to be located in environmentally less vulnerable areas (situated away from riverbeds and larger forested areas, quality agricultural surfaces, populated places, protected natural sites).
Aside from the earth and the construction waste, which will be disposed of in accordance with the project to a defined location, the solid waste generated by the workforce, the containers for the construction materials are also tagged for disposal, the additives, oils and fuel, which according to their type fall under the category of harmful waste. The latter will need to be transported to the Drisla sanitary landfill.
The machinery and the equipment used during construction will remain in use up to the completion of the construction works.

3.3.1.3 Construction machinery

a) Construction mechanization

The type of the object and the scope of the construction works determine the type and the number of construction machines. Considering that highways are usually linear objects, the following machines

are required for its construction: buldozers, compression rollers, trench diggers, graders, finishers, dump trucks and a diesel power generator, i.e. a location with a surface area of approx. 0.2 hectares needs to be secured in order to accomodate the aforementioned machines.

b) Construction materials

The type of the object and the terrain characteristics suggest a certain scope of construction-concrete works (in the sense of constructing supporting walls and bridges) which in turn require storage space for the construction materials (aggregate rock, cement, additives, plating, metal framework etc.), which will be placed in a location in accordance with the building site organization. What should be taken into consideration when choosing a location for these temporary structures, besides rationalization of the operative and transport costs, is its position relative to the agricultural surfaces (production of dust, noise, the possibility for oil spills etc.), populated areas and surface waters.

3.3.2 Water pollution

During major construction undertakings, as is the case when constructing highways, the possiblility for spilling of oil derivatives and their penetration into the hydro-geological environment of an inter-granular character, as is practically the case with the entire route of the Tabanovce-Kumanovo section, poses a significant potential threat to ground water purity. In this context, for the sake of presenting these little-known facts, we are displaying concrete, scientifically proven data, which illustrate the mechanism-process of the possible repercussions.

3.3.2.1 Oil pollution

It is widely known that spilling oil derivatives in ground waters in concentrations below those detectable by taste and smell, make their use as drinking water impossible, while a large number of products of oil transformation have a significantly lower limit of permitted concentrations which in drinking water, especially if tagged as carcinogenic, such as phenols for example. When such pollutants are absorbed underground, they tend to reside there for relatively long periods of time, especially in the intergranular environments. To illustrate, we will provide the following example: One kg. of sand possesses an internal surface area of the grains of approximately 6000 m^2, and clay a surface area of 600,000 m^2, which enables the oil and its derivatives to form a powerful bond with such surfaces.
The basic composition of oil (raw) is quite uniform, and there is a relatively small number of variations in its composition. The general elemantary composition of oil varies within the following boundaries (according to V. Aksin) :

Carbon	(S)	83-88 %
Hydrogen	(N)	11-15 %
Sulphur	(S)	0,1-5,5 %
Nitrogen	(N)	0,1-2,5 %
Oxygen	(O)	0,1-3,5 %
Minerals		01,1,2 %

Carbon and hydrogen often appear in compounds such as carbohydrates of many different series'. The parrafin and oil carbohydrates are the most widespread, followed by the aromatic carbohydrates.
Sulfur appears in oil mainly in three types- free sulfur, hydrogen sulfide and organic compounds of sulfur such as tiophen, tiophan, carbon bi-sulfide etc.
Nitrogen in oil appears in the form of various organic compounds, while oxygen is usually in free form, or fixed in different kinds of chemical compounds. Considering the oil migration throughout the porous hyfrological environment, the most physical features are as follows

- mechanical (specific weight, molecular weight, capillarity, volume coefficient, compressibility etc.);
- optical (colour, fluorescence, light diffraction, optical activity etc.);

- thermal (boiling, coefficient of thermal expansion, thermal conductivity, flammability, thermal value etc.);
- electrical;
- odour;

All these factors are important for the oil migration process throughout any hydro-geological environment, furthermore any hydrocarbon blend encompasses own physical constants, therefore adequate variable behaviour in the underground may be expected.

Polluting liquid and other types of hydrocarbons once appearing in the underground, they will be exposed to numerous processes and reactions with other polluters, all differing by their physical-chemical characteristics.

Absorption of the pollution in the underground environment highly depends upon the size and type of the contact surface with the spillages. The physical binding of the oil with the rocks, gravels and sands will result in the so called creation of the "body:" of the oil pollution. Molecular attachments and capillarity, especially in sandy geological formations, will contribute to the expansion of the "body". It becomes consolidated with time, but the decomposition and dissolution is conducted slowly and creation of other polluting substances may be expected. The analyses periods for various elements and compounds, as well as the impacts upon environmental media have been specified in various EU and Macedonian regulations. Below some figures are given to illustrate this

Substance	Maximum allowed concentrations	Analysed period	factor	source
CO	10.000 1.000	8 h 24 h	human health	EC/2000/69 Macedonian
SO_2	20 125 150 350	1 year 24 ~ 24 ~ 1 ~	ecosystem human health	EC/1999/30 EC/1999/30 Macedonian i EC/1999/30
NO_2	40 85 200	1 year 24 ~ 1 ~	vegetation	EC/1999/30 Macedonian EC/1999/30
NO_x	30	1 year	vegetation	EC/1999/30
^esti~ki partikuli (< 10)	40 50 100	1 year 24 ~ 24 ~	human health	EC/1999/30 EC/1999/30 Macedonian
Pb	0,5 0,7	1 year 24 ~	human health	EC/1999/30 Macedonian
Benzene	5	1 year	human health	EC/2000/69

3.3.3 Pollution with harmful noise

Emissions of harmful noise of various intensity will origin from the use of construction machinery to be employed during various construction phases and transportation vehicles (trucks etc.) which will run throughout the construction site.

