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Corridor X highway Project

Preliminary Design for E-80 Highway NIS – DIMITROVGRAD Section: Prosek-border of Bulgaria

REVISED CORRIDOR LEVEL EIA REPORT

F I N A L

November 2010

CONTENTS

EXECUTIVE SUMMARY

Project Description

An branch of the Highway X between Nis and Dimitrovgrad has been projected in 5 parts:

1. Prosek – Crvena Reka
2. Crvena reka – Ciflik
3. Ciflik – Stanicenje – Pirot
4. Pirot – beginning of the bypass at Dimitrovgrad
5. The northern bypass of Dimitrovgrad

The geometrical cross section of the highway is defined for calculated speeds of 100 km/h and 120 km/h, so that we have cross sections the widths of which are between 26.10 and 28.40 m. The geometrical cross section consists of two driving lanes, the slow lane and the deceleration lane, in each direction, and the width of the separating area is 4 meters.

The total length of the highway E–80 between Prosek and Dimitrovgrad is about 90 kilometers. The estimated traffic density for the forecasted year 2021 is between 13405 vehicles/day and 15782 vehicles/day. The applied radii of horizontal bends are between 500 m and 5000 m. The minimum lengthwise inclination is 0.25 %, and the maximum one 5.00 %. A closed draining system has been applied.

Current state

Geology and soil

The analyzed area, which includes a part of the Nis basin, the Belopalanacka and Pirotska basins, the alluvion of the Nisava river and its tributaries, has about 25 types, subtypes and varieties of soil. Due to relief complexity, geological structure, climate, vegetation and effects of time and man, various genetic types of soil have formed in a very small area. For that reason, many soil types, subtypes and varieties have been identified within the study area incorporating a part of Pirot valleys, the River Nisava's alluvium and its tributaries. These types include calcareous alluvium, alluvium developing into cambisol, waterlogged alluvium, acidified grassland, chernozem soil, eutric cambisol, terra rosa, rendzina, umbric leptosols, podzols including slates, degrading calcomelanolosole complex, etc.

The fractured bedrock aquifers are formed in the River Nisava basin in terrains containing Paleozoic slates, schistose Devonian flysch, red sandstones, shales and marlstones from Oligocene period.

According to its geographic position, the Project area is a part of Southeast Serbia and morphologically, the area's relief covers highlands and flatlands. The mountain slopes of Suva Planina, Svrljiska Planina and Stara Planina are a part of the highlands area. The relief is characteristically "sharp" with great differences in height. Alluvial areas of the Nisava River and its terraces present the flatland relief.

This part of the Balkan Peninsula is a part of seismically highly active area and is included in the Mediterranean- Trans-Asian Seismic Belt.

The terrain in the area along the route of highway E–80 between Nis and Dimitrovgrad is made of rock masses of different age (from the Paleosoic, Mesosoic and Cenosoic eras) grouped in engineering – geological complexes. The complex of tightly and loosely

connected rock masses originating from the Quartarnal period is represented by alluvial sediments, fluvial drifts along waterways and slopey formations. In an analysis of the existing hydrogeological researches in the area along the route of the highway E–80 between Nis and Dimitrovgrad, compact springs with a free water level and fissure – like springs have been singled out. Alluvial sediments are common along all waterways in the observed area and it is quite common to find springs with free water level in them. In the Nisava river watershed a fissure – like spring is formed on the terrains built of Paleosoic slate, slaty series originating from Devon, red sandstones, clay and marl originating from Oligocene.

The lythological structure shows clearly that the projected route of the highway lies on primarily rocky masses of intergranular porosity and, in fewer cases, intergranular – fissure and fissure porosity or fissure – cavernous porosity. According to these facts and the hydrogeological facts, these rock masses can be highly-permeable, and completely impermeable. The category of highly-permeable rocks includes alluvial sand and gravel in the planes and three terraced levels on the verge of the alluvions. Permeable rocks, which are common on the slopey parts of the terrain, make deluvial and proluvial sediments of heterogeneous material structure. The impermeable rock masses consist of sandstone, allevrolite and conglomerates of perm and are practically impermeable environment whose filtration quotient is $k_f < 5.5 \times 10^{-6}$ cm/s.

Exodynamic processes and occurrences – surface decomposition, crumbling, line and plane erosion are present in the largest part of the analyzed area, mostly on he slopey parts of terrain. The processes and products of surface decomposition of rock masses are present in the entire analyzed area.

The analyzed area is the space where the Dinarides and the Serbian – Macedonian mass confront. During its geological history, the entire region suffered intensive tectonic spreading and converging motions. These tectonic gaps are inactive at the moment, except two fractures south of Crvena Reka, which point out to some more recent tectonic activities. This part of Balkan peninsula is, seismically, very active, and according to the seismic maps, belongs to complex terrains where earthquakes of 7, 8 and 9^o MKS are possible.

Soil degradation is primarily caused by the need to transport large amounts of building material, as well as by the need to take material from the nature or create garbage depots. Since a significant part of the highway E–80 between Prosek and the border with Bulgaria is intended to be built in cuts and carvings into rock masses, as well as in tunnels, the excess material can be used as a lending area for stones which will be built into the highway body. In case of the lack of high-quality material for the construction of dykes in the area of Pirotska basin (limestone rubble from the material dug out from the "Sarlah" tunnel is intended for this), it is recommended to use the limestone from local lending areas, which are about 10 km away from the place of construction. In this case, it should be counted on lending sites "Koren" and "Tomin trap".

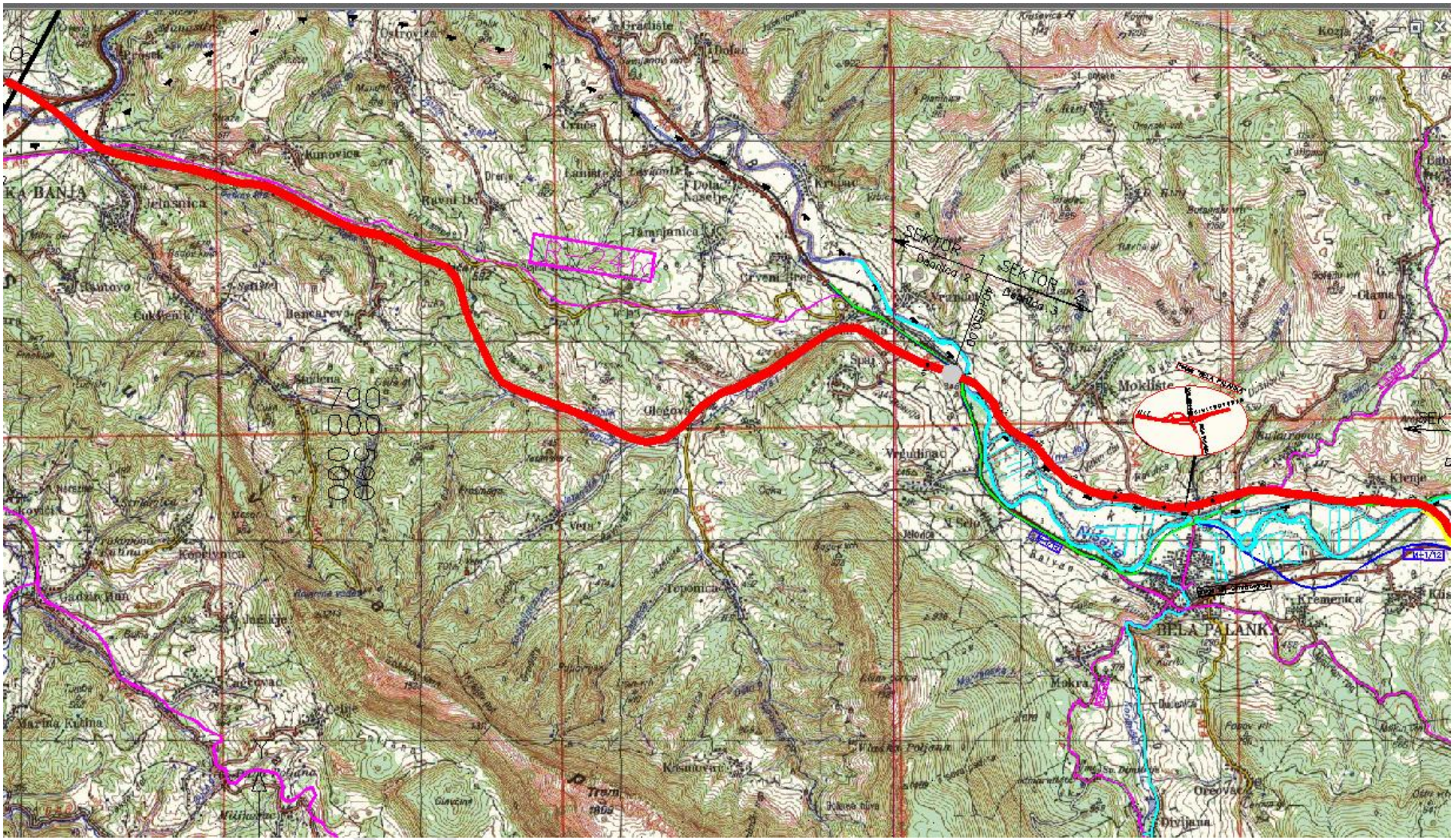
According to its geographic position, the Project area is a part of Southeast Serbia. North-western border of Project area is mountain slopes of Svrljiska Planina. Southern border of the Project area are slopes of Belava mountain. North-eastern border are slopes of the Stara Planina mountain.

Air quality

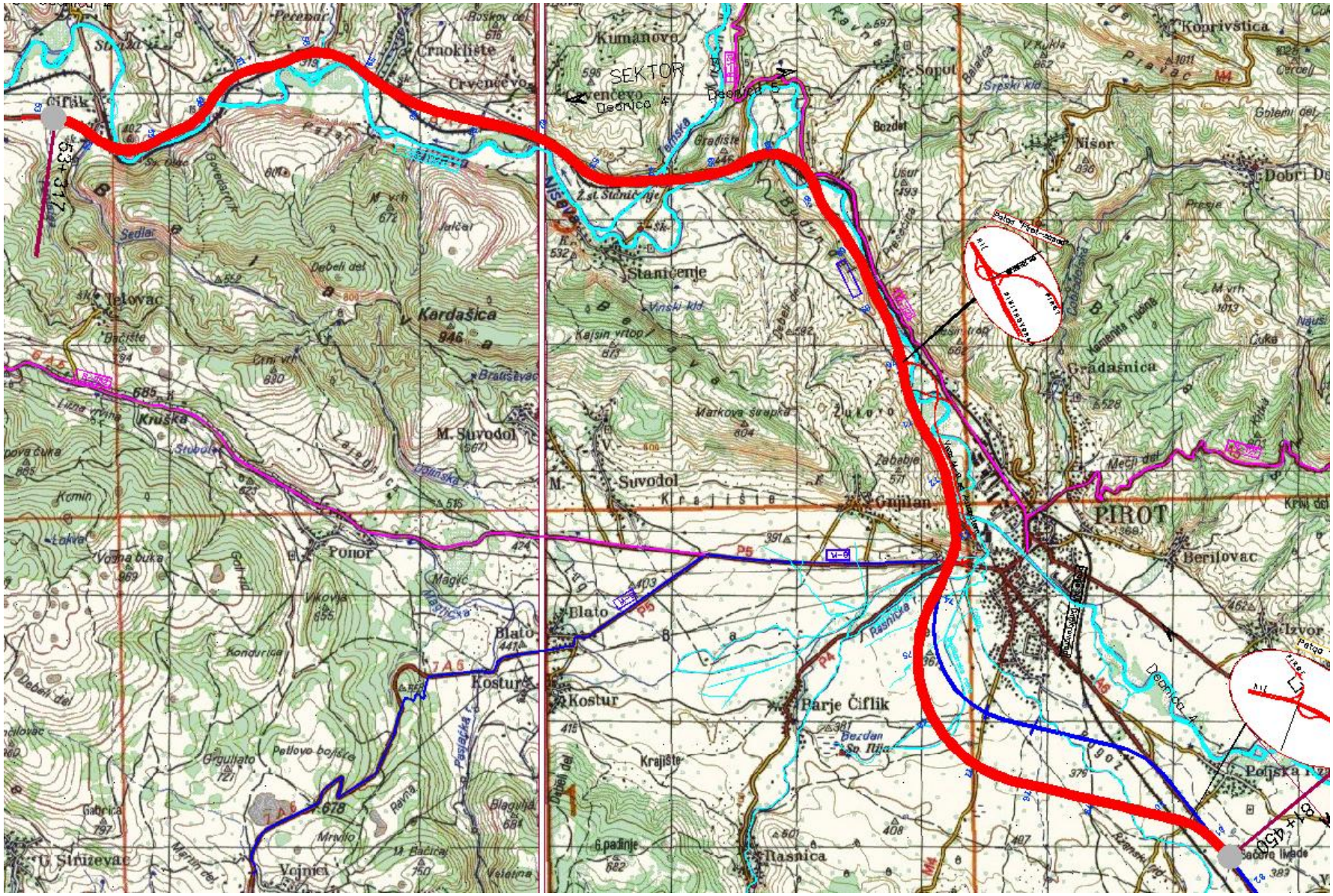
All available data on certain climatic parameters and occurrences have been analyzed in meteorological stations on a part of highway E–80 - in Nis, Bela Palanka, Pirot and Dimitrovgrad. When assessing the measured current state of the air pollution, it should be taken into consideration that the traffic was blocked while the measuring was performed and that it was significantly reduced. Measuring was performed by taking samples from two places – Veliki Jovanovac and Gradinje. The highest level of air pollution according to all the parameters has been registered in the surroundings of the Gradinje village, which is the consequence of the vicinity of the road border crossing. There are no significant points of air pollution along the route of the future highway. The interstate road M – 1.12 and the regional road R – 214a are line sources of air pollution which might cause an increased concentration of air pollutants. The assumption is that the planned highway will become the dominant line air pollutant in the analyzed area.

Noise

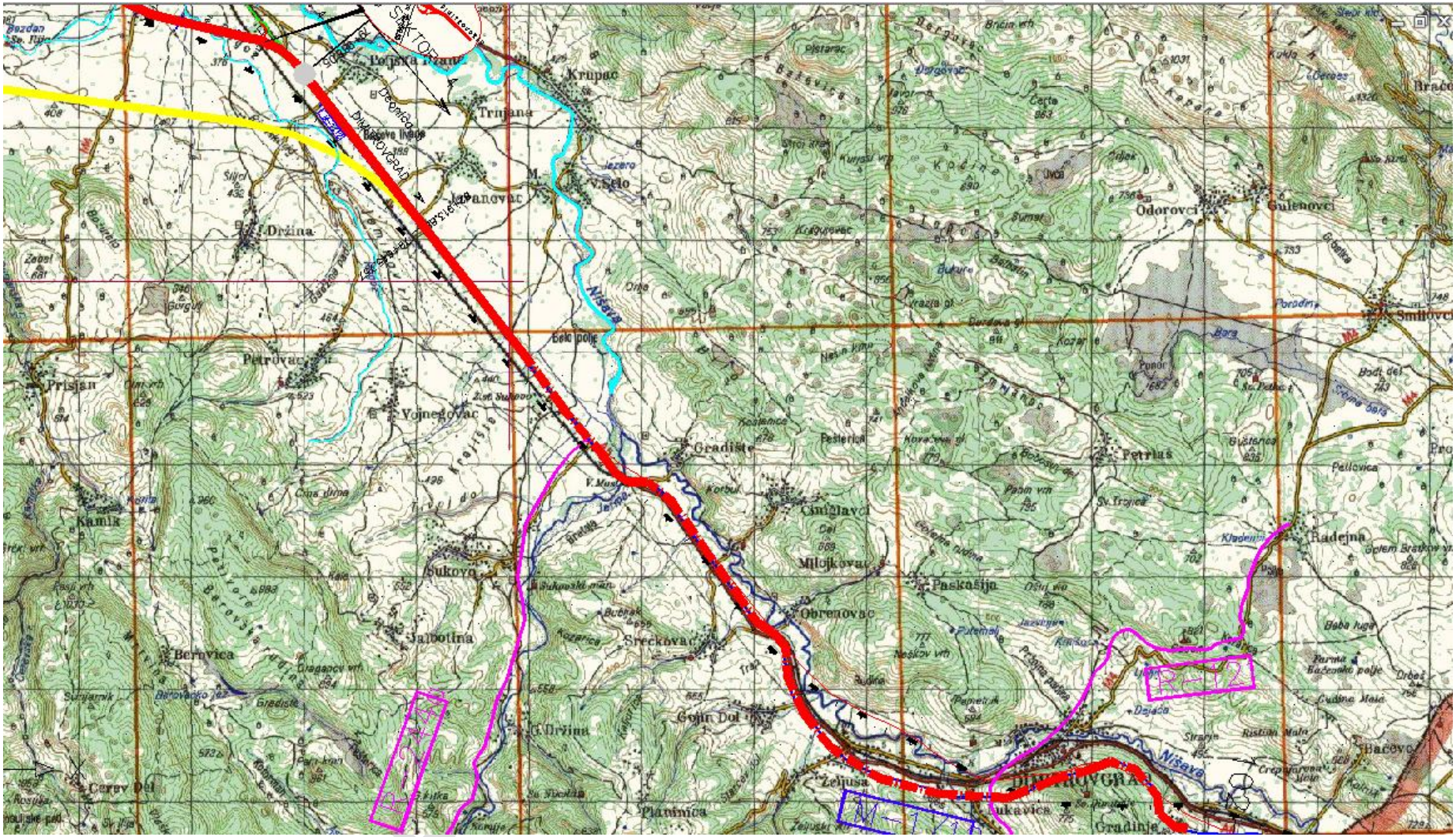
There are no data on the current noise levels for the considered area along highway E–80 between Prosek and Dimitrovgrad, and no subsequent measuring have been made. The current level of traffic noise along the route of the analyzed part of the highway comes from the traffic on the interstate road M - 1.12 in the part between Pirot and Dimitrovgrad, from the regional road R – 241a and the railway between SZ Nis and Dimitrovgrad. A conclusion can be made that, when the highway is finished, it will become the dominant source of noise in the considered area.



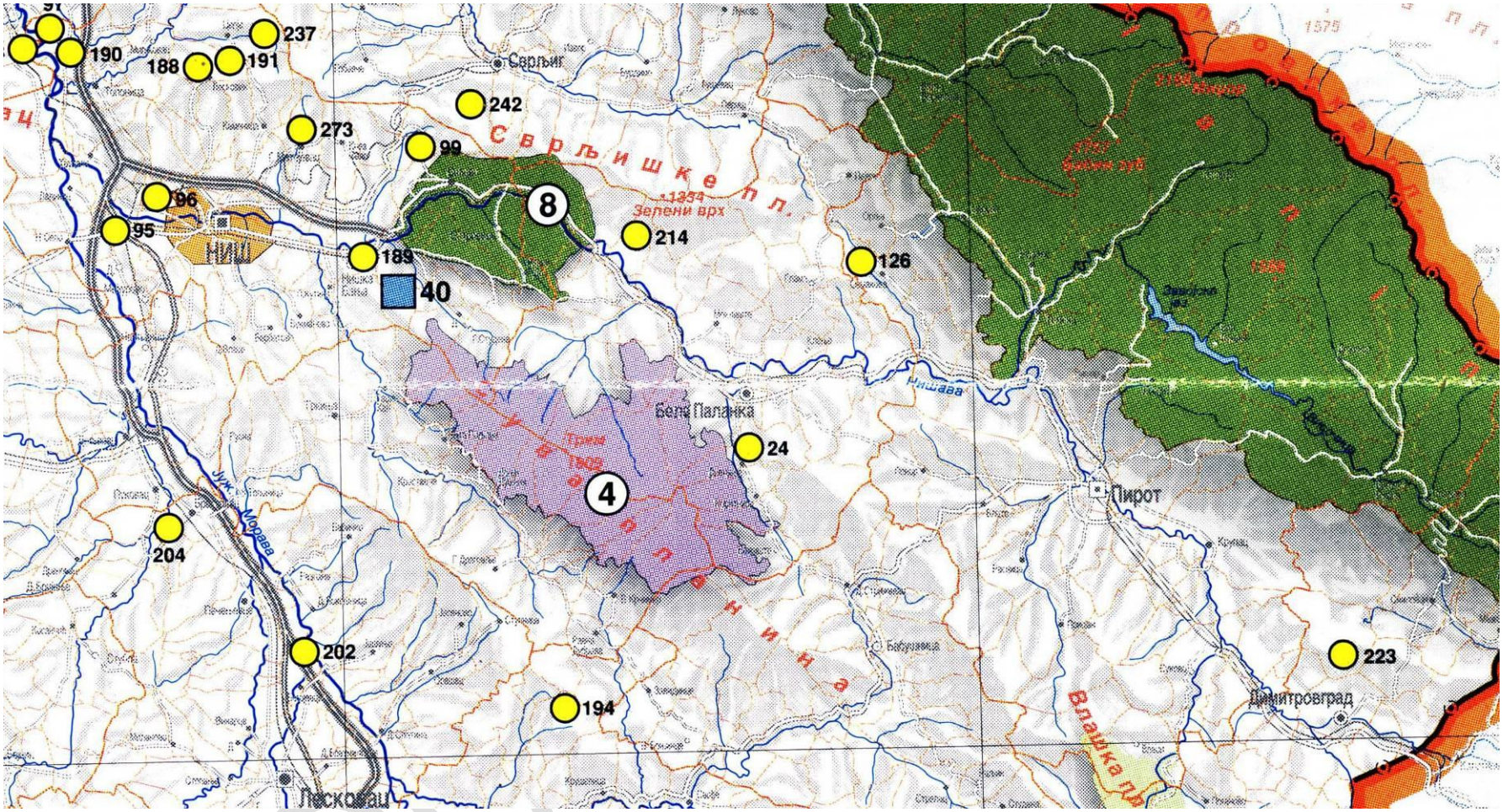
Picture No.1. Situation map of the E-80 Highway sub-section Prosek – Crvena Reka - Ciflik (red line)



Picture No.2. Situation map of the E-80 Highway sub-section Ciflik – Stanicenje - Pirot (red line)



Picture No.3. Situation map of the E-80 Highway sub-section Pirot – Sukovo – Dimitrovgrad – border of Bulgaria (red line)



Picture No.4. Position of Nature Protected Areas around the project zone (dashed area). NO CONFLICT situation.

Flora, fauna and visual impact

There are various plant communities in the area along the planned highway. They are differentiated depending on the characteristics of the soil, relief and underground water levels. The vicinity of waterways causes an appearance of hydrophilic meadows, as well as of smaller areas covered in willows and poplars. In the areas which are more distant from the rivers are forests of several kinds of oak which depend on climate – related zones. Apart from these communities, which are typical for the entire Serbia, on the slaty terrains in the gorges one can find species characteristic for East and South – East Serbia. They are represented by ceno – ecological communities of lilac and dry oak. Habitat conditions are such that they ensure the presence of different animal species which have found convenient life and procreation conditions in this area.

Surface and underground waters

The hydrografic network of the area along the future highway between Nis and the border with Bulgaria consists of the Nisava river and its tributaries. The Nisava river belongs to the watershed of the South Morava river. In order to define the current state of the quality of surface waters of the Nisava river, we have used the data from the Republic Hydro – Meteorological Institute of Serbia for year 2006. The quality of the water in the Nisava river is tested at the following water stations (the determined class of water quality is given behind every name of the water station): Dimitrovgrad – border water station, Bela Palanka and Nis. Upon smapling it has been determined that, at certain water station and in certain series, organoleptycal characteristics of water have been changed, i.e. The water was of slightly visible and visible colour.

The percentage of O2 saturation in the water between Dimitrovgrad and Bela Palanka in certain testing series corresponded to water classes III, whereas at the water station Nis it has occasionally corresponded to VK state, and in this case BPK – 5, in one case, corresponded to class III. The measured values of suspended substances at water stations Dimitrovgrad and Nis, in certain series corresponded to class III and VK state. Considering dangerous and hazardous substances at the water station Nis, increased value of dissolved mangane (Mn) has been registered in one case. The increased percentage of BPK5 and the green colour of water point out that the waters of Nisava have been polluted with communal waste waters.
The conclusion that can be drawn from the said state is that, due to inadequate treatment of industrial and communal waste waters, which then flow into the river of Nisava, the water quality has been reduced and now it corresponds to the waterways class III. The quality of underground waters in the area of the future highway between Crvena Reka and Pirot could not be tested because water analysis data were not available, which could have been taken from piesometers or wells along the coast of the Temstica, Nisava and Crvena rivers.

The analysis gives the data on water intakes and the on the distance from the axis of the route of the future highway.

