

EXECUTIVE SUMMARY

ENVIRONMENTAL IMPACT ASSESSMENT STUDY

Project: FINALISATION OF CORRIDOR 10, HIGHWAY E-75

Section: DEMIR KAPIJA - SMOKVICA (32.8/27.8 km)

Project intention

The project intention is to construct a modern highway with four lanes (two in each direction + additional lane for stopping) with predicted traffic frequency of 12000 vehicles per day as an annual average. It includes two proposals for the alignment:

- First variant/alternative (hereafter referred as Alternative A) represents upgrade of the existing motor road from Demir Kapija to Smokvica, which runs along the river Vardar valley on its left side and mostly close to the river; for this alternative there is a final design already 10 years old.
- Second variant/alternative (hereafter referred as Alternative B) is construction of a completely new highway on a predominately hilly and mostly natural area on the right side of the valley, far from the river; for this alternative the design is in a very beginning stage.

The **proponent** (Investor) of the project for construction of the Highway Demir Kapija-Smokvica is the "FUND FOR NATIONAL AND REGIONAL ROADS". The Highway Demir Kapija-Smokvica is part of E75 road (ETC 10) which runs through Macedonia in North-South direction along the river Vardar valley and connects the Republic of Serbia and the Republic of Greece.

For the purpose of the EIA Study two corridors of one kilometre width were set up along the two proposed alternative alignments (500 meters from both sides of the alignment axis). Both corridors are passing through the central-southern part of the country, along the valley of the river Vardar. First corridor follows the alignment along the river Vardar that overlaps with the existing motorway (32.7 km) and the other one is stretching on the hills that make the right side of Demir Kapija gorge (27.7 km).

The major reason for implementation of the project under review is discontinued highway connection of the city of Skopje (capital of the Republic of Macedonia) with the town of Gevgelija at the southernmost part of the country, and Greece. The decision to complete this highway was derived from several key factors:

- Necessity for good connection with Greece as a country of EU
- Improvement of traffic to Thessaloniki - sea connection to Macedonia
- Faster and safer transportation
- Enhancement of the national and local economy
- To take advantage of available funds - grants.

The Investor provided the information concerning the raw materials, energy consumption, waste production and other basic data concerning the construction and operation phase of the highway Demir Kapija - Smokvica. However, during the elaboration of the study, several inadequacies in knowledge and/or uncertainties were

identified: elaboration of the highway design for the Alternative B was in the phase of preliminary design study, while final road design did not exist; detailed information about road construction was not yet available and present status of environmental parameters (air and climate, water and to a certain degree biodiversity) in the area under assessment was not known in details as there are no monitoring stations located there.

Applied methodology

The elaboration of the presented Environmental Impact Assessment Study was performed according to the requirements of the current national legislation and EU Directives as well as the obligations emerging from international conventions to which Macedonia is party. The respective procedure is presented in Chapter III.

During elaboration of the Study, the following methodology was applied:

- In order to assess the impacts of the project/intention on the environment, two detailed descriptions were elaborated and presented:
 - The scope of intention (size, activities, economic parameters etc.) is presented in Chapter II.
 - The detailed description of natural and anthropogenic environment (Chapters V and VI).
- Sensitivity of ecosystems, habitats, sites and localities was assessed (Chapter VII).
- Impacts arising from the construction and operation were identified and analysed (Chapter VIII).
- All negative impacts were reviewed and adequate mitigation or compensation measures were proposed in order to diminish or eliminate negative impacts (Chapter IX).
- Analysis of alternatives was done and recommendation for the best option/solution is presented.

Administrative procedure

Environmental Impact Assessment (EIA) is legal procedure stipulated by the Law on Environment by which a proponent is granted consent for the realization of the project by the Ministry of Environment and Physical Planning (MoEPP). According to the Law on Environment the EIA procedure consists of several steps:

Notification on the intention for project implementation (responsibility of Investor)



Screening (responsibility of MoEPP)



Scoping (responsibility of MoEPP)



Preparation of the EIA Study (expert team)



Review of the EIA Study (responsibility of MoEPP)



Granting consent

(or rejection of the application) (responsibility of MoEPP)

One of the most important parts prescribed by the legislation on EIA is **public participation** in different phases of the EIA procedure. In the first phases, the Investor can involve public in the form of direct discussion after the presentation of the key objectives of the project. Ministry of Environment and Physical Planning shall present the most important documents during the EIA procedure in daily newspapers, local TV and radio stations as well as on the web page of the Ministry.