The assessment of the noise impacts is carried out based upon the measured noise indicators expressed in dB compared with the norms given on the Official Gazette Nr. 64/93 (Decision for identification of conditions upon which the peace of population is disturbed by harmful noise). By the articl 3 of this Decision the maximum allowed noise level for various structures where the peace of population should be guaranteed is precisely defined. However, the Decision is regarded as redundant for the case of the considered alignment, due to the fact that it doesn't approach to any schools, hospitals, ambulances and similar structures requiring such special conditions connected to the limitation of the

noise levels. In the article 4 concerning buildings and residential areas, the maximum allowed values amount up to 79 dB, for daily and noise at night, whereas occasional picks of 90 dB are tolerated.
The alignment at the point of its passing through the village of Tabanovce is critically approaching to individual houses and weekend houses. Also the junction of the highway with the local road towards Tabanovce creates problems with noise, due to the vicinity of the nearby houses. These limited sections will be elaborated and suitable environmental measures will be presented with this Study.

3.3.4 Socio-economic impacts

The population structure will interact with the new highway and the accompanying structures concerning the superstructure (hotels/motels, petrol stations, bus stations etc). The main aspects which will influent the implementation of the construction phase, and will be further improved during the exploitation are the following:

- The relation between the active and passive population, employments generated in the agricultural sector, construction and industry expressed by various statistical parameters for the area of the alignment is showing an inappropriate demographic structure, due to the low education and unsatisfactory qualifications of the labour.
- Availability of labour, local entrepreneurship and possibility for hiring local population in various construction phases is low, except for the phases when unqualified staff is required.

Demographic changes for the concerned area are relatively stable, due to the vicinity of the town of Kumanovo, where the use of public services (health, higher education, sport etc.) are provided, in addition to those which are available in villages located nearby the alignment.
The average number of household members is estimated at 3, while the socio-economic groups belong to the poorest levels.
By the data on dwellings it may be concluded that there is a surplus of dwellings (a number of abandoned houses, weekend houses are present), which, on the other hand, determines some demographic stability, because there is a tendency for returning of people in settlements (building of residential houses is a sign that there is an interest for inhabiting these areas). Population density is about 30-40 inhabitants per hectare in settlements, while outside the inhabited areas the density is significantly lower; this characterises the area with a low development capacity.
The economic development is in close relation with the availability of social infrastructure, but further investments are not justified for such low population density. However, the economic development should be motivated and there should be incentives created to attract public and private capital, in order to stimulate investments in infrastructure and superstructure in the area.
Social issues should be further analyzed, and suitable measures for improvement of the population lifestyle should be initiated, financed and implemented. It will finally influent the increased traffic frequencies (to allow for the cost recovery of the investment for the development of the highway) but it will also require implementation of protection measures to improve safety, improvement of the attractiveness of the area and its integration within the urban and natural environment.
The population along the highway is completely isolated from the development trends in Macedonia, which are characteristic for bigger agglomerations. The highway construction will contribute to the stimulation of the development processes, based upon the sustainable principles.

3.3.5 Endangered wildlife

During he construction of the highway Kumanovo Tabanovce the upper soil layer will be removed together with the surface low vegetation.

Based upon the types of vegetation present along the highway, it may be concluded that the soil and climate conditions are not suitable for the natural succession of the forest, bush and grass vegetation.

There will be no need for clearance of the tree vegetation, except for a limited area along the river bed of the Konjarska River, at the section where the river is passing from the left to the right site of the alignment and goes in parallel with the route (0+500m by 2+000m).

Special care should be put upon the conservation of tree lines for protection against wind, for the particular section of the alignment where the clear-cut of high vegetation is necessary for the construction of the highway (nearby the riverbed of the Konjarska river upon the exit from the village of Tabanvce on the right side (2+000); at this point a hilly terrain is replaced by a flat agricultural area under and irrigation system. There should be no interventions upon these created landscape and land use elements which have and extraordinary importance for the quality of the agricultural production; in addition, the role of these tree lines is important concerning the rehabilitation of the ecological corridors which are presented in the area.

In the corridor of the alignment there are several watercourses which are surrounded by vegetation, creating habitats for many local aminal and vegetation species. These ditches and streams allow for a migration and genetic communication along the valley of the Konjarska river. These watercourses are bridged appropriately, underpasses are implemented, to provide the communication of species; barrier effects are therefore avoided to the most possible extent. Some barriers may be created during the construction, but their removal must be considered for the period of the exploitation.