Social and cultural heritage

The settlement network in this area consists of the macro – regional center of Nis, the regional center of Pirot and the municipal centers – cities of Bela Palanka and Dimitrovgrad. The position and function of these settlements have formed their own converging zones comprising of smaller rural settlements. The analyzed area includes 42 such settlements. The

villages have a small density of population. The entire area is affected by the emigration of the inhabitants and the depopulation of the rural areas. Between 1991 and 2002, the population was reduced for 32%. In the same period, the number of rural households in some settlements was increased. The average size of a household has been decreasing both due to household division and by migration from the villages and into urban areas.

The highest birth rate is in the urban settlements of Pirot and Bela Palanka, Dimitrovgrad and their suburban municipalities of Gnjilan, Poljska Razana and Crvena Reka. All settlements belonging to the municipality of Bela Palanka are strong emigration zones.

The area of Dimitrovgrad includes the wide borderline area towards the Bulgarian border, mostly on the slopes of Stara mountain. This area is a strong emigration region. The number of citizens is progressively reducing, and the negative birth rate only exacerbates the situation – in the last several years, the rate has been 8 promiles. The participation of the number of the young in the structure of the inhabitants is about 25% - 35% in cities and 19% in the countryside.
The analyzed area is marked by the predominance of farmed fields (59.2%). The best quality agricultural soil is situated in the Nisava valley. The participation of the wooded area is 22.2%. Areas under meadows (12%) and perennial agricultural cultures (6%) are intertwined. The rest of the land belongs to built settlements (0.4%).

Health influences of the planned highway include influence on the health of the population along the highway, as well as on the drivers of vehicles and other participants in the traffic (passengers and pedestrians). These influences include an exposure to the noise, vibrations and air pollution (oil combustion and exhaust fumes). During the construction of the highway, the citizens of the settlements which the newly projected highway crosses through, or it just touches them will be exposed to different temporary influences on a limited space. They will be exposed to the evaporation of polycyclic aromatic hydrocarbons (PAH) during the setting of asphalt layers. Ground works cause a significant dust emission. Unpleasant odours which are produced during material handling, including construction materials, sewers and garbage.

The immovable cultural heritage are protected along with the area they are in. In the areas where this heritage is completely integrated in the natural environment it is protected together with the nature it is in. After a consideration of the existing planning and project documentation, as well as the recognition of the terrain, it has been established that there are 44 objects which belong to the above mentioned category in the analyzed area. The data on the cultural heritage monuments have been registered according to the data owned by the Republic Institutte for the Protection of Cultural Heritage Monuments in Belgrade and the Institutte for the Protection of Cultural Heritage Monuments in Nis.

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Environmental Impact

Geology and soil

When soil influence is considered, two important phases, which refer to the construction phase and exploitation phase, stand out.

During the construction phase, there are two main influences caused by the construction of the highway – soil pollution and soil degradation. During this phase, the soil can be polluted

by improper handling of oil and its derivatives, vehicle and machine washing out of areas which have been intended and prepared for that, inadequately prepared construction site and other activities which do not follow the recommendations of technical measures of protection during the construction. Soil degradation is primarily caused by the transportation of large quantities of construction material, as well as by the need to open material lending sites and depots. In specific conditions, soil degradation due to material lending sites and depots will not be caused on any part of the newly projected highway E–80. On the highway parts between Prosek and Pirota, and over Crvena Reka, Ciflik and Stanicenje, the nivelating solution is such that cuts and carvings into the rock mass are necessary in a significant length, as well as digging out from the „Staro Bencarevo“ tunnel (the options were: left tunnel arm km 28 + 670 - km 29 + 320; right tunnel arm km 28 + 650 - km 29 + 600; right tunnel arm km 28 + 638 - km 29 + 323). The excess material which is dug out can be built in the body of the highway. Every possible lack of material for building into the dykes should be compensated from the existing lending sites in the very vicinity of the highway (up to 30 km).Excessive material of poor quality can be dumped into ravines, but a pipeline should be positioned along thwm first since, otherwise, they can cause local unstabilities which would jeopardize the future highway. Sand and gravel, as the high-quality material for the construction of the dykes and bases, can be used from the alluvion of the Nisava river and its larger tributaries, but not directly from the river. In case of the lack of high-quality material for the construction of dykes in the area of Pirotska basin (loose and flooded soil), it is recommended to use the limestone rubble dug out from the "Sarlah" tunnel. It is also recommended to use the limestone from local lending areas, which are about 10 km away from the place of construction, if needed. During the construction of the planned route of highway E–80, it is necessary to undertake a range of measures which will minimize all possible influences on the natural environment. These measures entail numerous activities which are given in section 5.1.1.

Considering the current traffic trends, the concept of water draining off the driveway (controled, closed system), of concentration of pollutants in the soil which are consequences of regular exploitation of the planned newly projected highway route will not represent a major problem for the analyzed planned period (year 2021). When speaking of influencing the natural environment, soil degradation during the exploitation of the highway can manifest itself in several processes, the gravest of which are landslides, crumbling and erosion.

In order to apply adequate mitigation measures, it is also necessary to define certain actions which have to be followed during the exploitation phase of the object. These actions are in the domain of exploitation management, and they include traffic organization and the maintenance of the road itself. All activities intended to be included as mitigation measures (biological, bio – technical and technical) are given within chapter 5.1.2.

Air quality

After a consideration of the concentration of air pollution along the highway E–80 between Nis and the border with Bulgaria in the given weather conditions and the comparison of the obtained results with the border concentration levels listed in table T 5.2. – 01 (according to the Rulebook on borderline levels, emission measuring methods, criteria for establishing measuring places and data registering — Official Gazette of RS No. 54/92), the following conclusion has been drawn:

- during the activity of a wind whose average speed is 1.5 m/s, for a short while the concentration level of nitric dioxide NO_2, are above the allowed limits in the area 37 – 50 m from the driveway, and for a longer period they are found at the distance of 33 m;
- after air pollution is calculated during the activity of the dominant wind (NW) whose speed is 2.9 m/s, zones of exceeded values are narrower than the previous ones;
- concentration of sulphur dioxide, solid particles and lead are below the legally defined limits along the road and in all microclimatic conditions
- higher concentrations of pollutants have to expected in the zone of tunnel ports.

Considering the influence of different pollutants on the flora, this phenomenon is particularly important for farmed areas and agricultural cultures. The obtained results show that, within an area of 37 m (17 m in the first phase) from the curb of the road and during a wind of the average speed of 1.5 m/s, the pollutant concentrations (especially nitric oxides) can be expected to cause permanent negative consequences for the growth and the development of plants. It is recommended to avoid growing plants for human nutrition in this area, and to cultivate only those species which are resistant to the above said substances. The general conclusion which can be reached after all the analyses is that the problem of air pollution is not neglectable in the area along the planned highway.

After a consideration of the concentration of air pollutants in the area along the northern bypass of Dimitrovgrad, in certain weather conditions, and after these data have been compared with the limit values of the concentration, the following conclusions have been reached:

- concentrations of all pollutants, apart from saturated hydrocarbons (CxHy) and nitric oxides (Nox), are below maximum allowed concentrations (MAC) in all weather conditions;
- in general, during the acitivity of the dominant wind (SE), the left side of the bypass road has higher concentrations of air pollutants;
- short-term concentrations of saturated hydro-carbons (CxHymax) have been exceeded along the entire route on the left side (on average 21 m from the road curb) and along the major part on the right side (except between km 94 + 700 and km 96 + 700)
- for long-term concentrations of CxHysr, exceeded values are within the limits of the road area on the left side (on average 2 m from the road curb), whereas on the right side the concentrations are within MAC;
- in case of nitric oxides, MAC are exceeded only occasionaly and for a short while and in case of nitric dioxide (NO_2 max), mostly on the left side of the road, with an average distance of 3 m from the road curb, i.e. The affected area is within the road zone;
- higher concentrations of pollutants have to expected in the zone of tunnel ports on the left side of the road.

Noise

Noise is one of the most frequent influenced on the natural environment. The highest percent of all noise sources belongs to traffic noise, whereas a smaller part of these sources goes to other noises (industry, construction activities, spare time activities noise, etc). The influence of the noise related to the observed object has been considered during to phases – the construction and the exploitation phase.

The construction phase, noise – wise, is marked by the operation of the machines and the units located along the highway which is being built. The exposure to these influences is temporary and limited, and, as such, it is treated by mitigation measures in the construction phase. Since at this point of project the concept of the performance of construction works, including transport routes as well, is not available, it is impossible to estimate the specific noise levels which will be reached during the construction. Nevertheless, the following actions may be defined as general mitigation measures, whose application can mitigate the noise influence during the construction phase: raising workers' awareness of the necessity to minimize all noisy activities, working hours adjustment, using modern equipment and machines with mufflers when working near populated areas, regular maintenance of construction vehicles and equipment in order to eliminate all unnecessary noise sources, avoid simultaneous operation of several noisy machines, whenever that is possible, turning off the machines when they are not in use, use natural sound barriers or screens as a protection against the noise around the machines, driveways and temporary roads should be regularly maintained and vehicle speed on unasphalted roads for material transport should be limited.

Exploitation phase is marked by traffic noise. Maximum allowed levels of external noise for populated areas along the route of the future highway E–80 are 65 dB(A) in daylight, i.e. 55 dB(A) at night (JUS U.J6 205). According to the performed analysis and calculations, maximum noise levels on the relevant distance of 25 meters for the highway E–80 from Prosek to Dimitrovgrad for daylight traffic is 74 dB(A), and 69 dB(A) at night. Distances where the borderline levels of the allowed values are achieved are between 45 m and over 300 m. It has been concluded that noise borderline levels have been exceeded in the places where the registered objects are.

Technicalmeasures of protection have been defined in order to bring the quantified negative effects back below the allowed limit. In this specific case, for the highway E–80 between Prosek and Dimitrovgrad, it has been decided that noise protection constructions and passive mitigation measures should be applied (carpentry with sound isolation). The most important sound mitigation measure is the construction of sound-proof walls. This mitigation measure will be applied in the places where the most affected object groups are located.

Along the highway E–80 between Prosek and Dimitrovgrad, it is necessary to install a little bit more than 4 kilometers of noise-proof constructions. The application of passive mitigation measures for a specific number of individual objects has been intended, but only in cases when these measures are rational, i.e. Economically justified.

Also, the construction of residential premises within the distances from the highway axis where the allowed noise level can easily be exceeded should be prohibited in order to avoid further complication of the noise issue.

Flora, fauna and the visual impact

The influences of the construction, exploitation and maintenance of the highway in the domain of eco-systems, represent an inevitable fact which, naturally, have negative effects. Highway construction inevitably leads to temporary or permanent loss of green areas covered in bushes, wooded land, trees and other vegetation growing along the waterways, as well as of the land used for agricultural production. The major part of fauna will temporarily migrate out of the area along the highway during the construction. Since the newly projected highway

crosses the alluvion of the river in some places, it is supposed that the biggest influence of the new objects will be on the animals which depend on water as their eco-system. Considering the analysis of the influences on the landscape during the construction period, it cannot be said that, since the route of the highway which has the minimum of harmful effects has been chosen, this influence will have minimal inneviatble negative consequences caused primarily by the existent topography of the terrain. After all construction works have been finished, the new traffic flow has been established and the exploitation phase has begun, the influence on the landscape will definitely be in the sphere of positive influences, because, in this way, the landscape with its natural and decorative — esthetic peculiarities will become fully obvious both in the vegetative period and outside of it. Mitigation measures which should be enforced in order to preserve the flora and fauna, first of all, refer to planting new plants and getting more green areas, to adjusting of round and flat outlets for animal crossing, as well as to construction of protective fences.

EIAs were completed fully in accordance with conditions of the relevant institution – Institute for Nature Protection of Serbia. Flora, fauna and whole ecosystem in the project surroundings were analyzed by the Institute, and conditions determined by this institution were included in the designed solution. Designs incorporated all measures stated for conservation of ecosystems in the project surrounding.

All relevant documentation related to this issue is presented in Appendix D - Reference, document number 03-853/2 from 29.06.2006, 03-2058/2 from 07.12.2005, 03-852/2, from 12.06.2006, 03-2581/2 from 29.11.2007, 03-2582/2 from 29.11.2007. According to this documents there are no areas of conservation significancealong the route. Through these conditions all necessary mitigations measures for protection of endangeres species that are found within the project area are presented in details.

Surface and underground waters

Water pollution process related to roads is marked by two basic phases – the pollution during the construction and the pollution during the exploitation.
The pollution during the construction is temporary, and limited in scope and intensity. We can differ two types of influence caused by the construction of the subject road and these are water pollution and the change of the surface and underground waters regimes. During the construction phase surface waters can seriously be affected by pollution (accidental spills of hazardous and dangerous substances into open waterways) or physical crumbling of river banks (works on waterway regulation). The flow, speed and the very direction of surface waters are altered because of the changes to the terrain morphology during the performance of ground works and the construction of bridges and outlets. During the construction of the planned route of the highway E–80, it is necessary to undertake a number of measures which minimize the influence on the natural environment. These measure include numerous activities which are necessary to return the quantified negative influences into the allowed lomits and are listed in chapter 5.5.1.

Considering the exploitation phase, and according to the data on traffic trends for the planned period (year 2021) along the observed route of the highway E–80, in order to reach certain conclusions, apart from spatial characteristics of the relevant highway parts, hydrogeological characteristics of the area, characteristics of the flows of crossed waterways and the concentration of pollutants in atmospheric waters drained off the road, a draining concept has to be defined. It has been planned for the waters which will flow off the surface of the future highway in the area between Prosek and the border with Bulgaria to be evacuated under

control and purified before being let out into recipients. The planned solution for the water draining system off all road surfaces will belong to the closed – controlled type. The evacuation of atmospheric waters off the road surface will be performed according to the system „drain – draining pit – collector“ and all the used elements have to be impermeable. The dimensions of the retensions are such that they can hold one hundred years amount of water in order to prevent spill-outs during possible floods, which would entail spilling out of polluted waters into the surrounding area.

Retensions with separators and deposits, places of the accumulation of waters flown off the road surface, are situated along the subject highway E–80 on the left and the right side on the lowest points of the road or the terrain, as close to the recipient as possiblr. Retensions will be coated with clay in order to avoid infiltration of polluted water into the permeable underlying layer.

Sector 1 between prosek and Crvena Reka has been intended to be provided with 38 retensions. Sector 2 to Ciflik was intended to be provided with 17 retensions. Secotr 4 between Pirot and Dimitrovgrad, i.e. The area of the Northern bypass (sector 5) was intended to be provided with another 23 retensions. Road draining concept on the „Northern bypass of Dimitrovgrad“ is based on transversal rainwater draining to the draining pits with barred lids which are the primary recipients and to the piped rain gutter in the deceleration lane of the highway, and then, depending on the terrain, the said water is let out into the stormceptor.

According to the everything said, it has been concluded that water quality, both in case of surface and underground waters, will not be altered.

Regarding the application of the adequate mitigation measures, it is also necessary to define specific actions which have to be followed during the exploitation of the object. These actions are in the domain of exploitation management and they include traffic organization and the maintenance of the very highway parts. All the activities which are intended as mitigation measures are given in chapter 5.5.2.2.

Social and cultural heritage

The highway construction will bring about a range of positive effects. The intensification and connection of road networks in the region will improve the economic and other functions of Nis, which is already the second most significant transport centre in Serbia, after Belgrade, as well as the development of Pirot, Bela Palanka and Dimitrovgrad, which are all centers on the route between Nis and the Bulgarian border. The negative effects are the exacerbation of the life conditions in the settlement and its surroundings. These negative effects manifest themselves in cases when a highway route divides (separates) the already constructed parts of a settlement, i.e. when it desintegrates the local space. The opposite effect is achieved if the newly projected highway touches a settlement giving it, thus, a possibility of spatial and economic growth. A part of negative consequences will be manifest on that part of local features where interventions within private properties will be necessary. Th e fact is that the basic activity of the population in this area is agriculture, and that land occupied by the highway is a wasted resource. Soiciologically, this is the case when negative influences are present.The intensificationof transport in these interstate directions will enable further strengthening and development of specialistic centres such as: spas (Niska spa, Ostrovicke terme, spa Topilo), goods transport centres (Nis, Pirot), borderline (Gradina), tourist and sports and recreational centres (Stara mountain, Suva mountain, Selicevica, Sicevacka gorge, Jelasnicka gorge and other zones of natural resources and immovable cultural monuments).

Settlements are protected from the negative effects of the highway (noise, vibrations, air pollution, accident hazards) by the construction of a bypass of the highway E–80 out of the construction area of Nis, Pirot and Dimitrovgrad, as well as by provision of technical measures of protection against noise, vibrations and air pollution of all residential premises which are built within less than 300 m from the highway route.During the preparation of the technical documentation, and prior to the beginning of the works, it is necessary to enforce administrative measures to sancstion every possible individual construction within the very vicinity of the highway. In this way, negative effects on such buildings and subsequent demands for mitigation measures will be prevented. Further construction within the zone of the future highway has to be prohibited. The influence of the planned highway E–80 between Nis and Dimitrovgrad on the health of the population includes the effect on the inhabitants of populated areas along the highway, as well as on the drivers of motor vehicles and other participants in the traffic (passengers, pedestrians). These influences include noise, vibrations and air pollution exposure (oil combustion and exhaust fumes).

In order to protect the citizens and to closely follow the level of air pollution, it is necessary to prepare a Monitoring Project. Due to soil pollution, which is a consequence of highway exploitation, it is necessary to provide a minimal protective area which willnot be cultivated. Considering the expected level of present pollutants, this area should not be wider than the road width. The grass from the maintenance of the green areas along the highway must not be used for cattle feeding. The weed must not be destroyed by herbicides. It is recommended to enforce a prohibition of constrcution of residential premises in the protective area along the highway.

After an analysis of the observed area, as well as after a consideration of the existing documentation, 44 objects belonging to the category of cultural monuments have been registered. Apart from the direct danger from the highway as an object, these cultural and historical monuments are also exposed to traffic influences which manifest as air pollution, soil pollution, water pollution, noise and vibrations all along the highway. The borders of the protective area around the immovable cultural monuments depend on the type of monument and on the amount of information on its location and dimensions and they are usually set at the radius of 40 м.

Sites which are on the very route of the highway and which are directly jeopardized are: Site Livade (at km 42 + 950), Madjilika (at km 63 + 600), Site at km 82+100 and 83+000, Site Seliste at the bypass of Dimitrovgrad. It is necessary to perform probing archaeological researches in order to completely define the sites prior to the beginning of the newly projected highway. Other sites are at a distance of 100 m to 200 m from the road axis and most of negative effects acn be avoided.

According to the conditions given by the Republic Institute for the Protection of Cultural Monuments from Belgrade, the following mitigation measures have been enforced: no digging, tearing down or any kind of works which can damage any of the features of the cultural monument can be performed on the said sites, until the measures of technical protection of the immovable cultural monuments and their surroundings have been determined, no construction or landscaping activities can be performed without a prior consent of the competent authorities for the protection of cultural heritage. , the Republic Institute for the Protection of Cultural Monuments and the competent expert have to be timely informed about the beginning of ground or other works at the place where the archaeological site is situated or in its very vicinity, so that all preparations necessary for obtaining an archaeological research permit can be performed in time, It is necessary to mark and protect all registered sites with a protective

fence or in some other way in order to prevent any damage to these monuments during the construction of the highway.

Cumulative influences of the project

The presence of other objects in the observed area of the highway between Prosek and Dimitrovgrad, as well as a possible sonstruction and exploitation of new ones, can cause an increase of the intensity of the influences caused by the construction and the exploitation of the subject highway. From this reason, the already analyzed influences, which have been labeled as of minor significance, can reach levels which are higher than the allowed borderline values through sheer superposition. All data on possibilities of the occurrence of such cumulative effects can be obtained only by registering the presence of all such objects within the zone of influence of the future highway. The already present objects along the subject route of the highway are: maintenance bases, a motel, resting places, psint factory „Sukovo“. Possible cumulative effects are given in chapter 5.7.

Trans-boundary impacts of the project

The crossing of negative influences over the state border can be a consequence of high intensity of influence, the proximity of the influence source to the state border, or of specific conditions for the spreading of the influence. The results of the analysis of the traffic influence on the road between Prosek and Dimitrovgrad have proved that their spreading is spatially limited to the influence zone which is not larger than 500 m to the left and the right side of the highway respectively. The position of the road is such that, except in the borderline area of Dimitrovgrad, it never approaches the border with Bulgaria, which is the only potentially affected neighbouring country. The only influence which contributes to the degradation of the natural environment on the global level is air pollution, i.e. Exhaust fumes emission which cause the creation of the greenhouse effect due to the combustion of oil derivatives which are used as fuel in the traffic.

Analysis of alternatives

The preparation of the design documentation was preceded by the General Design of the E–80 Motorway prepared by the Highway Institute in 1996. Multicriterial evaluation of the alternative versions of the corridor is excuted. Maximum priority is given to the expences of construction and traffic safety , then expences of exploitation, and lower priority is given to the spatial consequences and environment. Regarding the corridor impact - maximum calibration is given to the noise, pollution and biodiversity impact, while vibrations and visual impact were considered as the lower priority.

Specific details about the procedures of the multicriterial evaluation of the alternatives are implied in the General Design of the motorway E – 80.

The General Design was the basis for the preparation of the Spatial Plan of the infrastructural corridor Niš – Bulgarian border. The Spatial Plan is a long-term planning document elaborating on the Spatial Plan of the Republic of Serbia, defining planning solutions, guidelines, and rules for usage, organization, development, and protection of space, and construction, reconstruction, and operation of main and regional infrastructural systems in the territory of the Plan by 2020. The Spatial Plan was prepared by the Institute of Urban Planning, Nis, in 2001.

This planning document defines the corridor of the future motorway route and proposes its variants.

Variant solutions were proposed on the following sections:

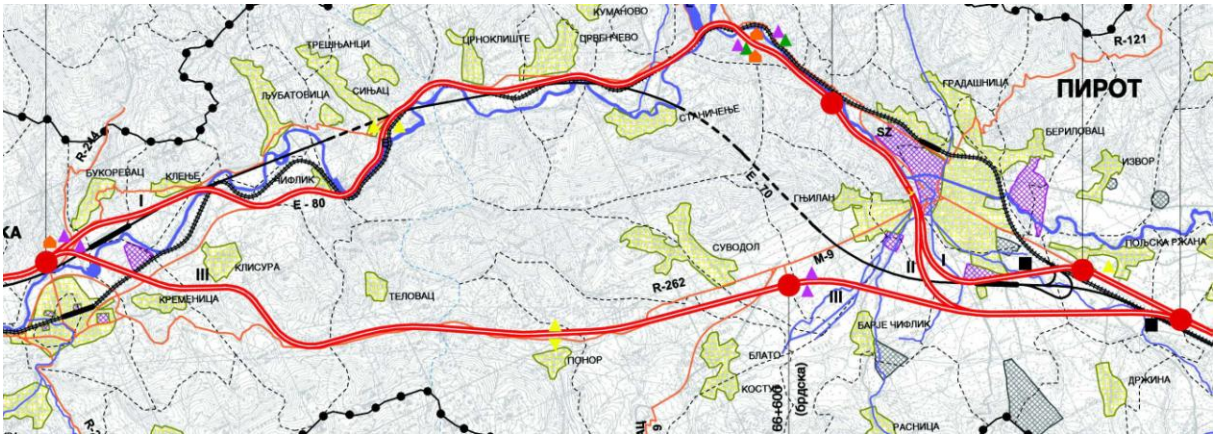
- Bela Palanka – Pirot
- Sukovo junction – Bulgarian border

6.1 Bela Palanka – Pirot Section

There are four variant solutions proposed for the given section:

- Variant I (valley route, according to the General Design of the E–80 Motorway)
- Variant II (valley route, bypassing Pirot)
- Variant III (hilly route, southern)
- Variant IV (hilly route)

The Spatial Plan for the area of infrastructure corridor Nis - Bulgarian border ("Official Gazette of RS", No. 86/2009) which includes E-80 Highway section Ciflik – Stanicenje – Pirot (“Valley Route Alternative”, see pic 2 of this document) is adopted on 21st October 2009.