Spatial plan

The whole area of the highway corridor is foreseen in the Spatial Plan as "Transit Corridor". Additionally, a dam on river Vardar is planned.

There are two protected areas in the highway corridor:

1. Demir Kapija which is protected as Monument of Nature.
2. Iberliska Reka as "Special Plant and Animal Species outside the Protected Areas".

Other six localities are designated for protection according to the Spatial Plan projections.

Natural characteristics of the area of interest

The current status of the basic environmental features of the project area, including the surrounding regions, that may be affected by the project construction and operation is presented in the respective chapter.

The area of interest of this study is well-defined geographical unit that is encircled by mountains from west and east and opened on the north and south by the river Vardar valley and it has specific climatic characteristics. The region is one of the warmest regions in the Republic of Macedonia with characteristic Mediterranean climate.

From the geotectonic point of view, the investigated area (Demir Kapija–Gevgelija) belongs to the very unstable geotectonic unit in the Republic of Macedonia known as Vardar Zone of folding which is forming a composite valley i.e. it flows through many plain parts and gorges.

The area (projected high-way corridor) can be divided into two well-defined morphological units such as:

- Demir Kapija gorge including the River Vardar valley to village Udovo;
- Valandovo valley, hilly area between Valandovo valley and Gevgelija valley.

Geological composition is characterized by the presence of cliffs and Jurassic carbonate complex in the beginning part of the corridors. Ten caves in the carbonate complex on both sides of River Vardar can be found. Fluvio-denudation relief is prevailing from both sides of the river-valley (Demir Kapija–Udovo).

The main geologic compounds for the region are diabases (green or grey-green coloured and homogenous, massive textured rocks).

The area is characterized by rich hydrographical network represented by the flow of river Vardar and its tributaries as well as the thermo-mineral and mineral springs, wells, etc.

Typical soils are cinnamon soils in the hilly area and modified soil types in the plain area.

Climate in the region of interest is modified sub-Mediterranean characterised by hot and dry summer and moderately cold and wet winter.

Very important characteristic of the intention of constructing the highway from Demir Kapija to Miravci is that (especially in case of Alternative B) it will occupy almost entirely natural or semi-natural territories. The part from Miravci to Smokvica has more anthropogenic features - rural areas and more or less degraded habitats.

Ecosystems and habitats

Very thorough fieldwork along the existing and projected highway line from Demir Kapija to Smokvica resulted in establishing a long list of habitats, which were systematised in six main groups according to the type and density of the vegetation cover, type and relief characteristics of the site, natural/anthropogenic origin of the vegetation, presence or absence of human settlements or objects and water areas. According to these criteria the following habitats were identified (see also Habitat map in the appendix):

- forests and shrublands (both natural and anthropogenic);
- open terrain: grasslands, shrubby grasslands, meadows etc. (both natural and anthropogenic);
- rocky areas (including caves);
- water biotopes;
- agricultural land: orchards, fields, gardens, vineyards and cattle breeding areas;
- urban or urbanised and industrial areas;

The dominant forests in the project area are xerophytic mixed evergreen shrublands (pseudomaquis) and thermophyllous deciduous oak forests. Pseudomaquis, as a vegetation type is represented by the Kermes oak community, an evergreen shrub-like oak. Very important pseudomaquis type is the Greek Juniper shrubland on rocky sites, especially in Demir Kapija canyon. Oak forests (forests of Pubescent oak and Oriental hornbeam) develop on higher altitudes (above 300 m).

Riparian forests and shrublands develop along the riverbanks and streams everywhere in the area under consideration. The most important habitat types are the Oriental plane woodlands and belts along the rivers, dales and ravines. Willow stands and belts usually occupy the banks along river Vardar in the lower parts of the valley. Tamaris shrublands and sands are important habitats for the diversity of bird species.