3.4 Impacts during operation

3.4.1 Air pollution

The impact of toxic gases may cause consequences upon the human health, especially upon these people who are long-term exposed to this impact, by direct or indirect exposures (inhalation, or by consummation of polluted agricultural products). Fume affects the respiratory organs and skin, while the hydrocarbon oxides act as toxics and anti-oxidants. The lead which is added in the petrol as tetraethyl lead is particularly harmful for the respiratory and digesting organs, as well as for nerves; even at the allowed concentrations the lead may cause adverse affects upon the blood tissues. Nitrogen oxides cause asthma, allergies and cancer of the respiratory organs. Some compounds from the group of poly-cyclic hydrocarbons (benzene, as a product of the burning out of diesel, while on tone of diesel produces 50 mg of benzene) are leading in the list of compounds responsible for the appearance of cancer (it is also the most distributed compound in the air polluted by the traffic) Fume is also containing cancerous substances (similar to the effects of tobacco smoke), but extremely cancerous features are attached to various particles originating from the process of the burning out of diesel.
A permanent emission of such polluting substances will be present during the operation of the highway. Vulnerable sections are those approaching to the inhabited areas; moreover, such sections are constructed by embankments, allowing for free distribution of the polluting substances. Some parts of the alignment where the highway is approaching to high quality agricultural land may be considered as vulnerable as well.

Maximum allowed concentrations of harmful substances in the ambient airs should be in the following ranges:

compounds	**emission maximum allowed concentrations (gr/hour)**	**emission maximum allowed concentrations (mg/m3)**
lead	25.0	5.0
Nitrogen oxides	5000.0	500.0-800.0
hydrocarbons		500.0

compounds	**emission maximum allowed concentrations (gr/hour)**	**emission maximum allowed concentrations (mg/m3)**
formaldehyde	100.0	20.0
particles		130.0
carbon monoxide		650.0
carbon dioxide (%)		2.5

Maximum allowed concentrations (average per annum / 10 meters length of the highway/ for the period by 2015)

matter	standard for air quality	maximum concentrations		note
		estimated	percentage of the standard	
CO	10	< 0,1	< 1%	8 hours standard
SO_2	20	0,14 - 0,24	0,7-1,2 %	ecosystem
NO_2	40 200	7 -11 3 exc	18-28% 13% exc	1 god 1 ~
NO_x	30	9-27	30-90%	vegetacija
particles (< 0)	40 50	18-32 11-59 eks	45-80% 31-120%exc	1 yesr 24 hours
Pb	0,5	0,005-0,009 <0,001	1-1,8 % <0,2%	current emission future emissions
Benzene	5	0,004-0,08	8-16%	

Present data on air quality show appropriate results. Due to the lack of any polluters in the area the air is relatively clean. Therefore it is not considered any significant worsening with the traffic. Terrain is open, natural ventilation is appropriate, therefore the dispersion of air pollution is expected. However, monitoring (especially in winter season) should take place. If any indications on pollution would be found, the project developer will be responsible to apply appropriate measures.

3.4.2 Water pollution

Konjarska river at this part of its river flow is showing certain disturbance (IV class), while in the periods of low water flow the surface water quality is being decreased (exceeding the standards for the IV class and showing characteristics for a quality for the highest class, which is used for expression of the pollution by many indicators).

Tabanovacka (Banjska) river, which is known in its upper river flow as Konjarska, is rich with ichtiofauna and coastal species, which are sensitive to the changes of the river water quality, as well as to disturbances of the coastal conditions of any kind. Earth and concrete works which will be extensively required for the construction of the highway (especially in the settlement of Tabanovce) will be conducted at critical distances and therefore may cause disturbances of the aquatic and coastal wildlife.

Reasons for the currently disturbed quality of the Konjarska river downstream the settlements can be found in the facts that the discharge of the wastewater from the pig farm in Gorno Konjare is carried out without purification/treatment, but also the storm water drainage form the abandoned site of the mine of arsenic and antimony "Lojane" is a source of hazardous impacts.

Organic pollution which is characteristic for bigger pig farms (they will be covered by the IPPC regulation which have been recently issues in Macedonia) is estimated by some practical and theoretical samples by 100-200gr/heads BOD5, which results in extreme loads for the recipient of the Konjarska river, which has a very low auto-purification capacity due to the low water flow, especially in summer periods. There are some potential impacts form the use of chemicals in the agricultural production, which may be drained in the storm water as well as through the irrigation systems.