The part between Sukovo and the Bulgarian border three optional solutions have been given:

<u>Option I (acc. To the General project of highway E–80)</u>

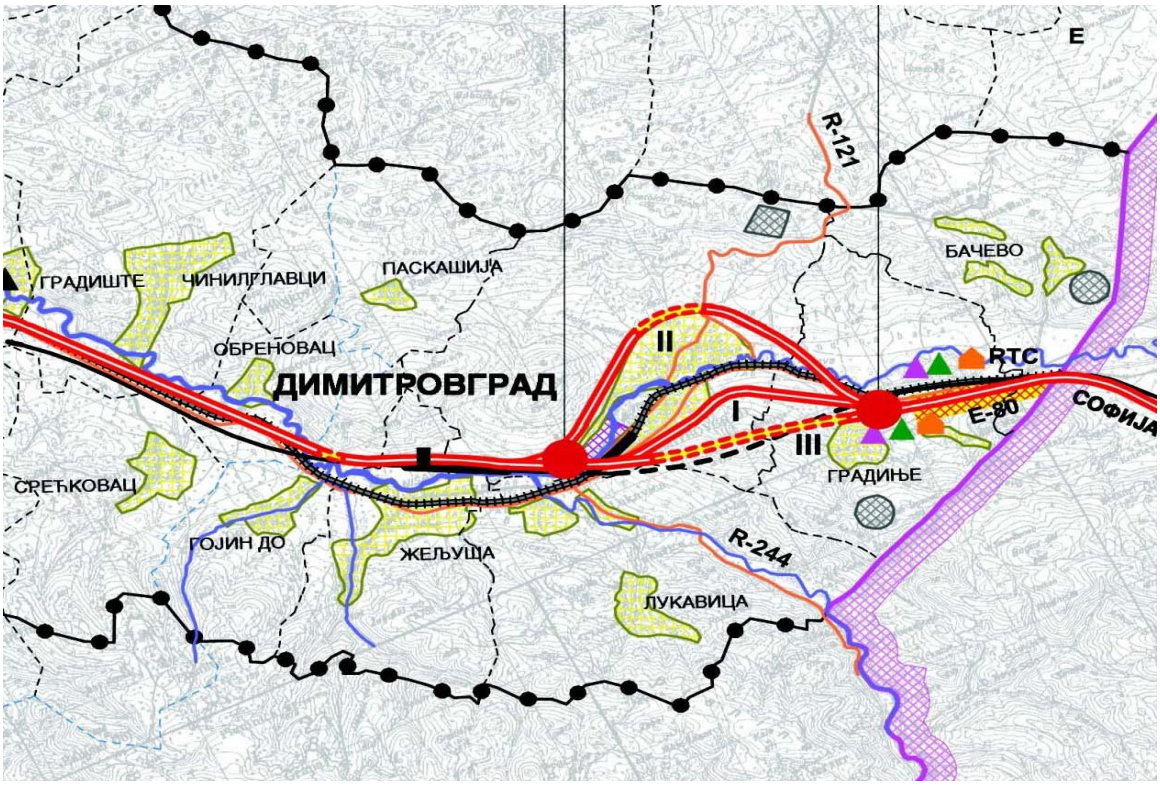
According to the solution form the General project, the highway route, after the loop at Sukovo, follows the flow of the Nisava till the entrance into the area of Dimitrovgrad where it crosses the Nisava, the existent railway Nis – Dimitrovgrad, the regional road Nis – Dimitrovgrad and all city roads. After this multiple crossing, the route goes along the north slope of the Mrtvina hill till the crossing with the exisating route at the border crossing „Gradina. In the part where it rounds Dimitrovgrad the road goes above the Cuj petl settlement by a viaduct , it cuts across the city graveyard and it endangers the only green oasis in the surroundings of Dimitrovgrad. Dimitrovgrad is connected with the highway over the Dimitrovgrad loop which is located westward from the city centre.
<u>Option II (north)</u>

From km 96 + 180, the highway route rounds Dimitrovgrad and the suburbs at the north side over the stable, infertile and unconstructed land, which does not disturb the current functioning of the city and its future spatial development. In the part where the highway route reaches the border crossing, it flows into the existing road.

Option III (south)

According to this option, the highway at km 96 + 000 goes south, crosses the regional road Nis – Dimitrovgrad, the Nisava and the route of the high-speed trains, and then enters the tunnel which is 3500 m long and it crosses below the hill of Mrtvina and rounds Dimnitrovgrad at the south which means that it avoids all the crosses with city streets, tall viaduct constructions and it eliminates all the pollution from exhaust fumes and noise. The Ministry of Capital Investments of RS and the representatives of the municipality of Dimitrovgrad have decided to reject option I because it sollides the highway with the city graveyard and the green oasis in the surroundings of Dimitrovgrad. Institut za puteve a.d and the Traffic institute of CIP prepared the project documentation in 2002 for this option of the highway. After the experts of the Institut za puteve a.d and the Traffic institute of CIP, option III was rejected due to the high price of the construction of a tunnel. The representatives of the Ministry of Capital Investments of RS and of the local authorities have decided to adopt option II as the best solution for the municipality of Dimitrovgrad. The suggested optional solutions from the Spatial plan of the infrastructural line between Nis and the border with Bulgaria are given in the picture 6.2 – 0.2.

Picture 6.2 – 0.2



Data source: Spatial plan of the infrastructural line between Nis and the border with Bulgaria

Environmental Management Plan

Mitigation measures

Chapter 7.1 suggests protective measures in order to reduce the negative effects on the environment to the minimum during the project preparation, construction and exploitation of the highway: general environmental protective measures, administrative environmental protective measures, Regulative meausres; Protective measures in case of accidents, Protective measures in tunnels and technical solutions for environmental protection.

Monitoring

The monitoring project defines the monitoring programme for each component of the environment respectively, including relevant legal regulations referring to the processes of sampling and monitoring, methods of monitoring, sampling locations, sampling times and sampling and monitoring duration.

The state of the environment concerning dominant existing influences in the analyzed area is marked by negative effects which are, primarily, the result of the urbanization of the surrounding area. The observed and analyzed area is exposed to noise pollution coming from the traffic. The existing state is marked by the realization of the traffic on the existing railway Nis — Dimitrovgrad, interstate roads M 1.12 and M 9, as well as regional roads R 241a and R244.

According to the consideration of the existing state and the estimation of the influence of the newly projected highway onto the environment, we have defined parameters which have to be measured for each segment of the environment individually wherever it is expected that the environment might be affected, both in the construction and in the exploitation phase. The given parameters are: Noise, Air pollution, Water and Soil

The construction of such a road as the considered highway is is an activity marked by a complex time and spatial activity of works, which makes the choice of place, way and frequency of the measuring of the determined parameters more difficult. It is necessary to increase the scope of research if the process of the performance of works and the monitoring of the state of the environment register any increase of negative effects in order to obtain reliable data on the affectedness, causes of the increase, as well as the necessary measures which have to be undertaken in order to eliminate the negative influences or reduce them to the legally defined levels. If the occurrence of new circumstances raises a need for new monitoring parameters for the quantification of the newly occurred situation and the location of new places for sampling, a competent inspection service for the enviromental protection will be formed.

Noise measuring programme:

During the construction phase, noise level has to be controlled as necessary, i.e. If any complaints on the excessive noise are filed during the performance of the works. The Rulebook on the Allowed Level of Noise in the Environment defines the moethods of measuring, the choice of measuring spots and the duration of measuring.

During the exploitation, the noise has to be controlled in order to control the effectiveness of the defined measures for the protection against noise. The noise level measuring has to be performed every 5 years and in cases of complaints of the inhabitants of surrounding settlements. This chapter lists the places which have been chosen for the monitoring of noise levels during the exploitation since they are places which are affected the most.

Air quality measuring programme:

The monitoring of air pollution during the highway construction phase includes determining the influence on the air quality at the moment of the performance of construction works in the vicinity of inhabited areas. In case any complaints of the local citizens are filed, special monitoring of the influence of the construction site onto the air quality will be organized. The air quality measuring programme should include the places within the zone of influence of the future highway: Prosek and Jelasnica between 20 +000 km and 21 + 000 km and Klenje at km 50 + 200. In order to measure the content of the pollutants emitted by vehicles during the exploitation of the future highway E–80, it is necessary to install all measuring stations in the same way because only that way an adequate dispersion model can be created which would provide quite reliable data on the spatial dispersion of air pollution in the influence zone.

Water quality measuring programme:

During the highway construction phase, water monitoring includes determining the influence of construction works which are performed in the direct vicinity of waterways, i.e. Water intake onto the quality of the said waters. The monitoring programme includes parameters which are competent for the determination of the affectedness of surface and underground waters. For surface and underground waters, the programme includes the following parameters: pH, concentration of the dissolved oxygen in the water, waste percent, clarity, concentration of organic substances and mineral oils, temperature, colour and smell. Water quality measuring of the recipient (Nisava and tributaires) wants to see all the influences of purified waste waters on the quality of the recipient water and the indirect control of the operation of the intended systems for the treatment of atmospheric waste waters. The projected task, according to the criteria of the EU, envisaged that the draining system should be a closed controlled type system. Having that in mind, surface waters monitoring should be performed at places which are downstream from the points where outlet canals flow into the recepients (Nisava, Vranasnica, Temstica, Rasnicka) during the exploitation phase of the project.

Soil pollution measuring programme:

During the construction phase, soil monitoring programme includes parameters which are competent for the determination of the affectedness of the said soil. A wide range of pollutants are present here, and they are divideed in two groups: heavy metals, grease and oil (leftovers of uncombusted fuel, greases and motor oils, anti — freeze, hydraulic liquids, etc).

The monitoring is performed in such a way that it can determine which construction works are affecting the soil. Samples have to be taken before the beginning of the construction works, at the moment of humous stripping and when the ground is dug out or filled in.

Soil quality analysis in the zone of influence of highway E–80 should last at least 5 years, and sampling has to be performed once in three months.Monitoring should be performed in such a way that it can establish which construction works influence the soil quality. It is necessary to take the samples prior to the beginning of the works, at thye moment of humous removal and during digging out or filling in of ground.

Soil monitoring during the highway exploitation, i.e. monitoring of the influence the exploitation of the future highway E–80 has on the soil quality has to be performed within the zone of the road strip. Along with the soil control, it is necessary to follow the quality of underground waters as well. The determination of underground waters quality requires monitoring of pollutants which are present in the soil, with a view to determining the influence of soil pollution onto the underground water pollution.

1. INTRODUCTION

1.1 Purpose of Report

Construction of E-80 highway section from Prosek to Dimitrovgrad is stated as one of the highest state priorities and thus the PE "Putevi Srbije" (PEPS), as Project carrier has taken all necessary activities in reference to timely preparation of planning and design documents. Particularly, in part of the Project dealing with the environmental protection issues, adequate design documents were prepared. Previous analyses of environmental impact were completed for the needs of general highway project, while for the purpose of preliminary designs preparation, detailed EIA were carried were carried successively for all 5 sections of prospective E-80 highway.

Simultaneously with the procedure in progress, at the meeting of representatives of the European Bank for Reconstruction and Development (EBRD), European Investment Bank (EIB) and World Bank (WB), which was held on October, 17 2008 in Luxembourg, the Government of the Republic of Serbia, i.e. PEPS received recommendations for continuation of activities that should create a foundation for reaching decisions on acceptance of the Project by the banks and approval of the credit funds for financing of this highway stretch. Three banks jointly agreed that during the realization of the stated activities in reference to environmental protection issues, procedures of the World Bank should be accepted as relevant.

In accordance with the agreement reached in Luxembourg, Preparation Mission of the World Bank visited Serbia in the period from December 02 to December 12, 2008 (*Preparation Mission for Corridor X Highway Project*). The Mission organized meetings as to define the activities needed for successful realization of the subject highway project. Additionally, several meetings were organized with the PEPS management and agreement was made in relation to continuation of the activities needed for the Project approval by the Banks. Aspect of environmental protection was specially analyzed at those meetings and the PEPS was requested to integrate the existing studies into a singular unity, that is, to prepare Corridor level environmental impact assessment, for the E-80 highway section from Prosek to Dimitrovgrad (in further text EIA). Additionally, in the part of the EIA dealing with potential trans-boundary Project impacts and cumulative Project environmental impacts it was necessary to take into consideration all subsequent sections of the highway from Nis to Bulgarian border.

Pursuant to item 24 of the Aide – Memoire (Preparation Mission for Corridor X Highway Project, December 02 – December 12, 2008), up to this moment the PERS has executed all the activities in relation with the fulfillment of the following requirements:

i. The existing EIAs were integrated into Corridor X level EIA Report, section from Nis (Prosek) to the border of Bulgaria
ii. Preparation of the EIA Report was undertaken by a qualified independent party and the draft of EIA Report was submitted to the Bank in due time

1.2 Project Background

The branch of corridor X, highway E - 80, section Niš – Dimitrovgrad was designed through five sections:

- **Prosek – Crvena Reka**
- **Crvena Reka – Čiflik**
- **Čiflik – Stanicenje – Pirot**
- **Pirot – commencement of Dimitrovgrad bypass**
- **Northern Dimitrovgrad bypass**

This project should be viewed in the larger context of the overall national transport network in Serbia. The national network has suffered from lack of maintenance funding over the last decade and also severe war damage in some locations. The *Multi-Annual Indicative Programme and Annual Action Programms* approved by the Government reflect both the need to repair and to improve the overall national transport network, as well as the willingness of the International Financing Organizations (IFI) to support this process in order to facilitate the free flow of goods and people, and to spur economic and social development.

1.3 Previous Environmental Studies

Foundation for preparation of Corridor level EIA, for the E-80 highway section from Prosek to Dimtrovgrad is comprised of the following planning and design documents:

- previous analysis of EIA for the E-80 highway project, from Nis to the border of Bulgaria
- detailed analysis of EIA and EIA Study for the section **Prosek – Crvena Reka**;
- detailed analysis of EIA and EIA Study for the section **Crvena Reka – Čiflik**;
- detailed analysis of EIA and EIA Study for the section **Čiflik – Stanicenje – Pirot**;
- detailed analysis of EIA and EIA Study for the section **Pirot – commencement of Dimitrovgrad bypass**;
- detailed analysis of EIA and EIA Study for the section **Severna obilaznica Dimitrovgrada (Northern Dimitrovgrad bypass)**;
- Spatial Plan of special purpose areas – infrastructural corridor **Niš – border of Bulgaria**;

This Report has considered all cumulative or synergistic environmental impacts, together with all significant trans-boundary effects (for Bulgarian border) and it is in full compliance with the **Espoo convention**.

Most of the environmental documents have been approved by the relevant national environmental authority as part of the procedure for obtaining the construction permit.

1.4 Structure of Report

Scope and contents of the EIA are defined by the operational policy and procedure of the World Bank (*WB OP/BP 4.01*). Following the criteria of the Bank for categorization of the projects based on their assessed environmental impacts, this project was included in the category implying the strongest impacts (*environmental Category A*). The EIA Report is prepared fully in accordance with the Annex B and Annex C of the WB operational policy (*WB OP 4.01, Annex A and Annex B*).

This EIA report include the following chapters:

1. Introduction;

2. Policy, legal and administrative framework;
3. Project description;
4. Baseline data;
5. Environmental Impact;
6. Presentation of main alternatives;
7. Environmental Management Plan – EMP;
8. Appendices.

Following an introduction to the project as presented in Chapter "1", an outline of the policy, legal and administrative framework is presented in Chapter "2". A description of the route and structures proposed is given in Chapter "3". Presentation of the current state of environment in the project surrounding area is presented in Chapter "4".

Description of significant project environmental impacts, which includes analysis of cumulative project impact and analysis of trans-boundary impact are presented in Chapter "5". This chapter also comprises two road sections of the highway from Levosoje to FYRM border. Chapter "5" assess the potential impacts of E-80 Motorway Project construction and operation on the local environment. The studies cover: geology and soils; surface and groundwater; air and climate; noise; flora and fauna; landscape and visual; cultural heritage; population and economy, including material assets and health & safety; efficiency of use of natural resources..

Measures to avoid or mitigate adverse environmental impacts identified in the preceding chapters are summarised in the draft environmental impact, mitigation and monitoring plan in Chapter "7".

Appendices include:

A Terms of reference
B List of EIA Report preparers
C Legislature and multilateral agreements
D References
E Tables, Maps and Drawings
F Noise and Air quality standards

2. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 Relevant Institutions

2.1.1 Government Organizations

During the construction and operation of highways in the Republic of Serbia, the issue of environmental protection is being solved by mutual cooperation of the following authorized government institutions:

- Ministry of Economy and Regional Development
- Ministry of Infrastructure
- Ministry for Environment and Spatial Planning
- Ministry of Agriculture, Forests and Water
- Ministry of Culture
- Public Enterprise "Roads of Serbia"
- Institute for Nature Protection of Serbia
- Institute for Protection of Cultural Monuments of the Republic of Serbia

NOTE:
It is important to note here, that according to the current Serbian Legislative, preparation of EIA for the purpose of building new highways is obligatory.

The Ministry for Environment and Spatial Planning is the main institution in Serbia responsible for environmental matters. The Ministry is responsible for the protection against noise and vibration, hazardous and toxic material, air pollution, ionic and non-ionic radiation, nature protection and international co-operation.

2.1.2 Non-Government Organizations

There are many environmental organisations in Serbia. Most were established during the 1990s, concentrating on environmental awareness raising, environmental education and information dissemination. The Serbia office of the Regional Environmental Centre (REC) for Central and Eastern Europe was established in Belgrade in May 1998.

2.2 Environmental Laws and Regulations

2.2.1 Existing Serbian legislation

Environmental protection in Serbia is regulated by many republic and municipal laws and by-laws. The environmental legislation in force in Serbia is summarised in Appendix C.

The main laws and regulations currently in force which are relevant to the EIA for this project are listed below:

- *Law on planning and construction* ("Official Gazette of RS" No. 47/2003, 34/2006) which details the requirements for different phases in the planning cycle, i.e. pre-justification (pre-feasibility) and justification (feasibility) studies and the application for the main (general) project permit, as well as the requirement for public consultation during the preparation of master plans. Pre-feasibility and feasibility studies must both include environmental assessments.

- *Law on environmental protection* ("Official Gazette of RS" No. 66/91, 83,92, 67/93, 48/94, 53/95, 135/04). The law states that 'the use of natural resources, construction of structures or any other activity may be carried out under the condition that they cause no permanent change and significant change of landscape, no pollution, no other forms of environmental degradation'.
- *Law on Environmental Impact Assessment ("Official Gazette of RS" No. 135/2004) and Law on Strategic Environmental Impact Assessment ("Official Gazette of RS" No. 135/2004)* . By this Law, during 2004. harmonization between Serbian and EU legislation in the area of environmental protection was done. This harmonization included adjusting the existing EIA regulation (lists of projects and procedures) to the EIA Directive 97/11/EEC, introducing Strategic Environmental Assessment (SEA) procedures following the Directive 2001/42/EEC and securing public access to environmental information following the EU Directive 2003/4/EC.
- *Regulations on permitted noise level in the environment ("Official Gazette of RS"* No. 54/92). Serbian noise and air quality standards are detailed in Appendix F.

Regulations established on the basis of the Law on Environmental Impact Assessment include the following:

- **Decree** on establishing the List of Projects for which the Impact Assessment is mandatory and the List of projects for which the Environment Impact Assessment can be requested ("Official Gazette of RS" No. 84/05)
- **Rulebook** on the contents of requests for the necessity of Impact Assessment and on the contents of requests for specification of scope and contents of the Environmental Impact Assessment Study ("Official Gazette of RS" No. 69/05)
- **Rulebook** on the contents of the Environmental Impact Assessment Study ("Official Gazette of RS" No. 69/05)
- **Rulebook** on the procedure of public inspection, presentation and public consultation about the Environmental Impact Assessment Study ("Official Gazette of RS" No. 69/05)
- **Rulebook** on the work of the Technical Committee for the Environmental Impact Assessment Study ("Official Gazette of RS" No. 69/05)

2.2.2 Other relevant Serbian legislation

- *Law on public roads ("Official Gazette of RS" No. 101/2005)*
- *Law on expropriation ("Official Gazette of RS" No. 53/95, 16/2001)*

2.2.3 Relevant World Bank policy

- *The World Bank OP 4.01;*

2.2.4 Existing EU legislation

The main EU environmental legislation relevant to this project is as follows:

- European Commission (1997) *Council Directive 97/11/EC of 3 March 1997 amending Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment* OJEC L 073 14/03/1997 p5-15, known as 'the Directive on EIA'

- European Commission (2003) *Council Directive 2003/35/EC of 26 May 2003 providing for public participation in respect of drawing up of certain plans and programmes relating to the environment and amending with regard to public participation and access to justice Council Directives 85/337/EEC and 96/61/EC* OJEC L 156 25/06/2003 p17-23, known as 'the Directive on Public Participation'
- European Commission (1979) *Council Directive 79/409/EEC of 4 April 1979 on the conservation of wild birds*, known as 'the Directive on Birds'
- European Commission (1992) *Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora*, known as 'the Habitats Directive'

2.3 Environmental Conventions

- *Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Washington DC, 1973*
- *Convention on Conservation of Migratory Wild Animals, Bonn, 1979*
- *Convention on Conservation of European Wildlife and Their Natural Habitats, Berne, 1979*
- *Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, Aarhus, 1998*
- Convention on Environmental Impact Assessment in a Transboundary Context Espoo, 1991

Detailed list of international conventions is given in Appendix C.

2.4 Planning framework

Planning framework for the preparation of the Preliminary Design of the highway E-80 section Nis - Bulgarian border is presented in:

Spatial Plan of the Republic of Serbia, determined by the Law on the Spatial Plan of the Republic of Serbia ("Official Gazette of RS", No. 13/96)

The Spatial Plan for the area of infrastructure corridor Nis - Bulgarian border ("Official Gazette of RS", No. 86/2009, adopted on October 21st 2009) which includes E-80 Highway section Ciflik – Stanicenje – Pirot ("Valley Route Alternative").

2.5. Main steps of national procedure on EIA in the Republic of Serbia

In the juridical system of the Republic of Serbia, the Environmental Impact Assessment procedure is regulated by the Law on Environmental Impact Assessment, along with appropriate sublegal enactments which determine particular issues within the Impact Assessment procedure in more detail. One of the extremely significant elements in the procedure itself is public involvement and the duty of forming the Technical Committee. The subject-matter of the Environmental Impact Assessment are the projects which are being planned and conducted, technology improvements, reconstructions, capacity expansion, work termination and removal of projects which significantly influence the environment. The procedure of Environmental Impact Assessment consists of three phases (depending on the List containing a certain project, there can be one, two or more phases):

- Phase I: Decision-making on the necessity of Environmental Impact Assessment of the project
- Phase II: Specification of scope and contents of the Environmental Impact Assessment Study
- Phase III: Environmental Impact Assessment Study

Entities which participate in the Environmental Impact Assessment procedure are the following: project contractor (PEPS), relevant authority (Ministry for Environment and Spatial Planning), elaborators of the study, interested authorities, organizations and general public.

Environmental Impact Assessment of the E- 80 highway project, Nis - Bulgarian border, section Prosek – Dimitrovgrad, divided into five sections, is procedurally completed for two sections (official approval has been obtained), whereas the study for one section has passed the public consultation and is in the phase of acquiring the official approval from the relevant Ministry. The EIA Studies preparation for the remaining two sections is still in progress.

3. PROJECT DESCRIPTION

3.1 Route Characteristics

3.1.1 Route Description

The branch of corridor X, highway E - 80, section Niš – Dimitrovgrad was designed through five sections:

a. **Prosek – Crvena Reka**
b. **Crvena Reka – Čiflik**
c. **Čiflik – Stanicenje - Pirot**
d. **Pirot – commencement of Dimitrovgrad bypass**
e. **Northern Dimitrovgrad bypass**

a) Section: "Prosek – Crvena Reka"

Highway route turns southeast in the area behind the village Malča, crosses the urban road, then goes across the existing railroad Niš – Dimitrovgrad and accross the river Nišava, intersects the railway for high-speed trains and on the section Prosek – Crvena Reka goes through the area of Jelašnica gorge, through the narrow valley of the river Kunovaka to the village Bancarevo, where it first turns east, then north and then through the valleys of several small streams slopes down to the valley of the river Nišava. On this section, the highway mostly follows or coincides with the route of regional road R-241a Niš – Crvena Reka.

New sections of the regional road will be conctructed on those parts where the motorway route uses the regional road route. On this section, the motorway route lies on a slightly sloped ground only before the entrance to the gorge, whereas higher slopes occur from that point onward, which requires the application of adequate sharper route elements. The highway slopes down from the hilly terrain to the valley region in the vicinity of the village Bancarevo, through the tunnel under the fold Ploča.