Dry grasslands in the area cover small surfaces but their importance comes from the dominance of annual plant species and very rich fauna (European priority habitat type).

Rocky areas are occupied by some chasmophytic (rock-dwelling) plant communities, which are very rare, and some of them are unique for Demir Kapija canyon.

There are about 10 caves in the limestone complex of Demir Kapija and Chelevechka Reka gorge. Most of them are very short caves used by many bat species as shelter. Out of these caves, Bela Voda (955 m) is the longest and the most important. There are several cave-dwelling species that are restricted only to the underground habitat of Bela Voda (cave cricket, cave beetles etc.).

River Vardar has the dominant drainage area in Macedonia (20535 km²) and in the area of the road corridor has about 45 km length. Boshava is the largest tributary of Vardar in the highway corridor. Chelevechka Reka and Petrushka Reka have unique geomorphologic values while Mala and Golema Javorica watersheds represent refugial regions with remains of plant assemblages from distant geologic periods.

Broadleaf and coniferous plantations in the highway corridor cover very small surfaces. Out of the anthropogenic habitats, abandoned fields and meadows differ by their greater biodiversity values. Agricultural land (fields and acres, orchards, vineyards, gardens) have smaller importance as habitats for important plant and animal species. Some of the villages in the area still hold values as habitats for several endangered bird species.

During the analysis performed on the basis of National Biodiversity Strategy and relevant international conventions, several habitats and number of species were identified as important. According to EC Habitat Directive there are several important habitats like Greek juniper community, Plane woodlands and belts, Willow woodlands and belts, dry grasslands, caves, chasmophytic vegetation of cliffs and rocks etc. About 40 plants, 30 fungi, 10 insects, 10 amphibians, 20 reptiles, 60 birds and 35 mammals are protected by several international conventions and documents (IUCN, Bern Convention, Emerald Network Species).

Anthropogenic environment

Occupation: Agriculture is the most important economic activity in the region of interest. The intensive farming (vegetables), crop growing and production of industrial cultures as well as vineyards are characteristic ones.

The agriculture is the basic economic activity for the population of the rural settlements in the highway corridor. According the land-property 90% of the land belongs to the public sector and only 10% are private property.

The most important are fields and acres, vineyards and gardens while the orchards are represented by insignificant surfaces. The most frequent acre cultures are corn, especially the maize and wheat.

Livestock breeding is an important economic activity in the region. The goats and sheep are dominating by their importance followed by cattle. Goats are especially well adapted for foraging on shrubby species of the pseudomaquis.

Settlements: Several populated places are found along the highway corridors: Demir Kapija town and villages Klisura, Davidovo, Miravci, Miletkovo, Smokvica, Udovo,

Josifovo and Marvinci. Demir Kapija is the largest populated place along the corridor, with main occupation of the population in agriculture (see also map in the appendix).

In the frame of Gevgelija–Valandovo valley as a natural opening to the south, i.e. to Thessalonica, there is a developed line infrastructure represented by roads, railways, irrigation systems etc.

Quality of environmental spheres: Air, water and soil were considered as unpolluted (in natural areas) or moderately polluted (in settlements and agricultural land). Only river Vardar has poor water quality. Also Boshava and Anska Reka show signs of pollution impact from the agriculture.

Archaeological sites: The area south of Demir Kapija is extremely rich in cultural, historical and archaeological sites. More than 20 archaeological sites were identified in the corridor area (see also map in the Appendix).

Land use: The main land use types in the highway corridor area are forest and shrublands, agricultural areas and urban/rural areas. Agricultural land occupies significant surface in the lower parts of the highway corridor: along river Vardar and in the Valandovo-Gevgelija valley. Most of the agricultural land is represented by fields and acres (see also map in the Appendix).

The highway corridor area overlaps with the territory of two forestry districts “Demir Kapija” and “Kozhuf” from Gevgelija. Forests in the corridor have low biomass and production. Pubescent oak provides most of the timber in the corridor area.