3.4.3 Harmful noise

The highway section is passing a flat area allowing for noise distribution, due to the lack of barriers and absorbers, which could be otherwise created by hilly terrain, vegetation etc. However, the originally high noise intensity in non urbanized areas may abate in inhabited areas due to the lower speed of vehicles.
During the construction the heavy machinery and the transport of construction material to the construction site and within the immediate construction area will generate noise. In addition, the traffic of the existing road will be a permanent source of noise generation.
Construction machinery and trucks used for the transport of construction materials usually generate noise with an intensity of 85-90 dB at the source, while the noise propagation will depend on the climate (wind speed, moisture, air pressure etc.), morphology, absorption capacity of vegetation and other factors whose differences may impede projections of the noise intensity at various distances from the source. Namely, the noise, as a physical component, depends on various barriers and absorbers and their mutual interaction in the process of reflection, absorption and interference, as well as the distance from the source
The considered alignment is mainly conforming with appropriate conditions for noise abatement: lack of reflection surfaces, relatively small paved surface, windy area, absence of other barriers, such as walls, hills etc.

Maximum allowed noise levels in Macedonia

Characteristics of the area	Allowed noise level dB(A)	
	day	night
Health care centres, spas weekend houses	45	40
Tourist and recreation zones	50	45
Residence areas, schools, parks and other open spaces	55	45
Trade and business centres, residence areas, buffers near roads at a distance of 50 m.	60	50
Trade and business centres, excluding residence areas	65	50
Industry, commercial, transportation centres, excluding residence areas	70	70

The traffic and other functions which will be attached to the highway (such as petrol stations, motels, industrial zones etc.) will be the main sources, but also the recipients of the noise.
Noise levels will require control in settlements and along the crops. In the settlements the noise will be controlled whenever the residence areas are adjoined closely to the alignment and houses are at small distances from the noise sources. On the other hand, the agricultural land is regarded as vulnerable due to the impacts on birds, causing their migrations and therefore initiating disturbed food chains and

expansion of vermin; also, absence of birds creates adverse impacts upon the natural distribution of seeds. It finally results with the need for intensified application of insecticides, herbicides and other chemical products, thus lowering the value of both-the soil quality and the agricultural products.

3.4.4 Impacts over the wildlife

The harmful noise is usually causing migration of species and disturbing the ecosystem balance of the agricultural areas, meadows, coastal areas near permanent and temporary water courses, tree and bush ecosystems. Clearance of vegetation for the construction works will disturb and fragment some natural biotopes functioning at present in the corridor of the alignment. The barrier effects created by the highway will influent the migration regimes and the exchange of the genetic information among the species. These biotopes may be also endangered by fires for which the risk is increasing due to the presence of flammable substances (engines, transport of flammable substances etc.) in normal and accidental circumstances.
On the other hand, the buffers which may be created by trees and bushes along the highway at some sections could compensate for the loss of vegetation during the clearance for the purposes of construction works.
In the immediate area within the corridor of the highway there aren't any protected vegetation (flora) and animal (fauna) species
Biotopes which are created in the riverbeds and their coastal areas will be endangered in case of clearance of vegetations for the purposes of the regulation of the rivers and other water streams and installation of underpasses. Original vegetation which will be removed due to the construction works will have to be registered by species and age; out of this inventory the planning for reintroduction of those species can be conducted, allowing for re-vegetation at certain sections, vegetation belts and arrangement of coastal areas at which some regulation works should be applied
Concerning the aquatic ecosystems, the most important is the river ecosystem of the river Konjarka, which, even at present, is very vulnerable. Its regeneration capacity is relatively limited, thus it could not be regenerated without removing the causes for its disturbed quality.

3.4.4.1 Storm water drainage from the highway surface

The storm water which is drained freely by gravity (following the longitudinal as well as cross section slopes) from the paved asphalt surface of the highway towards the river courses, in case if the alignment is placed upon embankment. Partially, it is infiltrated in the soil and potentially in groundwater. Substances which may be found in such rinsing water will have organic and inorganic compounds: heavy metals and mineral oils could be contained. The analyses show that the technical measures to be applied in accordance with the detailed design, will control the drainage of the storm water and prevent pollution of watercourses and groundwater. Retention basins will, therefore, not be required.

3.4.5 Pollution of soil

In the soil composition mineral and organic compounds are presented. Predominantly organic soils, such as the peat, contain decomposed organic matter originating from vegetation. Mineral compounds may have different granulation: >2.00mm, sands - 0.06-2.0mm. (0.002-0.06mm.) and clay and silky particles < 0.002mm.
Soil structure which is defined by the participation of previously mentioned fractions will influent the soil cohesion, porosity, and therefore the oxygen saturation, water permeability and the root distribution in the soil layers, as well as their ability to extract the solutions of minerals from the soil.
In the area of the alignment soils in which the transformation of residual hydroxide originating from the decomposed vegetation and crops is presented, form a layer of extended humus in which acids and hydroxide elements are linked to Sa and clay. This humus horizon shows mainly a neutral reaction and saturation with basic ions (which is characteristic for dry conditions and limited rinsing). Humus is