Upon exiting the tunnel from the confluence of Bancarevo stream into the Draguša river, the route is generally located on the contact of the left slope and the valley of the river Draguša. From the confluence of the river Draguša into the river Crvena reka immediately in front of the village Glogovac, the route is generally located in the same manner on the contact of the valley of the river Crvena reka and its left slope. The rivers Draguša and Crvena reka create numerous meanders on those parts where their valleys are widened. Downstream from the village Glogovac, the Crvena reka has several relatively short stretches with narrow, gorge-like valleys. Along the left curve, the route transfers to the right bank of the river Crvena reka, i.e. to the slope above the left riverbank of the river Nišava in the district of the village Crvena Reka.

b) Section: "Crvena Reka - Čiflik"

After the highway route descends into the district of the village Crvena Reka, the highway transfers by one structure to the right bank of the river Nišava across the regional road Niš – Dimitrovgrad, the existing railroad Niš – Dimitrovgrad and the railway for high-speed trains Niš – Dimitrovgrad. In its following course, on the section Crvena Reka – Čiflik, the highway route is located on the contact of the slopes of Svrljig mountains and the valley of

the river Nišava, thus bypassing Bela Palanka from the north. Traffic connection between Bela Palanka and E – 80 highway is represented by a delevelled crossroad – Bela Palanka interchange.

c) Section: "Čiflik – Stanicenje – Pirot“

The E-80 Highway sub-section Ciflik – Stanicenje – Pirot, which is presented in this Report, is known as a “Valley Route Variant”, starting on km 53+316.91 close to settlements named Ciflik and ending on km 81+450.00, southeast of Pirot, near place named Baceve Livade. A situation map of the E-80 Highway sub-section Ciflik – Stanicenje – Pirot is presented on Picture No.1. Proposed alignment of the highway is marked with the red color on the Situation Map. Starting point of Highway section is close to settlement Ciflik, and alignment of the road is placed close to following places: Sinjac, Crnokliste, Crvencevo, Stanicenje, Sopot, Gnjilan, Pirot and ending near place named Baceve Livade.

Hydrographic network is extremely diversified and belongs to the water basin of the Juzna Morava. The main water flow is the river Nisava with its tributaries: Petrova reka, Temska, Vranasnica, Kosturska reka.

d) Section "Pirot – commencement of Dimitrovgrad bypass"

Between Pirot and Sukovo, the highway route is in the corridor of the regional road Niš – Dimitrovgrad (current M.1.12.), it stretches over a flat terrain and is mostly on the course. Further, the highway route mostly consists of consecutive S curves up to a point on the river Jerma. From the bridge over the Jerma, the route lies on an extremely flat terrain. Cutting the Nišava meander by means of bridges near the village Obrenovac, the route transfers its position from one to the other riverbank.

The village Obrenovac represents a starting point for more complicated conditions for the route lay-out. There is a tunnel in the vicinity of Obrenovac. After the village Obrenovac, the highway lies on a slightly steeper slope immediately alongside the railway which is, similarly to the highway, in the right curve but of a smaller radius. Following the left curve, the highway then moves away from the railway and crosses the bridge to the right bank of the Nišava, where it continues its course all the way to Dimitrovgrad.

e) Section "Northern Dimitrovgrad bypass"

Highway E-80 bypasses Dimitrovgrad and its suburban settlements on the north side, covering a stable, barren and undeveloped ground without disturbing the existing city operation and its future spatial development. On the segment of border crossing, the highway route fits into the existing road. The terrain on this section can be characterised as mountainous and extremely difficult for highway construction. Such a terrain caused the construction of two tunnels and a bridge on the route. The position of Dimitrovgrad interchange is west of the city centre.

3.1.2 Constructive characteristics

- Geometrical cross-section

Geometrical cross-section of the highway for design speed of 100 km/h:

Driving lanes	4 x 3.50 m	=	14.00 m
Emergency lanes	2 x 2.50 m	=	5.00 m
Marginal strips	2 x (0.35 m+0.20 m)	=	1.10 m
	Total pavement	=	2 x 10.05 m
Verge	1 x 4.00 m	=	4.00 m
Earth shoulders	2 x 1.00 m	=	2.00 m
TOTAL			**26.10 m**

Geometrical cross-section of the highway for design speed of 120 km/h:

Driving lanes	4 x 3.75 m	=	15.00 m
Emergency lanes	2 x 2.50 m	=	5.00 m
Marginal strips	2 x (0.50 m+0.20 m)	=	1.40 m
	Total pavement	=	**2 x 10.70 m**
Verge	1 x 4.00 m	=	4.00 m
Earth shoulders	2 x 1.50 m	=	3.00 m
TOTAL			**28.40 m**

Table T 3.1.2-1: Constructive characteristics of E – 80 highway Prosek – Dimitrovgrad

	Section: **Prosek – Crvena Reka**	Section: **Crvena Reka - Čiflik**	Section: **Pirot – commencement of Dimitrovgrad bypass**	Section: **Northern Dimitrovgrad bypass**	**Highway E-80 Prosek - Dimitrovgrad**
Length (km)	22,525	10,296	12,754	8,672	83,314
AADT* (veh/day)	14 073	13 786	15 782 / 13 405*	14 773	
Design speed Vr (km/h)	120	120	120	120	100 / 120
Horizontal curve radius, min. / max. applied (m)	750 / 4 500	750 / 1875	750 / 5 000	775 / 4 000	
Longitudinal grade, min. / max. applied (**%)**	0.8 / 4.70	0.25 / 2.25	0.8 / 5.00	0.5 / 5.00	0.25 / 5.00
Total width of roadbed (m)	28.40	28.40	28.40	28.40	26.10 / 28.40
Drainage concept	closed system	closed system	closed system	closed system	closed system
Retentions, number	38	15	23	stormceptors	108 and stormceptors
Delevelled crossroads	-	• Bela Palanka (Y-junction)	-	• Dimitrovgrad • Gradina (Y-junction)	
Underpasses AP, total length (m)	110	81	50	50	398
Overpasses, total length (m)	39	168	385	-	950
Bridge Total length – left (m)	467	582	116	1 148	4 744

		Section: **Prosek – Crvena Reka**	Section: **Crvena Reka - Čiflik**	Section: **Pirot – commencement of Dimitrovgrad bypass**	Section: **Northern Dimitrovgrad bypass**	**Highway E-80 Prosek - Dimitrovgrad**
	Total length – right (m)	518	581	116	949	4 313
Tunnels	Total length – left	648	-	199	176	3 872
	Total length - right	950	-	176	199	4 326
Supporting facilities		• 6 parking lots	-	• 2 lay-bys	-	• maintenance centre • 8 parking lots • 6 lay-bys
Pavement		flexible	flexible	flexible	flexible	flexible

* **A**verage **A**nnual **D**aily **T**raffic (**vehicle per day**)

3.2 Geographical position

The newly designed E – 80 highway route is situated in the region of Balkanian Serbia. This region encompasses the southern part of Eastern Serbia and is adjoined on three sides: the border with the Carpathian Serbia is represented by the line Rožanj – Rtanj – Stara planina, the border with Pomoravlje is the valley-like watershed between the water basins of the Nišava and the Vlasina, and the border with Bulgaria. The mountains of the Balcan Serbia represent the western part of the parallel Balkanids (Carpatho – Balkanids). Among the Balkanids, the most prominent mountains are Stara planina, Suva planina, Svrljig mountains, Belava and Tupižnica. Hydrographic network is extremely diversified and belongs to the water basin of the Južna Morava. The main water flow is the river Nišava with its tributaries. The Nišava (length 218 km), as the longest tributary of the Južna Morava, originates in the Republic og Bulgaria and flows through Dimitrovgrad basin, Pirot basin, Bela Palanka basin and Sićevac gorge.

The highway stretches out in the direction northwest - southeast, from the city of Niš, through Bela Palanka and Pirot, to Dimitrovgrad (the border with the Republic of Bulgaria).
At its very beginning, the route of the future road extends onto the northern slopes of Suva planina mountain, goes through the valleys of the rivers Nišava, Studena, Kunovačka reka, Draguša and Crvena reka. On this section, the highway touches the southern border of the Natural park „Sićevačka klisura“ from the settlement Prosek to the settlement Crvena Reka.

From the settlement Crvena Reka, the route transfers to the right bank of the river Nišava. The corridor’s northern border is the southern edge of Svrljig mountains, whereas its southern border are the northern slopes of the mountain massif Belava. This region is dominated by the Bela Palanka basin and the river Nišava, which flows through the basin together with its tributaries: rivers Petrova reka and Temštica, as well as the small streams. Further, the future road passes close to the settlements Bela Palanka and Čiflik. After Ciflik, alignment of the road is placed close to following places: Sinjac, Crnokliste, Crvencevo, Stanicenje, Sopot, Gnjilan, Pirot and ending near place named Baceve Livade.

Hydrographic network is extremely diversified and belongs to the water basin of the Juzna Morava. The main water flow is the river Nisava with its tributaries: Petrova reka, Temska, Vranasnica, Kosturska reka.

From Pirot to Dimitrovgrad, the route follows the valley of the Nišava. It bypasses the settlement Dimitrovgrad on the north, thus being on the southern slopes of the mountain Stara planina (Vidlič).
Larger urban centres encompassed by the corridor of the future road are Niš, Bela Palanka, Pirot and Dimitrovgrad.

3.3 Ecosystems, protected natural resources and their locations

E-80 highway corridor comprises a wide range of ecosystems, which is caused by diversity of reliefs and variations in altitude.

At the beginning of the explored area, the terrain is mostly flat, approximately to the 58 km of the route, and it is situated in the valleys of the rivers Nišava, Crvena reka, Studena and Kunovačka reka, which themselves represent separate water ecosystems. Flattened terrain also occurs from the 80 km to the end of the section. The altitude (approximately 230 m)

influences the structure of flora and fauna together with the abovementioned water flows. River valleys are characterised by anthropogenic and natural ecosystems.

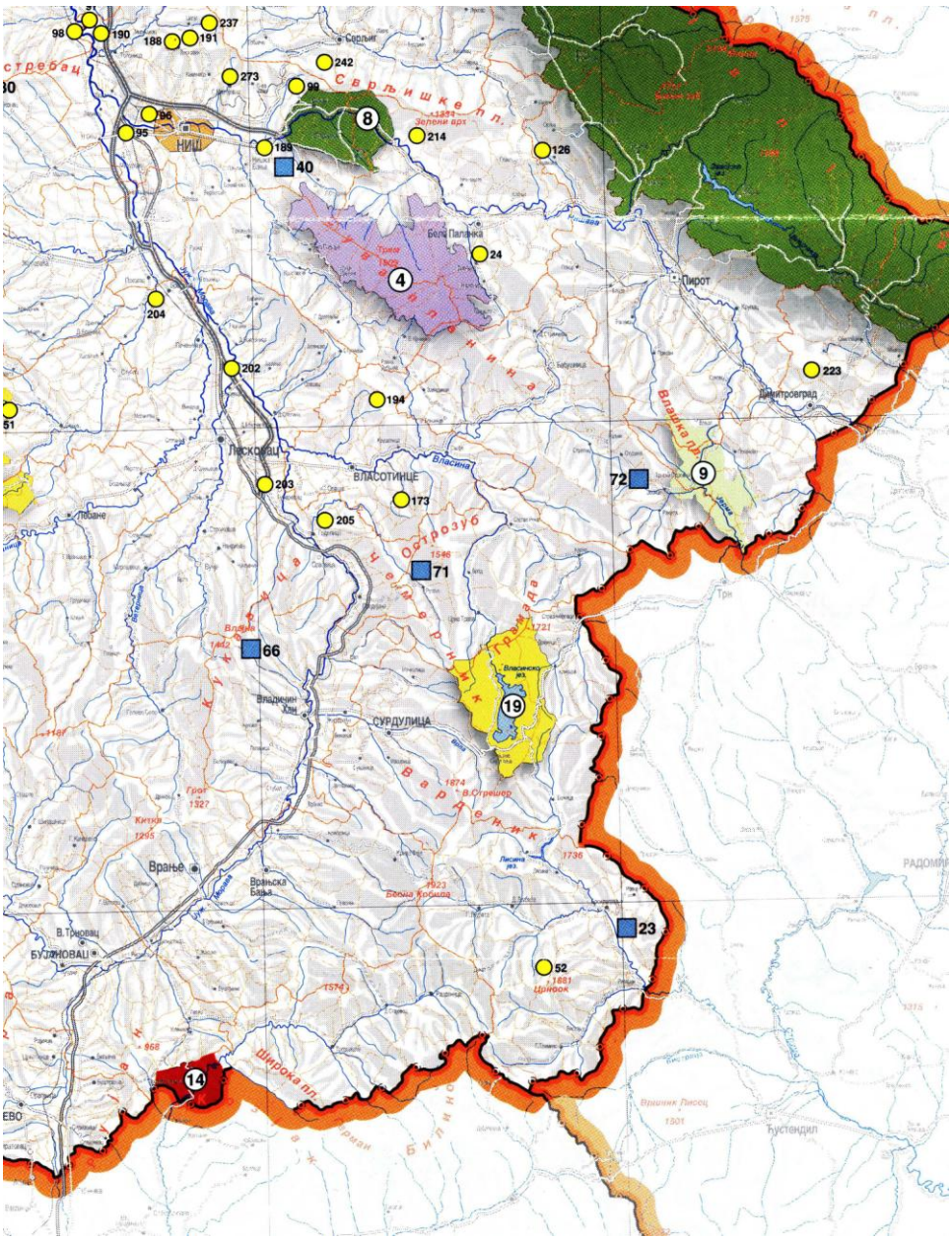
As regards the anthropogenic ecosystems, the autochthonous flora was cleared in order to turn the fertile land in the valley of the Nišava and its tributaries into arable land. This also led to the disappearance of natural habitats for numerous animal species. Ploughlands prevail, whereas vineyards and orchards alternate in smaller parcels. Within the cultural ecosystems, there is a differentiation between two basic types: cultures of grains and vegetables, and cultures of fruit and vineyards.

Meadow communities in the region of alluvial plains represent natural ecosystems and are inhabited by species characteristic of areas with a high level of ground water. Considering that the meadows are mostly degraded by poor management (of previously well maintained mosaic of small scale mixed farming) and, the occurrence of various weed species is significant. Of all the fauna representatives, only those which have adjusted to the anthropogenically modified conditions can now be found.

The route of the Project highway section from Ciflik to Pirot does not follow the existing road through the Nature Park, but takes a southerly route outside the park, such that the left (northern) edge of the road zone lies approximately 200m away from the southern border of the park. (see pic 1, page 8). Preconditions obtained from INP (No 03-527/2 from 16th Oct 2010 – see App.) strictly pointed that there is no statutory protected areas within the highway section zone and there is no specific obligations or demands prescribed in order to protect such areas.

Natural park „Sićevačka klisura“ which is classified in the II category of protection is also located in the explored area, outside the area of subject road. It is featured by well-preserved natural characteristics of waters, air, land and ecosystems. There are no bigger degradational changes in the area itself, hence it represents a significant part of preserved nature and healthy environment. Upon checking the registry of protected natural resources, it was established that the newly designed highway lies alongside the very border of the natural park, so that the left (northern) edge of the road zone represents the southern border of the park. In addition to the Sićevac gorge, there is also the Jelašnica gorge in the vicinity of the explored area, which is registered as a special natural reservation.

During the design of section of highway is specially taken into account the position of well-protected natural using the conditions that had been given from Institute for Nature Protection for Highway E-80, section Nis-Dimitrovgrad (see Appendix D- Reference, the 4th point) where is determined that there are no well-protected naturals, and that there are in the close and wider surroundings are natural, which are mentioned because of possible plans for the design of the following facilities.



Picture 3.3.1 Map of well-protected naturals in the wide area of project

3. 4 Social Aspects

From the aspect of organization, arrangement and usage of the territory of the Republic of Serbia, the basic objective of development strategy is to achieve a more uniform territory distribution of the population, as well as the intensification of its reproduction, i.e. the increase in the share of younger population in emigration areas and areas with a high index of ageing. Realization of this goal is achievable by combined, adjusted measures of demographic policy and policy of regional development in the field of two fundamental components of demographic development (biodynamics and migration).

Construction of the infrastructure corridor Niš – Bulgarian border will have a favourable impact on the traffic and economic connection of the Republic of Serbia with its neighbouring countries, as well as on faster development of the region surrounding this corridor. More beneficial connections of the southeast Serbia with the west, central and south Serbia and the region of Podunavlje near the river Timok will be established through this corridor and the regional traffic network. Intensification and connection of traffic courses in the corridor will influence the strengthening of economic and other functions of Niš, which is now the most significant transport node after Belgrade, as well as on the development of Pirot, Bela Palanka and Dimitrovgrad, cities on the route of the corridor Niš – Bulgarian border.

From the aspect of functional classification of settlements in the area, there is a conspicuous differentiation between urban and rural settlements.

Distinctive 5 levels of centres are defined in the potential settlement network as follows:

- macro-regional centre: Niš (235159 inhabitants)
- regional centre: Pirot (63791 inhabitants)
- urban centres: Bela Palanka (14381 inhabitants) and Dimitrovgrad (11748 inhabitants)
- village community centres: Gornji Matejevac (city of Niš); Crvena Reka and Čiflik (municipality of Bela Palanka); Temska and Sukovo (municipality of Pirot)
- centres of two or more villages: Jelašnica, Sinjac, Glogovac, Dol, Moklište (municipality of Bela Palanka); Krupac and Staničenje (municipality of Pirot); and Željuša (municipality of Dimitrovgrad).

The corridor area represents a part of macro-regional area of Niš, which influences the area populated with 1.3 million of inhabitants. Concentration of all traffic types on the narrow area of river valleys of the Južna Morava, Nišava and Toplica caused approximate concentration of 90% of the total population of the region, urban settlements, economic capacities of non-agricultural type and main infrastructure systems on these axes.

Developmental perspectives of the area encompassed by the corridor of E – 80 highway will be multifunctional:

1) Advantages originating from geographical and traffic position of the area, with a permanent value, and based on which the realization of significant effects in the domain of investments can be expected, which will generate other positive economic effects and changes in the area.
2) In the domain of demographic tendencies, a higher volume of spatial redistribution of the population is not expected. For more intense migrational tendencies there are no assumptions in the total demographic potential, which is in a declining developmental phase (negative population growth, unfavourable age structure of the population). Population concentration rate in urban centres (Niš, Pirot, Bela Palanka, Dimitrovgrad) will increase, more on the basis of decrease in the total population in rural settlements, than on the basis of increase in cities.
3) Hierarchy of urban centres determines the dominant role in the settlement system to the already affirmed centres (Niš, Pirot, Bela Palanka and Dimitrovgrad), which will hold the acquired positions from the aspect of interregional distribution of functions.

Intense urbanization zones will remain in the valley of the Nišava along the highway. Concentrated urbanization will continue around the urban centres of Niš, Pirot, Bela Palanka and Dimitrovgrad. Larger expansion of construction areas of rural settlements is not planned, only the supplement of the existing areas. New construction is only possible as an interpolation in already constructed objects, or as a replacement of dilapidated residential objects with the new ones.

The newly designed highway represents an integration factor of national and regional area, simultaneously being a disintegration factor of local area, i.e. local community.

The analysed corridor area encompasses the settlements belonging to the municipalities of Bela Palanka, Pirot and Dimitrovgrad. The settlements are of rural type, with small population density, except for the urban centres of respective municipalities: Bela Palanka, Pirot and Dimitrovgrad.

The area is stricken with population emigration and depopulation of rural areas. Urban settlements Pirot, Bela Palanka and Dimitrovgrad, and their suburban settlements Gnjilan, Poljska Ražana and Crvena Reka are on the level of population growth. Extremely emigrational settlements are those belonging to the municipality of Bela Palanka and Mali Jovanovac in the municipality of Pirot. Over the last ten years, the population has slightly decreased, and the same tendency is noticeable in a certain number of households. Everything points to a decreased rate of population growth and to local migrations directed towards the above-mentioned urban centres. Number of the working-age population and of those agriculturally active is in slight decline (in comparison to the period from 1991 - 2002).

The changes in rural settlements' structure will mark the continuation of initiated demographic decay of numerous little settlements on one hand, and the formation of smaller centres with urban structure features in the rural area, on the other hand (craftsmanship, petty industry, catering industry and other commercial activities).

4. BASELINE DATA

4.1 Geology and soil

4.1.1 Pedological Characteristics

Due to relief complexity, geological structure, climate, vegetation and effects of time and man, various genetic types of soil have formed in a very small area. For that reason, about 25 soil types, subtypes and varieties have been identified within the research area incorporating a part of Nis valley, Bela Palanka and Pirot valleys, the River Nisava's alluvium and its tributaries. These types are calcareous alluvium, alluvium developing into cambisol, waterlogged alluvium, acidified grassland, chernozem soil, calcic vertisol, eutric cambisol, terra rosa, rendzina, umbric leptosols, podzols including slates, degrading calcomelanolosole complex, etc.

Generally, recent alluvial deposits (alluvial grassland) is a heterogeneous group of soils formed as fresh deposits in the area of rivers (the rivers Nisava and Jerma). Alluvial deposits take up large areas across which will pass the newly designed highway section, in all of the sections from Prosek to Dimitrovgrad, i.e. border crossing Gradina. These soils represent high quality soils, as regards agriculture, and are rated as Class II.

The main types of soil in the highland area of the region can be categorized in the mountain range of Stara Planina, the basin of Nisava, on red sandstones with regosols (petrographic formations which have not yet developed into soil), umbric leptosols or humus-siliceous soil and dystric cambisols (beech forest).

4.1.2 Relief – Geomorphological Features and Catchment Area

4.1.2.1 Geomorphological Features of the Terrain

According to its geographic position, the entire research area is a part of Southeast Serbia. Morphologically, the area's relief covers highlands and flatlands.

The mountain slopes of Suva Planina, Svrljiska Planina and Stara Planina are a part of the highlands area. The relief is "sharp-like" with great differences of height.

Alluvial areas of Nisava River and its terraces present the flatland relief. The bed of Nisava River was formed after the Neogene lakes retreated and dried out. The river Nisava cuts through the gorge known as Sicevo Gorge, which is most definitely the most prominent morphological feature in the research area. This river made several terraces during its formation, the highest of which is at 508 m.

Nisava valley is especially interesting as regards geomorphology. This river flows through several hollows: Nis, Bela Palanka and Pirot Hollow. The width of the river valley of Nisava is very changeable, its width varying from several tenths of meters to several kilometers. The other river valleys are mostly gorges having local broader areas. Sicevo Gorge, which connects the Nis Hollow to the Bela Palanka Hollow, has specific hydrographic features. In this part, Nisava runs fast and wild, its river bed ranging from 15 to 25 m of width. The width, height and depth of the flow rise when the water levels are high.

The most prominent area of the hollow of Pirot Hollow is the area between the river of Prisjanska Reka and the River Jerma, which have deeply carved their beds into the substrate due to their torrential flows.
The quantity of water in the River Nisava increases toward its mouth. This is mostly due to its tributary Temstica.

According to its geographic position, the research area of said highway corridor ranging from the Municipality of Pirot, via Municipality of Dimitrovgrad, to the Bulgarian border, represents an area ranging upstream of the River Nisava and which is a part of south Carpathian Mountains – Balkan region, with the Timok Zone as a subordinate unit. This large tectonic unit, located on the slopes of the River Nisava (before Dimitrovgrad) is a part of Vidlicka Navlaka mountain (the peaks: Pametnik and Kozarica).

Later morphological formations of the relief are fluvial denudation areas and slopes and areas formed by erosion and accumulation represented by alluvial deposits and terraces, alluvial fans, talus and scree deposits.

Complex geological structure, various and highly active tectonic movement, including later erosion caused by numerous and different exogenous factors, have all contributed not only to the morphological variety of researched area, but also to its hydro-geological complexity.

The river valleys have cut deep into the ground due to the long period of erosion, which has disturbed the unity of the mountain ranges and made them less prominent.

According to its geographic position, the Project area is a part of Southeast Serbia and morphologically, the area's relief covers highlands and flatlands. The mountain slopes of Suva Planina, Svrljiska Planina and Stara Planina are a part of the highlands area.

Alluvial areas of the Nisava River and its terraces present the flatland relief. The bed of Nisava River was formed after the Neogene lakes retreated and dried out. The river Nisava made several terraces during its formation.

Nisava valley is especially interesting as regards geomorphology. This river flows through several hollows: Nis, Bela Palanka and Pirot Hollow. The width of the river valley of Nisava is very changeable, its width varying from several tenths of meters to several kilometers.

Average height is approximately 300 m and proposed Highway sub-section fits on existing relief. Bridges over river Nišava, Vranašnica, Temska, Matica, Kosturska and Rasnička, together with numerous streams contribute to the very nice visual impression. Some obstacles into the relief are solved with the tunnel constructions named „Sopot“, km 66+383.08 to km 66+573.55, and „Sarlah“, km 73+274.91 to km 73+712.52

The age of bedrock, volcanic or tectonic activity, lacustrine and fluvial erosion of the entire area have greatly influenced the current geomorphologic features of the terrain and the exodynamic processes.