Tourism: Tourism is not well developed branch in the area of the highway corridors although there are potentials to develop this type of activity. The best known tourist places are the Demir Kapija canyon and Bela Voda cave.

Sensitive ecosystems, habitats and other sites

The most sensitive sites were pointed out, identified on the basis of 15 criteria. Separation of these key or high valuable ecosystems, habitats or sites is necessary in order to assess the possible impacts of highway construction and operation more thoroughly and to propose effective measures for their protection or future management.

Oriental plane woodlands and belts, caves and rocks and cliffs were assessed as *very high sensitive*. Pseudomaquis, willow woodlands and belts, Tamaris shrublands, dry grasslands, streams and some other habitats were assessed as *high sensitive*. The rest of the habitats were grouped into *medium sensitive* (degraded pseudomaquis, agricultural land, reed beds) or *low sensitive* (urban settlements, ravines, gullies).

Similar methodology was applied for the sites of human importance. Some of the archaeological sites that lie close to the alignment were assessed as *very high sensitive*. Some villages that will be affected the most were identified as *high sensitive* (Udovo, Miravci and Miletkovo).

Assessment of the impacts

Impacts of the road construction

Forests: The most affected forest ecosystems will be Kermes oak shrublands and Oak forests at number of localities by direct destruction and fragmentation effect.

The destruction of some Plane trees is recognized as the most possible impact during the road construction in the areas of streams, dales, ravines and gullies.

Water habitats: Impact on water ecosystems as a result of pollution and filling with construction material including stones, concrete waste, wood, steel, packaging plastics in the streams was assessed as significant.

Species: The construction of the highway will cause direct interruptions in the breeding cycle (clutch loss) and decrease in the breeding success of the birds breeding along the highway corridor. Bird community of the pseudomaquis, which holds significant number of species with unfavorable conservation status, will be the most affected. This is also true for the arable fields and oak forests. The passerine species (Shrikes, Thrushes, Warblers, Tits, Finches and other families) will be the most affected by fragmentation and direct habitat lost (both for breeding and foraging), but depending on the locality, highway constriction will also strongly influence the breeding behavior of some raptors. The most sensitive areas in this direction are the cliffs of Demir Kapija and their surroundings, especially in case of Alternative B. The entry point of the tunnel on the route at the right bank of the river Vardar will be in close proximity to the nest of the Egyptian Vulture, species threatened at European level and expecting uplisting to Globally Threatened Species under IUCN criteria. On the same location there is a nest of long-legged Buzzard, another threatened species in Europe. Both species have small populations in Macedonia, first one with strong declining trend and in need of special conservation measures. On the other hand, very close to the exit point of the tunnel a pair of Booted Eagle breeds, another rare species in Europe with Macedonian population less than 15 breeding pairs. This species is highly sensitive to fragmentation and disturbance. Another rare species breeding in this section is the Black Kite. Furthermore, close to the exit point is the locality Dolni Krastavec, where Griffon Vultures used to breed in the recent past and currently only a pair of Egyptian Vulture breeds.

Caves: The cave Bela Voda is sensitive habitat because of its stable conditions and specific fauna. Changes of the water regime and other disturbances can have severe impact on all animal species in the cave. Bats and other temporary cave inhabitants are susceptible to any type of disturbance and there is a danger that they will abandon the cave habitat. Similar consequences can be expected for the facultative cave inhabitant species. However, the real cave inhabitant species, which are adapted for this particular habitat, can be considered as the most threatened group. The destruction or severe disturbances of the cave system can lead to their extinction. At the present moment, the complete list of the cave species of Bela Voda cave is not known. It means that the disturbance of the cave will have impact on species that are not yet discovered or registered.

Impact of mining activities in the area of Demir Kapija limestone canyon. The conflict arises from very high sensitivity of this complex locality. The complexity is a result of presence of different habitats settled by rare and endangered species, especially bird species. The risk for these species arises from the construction work. The mining is unavoidable since the tunnel has to be staved through Jurassic limestone rocks. Although the area of the canyon was assessed as very high sensitive (Chapter X), the highway line must pass through the canyon since there is no other

solution (the canyon is extremely narrow and both sides of the river are valuable). The conflict becomes the most expressed during the breeding period of vultures (laying eggs, incubation period and fledging, from March to July).