contained with different extent, which depends upon the bio-mass production in dry conditions and the mineralization carried out in rainy periods during the year. Weather conditions together with the production of H_2CO_3, which is generated throughout the mineralization, make possible the creation of clay in the soil profile.
Main sources which cause pollution of the soil are the aero sediments and the storm water drained from the highway paved area. Within the sediments composition there will be solid particles presented (originating from diesel engines) sulphates, nitrates and aerosol sediments (aerosol may be acidic, due to the reaction of sulphuric, nitrogen and carbon oxides with the storm water). Bearing in mind the suitable morphological conditions in the area of the alignment, soil pollution caused by such sediments may not be expected. It could appear upon inappropriate weather conditions (fog, extremely low temperatures etc.).
Storm water which will be drained by the slopes of the embankments in which the highway body will be placed at the most parts of the considered road section, will cause potentially erosion of slopes, but also pollution of the alluvial soil which is presented in the riverbed if Konjarka river.
The agricultural land which is located nearby the alignment (predominantly grain, orchards, pastures, meadows and abandoned land) at a distance of 50m. could be polluted by the substances contained in the aero sediment and drained storm water. The agricultural plants may be also disturbed in terms of their quality by the pollution whose penetration may appear through the roots; such pollution substances (aero sediments) may penetrate through the plant reproduction organs as well.
As a special kind of jeopardy for the agricultural land is considered accidental fire appearance (especially in summer conditions) as well as the technical accidents connected with transport of hazardous liquids and their spillages. The vegetation is endangered, as well as the crops, which, of dry, contribute to the propagation of the fire.
It is certain that appropriate measures to prevent such events should be implemented; furthermore the agricultural production and the cattle breeding are branches in which the majority of the population generates income and therefore they deserve special attentions. All the measures which will be applied to protect the soil quality will contribute to the protection of the agricultural products as well.

3.4.6 Impacts during extraordinary conditions (accidents and hazards)

3.4.6.1 General

Accident (hazard) is unplanned or extraordinary event which is caused by indolence, force majeure, when there partial or complete absence of process control is presented, during limited space and time period and which may have adverse impacts upon human health and the environment. Accidents and hazards could influent adversely the quality of watercourses, groundwater, soil and ambient air. Causes for such risks may be accidents with the transport and other vehicles circulating in the highway, as well as the presence of explosive, flammable, corrosive, infectious and other substances transported by shipment. Not only the traffic is considered as source of such unwanted conditions, but also the stay of the merchandise at various points located along the highway (parking at restaurants, motels etc.).
Upon extraordinary conditions spills and leakage could appear which may further contribute to the creation of:

- Fire and explosions
- Soil, air and pollution of surface and ground water
- Jeopardy of human and material wealth
- Destruction of the road

Similar accidents could be initiated by prolonged stay of the shipments at the parking areas, at which suitable protection measures have not been applied, especially in summer conditions.
To identify and predict such risks, a plan for hazard control should be developed and attached to the technical documentation. It should contain statistical information about previous accidents, assessment of level of probability for appearance of accidents and hazards, identification of sensitive areas

and locations at which accidents may appear (sharp curves, steep slopes, parking areas, settlements - human indolence risk, etc.). Similar plan should be developed for fire fighting.

3.4.6.2 Spills of oil and diesel

By the generally adopted principles of the selective transport, the filtration of the mineral oils in the aquifers is conducted in the following way: upon the spillage of hydrocarbons an immediate distribution of the gaseous and liquid phases appears in the underground environment. The size of the oil spot depends directly upon the soil permeability and the higher permeability, the bigger the oil spot in the underground. The expansion of the spot is fastest at the contact with aquifers. Fluctuations of the water table also contribute to the drawing away of polluting substances by their saturation in the raising ground water. The liquid hydrocarbons transported by the filtration streams, become vacuumed and attached by the soil granules. This physical absorption is not as stable as the chemical, and therefore the reverse process is common. Apart from the soil permeability and the distribution of various soil layers in the underground, the most important factor which adversely influents the distribution of the oil emulsion is the water table and its fluctuation. Other factors which contribute to the process may be physical, chemical and biochemical.

Once the oil is present in the underground, the stabilization of the size of the oil spot, as well as the decomposition of hydrocarbons goes in parallel. The decomposition of hydrocarbons is prevented by the low oxygen saturation, as well as by other specific chemical reactions which are conducted in various types of soil. Presence of micro flora is another factor which creates suitable conditions for faster decomposition of oil.

Biological transformation of oils in the hydro-geological environment is the most important process which positively influents the reduction of the harmful impacts originating from the mineral oils spillage. As a result of biochemical processes which are present in both anaerobic and aerobic aquifers, a chain of changes within the composition of groundwater appear, leading to reduction of the concentration of the polluting hydrocarbons.

The dissolution ability of mineral oils highly depends on the type of mineral oil derivates and it is in general extremely low. The concentration by saturation of the water with petrol is estimated at Na primer koncentracijata na zasituvawe na vodata za benzin iznesuva 50-500 mg/lit, for diesel it amounts up 10-50 mg/lit.

The most important adverse impact caused by the spillages is the reduction of concentrations of oxygen in soil and groundwater, which becomes exhausted during the decomposition processes of hydrocarbons. Decomposition of mineral oil derivates in the underground environment is conducted very slowly.