The quantity of water in the River Nisava increases toward its mouth. This is mostly due to its tributary Temska.

Later morphological formations of the relief are fluvial denudation areas and slopes and areas formed by erosion and accumulation represented by alluvial deposits and terraces, alluvial fans, talus and screen deposits.

Complex geological structure, various and highly active tectonic movement, including later erosion caused by numerous and different exogenous factors, have all contributed not only to the morphological variety of the area, but also to its hydro-geological complexity.

4.1.2.2 Catchment Area

The river system is highly branched and is a part of the Juzna Morava river basin. The main watercourse is the River Nisava with its tributaries: Petrova Reka, Temska, Rasnicka, and several small streams within the study area of the new designed sub-section of highway E-80. All tributaries are more or less torrential and they form alluvial deposits at their endings. This has caused disturbance in the overall condition of the larger area. The main causes of these problems (surface wash, formation of bare and rocky land, formation of deposits in flatlands, formation of bogs in valleys) are the destructive effects of erosion. For this reason, particular attention will have to be paid to stabilization works and river defenses, where the highway is routed within watercourses.

4.1.3 Geological Structure

The terrain in the section of Highway E-80, Nis – Dimitrovgrad, is comprised of bedrock of various age (Paleozoic Era, Mesozoic Era and Cenozoic Era), arranged in geotechnical groups.

The oldest, Paleozoic formations are represented by Permian sediments (P) and are formed by red sandstones, aleurolites and conglomerates, which are discordantly spread over Devonian flysch.

Mesozoic formations are the most frequent at the research area. Triassic (T_{1-2}) formations, which are chronologically the first, onlap the Permian sediments. These are little present on the surface and appear as eroded areas. According to their lithological composition, these are limestones, sandstones and conglomerates. Jurassic (J_3^3) sediments onlap the Permian and Triassic sediments and are represented by thin series of calcareous clastic sediments – limestones and sandstones. Lower Cretacious sediments are concordantly formed on the Jurrasic sediments. Lower Cretacious sediments are Aptian (K_1^4) formations represented mostly by shallow water calcareous clastic rocks.

Cenozoic formations are unconsolidated and semi-consolidated rock formations of Pliocene and Miocene age (Pl,M_1) of lacustrine origin. These are mostly formed by clays, sands and gravels in the roof stratum, and sandstone marls and limestones in the substratum.

The group of Quarternary unconsolidated and semi-consolidated bedrock is represented by paludal alluvial sediments (b - al) connected with backwaters, fluvial deposits along the river flows (terrace - t, alluvial - al, talus - d, subordinate proluvial - pr) and slope formations made of talus sediments – d, bedrock and bedrock in active and still landslides - Ko, screes - S.

4.1.3.1 Hydrogeological Features of Bedrock

Hydrogeological features of bedrock and terrain are predisposed by geological features: lithological rock type, degree of tectonic and exogenous damage and hypsometric position with regard to erosion bases.

Analysis of results from hydrogeological investigations conducted in the section of Highway E-80 corridor, Nis-Dimitrovgrad, showed confined aquifers of free level and fractured bedrock aquifers.

Alluvial sediments have been formed along all the researched rivers where almost regularly free level aquifers are formed. Greater economic importance lies with the aquifers formed in the alluvium directly along the River Nisava and its larger tributaries, with significant amounts of sands and gravels which form a groundwater aquifer. These aquifers are actively hydraulically connected to surface flows and are replenished from precipitation and infiltration of surface flows. River deposits are 10 - 20 m thick, whereas the depth to reach groundwater level is up to 5.0 m. Results of laboratory tests conducted for the engineering geology and geotechnical study, which contain, among other things, tables of filtration coefficients, indicate average to good water permeability.

The free level confined aquifers in Tertiary sediments of the River Nisava basin are mostly formed in gravelly sands and in fine-grained to medium-grained Pliocene sandy gravels, which are the residue of the final sediments in lacustrine terraces. Aquifers are mostly formed by infiltration of water from precipitation and lateral underflow, they are drained by springs and are characteristic for significant changes of yield, so the largest number of aquifers dries out over the summer. The sediments are up to 10 m thick.

The fractured bedrock aquifers are formed in the River Nisava basin in terrains containing Paleozoic slates, schistose Devonian flysch, red sandstones, shales and marlstones from Oligocene period. Such aquifers have a very small yield and many parts of the terrain are practically arid. Absence of groundwater especially in Permian sediments is caused by precipitation not being able to reach below ground because argillaceous products fill up the fractures.

However, these sediments are very important because they form a impervious substrate and over it thick sediments of layered, massive and highly eroded limestones, and partially Miocene and Pliocene sediments, in which significant amounts of groundwater are accumulated as fractured bedrock aquifers or confined aquifers, thanks to the favorable spatial position.
Generally, the researched terrain lacks in sufficient amounts of groundwater. This entire area, especially schist formations, has no large springs, or the conditions to obtain sufficient amounts of dinking water by excavating wells. And nevertheless, local water requirements are met because the available amounts of water are used only for drinking.

Lithological composition clearly shows that the area of the new highway section is mostly taken up by bedrock of intergranular porosity and rarely by intergranular / fracture porosity and fracture porosity or fracture / cavernous porosity. Based on these facts, water permeable and impervious rocks have been separated according to hydrogeological functions.

Rock formations with good water permeable properties are alluvial sands and gravels located in the valleys and in the three levels of terraces on the perimeter of the alluvium as morphologically prominent plateaus. Rock formations with average water permeable properties are heterogeneous talus and scree deposits located on mountain slopes. These are comprised of debris, gravels, sands and clays. Talus deposits range between 1 - 3 m and 3 - 5 m of thickness. Bedrock with low water permeable properties are Pliocene and Miocene sediments as well as

groups of Cretacious limestones, sandstones, marlstones, groups of Jurrasic limestones and dolomites and Lower Triassic limestones, conglomerates and sandstones.

Impervious bedrock comprised of Permian sandstones, aleurolites and conglomerates are practically impervious areas with filtration coefficient of $k_f < 5.5 \times 10^{-6}$ cm/s.

4.1.4 Recent Exodynamic Processes and Phenomena

Exodynamic processes and phenomena – surface decomposition, landslide, dispersal, linear and planar erosion, are present in most of the research area, mostly sloping terrain, i.e. in the River Nisava area.

All present exodynamic processes are connected by cause and effect. The age of bedrock, volcanic or tectonic activity, lacustrine and fluvial erosion of the entire area – all have greatly influenced the current geomorphologic features of the terrain and the exodynamic processes.

The processes and products of surface decomposition of bedrock are present across the entire research area, whereas the extent of affected area depends on age and lithological composition of bedrock and the intensity of external. Decomposition, i.e. change of basic rock properties and a friable layer is formed due to physicochemical influences of surface water and groundwater, dissolution, surface wash, temperature variations, frost, crystallization, plant roots, etc. Intensity of changes in bedrock most often gets reduced along with the increase of depth.

Landslips and landslides are mostly caused due to complex geological and morphological development of the terrain. However, nowadays a more frequent cause is man's building and economic activity. This is what caused new landslides and "revived" the old ones.

As regards stability, the area belonging to the River Nisava's alluvium ($al^{g,p,s}$) is stable ground and portions of the area comprising of solid bedrock: sandstone, sand limestones, reef limestones and marls (K_1^2 and K_1^3), without talus sediments or with a thin layer of such sediments with the thickness of 1m.

Conditionally stable terrains are mostly slopes composed of talus sediments ($d^{g,dr}$), talus and proluvial sediments ($(d - pr)^{g,dr}$), proluvial sediments ($pr^{g,dr}$) and an area is composed of a heterogeneous group of Pliocene and Quarternary sediment (Pl,Q). The same has occurred to the surface area and places in altered solid bedrock affected by the intensive physicochemical alteration process and tectonic deterioration. Erosive processes of different intensity have been recorded at the sections from Ciflik to Pirot. Strong erosion has occurred at points: km 65 + 000 to km 65 + 500 and km 66 + 200 to km 67 + 800. Strong erosion has also been noted northeast from Dimitrovgrad, in the area of Przojna Padina, Progon and Stranje. Due to high slopes and said processes, this area is put at risk due to erosion.

Unstable areas are slopes with active or inactive landslides. Such are parts of Pirot Hollow which comprise paludal and alluvial marsh soil of low bearing capacity, represented by silt and peat. Building activities in this area and any similar area is not possible without proper remedial actions.

4.1.5 Seismology

Terrain seismicity represents an important parameter for the analysis of potential negative effects, both to geological (natural) environment and technological environment (roads, buildings, facilities). The term 'terrain seismicity' means, in this case, the analysis of seismic hazard and seismic risk. Seismic hazard includes studying of earthquake kinematics and dynamics, i.e. its intensity on ground surface, whereas seismic risk analyses include an estimation of the risk a specific facility is exposed to, which is expressed in potential minor and heavier damage.

Generally, the researched area is geologically highly heterogeneous and comprised by groups of solid bedrock in highland areas, sand and clay sediments in hill areas and fluvial deposits in valleys. This is the area where the mountain range of the Dinarides (Dinaric Alps) meets the Serbian – Macedonian formation. Throughout its geologic history, the entire area has been extremely fractured with faults and creases. The faults are currently inactive, excluding two structures south from the River Crvena Reka, which indicate recent tectonic activity.

This part of the Balkan Peninsula is a part of seismically highly active area. Said part is included in the Mediterranean - Trans-Asian Seismic Belt.

Seismic hazard has been assessed from the available Seismic Map of Yugoslavia, scale of 1 : 1,000,000, and 63 % probability of event, including tracing for recurring periods of 50, 100, 200, 500, 1000 and 10,000 years. According to these maps, the broader research area is a part of the following zones of seismic activity (Table T 4.1.5 - 01).

According to the seismic area maps, the research area belongs to complex terrains where quakes rated 7, 8 and 9^{o} of Mercalli Intensity Scale are possible. Seismic activity is caused by different geological, geotechnical, hydrogeological, engineering geological and geomorphological factors. Seismic activity is especially increased along the various geotectonic units, large faults, unstable areas – having active landslides and terrains which are flooded with groundwater and surface water.

Table T 4.1.5 - 01 Seismic intensity of research area

Return Period (year)	Seismicity according to Mercalli Intensity Scale
50	6°,7° and 8°
100	6°,7° and 8°
200	6°,7° and 8°
500	8° and 9°
1 000	8° and 9°
10 000	8° and 9°

Particularly strong influence to the increase of seismic activity was made by areas which are characterized with diverse terrain and areas at risk from landslides. Due to large landslides, the seismicity degree increased during these earthquakes and numerous buildings were torn down in all instable areas. This did not only reflect only large scale earthquakes, but also strong earthquakes which occurred at far greater distance from this area.

Seismicity and potential increase of seismicity indicate that during construction regulations regarding seismic protection must be met, which requires additional seismic surveys for all invested construction facilities.

4.1.6 Borrow Pits

The term 'soil degradation' with respect to environmental impact means several different processes, the most important of which are landslides and landfalls, erosion, changes of soil permeability, potential impairment of soil characteristics in the broader area, soil degradation due to opening of borrow pits for building material, soil degradation due to formation of waste disposal sites and other effects which may have a smaller or greater effect.

The problem of soil degradation with respect to highway construction is mostly concerned with the necessary transport of large quantities of building material and necessary borrow pits or waste disposal sites. Soil degradation due to opening of borrow pits or waste disposal sites will not occur under the actual conditions. Considering that most of the highway section Prosek – Crvena Reka will be constructed in side cut and also in a tunnel, excess material can be used as a borrow pit for road base construction.

In the event of a shortage of high grade material for embankment construction in Pirot Hull area (for which limestone debris from "Sarpah" tunnel excavation will be used), it is recommendable to use the limestone from the local borrow pits located at 10 km distance from the site. In that respect, the borrow pit "Koren" should be taken into consideration. The borrow pit is located on Pirot-Zavoj road, at 5 km of distance from Pirot, where total limestone reserves are estimated at 4,500,000 m^3. There is also th borrow pit "Tomin Trap" on Pirot-Knjazevac road, in Oreovica Village, located at 8 km distance from Pirot, where limestone reserves are estimated at 150,000 m^3.

Apparently, a shortage of material caused by embankment filling at the most part of the north bypass in Dimitrovgrad can be compensated with the material borrowed from the high side cut and two tunnels "Przojna Padina" (L = 550 m) and "Progon" (L = 1000 m). As high rate embankment and bedding construction material, sand and gravel can be taken from the River Nisava alluvium and large tributaries, but not directly from the river.

4.2 Air

4.2.1 Basic Climatic Characteristics

South part of the Eastern Serbia, through which the new Highway E-80 will pass, is characterized more by continental and less by moderate-continental climate (this is a climatically diverse subregion, which includes a mountain, hollow and valley microregion). This region is characterized by low precipitation. The autumn is warmer than the spring. Mean monthly temperature in January is below zero, whereas the warmest month is July with the temperatures ranging from 20 to 22°C.

Precipitation characteristics on the research area will be relevant for the basic analyses of water pollution and wind characteristics will be relevant for quantification of air and ground pollution. The effect of other climatic parameters for the actual site conditions will be of interest only in analyses of microclimatic changes caused by highway construction.

Available data on individual climatic parameters and phenomena for the section of Highway E-80 were analyzed at the meteorological stations in Nis, Bela Palanka, Pirot and Dimitrovgrad.

Climatic parameters are shown in table below (Table 4.2.1 - 01) and the overview of percentage of basic wind directions and their mean speeds (Table 4.2.1 - 02).

Table T 4.2.1 - 01 Climatic parameters in the Highway E-80 corridor, Prosek – Dimitrovgrad section

Meteorological Stations	Mean Annual Temperatures of Air (°C)	Precipitation			Average Annual Cloud Cover (n/10)	Sunshine Duration - Insolation (%)	Mean Value of Annual Air Pressure (mb)
		Average Value of Mean Annual Precipitation (mm)	Mean Date of the First Snowfall Date	Mean Date of the Last Snowfall Date			
Nis	12	586.8	16.12.	1.3.	5.5	55	1019 - 1020
Bela Palanka	11	-	16.12.	16.3.	5.5	55	1019 - 1020
Pirot	11	594	16.12.	16.3.	6.0	55	1019 - 1020
Dimitrovgrad	16	633.3	1.12.	1.4.	6.0	55	1019 - 1020

* data were taken from Climate Atlas, Federal Hydrometeorological Service of Serbia and Republic Hydrometeorological Service of Serbia

Table T 4.2.1 - 02 Meteorological stations in Nis and Dimitrovgrad

Meteorological Station	Wind Direction	N	NE	E	SE	S	SW	W	NW	no wind
Nis	frequency (%)	3.9	6.1	15.0	4.5	4.3	3.8	6.6	20.3	35.6
	strength (m/s)	2.1	2.7	2.3	1.6	2.2	1.7	1.5	2.9	-
Dimitrovgrad	frequency (%)	0.4	1.7	18.6	29.7	0.6	1.0	13.2	21.3	13.5
	strength (m/s)	2.1	2.4	2.8	2.9	2.2	2.1	2.9	4.7	-

4.2.2 Applicable Standards

The potential negative effects of certain air pollutants and the potential interaction of the effects on man, plants, animals and materials are especially important for the passing of regulations which govern this issue. The effort to reduce air pollution to acceptable limits by administrative measures has resulted in the passing of the Regulations on Limit Values, Pollution Concentration Measurement Methods, Criteria for Determining Measuring Points and Data Recording (Official Gazette of the Republic of Serbia, No. 54/92 and No. 19/06) which prescribe pollution concentration limit values, warning pollution concentrations, episodic air pollution, systematic methods for the measuring of pollution concentrations, criteria for determining measuring points and the method of data recording.

Table T4.2.2 – 01 Mean annual limit values of pollution concentrations represent MAC (Maximum Allowable Concentrations)

Substance	Value	Pollutants' MAC	
		Inhabited Area (mg/m^3)	Uninhabited Area (mg/m^3)
Carbon Monoxide CO	mean max.	3 10	3 5
Nitrogen Dioxide NO_2	mean max.	0.06 0.15	0.05 0.085
Lead Pb	mean max.	0.001 0.01	0.001 0.01
Sulfur Dioxide SO_2	mean max.	0.05 0.35	0.03 0.15
Solids PM10	mean max.	0.05 0.15	0.03 0.05

4.2.3 Current State of Pollution

Please bear in mind that at the time the current state of the measured air pollution was inspected, the traffic was blocked and therefore greatly reduced. Measuring was done by taking samples in two places.

Table T4.2.3 – 01 Measurement results of air pollution at measuring points (mg/m3)

Pollutant (mg/m3)	in Veliki Jovanovac	Gradnje near Dimitrovgrad
CO	0,5	1,14
NOx	0,527	0,836
NO	0,07	0,13
Pb	0,0011	0,003
SO2	0.017	0,041
Dust	0,005	0,007

The highest air pollution values according to all parameters were recorded near the village of Gradinje, which was caused by the road at the border crossing.

The samples were partially analyzed in a laboratory, and partially measured on site at the height of 1.6 m.

The following instruments were used:

- eight-channel sulfur dioxide and dust sampler,
- constant flow rate pump,
- filter paper, 0.5 μ,
- automatic dust reader ″HOND″,
- portable gas analyzer for nitrogen oxides, carbon monoxide and carbon dioxide
- atomic absorption spectrophorometer.

In the highway corridor there are no significant point sources of air pollution. The Main Road M-1.12 ad the Regional Road P-241a are interconnected pollution sources which may cause emissions of increased concentrations of air pollutants. It is assumed that the planned highway will become the dominating linear air pollutant in the researched area.

4.3 Noise

Noise, as one of the more significant influences in this type of project, is defined by local legislation and standards:

- Law on Environmental Protection (Official Gazette of RS No. 135/04)
- Law on Environmental Protection ((Official Gazette of RS Nos.. 66/91, 83/92, 53/93, 67/93, 48/94, 53/95)
- Regulation on Allowed Environment Noise Levels (Official Gazette of RS No.54)
- JUS U.J6.090 and JUS U.J6.205 standards. Standards for noise and air quality are given in Appendix F – Standards for noise and air quality.

Regulation on Allowed Environment Noise Levels provides for allowed noise level within the environment inhabited by man, methods of noise measuring, more detailed requirements to be met by professional noise measuring organizations as well as the contents of the document for sources of noise used. Allowed noise levels have been defined by JUS U.J6.205 standard. Report on preformed measuring and measuring methods have been defined by JUS U.J6.090 standard.

There are no data on existing noise levels for the research area of the highway E–80 Prosek – Dimitrovgrad nor there was any subsequent measuring. Highways, as linear structure, take up large research area, so the recording of current status was difficult. Organizing such measuring requires considerable effort and funds, and it is estimated that the traffic noise will be dominant after the highway has been built.

The current state of traffic noise in the analysed section of the highway corridor is characterized by traffic activity on the Main Road M-1.12, Pirot – Dimitrovgrad section, Regional Road P–241a and railroad Nis – Dimitrovgrad. It is assumed that the planned highway will become the dominating noise source in the researched area.

Maps of noise that show noise levels in the existing conditions are given in the Appendix E-tables, maps and drawings.

4.4 Biosphere (Flora and Fauna)

The most important ecosystems in research area are presented in the project description. These represent the unity of the wildlife and their habitats. More attention will be given here to plant and animal species inhabiting different areas within Highway E–80 corridor.

For sole purpose of this report, in order to protect endangered plant and animal species, specific preconditions given by Institute for Nature protection of Serbia were used. According to actual environmental legislative (see App. C – Legislation and Multilateral Agreements) obtaining of these preconditions is highly required.

Flora, fauna and ecosystem implied in the Project were analyzed in detailed by Institute and preconditions are incorporated in Project design.

4.4.1 Plant Species Survival of which Depends on Watercourses

The proximity of watercourses affects the presence of hygrophile meadows which grow spontaneously due to high groundwater level. Plant species belong to *Molinio-Arrhenatheretea* class and grow in willow and poplar forests *(Salici-Populetum*). The dominating plant species are: *Plantago altissima, Serratula tinctoria, Gentiana pneumonanthe, Pseudolysimachion longifolium, Gratiola officinallis.* At such habitats perennial plants can be found in the form of willow and poplar growths. In areas which are flooded for only a short period of the year, but with high groundwater level, grow the species such as *Salix alba*, including *Populus alba* and *Populus nigra.* More plants grow on drier soil, where the following species of undergrowth are found: *Frangula alnus, Crategus nigra, Viburnum opulus, Cornus sanguinea, Robus caesius,* and the dominating herbs are members of *Populetalia* genus*: Iris pseudoacorus, Agrostis alba, Lycopus europaeus, Lysimachia vulgaris, Lysimachia nummularia, Ranunculus repens, Stelaria nemorum,* etc.

4.4.2 Plant Species of the Climatic Community

Typical forests of Italian oak and bitter oak are represent a climatic community of the most part of Serbia, which is developed on smaller slopes and heights of about 600 m. The edificators are Italian oak and bitter oak, including several woody species, mostly xerophile: *Sorbus torminalis, Sorbus domestica, Fraxinus ornus, Tilia argentea, Pyrus pyraster, Cornus mas, Crategus monogyna, Viburnum lantana, Rosa arvensis, Acer campestre, Acer tataricus, Lonicera caprifolium, Tamus communis, Lathyrus niger, Heleborus odorus*, etc. These communities have mostly been deforested or they have become extremely degraded and are being preserved in sporadic small areas.

4.4.3 Agricultural Plant Species

Agricultural plants or annual plants were grown by man. Rich soil in the proximity of the rivers was converted into arable soil, mostly plough land, and farther away from the rivers in the area of autochthonous vegetation for this climatic zone, plough land is replaced by vegetable crops and in some places orchards and vineyards. The main characteristic of this kind of plant life is the dominant man's influence in growing and nurturing these plants.

4.4.4 Plant Species Typical of South and South East Serbia

Frequent growths of shrubs and lilac are typical for gorges and highly sloped limestone areas (*Syringo-Carpinion orientalis*). These species have no ecological or productive potential, however, their role is to protect the preservation of the habitat. They form small groups of trunks which are up to 4 m high. Beside hornbeam and lilac, there are: *Fraxinus ornus, quercus pubescens, Quercus cerris, Quercus farnetto, Cornus mas.*

4.4.5 Mountain Plant Species

The growth of forests in the hills is conditioned by colder and more humid microclimate. Orographic growths of sessile oak and hornbeam (*Querco-Carpinetum moesiacum)* have the best conditions for development due to increased precipitation and temperature variations without extreme values. This community is rich in plant life and has a good combination of plants the most frequent of which are: sessile oak, hornbeam, small-leaved linden, maple, cornel, blackberry, etc.

4.4.6 Animal Species

Research area of Highway E–80 is inhabited by numerous animal species which are specified as animals important for hunting and which are kept in the hunting-ground and animals which have no importance as regards hunting.
Doe *(Capreolus capreolus)* is ecologically our most frequent autochthonous artiodactyl and the most numerous largest game, apart from wild boar. Biome and habitat of this species are connected to the biome of South European mostly deciduous forests. The doe has adapted to living in flatlands and highlands. It prefers semi-open habitats, although it can be found in completely open semi-autonomous ecosystems such as wheat crops, orchards and meadows streaked with small growths of trees, ridges and hedges. Although, the population trend of this species is stable and it can be more or less found in the hunting-grounds, for the past decades this species has been exposed to highly negative anthropogenic pressure in its entire living area, which has resulted in drastic reduction in the number of these species in many areas.

Like the doe, biome and habitat of the wild boar *(Sus scrofa)* are also connected to the biome of South European mostly deciduous forests. This is a very adaptable species and it can be found in the most different types of habitats in many parts of the land. Thanks to its high biological potential and opportunistic way of life, it persists well to being hunted by man and other predators.

Rabbit *(Lepus capensis)* is mostly related to the habitats in steppes and forest-steppes. Even though, for the past few years its receding of population has been somewhat stopped and the species itself has been characterized by a wide environmental range, and therefore its general population trend could be deemed stable, as game, this species has been irrationally exploited, which results in its receding number and regression of the range of this species.

Pheasant *(Phasianus colchicus)* is an introduced species inhabiting quite a wide range of habitats, from underwood and thickets, which are physiognomically highly heterogeneous, to dry grass habitats on limestone and silicate soil, to artificial ecosystems containing agricultural crops, neglected land covered with high grass, thorns and bushes. The pheasant is a species subject to special regime of hunting management and its natural population is being constantly restored by releasing artificially grown pheasants. This is how it population in the hunting grounds is maintained at the level of its environmental capacity.