Other conflict connected to this area that may arise from constriction work is damaging or destroying the protected area Chelevechka Reka. For this particular part, the conflict is not just during the construction period but also during the highway operation (due to the pollution of the stream). In this case, as it was the case with previous, the recommendation for selecting the Alternative B is not possible (at the other side of the river Vardar, the Bela Voda cave is situated next to the river which may produce another conflict).

Agriculture: The most important impact on agriculture during highway construction is destruction of agricultural land. The surface of agricultural land that will be destroyed if Alternative A is accepted equals 56.6 ha. In the case of Alternative B, significantly smaller agricultural land will be destroyed (approximately 13 ha). Fragmentation of agricultural land is also significant impact.

Archaeological sites: As presented in the baseline situation, the area is rich in cultural heritage. Monuments under special protection regime are close to construction undertaking. Unknown archaeological sites might be found during the construction of the highway. Therefore it is suggested to pay special attention to this potential impact particularly because destruction of archaeological sites or their parts is irreversible process.

Pollution: The level of emissions and duration of the construction period will not exceed the carrying capacity of the natural ecosystems. A certain increase of air pollution in the broader area of interest will certainly occur due to the increased traffic frequency. However, these emission levels will be insignificant for human health.

Waste related to construction of the highway section Demir Kapija - Smokvica will be diverse and produced in large quantities. Most of the waste will be inert waste, but also large quantities of hazardous and toxic waste are expected to be produced. One can predict sufficiently accurate that the level of impact would not be significant due to the reasonably short duration of the construction activities.

Risk assessment (oil leakage, fire, hazardous substances, personal risks etc.) was performed in order to propose adequate mitigation measures. In the course of road construction and respective infrastructure only individual risk of work injury, leak of fuel or oil from trucks or construction machines and/or risk of fire is considered.

Impacts of the road operation

The fragmentation of the **forest ecosystems and pastures** will actually be a result of the road operation. In case of Alternative B, fragmentation of forest and shrubland habitats is particularly important, due to the cut of regular biological movement routes of large animals from Kozhuf Mt. to river Vardar (for drinking water and feeding). Many animal species depend on these migration routes, including species of European conservation concern, such are roe deer, wolf, otter and wild cat. Even Brown bear was registered in this area several times (last time in March 2007). For more details see Impact on species.

Rivers and streams. The pollution of water ecosystems is caused by discharging of residues from fuel combustion (lead and hydrocarbons), lubricants and tyre parts. All of these contaminants will enter the rivers with wet deposition that washes out the surface of the road.

Usage of defrosting agents (salts and sand) will increase conductivity of river and streams' water, and sand will increase turbidity. In both cases, water quality will decrease with great impact on aquatic life. This kind of pollution is typical for strong winters with very low temperatures.

Species: In general, the impacts on the species can be divided into fragmentation effects, increased collection or hunting/poaching, changes in the reproduction and road kills (important for amphibians, reptiles, mammals).

Agriculture. Impacts on agriculture are presented by the effects of air, soil and water pollution by the increased traffic on the highway. One of the specific impacts will be fragmentation of agricultural land caused by intersection of the “agricultural” roads and new highway.

Settlements. The operation of the highway Demir Kapija - Smokvica will have both positive and negative impacts on the settlements in the area of intention. However, negative impact will be much more severe than positive ones (positive impact concerns socio-economic aspects).

Noise: The noise generated by vehicle traffic on the highway will affect the settlements located alongside the planned highway. For evaluation of noise impact and determination of suitable noise abatement measures, calculations of noise levels were carried out. The predicted noise levels were evaluated with respect to noise standard regulations of Macedonia, WHO and EC regulations. The applied noise standards for existing residential areas were 60 dB(A) at daytime and 50 dB(A) at night time. However, 55 dB(A) at daytime and 45 dB(A) at night time are recommended for the residential areas.