Monitoring over the decomposition of mineral oil derivates is a very complex process; the identification of decomposition products in practice is impeded due to the variety of underground conditions and such biochemical processes, which further hamper the process control and interventions. At present only 5% of hydrocarbon components can be isolated and prove analytically, such as phenols. Other known products with harmful effects have very complex composition.

4 GOALS OF THE ENVIRONMENTAL PROTECTION FOR HIGHWAYS

Based upon the alignment characteristics and the environmental conditions which have been described previously, for the purposes of the definitions of appropriate environmental protection measures, the following goals have been set out:

- Protection of the quality of surface and groundwater
- Protection of the valuable agricultural land
- Protection of the coastal vegetation (which has multifunctional protection role, such as the erosion prevention, retention of polluting substances drained with the storm water and other migrating media)
- Estimation of cultural and traditional values of the population
- Limitation of areas for conversion of land use (from agricultural use to unproductive uses, such as the construction, highway etc.)
- Introduction of environmental criteria upon the selection of sites for extraction of sand and gravel, as well as disposal of debris and other waste during the construction
- Definition of protection regimes at certain highway sections
- Consideration of existing protection regimes defined for certain areas protected as cultural heritage zones and monuments

5 MEASURES FOR PREVENTION, REDUCTION AND MITIGATION OF ENVIRONMENTAL IMPACTS

The identified adverse impacts which may cause disturbance of the environmental condition should be:

- Avoided (by optimal spatial organization of the construction works and the placing of structures, parking areas, distribution of pedestrian traffic, implemented construction materials, application of alternative energy sources, avoided use of harmful and dangerous substances in accordance with the regulations, appropriate waste management practice);
- Reduced (applying previously defined measures) and
- Mitigated, by the implementation of suitable biological and technical measures.

The following criteria are applied towards the definition of the most appropriate measures;

Protection of natural conditions

The natural ecosystems are the most valuable and the human interventions should be kept at minimum. Within the highway corridor there aren't any natural ecosystems which deserve protection, while the human interventions should be assessed and classified by size and influence upon the natural processes. The alignment is placed in cultural landscape characterized by high anthropogenic pressure which is present at agricultural land. The natural shape and processes have been almost completely lost. It allows for further controlled human pressures in combination with biological measures to strengthen the ecological functions.

Size

The size of the location is rather limited, if compared with similar projects concerning linear transport infrastructure. In addition, the infrastructure components are not differing by the function and applied construction materials. In that way the attractiveness of the site is not lost, however, the accessibility of settlements will increase by the implementation of junctions and other highway elements allowing for the increased connection of the secondary infrastructure with the highway. The attractiveness of the area may gain by the carefully designed measures, such as biological measures. These biological measures may influent positive changes of the micro climate, such as the mitigation of temperature oscillations, increased moisture etc.

Diversity

Among the most important site attributes the variety and diversity of biotopes and species takes a very high position. On the other hand, the diversity is sometimes related to the instability of habitats which must be taken account during the development of the detailed design. The biological diversity along the alignment is rather low and the appreciation of this factor is not a limitation for the construction as well as exploitation of the highway. Measures to be taken will be applied to contribute to an increased biological diversity, therefore the biological measures will be preferred for protection against harmful noise, retention of storm water drainage etc.

Rarity

This criteria comprises of rare biotopes, species and ecosystems. Presence of one or more rare natural components at the site shifts its importance higher, if compared with the sections where there are not such rare components present. Along the site there is no any rare natural component which is either proposed for protection, or protected by some regime by law.

Vulnerability and fragility

These criteria are reflected by the vulnerability and fragility levels of habitats, species and ecosystems upon changes of environmental conditions. Such locations often represent heavily fragmented ecosystems, those which are exhausted and can not be created by application of any interventions. Such

fragmentation of ecosystems is present in the considered area. To renew such fragmented ecosystems the following will be taken into account: avoidance of any interventions upon the lines of trees which have been created for protection of the agricultural land fro wind, maintenance of the coastal vegetation and implementation of new compatible species. In that way the strengthening of the ecological network and reduction of barriers will be achieved.

Typical ecological conditions

Typical habitats, biotopes and species are very important. They should be conserved in order to maintain ecological variations. For the area of the alignment the most typical ecosystem is the agricultural land and therefore its importance for protection is high.

5.1 Protection measures during construction works

5.1.1 Air pollution and harmful noise

Considering the temporary character of this impact there are no measures foreseen. Dust control as usual procedure at construction sites is recommended.