Grey partridge *(Perdix perdix)* is a species whose habitat is especially interesting, for several reasons. This is a very popular hunting species, both in its number of population and its share in total number of animals caught. One more interesting aspect of this species are its varying numbers in a number past years, the causes of which are not quite known to this day. The complex effect of biotic and abiotic factors, significantly increased by anthropogenic pressure exerted on this species, certainly represents the basic cause of the variable numbers. Gray partridge inhabits the habitats which are similar to those of the pheasants.

Apart from the mentioned species, other mammals and birds, which are more or less present in the research area, should also be mentioned.

- Mammals: Badger *(Meles meles L.,)* Beech Marten *(Martes foina)*, Pine Marten *(Martes martes)*, Muskrat *(Ondatra zibethica)*, Eurasian Lynx *(Lynx lynx)*, Red squirrel (*Sciurus vulgaris)*, Edible (Fat) Dormouse *(Glis glis)*, Otter *(Lutra lutra)*, Wolf, *(Canis lupus)*, Red Fox *(Vulpes vulpes)*, Wildcat *(Felix silvestis)*, Polecat *(Mustela putorius)*, Jackal *(Canis avreus)*
- Birds: Great Crested Grebe *(Podiceps cristatus)*, Little Grebe *(Tachybaptus ruficolis)*, Cormorant *(Phalacrocoracidae)*, Greylag Goose *(Anser anser)*, long-tailed duck *(Clangula hyemalis)*, Red-crested Pochard *(Neta rufina)*, Gadwall *(Anas strepera)*, Pintail *(Anas acuta)*, Shoveler *(Anas clypeata)*, Greater Scaup *(Aythya marila)*, Marbled Duck *(Maaarmaronetta angustirostrismen)*, Common Merganser *(Mergus merganser)*, Red-breasted Merganser *(Mergus serrator)*, Snew *(Mergus albellus)*, Spotted Crake *(Porzana porzana)*, Little Crake *(Porzana parva)*, Baillon's Crake *(Porzana pusilla)*, Corncrake (Crex crex), Plovers *(Charadriidae)*, Sandpipers *(Scolopacidae)*, Stock Pigeon *(Columba oenas)*, Rock Pigeon *(Columba livia)*, Grey Heron *(Ardea cinerea)*, Greater White-fronted Goose *(Anser albifrons)*, Bean Goose *(A. fabalis)*, Dabbling Duck *(Anas spp.)*, Mallard *(Anas platyrhynchos)*, Common Teal *(Anas crecca)*, Garganey *(Anas querquedula)*, Wigeon *(Anas penelope)*, Ferruginous Duck *(Aythya nyroca)*, Tufted Duck *(Aythya fuligula)*, Common Pochard *(Aythya ferina)*, Common Goldeneye *(Bucephala clangula)*, Goshawk *(Accipiter gentilis)*, Hazel Grouse *(Bonasa bonasia)*, Rock Partridge *(Alectoris graeca Meisner)*, Grey Partridge *(Perdix perdix)*, Common Quail *(Coturnix coturnix)*, Pheasants *(Phasianus spp.)*, Water Rail *(Rallus aquaticus)*, Common Moorhen *(Gallinula chloropus)*, Woodcock *(Scolopax rusticola)*, Coot *(Fulica altra)*, Woodpigeon *(Columba palambus)*, Turtle Dove *(Streptopelia turtur)*, Rook *(Corvus frugilegus)*, Hooded Crow *(Corvus corone cornix)*, Magpie *(Pica pica).*

Conditions of Institute for Nature Protection are given in the Appendix D- Reference (03-527/2 од16.10.2001.).

4.5 Surface and ground water

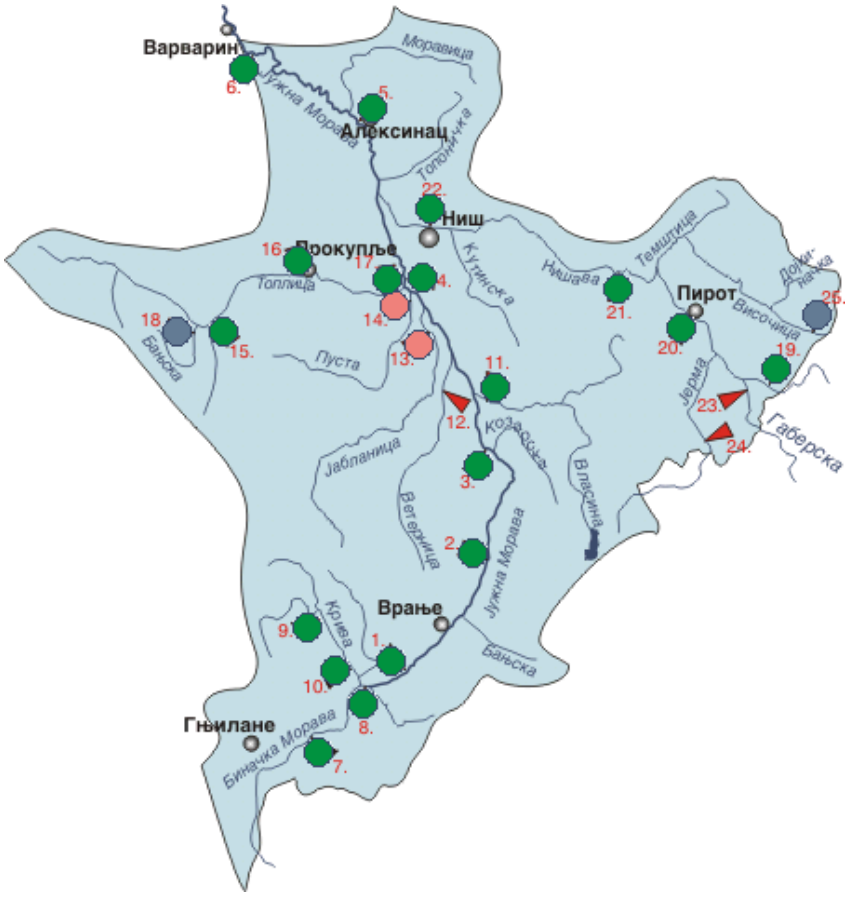
The principle specifying that surface water quality control is an instrument of protection regarding pollution concentrations is systematically introduced by regulations and legislations. In accordance with the Regulation on Water Categorization in the Republic of Serbia (Off. Gazette of the Republic of Serbia, No. 5/68) watercourses have been divided into classes IIa, IIб, III and IV according to predetermined limit values of quality parameters. This Regulation, which was passed in 1968, did not show how to determine a single combined class based on individually defined eleven parameters for water quality, which would be compared to the prescribed one. Further development of the regulation brought forth the

Regulation on Classification of Inter-Republic Watercourses, International Waters and the Sea of Yugoslavia" (Off. Bulletin of SFRJ, No. 6/78) according to which, watercourses were also divided into four classes. Upon that occasion, the quality classification was extended by new parameters (oxygen saturation, COD – chemical oxygen demand, toxic substances and radioactivity). However, the procedure for a single combined class based on individual parameters was not defined again as previously. This problem of undefined legal regulations was overcome to a point by a quality class which was defined based on physicochemical, biological and bacteriological parameters, by arithmetic mean value of the two unfavorable parameters.

4.5.1 State of Surface Water

The river system of the highway corridor ranging from Nis to Bulgarian border consists of the River Nisava with its tributaries. Nisava is a part of the Juzna Morava river basin. Information regarding the current state of the River Nisava's surface waters was obtained from the Republic Hydrometeorological Service of Serbia for 2006. The following figure shows the Juzna Morava river basin with its network of metering stations at surface watercourses.
The River Nisava's tributaries are as follows:

- Kunovacka Reka
- Studena
- Crvena Reka
- Vrasanica
- Kosturska Reka
- Petrova Reka
- several small streams and channels



Water quality according to Nisava Classes at measuring stations in Nis, Bela Palanka, Pirot and Dimitrovgrad is shown in the following table.

River Basin	River	Measuring Station	Actual Class	Required Class
Juzna Morava	Nisava	Nis	**III / IV**	**II B**
		Bela Palanka	**-**	**II A**
		Pirot	**-**	**II B**
		Dimitrovgrad	**III**	**II B**

Water quality from Nisava was tested on the following profiles: Dimitrovgrad – limit profile (III), Bela Palanka (-) and Nis (III/IV). During sampling from individual profiles and in some test series, a change of organoleptic features was recorded – the water had faint traces of color and visible color. In several test series, oxygen saturation values in Dimitrovgrad – Bela Palanka section corresponded to Class III, whereas Nis profile occasionally corresponded to unclassifiable state and the Biological Oxygen Demand BOD-5 corresponded to Class III upon one occasion. The measured suspended solids in Dimitrovgrad and Nis corresponded to Class III and unclassifiable state in several series. Dangerous and harmful substances measurement in Nis profile registered increased value of dissolved Manganese (Mn) in one case. Saprobiological quality testing in Dimitrovgrad, Bela Palanka and Nis indicate moderate organic pollution of watercourses. The dominating were β indicator organisms and α-mezosaprobic zones of *Bacillariophyceae*. Resulting saprobic index values ranged within Class II during all testing periods. The appearance of visible waste and increased suspended matter most definitely results from torrential properties of the River Nisava and its tributaries, and also there is a possibility that wastewater from some industrial plants which flows into the River Nisava contain particles corresponding to the sampled ones. Increased BOD_5 and green color of water indicate pollution of the River Nisava with municipal wastewater.

The conclusion according to the above said is that due to inadequate treatment of industrial and municipal wastewater, which flow into the River Nisava, water quality has declined and now it corresponds to Class III. Such water can be used for irrigation, when treated according to the usual treatment methods (conditioning) and as industrial water (with the exception of food industry).

The data on physicochemical characteristics and water quality of the River Nisava measured in measuring stations in Nis, Bela Palanka and Dimitrovgrad, are shown in the tables herein. The data and tables were obtained from the Hydrologic Annual for 2006, Republic Hydrometeorological Service of Serbia. The tables are enclosed hereto.

4.5.2 State of Groundwater

Analyses of water samples from piezometers or wells in the riverside areas of the River Studena, Kunovacka Reka, River Temstica, River Nisava and Crvena Reka were not available for the analysis of the current state of groundwater quality in the corridor of the road Crvena Reka – Pirot.

4.5.3 Water Intakes

Table T 4.5.3. – 01 shows water intakes and data on the distance from the axis of the new freeway. These data were obtained from Geotechnical Surveys Study prepared for the Preliminary Design of Highway E–80.

Table T 4.5.3 – 01

Survey Mark	A*	B*	C*
km19 + 630	spring of 20 l/min yield	120	prominent
km 19 + 650	well	175	prominent
km 25 + 530	tapped spring of 20 l/min yield	127	small
km 32 + 360	spring of 2 l/min. yield	143	none
km 38 + 580	well	27	small
km 38 + 950	tapped spring of 1 - 2 l/min yield	43	prominent
km 39 + 020	present bog	118	none
km 39 + 250	tapped spring	135	none
km 39 + 800	present bog	32	small
km 40 + 090	present bog	123	none
km 95 + 450	tapped spring	60	prominent
km 96 + 475	spring	125	/
km 99 + 600	wells	140	/

A – hydrogeological phenomena and structures;
B – distance from the highway (m);
C – effect of the highway with regard to the lithological composition, distance and above sea level

Conditions of relevant water management intitutions are given in the Appendix D- Reference (4-109/01 од 25. 07.2001, 4-108/01 од 25. 07.2001, 4-107/01 од 25. 07.2001, 92-I-91/2001-22 од 06. 08.2001, 325-05-1301/01/07 од 18.02.2002.).

4.6 Social – Cultural Environment

4.6.1 Demographic characteristics

Research area is located in Southeast Serbia, partly within the territory of Nisava District and mostly within Pirot District. This is a highland area which could not be linked infrastructurally to economically more developed areas and centers. The neglected economic development of the mountain area, which is also a border area, contributed to mass migration from the villages and their abandonment which was too large .

- Nisava District – Municipality of Niska Banja
- Pirot District – Municipalities of Bela Palanka, Pirot and Dimitrovgrad

The network of settlements includes Nis, a macroregional center, Pirot, regional center and Bela Palanka i Dimitrovgrad, municipal centers. Due to their position and function, the said settlements represent zones to which smaller rural settlements gravitate.

This area is characterized by different population characteristics, depending on whether it is an urban area or a rural settlement without strong urban matrix, the main activity of which is agriculture. The border municipality of Dimitrovgrad, as well the municipality of Bela Palanka, belongs to the category of highly underdeveloped municipalities in Serbia.

Research area comprises 42 mostly rural settlements, except for three urban settlements which, at the same time, represent the centers of said municipalities. The villages have low population density. The entire area is affected by emigration of the population and depopulation of rural areas.

Between 1991and 2002, the population decreased by 32%. During the same period, the number of households in some settlements was increased. The average size of households decreased due to their division as well as migration from the villages.

The urban settlements of Pirot, Bela Palanka, Dimitrovgrad and their suburban settlements of Gnjilan, Poljska Razana and Crvena Reka are at the level of population growth. All settlements within the municipality of Backa Palanka Settlements are high-emigration settlements.

The area of Dimitrovgrad includes the wide area along the Bulgarian border, mostly on the slopes of Stara Planina Mountain. This is a high-emigration settlement. The number of inhabitants is constantly decreasing, which is further exacerbated by negative population growth which, in recent years, equals 8 per mill. The youth population accounts for 25 % of the entire population, 32 % in the city and 19 %. in villages.

The natural environment is a limiting factor for agricultural production due to configuration of the highland terrain, except for the narrow strip in the valley of the River Nisava. The share of arable land in the total area has been decreasing (from 53% in 1991 to 49% in 2002.) which is also reflected by the fact that the number of inhabitants employed in agriculture is in decline. Table T 4.6.1 - 01 shows statistical data relating to population in 1991 and 2002.

Table T 4.6.1 - 01 Comparative overview of demographic characteristics

No.	Settlement	Census Year	Number of inhabitants	Number of households
Municipality of Niska Banja				
1.	Prosek	1991 2002	470 612	125 142
2.	Jelasnica	1991 2002	1729 1709	539 529
Municipality of Bela Palanka				
3.	Glogovac	1991. 2002.	82 47	62 44
4.	Crvena Reka	1991. 2002.	404 304	121 130
5.	Spaj	1991 2002	66 81	28 30
6.	Vrandol	1991 2002	410 372	135 146
7.	Drazevo	1991	44	25

		2002	30	18
8.	Mokliste	1991 2002	704 498	286 227
9.	Dol	1991 2002	99 72	42 33
10.	Bukurovac	1991 2002	50 26	30 15
11.	Klenje	1991 2002	72 54	41 35
12.	Klisura	1991 2002	336 222	151 104
13.	Bela Palanka	1991 2002	8347 8691	2719 3046
14.	Sinjac	1991 2002	380 244	156 110
15.	Ciflik	1991 2002	140 105	63 46
Municipality of Pirot				
16.	Crnokliste	1991 2002	444 338	146 122
17.	Crvencevo	1991 2002	154 135	68 57
18.	Stanicenje	1991 2002	742 610	244 207
19.	Sopot	1991 2002	503 369	175 133
20.	Pirot	1991 2002	40267 41290	12419 13866
21.	Poljska Razana	1991 2002	1306 1357	375 401
22.	Veliki Jovanovac	1991 2002	487 402	155 148
32.	M.Jovanovac	1991 2002	180 155	60 55
33.	Trnjana	1991 2002	268 215	90 81
34.	Крупац	1991 2002	1883 1635	519 477
35.	Gradiste	1991 2002	153 144	62 43
36.	Sukovo	1991 2002	1099 899	377 341
37.	Sreckovac	1991 2002	278 299	107 93
38.	Obrenovac	1991 2002	171 140	59 54
39.	Ciniglavci	1991 2002	568 423	193 150
Municipality of Dimitrovgrad				

40.	Dimitrovgrad	1991 2002	7055 7276	2214 2384
41.	Zeljusa	1991 2002	1391 1442	423 454
42.	Gradinje	1991 2002	250 282	97 95

4.6.2 The purpose of the areas

Spatial defining of certain areas has been graphically represented in the maps Purpose of the Area and Use of Land and it is shown in the Appendix E- tables, maps and drawings.
. The maps were made based on geodetic maps which were prepared for the purposes of Preliminary Design of the highway E–80 Nis – Dimitrovgrad. The maps are presented and printed to a scale of R 1: 5000.

The map shows facilities within the highway corridor:

- populated areas with types of facilities (industrial, residential)
- whole agricultural facilities
- larger groups of perennial crops (forests, orchards, vineyards, grasslands)

Such profusion of data, its diversity and the size of the areas required generalization and systematization of the area purposes shown in the map. The category of grassland, apart from those stated, includes smaller groups of green vegetation. The category of arable land includes areas containing annual crops. Areas containing vineyards and orchards are classified under category of perennial crops. Forests cover areas which are above class six**.**

Table T 4.6.2 – 01 Overview of used areas

stretch	settlements	Agricultural land	Forests	Grasslands	Orchards and vineyards
Prosek– Crvena Reka	1.47	19.6	32.02	11.25	3.91
Crvena Reka – Ciflik	1.66	337.62	11.91	14.8	27.14
Ciflik – Pirot (East)	-	45.2	59,5	14,7	7
Pirot (East)- Dimitrovgrad north bypass	-	6.2	57.3	37.9	7.84
Dimitrovgrad north bypass	-	33.62	7.24	11.65	-
Total	3.13	442.24	167.97	90.3	45.89

Research area is characterized by dominance of plowland areas (59.2%). Agricultural land of the highest quality is located in the valley of the river Nisava. The share of forest areas equals 22.2%. grassland areas (12%) and areas with perennial crops (6%) are distributed in a mosaic pattern. Other areas are built-up areas (0.4%).

4.6.3 Population's health

Health effects of the planned road include effects on inhabitants of the populated areas along the highway as well drivers of motor vehicles and other persons involved (passengers, pedestrians). Such effects include exposure to noise, vibrations and air pollution (combustion of oil and exhaust gases).

Motor road vehicles, whose exhaust gases contribute to decrease in air quality pollution, significantly pollute the environment. Internal combustion engine emits a large number of gases, the most important of which (due to their proven adverse effect on humans) include: CO, NO_x, SO_2, hydrocarbons, lead , as well as solids (PM10) in the form of soot.

Exhaust gases resulting from combustion of fuels in internal combustion engines contain various amounts of carbon monoxide, carbon dioxide, nitrous and other gases. Such gases move through the human body through respiratory system and this is the reason why adverse health effects are mostly shown in respiratory organs. The consequences of poisoning with such gases may lead to pulmonary edema, bronchitis and bronchopneumonia. Only when in high concentrations some of these gases may have adverse effects on other organs (acute carbon monoxide poisoning can lead to death or coma accompanied by diffuse cerebral damage, carbon dioxide causes respiratory center depression).

In the event of accidental spoilage, water and soil pollution by hazardous and toxic substances is also possible.

During the construction of the highway, inhabitants of the settlements through which the newly designed road passes or which are affected by it will be exposed to various influences which are of temporary nature and spatially limited. They will be exposed to fumes containing polycyclic aromatic hydrocarbons (PAH) during application of asphalt layers. Earthworks lead to considerable emission of dust. Also, unpleasant odours occur during handling of materials such as construction materials, sewerage and waste.

Effects of vibrations on the human body include two types: physical (mechanical, thermal) and biological (effects on auditory and vestibular system, on proprioceptors and mechanoreceptors). Vibrations decrease sensitivity to pain, temperature and touch (especially affects fingers, toes and abdomen). Higher sensitivity to vibrations is present in people with coronary artery disease, hypertension and hypotension, middle ear diseases, ovarian cycle disorders.

Design solution reduces the road's adverse effects on population's health to a minimum.

4.6.4 Immovable cultural assets

Immovable cultural assets are being preserved together with the area in which they are located. In the areas where such cultural assets are fully integrated into natural surroundings, they are being preserved together with the preserved environment. Upon examination of the existing layouts and design documents, as well as terrain reconnaissance, it has been established that the research area contains several facilities which may be classified under the said category.

Conditions of Republican Institute for Protection of Monuments of Culture are given in the Appendix D- Reference (416/2 од 28.09.2001.)

Information on the cultural assets was recorded based on data of the Institute for Protection of Cultural Monuments in Belgrade and Institute for Protection of Cultural Monuments in Nis which is provided within Table T 4.6.4 - 01.

Table T 4.6.4 – 01 Recorded cultural assets

No.	area	site name	period
1	Jelasnica	Bare	prehistoric settlement
2	Jelasnica	Bare	prehistoric settlement
3	Jelasnica	Bare	prehistoric settlement
4	Jelasnica	Brod	prehistoric settlement
5	Jelasnica	Ladjiste	prehistoric settlement
6	Kunovica	St. Ilija Church	-
7	Bancarevo	Cesma Moralija	period of Ottoman domination
8	Glogovac	Toplik	Medieval period
9	Glogovac	Tabor	Byzantine period
10	Glogovac	Latinska Crkva	-
11	Glogovac	Seliste	-
12	Glogovac	Polje	prehistoric settlement
13	Crvena Reka	Ladanciste	Roman-Byzantine period
14	Bela Palanka	Suplji Kamen	prehistoric settlement
15	Mokliste	Livade	Roman-Byzantine period
16	Livade	Mokliste	remnants of old "Banovina"road
17	Roman Bridge	Bela Palanka	remnants of roman bridge – ancient period
18	Holy Emperor Constantine and Empress Helen	Bubetac	remnants of basilica, IV to Vi century period
19	Krst-Zapis	Ciflik	cross made of sandstone, erected in 1906
20	Crvencevo	Crvencevo	ancient period

21	Madjilika	Stanicenje	ancient period
22	Gradiste	Stanicenje	ancient period
23	Ciflik	Kameni krst	-
26	Ciflik	Debrin	ancient period
27	-	Simonov Bunar	-
28	V. Jovanovac	Dub	prehistoric period
29	V. Jovanovac	Rupa	-
30	between the areas of Dub and Abdulovac	remnants of the walls	-
31	Lazinje area	remnants of the road	Ottoman period
32	Lazinje area,	остаци пута	Ottoman period
33	Gradiste	праисторијска керамика	prehistoric period
34	Cinglavci	Mound dedicated to Yugoslav soldiers killed during the April War	WWII
35	Dimitrovgrad suburbs	remnants of ancient settlement	ancient period
36	Dimitrovgrad suburbs	demolished fountain from Ottoman period	Ottoman period
37	village of Zeljusa	Vocnjak	ancient period
38	settlement of Keramidilinci	Keramidilinci	ancient period
39	settlement of Keramidilinci	Crkviste	ancient period
40	Dimitrovgrad	Propast	ancient period
41	village of Gornje Gradinje	Seliste	ancient period
42	village of Gornje Gradinje	Veliko Kale	ancient period
43	village of Gradinje	Crkviste with the cross	ancient period
44	village of Gradinje	Vocnjak	ancient period

4.6.5 Social project impact due to land expropriation

Social project impact will be separately analyzed and presented in detailed through Environmental and Social Action Plan, which should be prepared by the PERS and submitted

to the EBRD in May 2009. This activity, in accordance with recommendations from Due Diligence Plan (EBRD Document), is stated to be completed in accordance with the IFI's procedures. Draft document should be prepared up to May 20, 2009, while final version is due to be received up to May 27, 2009. Sector for strategy, designing and development of the PE "Roads of Serbia" is not responsible for land acquisition issues and compensation to the land owners for the structures in the project impact zone and within the Final EIA Report this sector cannot analyze and quantify the project impacts in reference to potential demolition of structures and acquisition of land for project construction.

In this moment Ressettlement Policy Framework (RFP) is already done.

Impacts on special social groups

Impacts on special social groups are not identified with this Final EIA Report due to special social groups directly offered to negative project impacts are not designated.

5. ENVIRONMENTAL IMPACT

5.1 Geology and soils

The soil as a basic natural element is a very complex system, very sensitive to different influences. That is why the entire issue of the relationship between the road and the environment is also defined by the relations arising in the sphere of different impacts on the soil. Soil as a complex ecological system reacts to minute changes and this can cause the degradation of its main characteristics.

The above fact imposes on us an obligation to investigate, for each individual case, a large number of impacts which can be classified in two main groups: soil pollution and soil degradation. Both of these phenomena will be given appropriate attention considering that the as-built condition analysis identified a possibility of multiple impacts.