Soil pollution. It is well documented that the most significant pollution from gaseous substances and aerosols (emitted from exhaust pipes of vehicles) occurs in 10 meters distance due to the fast sedimentation of substances heavier than the air. The sedimentation depends on the geomorphology of the terrain, wind speed, vegetation cover etc.

Air quality. The fuel consumption on the new alignment has to be compared with the amount being emitted currently along the existing road to Gevgelija. For both situations, the number of vehicles will be the same. The speed is high with no stop-and-go characteristics.

Waste: Waste materials that will be generated during the road operation are not numerous and variable as in the case of the road construction.

Socio-economic impact: Increased traffic will improve employment possibilities to a certain extent and enlarge incomes of the local population.

Impact on human health can be considered only for the residents of the settlements close to the alignment (Demir Kapija, Udovo, Miravci and Miletkovo). Such impact can result from air pollution emission and to a limited extent to the noise generation.

Risks: in the case of traffic accidents, uncontrolled spilling of oil, oil derivatives, chemical and other toxic substances might occur. Fires are also possible as a result of traffic accidents. Of the utmost importance are the risks that may occur during transport of transformer oil (PCB). The danger of possible traffic accidents is very important impact.

Mitigation measures

Mitigation measures for road construction phase

Mitigation measures concern three phases of the realization of the project: preparatory phase, construction and operation of the highway.

Extensive mitigation measures were proposed for the **preparatory phase**.

Standard **general measures** for the construction phase were identified on the basis of the best international practice and recommendations of international institutions (e.g. World Bank). Some of the proposed measures concern specific habitats, localities and sites aiming to avoid construction of access roads and setting up work camps in sensitive habitats. Measures directed toward improvement of supervision of the construction work were proposed. The construction in the area of caves and archaeological sites is prohibited.

Special measures were proposed concerning tunnel construction at Demir Kapija canyon (construction works should not be undertaken during the breeding season of vultures and other birds of prey).

Constructions of culverts for amphibians, reptiles and mammals: in the regions without natural passes and without underpasses, tunnels or bridges will be constructed.

The most adequate compensation measure in order to mitigate the impact on the forest is to fund afforestation activities in the frames of the affected forestry districts. Afforestation should be performed with native (autochthonous) tree species as stated in the Law on Nature Protection.

It is necessary to design and construct appropriate objects along highway route in order to maintain the existing local roads and important forest paths. By implementing this measure, the fragmentation of agricultural land shall be avoided as well as access to various parts/localities in the hilly region for grazing. Enabling good connection between forest lands on both sides of the highway is essential for accessibility and interventions in case of forest fires.

Extensive mitigation measures were proposed to avoid the adverse impacts on waters (storage of liquid agents, set-up of the work camps, preservation of vegetation, erosion prevention measures etc.).

It is well established practice that investor and proponent compensate the damage to the environment by setting a scheme for enhancement and improvement of environment in adjacent regions, especially in biodiversity conservation field. This is an integral part of environmental assessment process according to World Bank rules. Extensive damage to the natural and seminatural habitats (irrespective to which

alternative) should be compensated by providing conditions for elaboration of management plan for Demir Kapija protected area (Monument of Nature, including Chelevechka Reka water gap) and action plan for conservation of vulture colony in the gorge. Creation of information center for Demir Kapija canyon will be expression of good will and will have positive socio-economic effect on the local population. The investment will be in the range of tens of thousands of Euros.

As a general mitigation requirement for noise reduction during the construction phase contractors will be required to use modern noise silenced equipment and to keep to usual daytime work hours (exceptions may apply for certain structures). Preferably, equipment that meets the requirements of the European Directive EC/2000/14 on noise emission by equipment for outdoor use should be used.

Borrow pits: In order to exclude the exploitation of the existing limestone mine at the entrance of the Demir Kapija Gorge and limestone marbleized masses on the section Josifovo–Valandovo–Dojran necessary quantities of carbonate material (limestone, marble) shall be provided from the reserves of the open quarry between the villages Kosturino and Memesli; the gravels and the sands from the alluvial stratum should be exploited from the existing localities at Przdevo and Gevgelija. It is necessary to prepare separate Environmental Impact Assessment for borrow pits after the design is available. Appropriate re-cultivation measures of all fields of structural stone, gravel and sand etc. should be proposed.