5.1.2 Endangered wildlife

After the clearance of the tree vegetation at the section where the river is passing from the left to the right site of the alignment (0+500m by 2+000m) and the clear-cut of high vegetation for the construction of the highway nearby the riverbed of the Konjarska river upon the exit from the village of Tabanvce on the right side (2+000) the following measure will apply:

- Removal of the vegetation, inventory of the removed vegetation (by age and type), its appropriate temporary storage and bringing back of the local vegetation at appropriate locations

To mitigate the impact for the transitional flora and fauna created by the concrete regulation of the river Banjka, it is recommended to apply natural material (stone, crashed rock etc.) and avoid hard concrete structures)

5.1.3 Construction waste and other debris

To reduce earth material for disposal mass balance (use of soil surplus for embankments and closure and reclamation of disposal sites) will be applied. By the project technical design this amount is estimated as 93.496 m^3; there will be need for additional 183.288 m^3 which will be taken from predetermined quarries (two in total). They are purposefully selected at the ending points of the existing highway, or in the area of the start-up operations of the construction site. The first one is located in so called “Adzi Pepe” area, on km 8+500 and the second site is situated in the so-called Trgoviste area on km 3+ 650; the latter is marked in the project design as a dumpsite for demolition and construction waste, after the termination of excavations. It is estimated that about 21.541 m^3 construction-demolition waste will be disposed off in the pit to be created by the excavations for provision of soil material to construct embankments.
It is proposed to appoint a waste manager who will take care about the demolition waste, especially for the part which possesses hazardous characteristics. Contracts will licensed companies for removal of hazardous waste will have to be made.

5.1.4 Cultural issues

An important consideration should be put upon the measure of a cultural character, such as the removal/dislocation of the cemeteries used by the population of the village of Recica. This activity will

require coordinated action in cooperation with the local population, towards respecting of local traditional values.
Private land (mainly under agricultural production) will be taken away (expropriated) for the pur[pses of the project implementation. Compensation measures will be negotiated with the local population upon the early stages.
Careful design of the compensation site for the local cemeteries for the population of the village of Recica is to be implemented, in agreement with local population.
Protection of the archaeological sites and supervision of construction works approaching to the protected areas by the personnel of the Agency for protection of the cultural heritage is recommended.

5.1.5 Socio-economic issues and benefits

Construction works bring certain positive socio-economic impacts. For the implementation of the complete construction works there will be a need to recruit about 50 unqualified persons, which will be present at the construction site during the shift only, so additional buildings for accommodation of workers will not be required. Local population could be considered to respond to these employment needs, however some qualified staff will be required for the engineering and supervision works, which should be recruited from Kumanovo and other more densely populated areas.

General recommendation:
The site should be returned in its original state. It means that dumpsites need to be reclaimed; temporary structures should be removed as well. Maintenance of the irrigation system and its revitalization if needed is crucial.

5.2 Impacts during operation

5.2.1 Pollution with harmful noise

To mitigate impacts concerning noise and air pollution in the area of Tabanpvce retention walls in the area of Tabanovce are foreseen
Their concrete position, height and design is to be determined with the detailed design

5.2.2 Air pollution

It is proposed to revitalize vegetation as a buffer along the alignment, at sections surrounded by high quality agricultural land.

5.2.3 Endangered wildlife

To mitigate the barrier impact and allow for undisturbed migration of species clearance of riverbeds and other watercourses to provide passing of water through the underpasses and prevent flood is foreseen. Due to the relatively frequent breaks of the motorway body due to ducts and other passages created for drainage of the surroundings, no additional measures are required. Windscreens created by tree lines in the field need to be maintained and revitalized if during the construction parts should have been removed. Maintenance of coastal vegetation is recommended as well.

5.2.4 Storm water drainage from the highway surface

No retention wells, ponds or any other kind of technical measures are foreseen. This impact is not considered significant, under the assumption that the drainage of motorway is constructed in accordance with the design.

5.2.5 Socio-economic issues and benefits

Increased traffic and creation of conditions for appearance of industry and services will contribute to the generation of new (permanent) employments and improvement of the local population lifestyle

5.3 Measures for labour protection

During the construction works the Contractor will be obliged to apply all labour protection measures as being defined in the existing regulations on the protection of workers which work on structures as well as protection of accidental passengers. (law on the labour protection for workers at construction sites and for the accidental passengers, Official gazette Nr. 13/98, 21/98, 33/2000).

In areas in which the works have been carried out, it is prohibited to introduce flammable materials and matters which emit explosive vapour. If necessary, ventilation and special protection measures should be applied and supply of extinguishing equipment. Presence of gasesmay be detected by special detectors, as well as by the registration of odour

Handling of tools and accessories which may cause fire is allowed to trained personnel only. The Manager must take care of the properly functioning devices, which may cause fire or explosions in case of their limited or lost functionality.

5.4 Measures for landscape management

At the beginning of the alignment of the roadway construction the perspective of the valley is creating the visual impacts of the presented landscape. The appearance is changing depending on the season and the type of crops. The valley of the Konjarska River is uniting an ecological diversity created by the conditions of the aquatic and coastal habitats. By the application of hard structures within the scope of the implementation of the highway infrastructure permanent changes will be created, which will further influent the naturalness of shapes. The requirement for keeping of natural river ecosystems for the case of the Konjarska river is not binding, however, the quality of its aquatic system should be maintained. Technical and biological measures to be applied for various reasons, will contribute to the landscaping and creation of completely new landscape units (such as the regulated riverbed at certain points, removed vegetation at some other sections etc.). In addition, de to the IPPC regulations, the pollution prevention and control measures to be designed and implemented for the pig farm will further contribute to the improving river quality, creating better conditions for the aquatic and coastal ecosystems.
The network of existing local and access roads, the network of the line trees (windscreens, landmarks and boundaries of individual agricultural parcels, coastal vegetation etc.) will contribute to the creation of the stable ecological network; this network will influent an increased carrying capacity of the environment being able to absorb polluters originating from the increased traffic along the highway.