The term soil degradation, in the context of environmental impact, implies several different processes among which the greatest weight is attached to the occurrences of land and rock slides, erosion, changes of soil permeability, possible degradation of soil characteristics in a broader zone, soil degradation due to the opening of borrow pits, soil degradation due to the formation of dump areas, and other impacts which in specific spatial circumstances can have a greater or lesser impact.

The works on clearing the existing soil, vegetation and structures, and topsoil stripping denote the beginning of construction works on the new road. It is when these works are executed that the greatest changes in topography take place.

When we look at the impact on soil, as it was also defined in the case of waters, two critical phases can be distinguished. They relate to the construction phase and to the operation phase.

5.1.1 Construction phase

We distinguish between two aspects of impact caused by the construction of a road facility:

- Soil pollution,
- Soil degradation.

The pollution of soil in this phase can be caused by improper handling of oil and its derivatives that are used for construction machinery and plants in the course of construction, washing of vehicles and machines outside the space designated for such purposes, inappropriately organized construction site, and other activities that are not implemented in line with the guidelines of technical mitigation measures during construction.

Soil pollution during construction is an aspect of the impact on soil, as an environmental factor, which can be reduced to a minimum or completely eliminated if the technical mitigation measures listed in the description of the measures for alleviation of project effects are respected.

In the case of road construction, the issue of effect on soil (degradation) is primarily seen in the need for transportation of large quantities of construction materials and the need for opening of borrow pits or dump sites.

Questions related to the borrow-pits, querry and depository sights will be analyzed in details through the Main Project Design – Environmental Protection.

Second important factor in this phase is the unavoidable need to have the topsoil stripped from a large surface. The very process of road construction implies a major mechanical stabilization in the roadbed and in places where temporary access roads are being formed, which, in certain sensitive parts, can impact the entire system of soil parameters, primarily in terms of its water permeability, air content in soil, etc.

No section of the newly-designed E–80 motorway will suffer any soil degradation due to the opening of borrow pits or formation of dump sites, in these specific circumstances.

Any missing materials for the road bed may be taken from the existing borrow pits in the immediate vicinity of the Motorway route (up to 30 km).

Any excess materials of poor quality may be deposited in ditches, but have to be controlled by piping, since they may cause local instability or jeopardize the future road.

Sand and gravel, as good quality materials for embankments and subgrade, may be tapped from the alluvion of Nisava River and that of its major tributaries.

In case of lack of good quality materials for the construction of an embankment in the zone of the Pirot ravine (soil of a low bearing capacity, swamped, most of the year, and largely present in the zone of Pirot ravine), proposals are to replace the deficit with limestone detritus excavated from "Sarlah" tunnel or to use limestone from local borrow pits up to 10 km away from the place of application. In that sense, it is possible to count on the borrow pit "Koren" situated along the road Pirot - Zavoj, 5 km away from Pirot, where total reserves of limestones are estimated at 4,500,000 m^3.

It is also possible to count on the borrow pit "Tomin trap" on the road Pirot - Knjaževac, in Oraovica village, 8 km away from Pirot, where limestone reserves are estimated at 150,000 m^3.

Ground degradation on the stretch of the Northern Dimitrovgrad bypass road will not occur due to the opening of borrow pits or formation of spoil areas. It is certain that any deficit materials, due to fills on most of the section, will be made up with materials excavated from deep cuts and side cuts, and from two tunnels - "Pržojna padina" (L = 550 m) and "Progon" (L = 1000 m).

In the course of the construction of the planned motorway route it is necessary to take actions that minimize possible environmental impact. These would primarily include:

- Drawing up of Environmental Impact Analysis within the project of organizing the construction and for the needs of placing the administrative facilities, warehouses and machines, and for finding the location for the plants for production of asphalt mixtures if such a plant is to be located in the zone of this road;
- Strict protection of all the parts of terrain outside the immediate zone of the works, which means that, outside the road route, no existing surface may be used as a permanent or temporary disposal site for materials, such as borrow pits, such as plateaus for machine parking or repair;

- Collection of hummus material and it storage in organized storage areas so that they can be used in final works for recultivation and biological protection;
- Any handling of oil or its derivatives during the process of construction, filling up of machines, must take place at a specifically defined place and respecting the highest mitigation measures so as to avoid any spillage. All packages for oil and other oil derivatives must be collected and disposed of at dump sites;
- Forbidding any opening of non-controlled access roads to individual parts of the construction site;
- Parking of machines only at regulated places. At the machine parking space, take specific measures for protection against soil pollution with oil, crude oil or oil derivatives. In the event soil gets contaminated by the spilled oil or otherwise, the relevant layer of such soil shall be removed and disposed of at a dump site;
- Systematic collection of solid waste that is normally a product of the construction process and the workers' stay in the zone of the construction site (food packaging, other solid waste) and its disposal at the landfills;
- Forbidding any washing of machines and vehicles in the zone of works and washing of concrete mixing machines and uncontrolled disposal of any remaining parts of concrete mass on any surface outside the immediate road route;
- After completion of works, it is necessary to, based on the specific recultivation projects, regulate all borrow pits, dump and storage sites, so as to prevent further degradation of soil and improve the visual effect.

5.1.2 Operation phase

In the road operation phase, soil pollution will be mostly a product of following processes:

- Pollution by rainwater from the road surface,
- Depositing of exhaust gases,
- Disposal of organic and inorganic wastes,
- Spillage of transported freight,
- Depositing of wind-borne particles from the atmosphere,
- Dispersion due to the vehicle movement.

The fact stated in the introductory observations that concerned the issue of soil contaminant quantification, and the already expressed viewpoints about the design phase, led to a possibility to define, in terms of numerical quantification, only those elements for which some patterns have already been verified. This, inter alia, involves the fact that soil pollution is primarily subject to the following:

- Road drainage system,
- Traffic volume and traffic flow structure,
- Configuration of the surrounding terrain and its forestation degree,
- Soil pollution due to dispersal during vehicle movement are limited to a narrow belt along the edge of the road,
- Dispersion of the material from the road surface during a dry period due to the air shifts caused by vehicle movement also takes place in a narrow belt along the edge of the road,
- Sedimentation from the atmosphere is present at a distance of as much as several hundred meters but, for the time being, this cannot be defined nor could specific patterns be observed to be used in quantification of these occurrences.

Most investigated soil pollution issue refers to the lead content. This fact is in the first place corroborated with the fact that agricultural cultures absorb lead directly from the soil and then, when they are consumed by animals and humans, lead accumulates in their organisms. Also, lead stays in the organism and thus the danger it involves increases with the increase of its content. Based on the data about traffic flows for the planned period (2021) in the relevant corridor, the content of contaminating matter in soil was determined by modeling.

Table T 5.1.2 – 01 Expected content of heavy metals in soil, for the analyzed sectors of the E–80 motorway (ppm)

No.	Elem.	MPC*	Expected content by motorway sector			
			Pro. - Cr. Reka	Cr. Reka - Pirot	Pirot – Dimitr.	Northern Dimitr. bypass road
1	Ag	50	110-145	110-160	42.2-60.5	40-60
2	B		130-170	180-230	55-66.2	55-70
3	Ba		335-370	600-780	138-151.8	140-155
4	Be		65-95	100-150	27.6-38.6	25-40
5	V		145-185	220-260	60.7-75.9	60-75
6	Ga		60-70	80-120	24.8-27.6	25-30
7	Co		30-45	50-90	12.4-17.9	15-20
8	Cu	100	185-225	190-240	75.9 -92.4	75-95
9	Cr	100	225-265	360-440	92.4-107.6	95-110
10	Mn		145-185	2210-2590	60.7-75.9	60-75
11	Ni	50	110-135	190-240	45.5-55.2	45-55
12	Sc		60-75	50-90	24.8-30.3	25-30
13	Zn	300	160-185	330-370	66.2-75.9	65-75
14	Zr		225-260	400-560	92.5-107.64	90-110
15	Sr		225-260	360-440	92.5-107.64	90-110
16	Pb	100	210-260	380-430	85.6-107.64	85-110
17	Y		110-145	220-260	45.5-60.7	45-60

*Defined in the Rules on permissible quantities of dangerous and harmful substances in soil and irrigation water, and methods for their testing (Official Gazette of RS, No.23/94)

Based on concentrations obtained for each Motorway corridor sector and all data presented within this Section, we may conclude that soil pollution problems take up a certain position within comprehensive relations between the road and the environment.

Already mentioned lead is the most significant traffic-induced pollutant when speaking about agriculture and food production. The greatest impact of lead and cadmium is in zones within 1.0 to max. 5.0 m along the road, which is within the road protection zone.

Soil in the vicinity of motorways may have cadmium concentrations up to 3 mg/kg. This element originates less from the deposition of exhaust gases, and much more from tires rubbing away against the pavement surface.

Considering relevant traffic flows, the pavement dewatering concept (a controlled, closed system), concentrations of pollutants in soil, due to regular operation of the planned newly designed motorway route, will not pose a major problem for the analyzed planning period.

The notion of ground degradation during road operation, in terms of environmental impacts, implies several different processes, those of which that have specific weight being soil and rock slides, erosions, changes in soil permeability, potential aggravation of soil properties in a wider zone, and other impacts that may be of higher or lower importance in specific spatial conditions.

On the designed route of the E–80 Motorway, unstable parts of the terrain encompass slopes with an advanced process of active and dormant slides, and parts of Pirot ravine (on the section Staničenje – Pirot, particularly from km 74 + 000 to km 75 + 700) made of marsh-alluvial swamp land of low bearing capacity, represented by muddy clays and peat where subsidence is substantial and has a character of long-term consolidation for several years. Specifically speaking, the biggest problem is with a landslide on the part of the route where "Sarlah" tunnel begins practically, and it needs to be stabilized. Construction in this and similar parts of the terrain is impossible without taking certain rehabilitation measures.

Active talus was registered in the zone of the route, of estimated depth of 1.0 - 5.0 m, from km 63 + 000 to km 63 + 250.

Land erosion means washing out and removal of the tiniest and most fertile particles from a loose base. This is a natural process which can be speeded up by uncontrolled tree felling and improper use of soil.

Not only does the erosion processes in the area surrounding the route of the newly-designed motorway impact the living environment in terms of soil degradation but they can also adversely affect the future road route, whether directly or indirectly.

Direct adverse effect on the road caused by soil erosion on the slopes located immediately next to the road.

When speaking of erosion-prone locations along the newly designed road, these are, naturally, places of deep cuts and side cuts (8 - 35 m). The elevation solution for the Motorway route in its entire length requires cuts/side cuts of variable depth in sediments of varying genesis, composition, degrees of consolidation, lithification, and of different degree of physical/chemical alteration or tectonic damage. Therefore, the slopes of cuts and side cuts need to be protected adequately against wash-off and erosion. In such places it is necessary to foresee mitigation measures (humification and planting of greenery). In order to preserve the stability of slopes of cuts and side cuts, it is necessary to drain surface water and seepage groundwater by constructing an adequate drainage system.

On the other hand, erosion processes indirectly affect the areas farther from the road from which the erosion deposits reach the road via water courses.

Erosive processes in the catchment areas of tributaries of the Nisava River within the Motorway corridor under consideration are mainly in the range from deposit accumulation to medium-high erosion.

After intensive precipitation in the catchment area, torrential waves form, carrying large amounts of erosion deposits.

Main problem with regard to the impact of erosion and torrential processes on the road is the potential effect of river deposits on structures located at places where the road crosses with the water courses. Stopping and accumulation of deposits in the zones of bridges and culverts can to a great extent reduce the capacity of these structures. In such an event, when high waters come in, the openings of these structures can get jammed and the road route can be overflooded.

In the process of preparing technical documentation for the road construction, it is necessary to draw up a plan for anti-erosion regulation of the surrounding area of influence. Specific biological, biotechnical, and technical measures can reduce the erosion production and transfer of sediments and, accordingly, the degree to which the future road route will be adversely affected by the erosion and the sediments.

Considering all the conclusions reached during the phase of analyzing the impact of the road route on soil, primarily with regard to the implementation of appropriate mitigation measures, it is necessary to define the specific steps to be taken in the phase of operation. These procedures constitute the operation management domain and include the organization of traffic and the maintenance of the road section as such. These measures shall include the following activities:

- It is necessary to provide suitable road markings, signs and signals for the section, including all forms of necessary bans and notifications;
- For winter maintenance procedures, it is necessary to draw up special operational plans taking into account environmental protection;
- Slopes of embankments need to be horticulturally developed in terms of improving the visual effects and reducing the effects of surface erosion, and envisage all measures for road land recultivation;
- Because of the soil pollution resulting from the road operation, it is necessary to provide for a minimum a road protection zone which will not be the arable zone. Considering the expected concentrations of the pollutants, this belt should not spread beyond 5 meters from the edge of the road right of way. The grass obtained by the maintenance of green surfaces in the vicinity of the road shall not be used as cattle feed. No herbicides shall be used for elimination of weed;
- To minimize the effects of salinization of soil in the vicinity of motorway resulting from the winter maintenance, the use of sodium chloride should be substituted by other substances with a similar or higher defrosting effect. Where sodium chloride is used in the maintenance process, precise planning of time distribution and quantities is of critical importance;
- Any contents accompanying the planned road route should be designed and erected in conformity with the main function of this road and after the environmental impact study has been made;
- Any accompanying content complexes should be furnished with special containers for collection of solid waste to avoid any soil pollution in the zone of the road. These containers must be emptied by an authorized company and solid waste must be stored in a landfill.

5.2 Air quality

The air pollution resulting from the road traffic, as a criterion defining the relationship between the motorway and the living environment, is relatively effectively quantified today,

regardless of the stochastic character of a large number of parameters which essentially define this phenomenon (meteorological, topographical, traffic, construction, etc).

The frameworks of this study research are built on the indicators defined as median annual values (long-term concentration) and the 95th percentile value (maximum short-term concentration).

So far, the analysis of waste gases which are produced by the operation of motor vehicle engines revealed the presence of as many as several hundred harmful organic and anorganic components. For the analysis of this study research, the following components were adopted: carbon monoxide (CO), nitrogen monoxide (NO), nitrogen oxide (NO_2), sulphur oxide (SO_2), hydrocarbons (CxHy), lead (Pb), and solid particles (CC).

The Rules on limit values, imission measurement methods, and criteria for the establishment of measuring points and data records (Official Gazette of RS, No. 54/92) prescribe limit values of imission, alarming imissions, episodic air pollution, methods for systematic imission measuring, criteria for establishment of measuring points and the manner of record keeping.

Noise and air quality standards are given in App F - Standards

Table T 5.2 – 01 MPC of pollutants in the atmosphere

Substance		Populated area (mg/m3)	Unpopulated area (mg/m3)
Carbon monoxide CO	median value highest value	3 10	3 5
Nitrogen oxide NO2	median value highest value	0.06 0.15	0.05 0.085
Lead Pb	median value highest value	0.001 0.01	0.001 0.01
Sulphur dioxide SO2	median value highest value	0.05 0.35	0.03 0.15
Solid particles CC	median value highest value	0.05 0.15	0.03 0.05

The impacts of road traffic on air pollution were analyzed in two aspects: the construction phase and the operation phase.

5.2.1 Construction phase

By its very nature the execution of construction works is a significant source of atmosphere pollution caused by the use of construction machines which are mostly driven by fossil fuels. Movement of large earth masses during the construction of road bed (cuts, embankments) results in raising large amounts of dust in the atmosphere, which can adversely affect the population and the vegetation. The operation of asphalt plants, and use of the asphalt mass on the road route, lead to the emission of volatile organic compounds (VOC) which incorporate a large percent of polycyclic aromatic hydrocarbons (PAH) whose impact on the occurrence of carcinogenic diseases in population have been confirmed.

In this case, the space in which construction works are to be executed is at more than 100m distance from the populated area and thus no considerable negative effects on health of the population are expected. The asphalt plant is located outside the project impact zone.

5.2.2 Operation phase

The calculations of air pollutant concentrations for the characteristic cross sections of the planned road were made using an advanced computer program that was developed on the foundations of a model defined in the guidelines for estimating the air pollution on roads (Merkblat über Luftverunreinigungen an Strassen, MLuS-90). Parameters of the air pollutants components in the form of median annual values and the 95^{th} percentile value.

5.2.3 Results of calculations and analyses

Based on the procedures used to calculate air pollution components for the characteristic microclimatic condition, the data that represent valid indicators of air pollution were obtained. The data were obtained by taking into account relevant meteorological conditions taking into account spatial position of the route and the speed of most frequently present winds. Also calculated were permanent and current concentrations of dominant pollutants - CO, NO, NO_2, C_XH_Y, Pb, SO_2, and solid particles at every 25m-100m from the edge of the pavement, and then at 200m and 300m. After analyzing data on wind frequency and speeds, the conclusion was made that a northwest wind, blowing at the speed of 2.9 m/s, is most frequent in the corridor under consideration. Concentrations of air pollutants were calculated for extreme conditions of lateral winds. They were also modeled for the wind speed of 1.5 m/s, which is the average wind speed in the corridor, taking into account windless periods as well. Due to phase construction, all calculations were prepared for 2012, as representative of Phase I, and 2022, as the final year of operation period.

Based on data obtained by analysis for typical conditions and selected sections from Prosek to Dimitrovgrad, as well as limit values defined in the Rules on limit values, immission measurement methods, criteria for establishing places of measurement, and data recording (Off. Gazette of RS, No. 54/92), we may conclude as follows:

- for a wind of an average speed of 1.5 m/s, short-term concentrations of nitrogen dioxide (NO_2) are above permissible limits at 37 - 50 m from the pavement edge, and long-term ones are above allowed limits at 33 m;
- with the air pollution calculation at a dominant northwest wind of the speed of 2.9 m/s, narrower zones of excess values than previous;
- concentrations of sulfur dioxide, solid particles and lead are above limits stipulated by the law within the Right of Way under all micro-climatic conditions.
- noteworthy concentrations of pollutants should be expected in the zone of tunnel portals.

From the aspect of impacts of polluting substances on flora, this phenomenon is particularly important because of cultivable areas and field crops. The obtained results show that in the belt of an average width of 37 m (17 m for Phase I) from the pavement edge, with a wind of an average speed of 1.5 m/s, concentrations of pollutants (particularly of nitrogen oxides) may be expected to be such as to cause permanent negative consequences for the growth and development of plants. It is recommended to avoid growing plants for human consumption in the mentioned corridor, but to cultivate this area with plants resistant to the mentioned

substances. A general conclusion that may be made based on all performed analyses is that the problem of air pollution is not negligible in the corridor of the planned road.

By modeling air pollution concentrations for the Motorway section (the northern Dimitrovgrad by-pas road) under weather conditions, and by comparing them with the limit concentration values, we come to the following conclusions:

- Concentrations of all pollutants, except saturated hydrocarbons (CxHy) nitrogen oxides (NOx), are below maximum permissible concentrations, under any possible weather conditions;
- In general, during the blowing of the dominant wind (SE) concentrations of air pollutants are higher on the left side of the bypass road;
- Short-term concentrations of saturated hydrocarbons (CxHymax) were exceeded along the entire route on the left side (in average 21 m from the pavement edge) and for the most part on the right side (except from km 94 + 700 to km 96 + 700)
- For long-term concentrations of alkanes (CxHysr), the excess values range within limits for the right of way on the left side (in average 2 m from the pavement edge), and on the right side, they stay within the limits of maximum permissible concentrations (MPC);
- Out of nitrogen oxides, MPC are exceeded only for short-term concentrations of nitrogen dioxides (NO_2 max), mostly on the left side of the road, with an average distance of 3 m from the pavement edge, i.e. the affected zone stays within the right of way;
- Notable concentrations of pollutants should be expected in the zone of tunnel portals, on the left side of the road.

5.3 Noise

Noise is one of the spatially most accentuated effects on the living environment. Among all sources of noises, noise from traffic accounts for the highest percent, and a lesser portion is accounted for by other sources of noise (industry, construction activities, noise from leisure-time activities, etc). The noise impact of the project under observation was studied in view of its two phases, the construction phase and the operation phase. Noise and air quality standards are given in App F - Standards

5.3.1 Impact in the construction phase

The construction phase, in respect of noise, is characterized by the operation of machines and plants located along the road under construction. The sources of noise during the construction are heavy construction machines and their traffic in connection with the execution of works. The organization of the construction of a linear structure, such as a road, is characterized by the arrangement of construction machines at a relatively large surface, which makes it more difficult to intervene with regard to the protection of environment from elevated noise levels in this phase. Exposure to these impacts is limited in time and temporary and as such it is considered in the mitigation measures during the construction phase.

5.3.1.1 Mitigation measures in the construction phase

Since in this phase of making a design no concept of the execution of construction works is available, including the transport routes, it is impossible to foresee the specific levels of noise which will be present due to the construction.

However, the general mitigation measures may be defined as the following procedures the application of which can impact the alleviation of the impact of noise in the construction phase:

- Raising workers' awareness that noisy activities should be minimized;
- Adjusting the working hours;
- Use of modern equipment and machines with noise suppressors when working in the vicinity of populated areas;
- Regular maintenance of construction vehicles and equipment in view of the elimination of unnecessary sources of noise;
- Avoiding the concomitant operation of several noisy machines, when possible;
- Switching-off the machines when out of use;
- Using natural acoustic barriers or screens for protection against the noise round the machines;
- Regular maintenance of access and temporary roads and limiting the speed of vehicles on unpaved roads for transportation of materials.

5.3.2 Impact in the operation phase

Road traffic plays a dominant role if compared with other types of traffic and is constantly increasing. This results in the increase of the level of noise in the zones around roads.

Noise is the most significant non-material source of pollution in road traffic; with regard to its origin it is a very complex occurrence and has a stochastic character. The noise impact analysis implies the definition of the parameters of traffic noise on a spatially and functionally defined road. The status which is defined in this way is compared with current legal postulates with regard to the maximum permissible levels for particular facilities. Exceeding the permissible levels imply the analysis of the need to take necessary protection measures.

Table T 5.3.2 – 01 Values of highest permissible noise levels, in dB(A) for the day and the night and for different intended uses of the space - JUS U.J6 205

Intended use of the space	Highest permissible level of outdoor noise dB(A)	
	Day	Night
Areas for relaxation and recreation, Hospital and rehabilitation zones, Cultural–historical sites, Large parks	50	40
Tourist areas, Small and rural settlements, Camps and school zones	50	45
Exclusively residential areas	55	45

Intended use of the space	Highest permissible level of outdoor noise dB(A)	
	Day	Night
Business–residential areas, Commercial –residential areas, Children's playgrounds	60	50
City centre, specialist's trade, commercial, administrative zones with apartments, zones along motorways and main traffic routes	65	55
Industrial, warehousing, and servicing areas and transportation terminals without residential areas	At the zone borders, the noise may not exceed the level present in the adjacent zone	

Maximum permissible level of outside noise for populated areas in the corridor of future E–80 motorway amounts to 65 dB(A) for the day, or 55 dB(A) for the night conditions.

Getting a complex insight into the issues of noise in the zone of the planned traffic possibility is possible only if its characteristics are investigated for all affected facilities and spatial units. Leaning on the knowledge of general conditions of spreading and the location constants, the relevant cross sections were defined that are of interest for the investigation and that, in this specific case, coincide with the suitable transverse profiles.

For this specific estimate of the relevant level at the arbitrary point of section, specific computer programs were used. They were made based on the guidelines entitled: "Richtlinien für den Larmschutz an Strassen". This methodology gives estimate of the traffic noise level for the period of 16 hours during the day (06:00 – 22:00) and 8 hours during the night (22:00 - 06:00). This method takes into account the volume of traffic during the day and the night, % of heavy goods vehicles (HGVs), average speed of motor vehicles and HGVs, the type of pavement structure, road gradient, absorption potential of the ground, distance from the road, and all other relevant data.

The calculation, for the level of these analyses, is made at an equidistant spacing from the axis of the road, on one and on the other side, up to the distance of 300m. This procedure includes the entire area of relevant impacts and the conditions made for the quantification procedures. Based on the obtained data, documented conclusions may be drawn in view of the adverse impact of traffic noise, and any need for mitigation measures can be identified.

Using the above described methodology and specific on-site conditions of the characteristic section, the calculation of relevant indicators was made for the selected characteristic sections in respect of the layout of facilities in the vicinity of the route. For the evaluation of condition, we adopted a permissible limit value of 55 dB(A) for night conditions that applies to the facilities alongside main traffic routes. Based on traffic noise estimates in the planning period, noted at the characteristic cross-sections were maximum noise levels that are reached at 25 meters from the edge of the road, and minimum and maximum distances at which limit values are reached. The difference in the level at some places result from the physical

restrictions in the transverse profile and the vicinity of a railway line and the main road that will remain in place as a parallel road route. The results are shown in Table T 5.3.2 -02.