Mitigation measures from road operation

General measures include elaboration of emergency plans, recommendations for storage of hazardous substances, decrease dustiness (cleaning of roads etc.) and elaboration of plan for action in emergency situations.

Specific measures include:

- Landscaping and forestation of bare land in the surrounding.
- Construction of protective panels along the highway, establishment of monitoring system for bird casualties and movements of amphibians, reptiles and mammals in order to construct direction barriers towards the culverts.
- Ground waters: construction of collecting ditches and sealing of surfaces by the road to reduce the area through which surface water can infiltrate into the ground (re-vegetation of the embankments).
- Surface waters: construct road channels and side ditches; outfalls must be equipped with oil separators to prevent environmental damages to the existing ground and surface water regimes. Considering potential surface water pollution, herbicides should not be used on the road shoulders or embankments for maintenance. Mowing of the verge is highly recommended as well as to leave green cut on site (it should not be used as animal fodder, could be polluted). It will be necessary for the local highway authorities responsible for maintaining the new infrastructure, to be equipped and well trained to service the oil separators and treatment facilities in addition to other normal road maintenance requirements. Emergency plan for threats from water pollution has to be prepared. Compensation measures such as improvement and strengthening of the habitat function of the rivers and riparian vegetation should be undertaken.

- Air pollution: vegetation as a buffer along the alignment has to be planted and monitoring of the air pollution has to be established.
- Noise: *reduction of noise emissions* (reduction of the vehicle speed, construction of special noise reducing road surface which is efficient for speeds over 60 km/h and avoidance of additional noise sources of constructive origin and damages of the road surface); *Reduction of sound transmission* (construction of noise abatement barriers like walls or embankments and construction of tunnels, housing-in-tunnels, or noise abating buildings at the road border) and *Reduction of noise impact at the impact area* (respecting a setback-/ noise buffer for new developments and installation of noise reducing windows in affected houses).

Analysis of the alternatives

As already mentioned, two basic options were considered for comparison of alternatives within this Study:

- Alternative A (Upgrading of existing motorway from the left side of the river Vardar)
- Alternative B (Construction of a new section from the right side of the river Vardar but higher up in the hills)

In case of Alternative A - construction works will comprise widening of existing road for its use as two lane road in one direction and construction of another two lanes in opposite direction next to the existing road, or close to it.

In case of Alternative B construction works will comprise construction of a completely new highway.

Advantages and disadvantages of each alternative were analysed through comparison of the participation of sensitive or low sensitive habitats and ecosystems, sites, localities, infrastructure and socio-economic activities along both alternative alignments. It was not possible to perform Full Cost/Benefit analysis due to the lack of data, especially in sense of economic parameters.

Sensitivity of natural habitats: Analysis of participation of sensitive habitats in each alternative highway corridors showed that "very high sensitive" and "sensitive" habitats participate with larger percent in Alternative B (51.8% in Alternative A and 79.5% in Alternative B). It is obvious that in case of Alternative B (part crossing Bela Voda cave), realignment of the proposed alignment is inevitable due to the possible destruction of the cave system. This was recognised by the proponent (FNRR) and immediately, in course of preparation of the EIA Study, new alignment for the starting part of the Alternative B was ordered from the designer. Before this study was finished, the new alignment was prepared: instead of crossing river Vardar before the Demir Kapija limestone canyon on the right side and entering the new tunnel after the town Demir Kapija, it was proposed to cross the river Vardar from the left to the right side after the existing tunnel. So, in this section, the Alternative B is overlapping with Alternative A. From this point on, the discussion about Alternative B and further recommendations include this change of the alignment.

Sensitivity of sites of human interest: For both alternatives, the number of objects (settlements/ archeological sites/ agricultural land) with "low sensitivity" is equal. "Medium sensitivity" objects are mostly presented in corridor of alternative A (in ratio 8:3 to alternative B). Alternative B is critical concerning "high sensitive" objects

due to their closeness to the highway. Alternative A has no "very high sensitive" objects while in case of alternative B there are three archaeological localities marked as "very high sensitive". In this case (if Alternative A is chosen), a realignment of the future road must be considered.