5.5 Socio-economic benefits

Most important socio-economic impacts during the construction works will be the employment of workers upon various construction stages; the presence of the highway itself may positively influent daily migrations due to the decrease of the time period for travelling to Kimanovo, where the majority of the existing employments have been generated. On the other hand, some adverse barrier effects may be created due to the separation of the agricultural parcels with the alignment. Compensation measures should be applied to develop sufficient access roads allowing for safe travel to the agricultural land. Decrease of the quality pf the agricultural land will result in decreased quality of the agricultural products and decreased harvesting results.

6 CONCLUSION

If the proposed measures will be applied, there should not be considered any significant impacts originating from the construction and exploitation phases of the highway. Short list of the most important types of measures is given below:

- Retention wall in Tabanovce (protection against noise and air pollution)
- Regulation of the Tabanovacka (Banjska) river (application of natural material and avoidance of hard concrete structures)
- Removal of the vegetation, inventory of the removed vegetation, bringing back of the local vegetation at appropriate locations
- Mass balance (use of soil surplus for embankments and closure and reclamation of disposal sites)
- Management of debris and demolition waste (demolition waste will be generated due toi the destruction of the overpass for Recica).
- Erosion control
- Re-vegetation of the buffer along the alignment, at sections surrounded by high quality agricultural land
- Maintenance of windscreens and the coastal vegetation
- Clearance of riverbeds and other watercourses to provide passing of water through the underpasses and prevent flood
- Maintenance of the irrigation system and removal of any destructions which may appear during the construction works
- Careful design of the compensation site for the local cemeteries for the population of the village of Recica
- Protection of the archaeological sites and supervision of construction works approaching to the protected areas by the personnel of the Agency for protection of the cultural heritage

In the table overleaf an overview on main impacts, measures, responsible institutions, implementation schedule and reporting requirements are presented.

Potential Impacts/Issues	Mitigation Measures	Implementation Schedule	Responsibility for implementation	Responsibility for supervision	Monitoring indicators	Type and Frequency of monitoring and reporting.
			Impacts during construction			
Air pollution and harmful noise	Monitoring of air quality in Tabanovce	Once a year in winter	Fund for International and regional roads	Ministry of Environment and Physical Planning (MEPP)	Thresholds for polluters in the Law and subsequent regulations	Annual report to MEPP
Endangered wildlife	Removal, inventory and bring back original vegetation close to its habitat	After finishing of the construction	Construction company	Fund for International and regional roads	Number, type and age of plants, trees, shrubs brought back on site	Records annexed to the report on construction works
Construction waste and debris	Appointment of a waste manager during construction	Continuously during construction works	Construction company	Fund for International and regional roads; MEPP	Identification forms and transport lists kept and updated	Records annexed to the report on construction works
Cultural issues	Compensation with local population	Prior to start up of construction	Fund for International and regional roads;	Ministry of Finance	Previously commonly applied compensation measures	Report by the Fund to the Ministry of Finance
Socio-economic benefits	Employments (seasonal)	During construction	Construction company	n/a	Number of workers	n/a

Impacts during operation

Potential Impacts/Issues	Mitigation Measures	Implementation Schedule	Responsibility for implementation	Responsibility for supervision	Monitoring indicators	Type and Frequency of monitoring and reporting.
Noise	Retention walls around Tabanovce	During construction	Fund for International and regional roads;	MEPP	Noise thresholds in the Laws and subsequent legislation	n/a
Air pollution	Vegetation buggers along high quality agricultural land	Immediately after construction	Fund for International and regional roads	Ministry of Agriculture, forestry and water economy	Concentrations of air sediment polluters in soil	n/a
Endangered wildlife	– Vegetation control under bridges, underpasses and ducts – Maintenance of coastal vegetation	Once a year, in autumn	Fund for International and regional roads	Ministry of Agriculture, forestry and water economy	Quantity of removed biomass	n/a
Storm water drainage from motorway surface	Monitoring of quality of effluent	Once a year, in summer (low river flow)	Fund for International and regional roads	MEPP	Thresholds for water polluters in the Law and subsequent regulations	MEPP
Socio-economic benefits	Industry, trade development	Project implementation	Private entrepreneurs	n/a	Purchasing power of population	n/a
Hazards	Plan for Hazard Management	Project implementation	Fund for International and regional roads	MEPP	Number of accidents and hazards	Annual reporting to MEPP (Law on Environment)

If the Project developer promotes above described measures to the population it is considered that project will start smooth implementation. It is also important to consider those measures with the detailed design. Their costs are to be determined further. Bearing in mind their character (monitoring to be applied once a year, biological measures favored against technical structures etc.) it is not expected to raise project implementation costs for a significant margin.
It is proposed to the Ministry of Environment to issue an approval for the start up of project implementation.