If the Alternative A is accepted, the following situation will occur in the area around the alignment from Demir Kapija to village Smokvica (nature concerns):

- There will be no significant increment in terms of traffic and emission of pollutants produced by the traffic and other facilities along the whole length of the Alternative A route; on the contrary, much of current unfavourable conditions will be improved.
- The destruction of natural habitats will be less significant compared to the case of Alternative B scenario, especially in case of high sensitive habitats; high rate of disturbances to threatened species will be restricted to the region of Demir Kapija canyon.
- There will be no destruction of very high and high sensitive habitats and sites, particularly the valuable Oriental plane woodlands and belts, pristine streams, oak forests and pastures (destructions of oak forests and pastures were assessed as comparatively small and compensation is possible - see Chapter IX.2.3.3.).
- There will be no disturbance to the living organisms in all ecosystems (particularly threatened species) and there will be no fragmentation of important biocorridors.
- Very high sensitive archaeological sites as non-recoverable objects of human history will be less threatened.

If the Alternative B is accepted, the following situation will occur in the area around the highway from Demir Kapija to village Smokvica.

- Most of the situations described above will be opposite.
- There will be a significant change in landscape characteristics (structural and functional) in the broader area of interest by introducing completely new line object of a large scale.

Although there are not enough data in the current stage of design for economic evaluation, several socio-economic considerations can be stated.

- No matter which of the alternatives will be accepted, none of the local communities will be favoured or neglected since the difference (distance between) of the alternatives is the greatest at unpopulated area.
- After implementation of proposed mitigation measures, no significant impact on land fragmentation and land accessibility is expected on both alternatives.
- Irrespective to the chosen alternative, there will be positive effect of highway construction and operation on job creation and opportunities.
- There will be large scale benefit on national scale due to the improvement of the traffic in north-south direction and accessibility of Thessalonica harbour.
- Alternative B solution is 5 km shorter and much cheaper variant compared to Alternative A.

Construction of Alternative B highway will require higher expenses for mitigation measures.

It is not possible to make final decision in this study which alternative will be the most appropriate due to the lack of necessary information for Alternative B. Much of the conducted analyses suggest that Alternative A is environmentally more suitable especially from biodiversity point of view. During the following process of finalization of the design, analysis of different stakeholders' interests has to be done, economic parameters have to be evaluated and measured against the environmental concerns described in this study. In any case, full implementation of mitigation measures is necessary.

Remarks and recommendations

Construction and operation of highways causes significant adverse impact on the natural areas and human environment. Beside implementation of the mitigation measures which intend to avoid significant negative impacts, some recommendations for conservation and promotion of the environment should be taken into account during the construction work and operational phase of the highway.

The destruction of the forested areas, grasslands, agricultural land can not be avoided during the construction although several mitigation measures were proposed in order to minimize this impact. About 165 ha (Alternative A) and 140 ha (Alternative B) of natural and agricultural land will be destroyed during the construction. In order to compensate this impact, reforestation measures along the highway are strongly recommended. This will contribute towards the erosion-prevention which improves the maintenance of the highway during its operation. According to the provisions of the Law on Nature Protection, autochthonous plant species should be used during the afforestation in natural areas. The best places for reforestation are highly degraded pseudomaquis habitats on steep slopes along the highway: in the vicinity of village Udovo (in case of Alternative A) and surrounding of the village of Miletkovo (in the case of Alternative B).

After the completion of the construction works, agricultural roads should be repaired and adopted for their use by local population. After the completion of the construction works in forested areas, unnecessary access roads should be re-vegetated and closed for operation. This measure will prevent illegal woodcutters and poachers from reaching undisturbed natural areas.

Since there are a lot of uncertainties and unforeseeable situations, recommendations for elaboration of additional assessments (in case of access roads, borrow pits etc.) after producing a final design for the preferred alternative have to be elaborated and respected.

Promotion of environmental quality in the region of Demir Kapija gorge could be done by compensating the damage to some sites by conservation of other part(s), namely Demir Kapija canyon.