Table T 5.3.2 -02 Summarized results of the traffic noise estimates

Section	Maximum levels of noise at the reference distance of 25 meters		Distances at which the permissible limit value was reached	
	Day	Night	Min.	Max.
Prosek – Crvena Reka	72 dB(A)	67 dB(A)	70 m	210 m
Crvena Reka – Čiflik	72 dB(A)	67dB(A)	60 m	>300 m
Pirot – Beginning of the Dimitrovgrad bypass road	74 dB(A)	62 dB(A)	55 m	>300 m
Northern Dimitrovgrad bypass road	74 dB(A)	69 dB(A)	20 m	240 m
E–80 motorway Prosek - Dimitrovgrad	74 dB(A)	69 dB(A)	45 m	>300 m

Based on the numerical data obtained by calculation and the relevant levels defined by law, a conclusion may be drawn that limit noise levels are exceeded in the zones in which the registered structures are located.

5.3.2.1 Mitigation measures in the operation phase

Main goal of analyzing the traffic noise on the E - 80 motorway is to select the appropriate procedures aimed at the mitigation of adverse impacts that the noise has on the population. Technical mitigation measures include all the procedures that are necessary for reducing the quantified adverse impacts to the allowed limits.

Reduction of the noise impact may be achieved by different procedures:

- reduction of noise impact by planting green protective belts between the motorway and affected facilities,
- reduction of noise impact in the facilities by installing soundproof windows and doors on the facades exposed to noise - passive mitigation measures,
- reduction of the noise transfer by installing acoustic barriers – walls for protection against noise.

In this specific case, for the E–80 motorway Prosek - Dimitrovgrad, it is envisaged to use structures for protection against noise as well as passive mitigation measures (soundproof doors and windows). The most important safeguard against noise is to build the walls for protection against noise. This safeguard will be applied at the places where most affected groups of facilities are located. When selecting a type of the wall, account should be taken of the criteria which need to be met, such as:

- resistance to weather conditions,
- structural rationality,
- visual effect,

- possibilities of prefabrication,
- possibilities of extension,
- spatial compliance,
- easy maintenance.

The required lengths and height ranges for the structures for protection against noise at the E–80 are shown in the Table T 5.3.1.1 - 01.

Table T 5.3.1.1 – 01 Structure for protection against noise at the E–80 motorway

Section	Position of the structure	Heights of the structure (m)	Lengths of the structure (m)
Prosek – Crvena Reka	left	2.5 – 3.5	2 144
	right	2.5 – 4.0	1 840
Crvena Reka – Čiflik	left	-	-
	right	-	-
Pirot – beginning of the Dimitrovgrad bypass road	left	-	-
	right	-	-
Northern Dimitrovgrad bypass road	left	-	-
	right	-	-
E–80 Motorway Prosek - Dimitrovgrad	left	2.5 – 3.5	2 344
	right	2.5 – 4.0	1 880

Tabela T 6.4.2 – 01 Noise protection barriers on Ciflik – stanicenje – Pirot section

chainage	settlement	position	height (m)	lenghth (m)	area (m2)
km 54+390 - km 54+760	Čiflik	Right	2.0	370	740
km 54+180 - km 54+710	Čiflik	Left	2.0	530	1060
km 59+750 - km 60+020	Crnoklište	Left	2.5	270	675
km 76+700 - km 77+110	Rogoz	Right	2.5	410	1025

It is envisaged to apply passive mitigation measures for a certain number of individual facilities where these measures are more cost-effective.

For the E–80 Prosek - Dimitrovgrad motorway slightly more than 4 kilometers of structures for protection against noise are needed. It is also envisaged to apply passive mitigation measures for a certain number of individual facilities where these measures are more cost-effective

Also, the construction of residential facilities must be forbidden at the distances from the road centerline where allowed noise level may be exceeded, so as to avoid further complications with the noise problem.

5.4 Flora, fauna and visual impact

The need to examine all adverse impacts which result from the construction of the planned highway requires the investigation of possible adverse impacts in the domain of flora and fauna. Based on the analyzed impacts of the planned road route in the sphere of air and water pollution, and soil pollution, occupancy of surfaces and division of space, it is possible to derive conclusions in respect of possible impacts on ecosystems of areas across which the road route shall pass.

The routing of the highway was undertaken to avoid all statutorily protected and sensitive areas, with data being obtained from published sources and from the Institute for Nature Protection (INP). During the EIA stages the INP provided comments on the routing, impacts and mitigation. INP provided written responses, which include recommendations and requirements for the sections of highway for which EIAs have already been prepared and submitted for approval (see Appendix V). The key comments from INP included:

- The highway can severe habitat and impact the free movement of animals and therefore designs should aim to allow movement of species through pipes and culverts, which should be subject to landscaping to encourage passage;
- Flood defenses at structures should be designed to allow free passage of species and should be designed to be as natural as possible;
- Borrow pits represent an additional impact and they should be managed and reinstated to reduce adverse impacts and encourage natural reinstatement.

5.4.1 Impact on flora

Impacts of construction, operation, and maintenance of the Motorway in the domain of eco-systems are an inevitable fact that, by nature, results in negative consequences. Blasting and drilling – the factor of impacts may be reflected in total devastation of habitats and disturbance of coeno-bionts, which results in a change of floristic and faunal composition of forest eco-systems.

The removal of pedologic cover brings changes to habitats and causes the disappearance of species of flora and fauna, particularly large representatives of pedo-fauna. The drying up of springs and dewatering – land drainage – are very negative factors of impact that may lead to the drying of forests due to changes in water regime and soil.

Bridges and overpasses, tunnels and underground structure in the course of motorway construction do not have a direct negative impact on forest eco-systems, but the factor of impact may have a local negative significance on a case-by-case basis.

Noise and vibrations – this form of physical pollution of the environment may affect negatively the life of certain coeno-bionts in forest eco-systems, particularly that of birds and mammals. The chemical pollution of soil caused by the operation and maintenance of the motorway has a negative factor of impact on forest eco-systems, too.

The construction of the motorway inevitably leads to a temporary or permanent loss of green surfaces covered with bushes, forest land, trees and other vegetation living along water

courses, as well as of land used for agricultural production. The quantification of impacts on flora is possible only through the identification of areas with the total loss of vegetation, areas with altered vegetation, and areas of autochthonous vegetation that will be under certain impacts. The total loss of vegetation will be on areas covered by the pavement. Areas encompassed by the road bed that are planted with greenery after construction within the landscaping of the right of way (slops of embankments, channels), as well as areas subject to land acquisition for the road construction, are areas with altered vegetation and they are under the greatest negative impact of the road. Table T 5.4.1 - 01 gives an overview of mentioned areas by road section.

Table T 5.4.1 – 01 Areas with the total loss of vegetation and altered flora

Road section	Total vegetation loss (ha)	Altered vegetation (ha)	Vegetation under some impact (ha)
Prosek – Crvena Reka	64	30	41
Crvena Reka - Čiflik	126.3	49.7	138

An appropriate approach to this problem is the only way to mitigate or minimize these impacts. When speaking of alterations in the nature made by any cause, and consequences that appear therefrom, these two factors (cause – consequence) often appear in time and space discontinuity. In interactions between multiple components of various eco-systems and sub-systems of the environment, it is difficult to measure total effects of some impacts. In the context of time, a substantial interval may elapse before a full implication of a certain previous activity comes into being.

5.4.2 Impacts on fauna

Modern traffic infrastructure facilities, such as motorway and railway lines, have a multiple negative impact on the living world. This negative impact shows up directly. The intensity and consequences of unfavorable impacts are specific, to some extent, for each animal group particularly, while the general effects most often show through:

- Direct devastation of habitats,
- Degradation of quality of habitats along the road,
- Fragmentation of habitats, alteration of their form and geometry,
- Intersection of ecological corridors and traditional migratory paths,
- Hindered access to vital parts of habitats,
- Fragmentation of population due to the effect of road barrier, and impossibility of constant and unobstructed communication,
- Higher hunting and poaching pressure due to an easier access,
- Higher mortality rate of animals due to running over,
- Disturbed regime of surface and ground waters,
- Accumulation of liquid, solid, chemical and other waste
- Intensified light and noise pollution of the area around the road.

Most of the fauna will temporarily migrate out of the motorway corridor during construction. The newly designed road may destroy a habitat, if its remaining parts are not self-sustainable. Consequences of such effects are: a disturbed normal life cycle of animal species, behavioral changes, reduced ecological stability, and disappearance of local populations, changes in

composition and structure of animal habitats due to avoidance of the road by some species, all of which has, as the final result, a substantially impoverished bio-diversity on all levels (genetic, species, eco-system).

Since the newly designed road passes through the river alluvion at some places, it is assumed that new structures will have the highest impact on animals that depend on water as eco-system. Since the project envisages river control, it is necessary to avoid this type of works in the period of reproduction of fish fauna.

On-site investigations that cover the motorway corridor, conducted in terms of identifying possible negative impacts on fauna, showed that salient negative impacts should not be expected in most of the area, simply because no significant faunal elements were registered.

5.4.3 Visual impact

The problem of visual pollution as a criterion of relations between the road and the environment became of interest at the moment when it was evident that landscape features are a quality factor that contributes greatly to the quality of design solution, or appear as an element of degradation of orderly and established relations.

In the course of works in the domain of visual impact analysis it may not be stated that considering a properly adopted route of the corridor with a minimum harm, this impact will have a minimum inevitable negative extent caused, primarily, by the alteration of the existing terrain topography. In the course of operation of the motorway, after all works have been completed and the new traffic flow has been established, impacts on landscape will certainly be in the sphere of positivistic activities, because, in that way, landscapes of the above-mentioned natural, decorative and aesthetic peculiarities will be expressed fully, both in the vegetation period and out of it, naturally under the condition of taking measures for the protection of landscape and natural environment.

The notion of geometric shaping implies the process of a harmonious combination of design elements with the basic goal to achieve a spatial image of the road which, in visual terms, makes positive impressions and gives drivers the sense of safety. Since drivers have in their visual field many geometric shapes at the same time that jointly define the spatial flow of the route, it is necessary to take care of optical properties of each design element. Harmonious relations are achieved only with harmonized elements of the road route on the layout plan, and in vertical and horizontal alignments.

Relations in the domain of geometric shaping on this level were quantified using information from the preliminary design of the planned road. After analyzing the applied elements of layout and elevation plans, and their mutual relations, we come to the conclusion that the criteria of homogeneity were mostly met. Shortcomings in the domain of spatial shaping are present mostly due to the discord between the horizontal alignment and the vertical alignment. This observation mostly refers to local transitions of the level line which harmonize elevation relations between horizontal sections.

For the quantification of relations between the road structure and the landscape the methodology of break-down to individual components (morphology, vegetation, surface waters, structures, and general appearance) was applied. For characteristics of the planned

road and local conditions, the only component that has impact on landscape features is morphology.

A zone of altered landscaping features may be defined based the medical threshold of visibility by adopting the design angle of vision of 100 as a measure for viewing maximum difference in elevation in the profile normal to the line of ground. Such a relation implies that the width of the zone of potentially affected landscape is 600N (N is maximum difference in elevation in the transverse profile). Based on spatial relations of the planned road route it is possible to come to data that the greatest width of this zone is about 4800 m. Therefore, the greatest grade-separations in the transverse profile would be visible from the distance of as much as 4.8 km.

A clear landscape with long lines of sight down the valley from 19 + 400 km to 20 + 900 km is disturbed by an 8m high embankment. Regardless of the presence of four bridges of small length, an observer's line of sight will be disturbed for that reason to a great extent by the road construction. The harmonious composition of the Kunovacka River and the forest belt from km 21 + 200 to km 21 + 550 is broken up by an embankment of an average height of 7 m. By passing onto the right side of the Kunovacka River, the newly designed road gets into the immediate vicinity of the existing regional road Niš – Pirot, which alleviates negative effects on landscape properties of the terrain. On this stretch, to km 23 + 000, fields and meadows are dominant. An observer's attention is drawn to the properties of a farmed and cultivated space, which is, in principle, considered to be much less attractive in aesthetic terms, than natural, original space. The road construction may lead to changes in the way and scope of cultivation of agricultural areas, and thus to changes in landscape character and value. From km 23 + 000 to km 31 + 900, the future motorway route runs through a forest which substantially narrows the belt from which the future structure disturbs the lines of sight. The terrain morphology conditioned the routing of the road by a side cut from km 31 + 900 to km 38 + 200, which also minimized the disturbance of the line of sight. The route extends mainly along a boundary line between forests and meadows.

From Crvena Reka to Čiflik, the motorway is designed so that the road elements fit into the ground morphology. The route stretches along edges of a mountain massif parallel to the direction of spreading of the river valley. It is sufficiently distanced from the river bed, so as not to disturb the line of sight, but to make a true belvedere. The ground morphology conditioned the routing of the road in side cuts and on a low embankment, which made the disturbance of the line of sight least notable. On this stretch, fields and meadows are dominant. An observer's attention is directed to the properties of a farmed and cultivated space, which is, in principle, considered much less attractive in terms of aesthetics, than a natural, original space.

Water surfaces, as landscape elements, have their role in the evaluation of landscape properties. Substantial contacts between the route and the open water stream are at km 19 + 250 and km 40 + 700, where the Nisava river is bridged at almost right angles, which enables open lines of sight both to the left and to the right. From km 68 + 000 to km 71 + 000, where the Nisava River passes through the Pirot ravine, the planned road narrows the valley, creating the sense of a limited freedom of the river and a restricted landscape.

As for structures built for the road operation purposes, it is possible to evaluate impacts of passes over the road and the railway line. Having in mind usual spatial relations, standard for the rank of the planned road, any special visual effects should not be expected, except for

noting that in the existing morphological relations, these structures become visually dominant.

What is necessary to point out refers to the existing condition and the fact that most of spatial wholes along the route, in terms of landscape, are degraded by the construction of the existing traffic communications, unelaborated urban development, and uncontrolled use of existing forest areas.

5.4.4 Measures for the protection of flora and fauna and preservation of the aesthetic value of the landscape

Within the protection of existing forest communities, i.e. phytocoenoses, in the given corridor, the following mitigation measures are necessary:

- Clearing up and removal of vegetation should be minimized to the extent necessary for the execution of works
- An adequate, timely compensation of the loss of biomass by planting autochthonous or introduced vegetation (that matches the habitat
- The recommendation to forest ground of classes 6 and 7 under high and excessive erosion, and to forest the springs of water courses;

The protection of fauna is possible by taking the following measures:

- The design documentation envisages the erection of a protective fence all along the road. Although this fence will prevent reproductive and every other communication within populations, and among populations of different species from one and the other side of the road, it is a safe protection against domestic and wild animals straying onto the road and being killed.

- The design documentation does not foresee animal passages, but it is possible to use all planned tube and slab culverts, as well as bridges. Thus, envisaged bridges over water courses may serve as ecological corridors. Beds of water courses under them occupy less than one third of the passage, i.e. banks are of sufficient width for animals to pass. Except from following the road line, it is necessary to ensure that the protective fence ends at the bridge base, so as to direct wild animals toward the passage under the bridge. The design documentation envisages bank revetments of rough, coarse surface, which would prevent animals from slipping into water, i.e. help them get out of water more easily.

The measures for protection of green surfaces, in the sense of landscape aesthetics, may be boiled down to

- Fitting of the entire road structure into the landscape (creating a compact, organic link between the motorway and the landscape of natural environment
- Emphasizing natural and artificial components of the landscape and harmonizing them
- Enriching the road (motorway) landscape, as well as winter landscape, by designing and constructing forest protection belts;
- Considering a possibility to grass surfaces in the zone of the road where higher concentrations of heavy metals (lead, cadmium etc.) are expected, to use plant species from the families (Brassicaeae, Euphorbiacaea, Esteracee, Lamiceaea, and similar) that are so-called hyper-accumulators (the process of phyto-remediation);

- Upon completion of all construction works it is mandatory to establish a plant cover on all affected places by planting adequate, primarily and if possible autochthonous species, the selection of which would be harmonized with the surrounding areas and their purpose.

5.5 Surface and ground water

Studying the water related issues with the aim of identifying possible impacts of the planned motorway route on the environment reflects primarily through the quantification of impact in the domain of possible changes to the surface and ground water regime and their pollution. Taking into account concrete location conditions which are characteristic for the area of planned motorway sections and are described in detail within the present status (hydrogeological and hydrological characteristics, quality of surface waters, etc), a conclusion may be drawn that, considering all the characteristics, the impact may be expected that is of interest for this analysis.

Preconditions of the Institutions incharged in the area of water management are given in the App. D – Reference (4-109/01 from 25. 07.2001, 4-108/01 from 25. 07.2001, 4-107/01 from 25. 07.2001, 92-I-91/2001-22 from 06. 08.2001, 325-05-1301/01/07 from 18.02.2002.).

The pollution of waters near roads is characterized by two main phases: pollution during road construction and pollution during road operation.

5.5.1 Construction phase

Pollution in the construction phase is temporary, limited in scope and intensity, but the consequences can be grave in the event of calamities.

There are two forms of the impact caused by the construction of a road facility:

- Water pollution,
- Change of the surface and ground waters regime.

During the construction phase, surface waters can be seriously affected by the pollution or physical damage to the river banks.

Changes to the physical and chemical characteristics of waters, provided the organization of the construction site and the procedures in the course of works execution complies with the environmental requirements prescribed by this study, can cause accidental pollution through the spillage of dangerous and hazardous substances into the open water courses. For this reason it is necessary to ensure a controlled access of the machines to the water courses and other surface waters.

Changes to the flow, speed, and the course of surface waters are caused by the changes to the morphology of the terrain when earth works are executed and during the construction of bridges and culverts.

Impacts on the regime of surface waters (water courses), on the newly designed motorway route, are not directly conditioned by the construction of sections, except within limited works on flow control (Table T 5.5.1 - 01).

Table T 5.5.1 - 01 Regulation of water courses within the construction of the E–80 Motorway, Sector 1

No.	Water course	Chainage	Length of flow control works
1	Studena River	km 19+260 - km 19+370	Flow control at its confluence with the Nisava river , L = 116m
2	Studena River	≅ km 19+750	Water race control length , L = 276.93m
3	Studena River	≅ km19+900 - ≅km 20+580	Flow control length , L = 740.17m
3a	Stream flowing into the Studena	≅ km 20+560	Control length, L = 204.24m
4	Kunovačka River	km 21+092 - km 21+760	River control length, L = 782.24m
5	Kunovačka River	km 21+935 - km 23+362	River control length, L = 1487.57m
6	Draguša River	≅ km 31+210 - km 31+390	River control length, L = 172.98m
7	Nameless stream	km 33+338 - km 33+740	In the length of L = 450.88m cascades are envisaged according to a separate water engineering design
8	Nameless stream	km 34+300 - km 34+775	In the length of L = 503.03m, cascades are envisaged according to a separate water engineering design
9	Crvena reka River	km 35+630 - km 35+850	River control length, L = 191.18m
10	Crvena reka River	km 37+630 - km 37+870	River control length, L = 215.84m
11	Nameless stream	km 39+700 - km 39+770	In the length of L = 140.82m, cascades are envisaged according to a separate water engineering design

The route of the Dimitrovgrad bypass road section is on slopes and is away from major water courses, so there is no risk of affecting their morphology or hydrological parameters.

In the course of construction it is necessary to ensure drainage profile for ditches and temporary flows that intersect the motorway route.

The justifiability of works on the development of river beds lies in the prevention of landslides and erosion, but, on the other hand, these same works can have a negative impact on the environment, primarily on flora and fauna in and around those water courses.

It is necessary in this phase to ensure an additional room for implementation of construction works, and for unloading the excavated material. At the places where a construction site is located in the vicinity of rivers or streams, surface waters will be adversely affected by the potential leakage of dangerous substances, such as motor oil or lubricants. Leakage of these matters from the construction site may become a serious problem unless the measures are taken to restrict this occurrence as described in the mitigation measures.

Mitigation measures include all the procedures that are necessary for rendering the quantified adverse impacts within the allowed limits, and the procedures for minimization of impact.

- Digging and making the foundations for bridge piers, retaining walls, and structures located at, or in the vicinity of, surface water bodies, will take place in the period of low water levels (July - September) so as to minimize negative impacts on rivers and their banks;
- In the immediate vicinity of a river, any spillage of dangerous substances must be avoided. To this effect, the contractors will be required to use, for their machines, biodegradable lubricants and biodegradable machine oil, so as to minimize pollution during the execution of works;
- Maintenance, fill-up with fuel, and cleaning of construction machines will take place at the locations which are farther away from the water courses and which will be identified before the commencement of the execution of works;
- River banks in the investigated area should be protected with fences during the construction so as to prevent any negative impacts that can be caused by the transportation and unloading of the material in their vicinity;
- Prevent the movement of machines inside rivers, streams, or on their banks, except when it is unavoidable due to the construction of a structure or construction;
- To mitigate the effect of pumping out ground waters, use driven reinforced-concrete piles, instead of bored piles; place the pile heads beneath the river bed level to avoid wash-away;
- To protect ground waters on the floodplains, do not use pits for discharging waste liquids out of vehicles;
- Define the appropriate warehousing and managing of oil derivatives and paints. Avoid pouring out of the substances dangerous for water, such as oils and lubricants and, in the event of uncontrolled spillage, promptly take the cleaning action. The waste material produced by the machine maintenance must be disposed at the waste landfills.

5.5.2 Operation phase

Main sources of pollutants in operation of the motorway section under observation include: vehicles, precipitation, and dust.

In the road operation phase, water pollution is primarily a result of the following processes:

- Depositing of exhaust gasses;
- Wear and tear of tires;
- Vehicle body failure and leakage of transported matter;
- Spillage of transported freight;
- Rejection of organic and inorganic waste;

- Deposits from the atmosphere;
- Wind-borne matter;
- Dispersion due to the passing of vehicles.

Pollution which results from the above processes can be, in respect of time characteristic, perennial, seasonal, or incidental.

Perennial pollution is in the first place related to the scope, structure, and characteristics of the traffic flow. A consequence of the traffic taking place is permanent depositing of harmful matter on the road surface and ancillary elements of the transverse profile, which is washed away by the precipitation. This is primarily about depositing of harmful matter from exhaust gasses, oils and lubricants, wear and tear of tires and pavement, wear and tear of vehicles bodies, etc.

Seasonal pollution is related to a particular time of the year. A typical example for this type of pollution is the use of salt for road maintenance during winter months. This type of pollution is characteristic for the occurrence, in a very short time period that includes putting salt on the road surface and consequences of thawing, of high concentrations of sodium chloride.

Incidental pollution usually arises due to the transportation of harmful matter. It is usually oil or its derivatives, even though it is not rare that vehicles transporting very harmful chemicals are damaged. That which in this case is a particular problem is the fact that here we deal with almost immediate high concentrations which cannot be foreseen in respect of time or space. The consequence is that, from the perspective of protection, very wide belts need to be protected, most often the zones for water supply but also quite often the high category surface waters.

5.5.2.1 Types of pollution and the forms of presence

In the waters coming down from the pavement there is a presence of a number of harmful matters. Here we have primarily the fuel components such as hydrocarbons, organic and inorganic carbons, nitrogen compounds (nitrates, nitrites, and ammonia).

A specific group of elements includes heavy metals, such as lead (fuel additive), cadmium, copper, zinc, mercury, iron, and nickel. A considerable portion is that of solid matter of different structures and characteristics that appear in the form of sediment, suspended and soluble matters. It is also possible to see the matters which are a product of the use of materials for protection against corrosion. A specific group of very carcinogenic materials include polyaromatic carbohydrates (benzo[a]pyrene, fluoranthene) which are a product of incomplete combustion of fuel and the used motor oil.

For the indication of present pollutants that appear in dissolved or non-dissolved form, there is a number of macro indicators such as: pH, electro-conductivity, suspended and sediment matter, COD, BOD, grease and oils, etc.

Table 5.5.2.1 shows pollution sources and typical pollutants that run-off from roads.

Table 5.5.2.1
Pollution sources and typical pollutants that run off from roads

Pollutants	Source of pollution
Solid particles	Wear and tear of pavement, vehicles, atmosphere and road maintenance
Nitrogen and phosphorus	Atmosphere and use of fertilizers
Lead	Lead in the form of tetra methyl lead from the exhaust gasses of vehicles, wear and tear of tires
Zinc	wear and tear of tires, motor oils and lubricants
Iron	Corrosion from the vehicles, metal structures on the motorway (bridges, crash barriers), movable parts of engine
Copper	Protective metal coats, wear and tear of engine bearings and engine brushes, movable parts of engine, wear and tear of brake lining, fungicides and insecticides
Cadmium	Wear and tear of tires and use of pesticides
Chromium	Protective metal coats, movable parts of engine, wear and tear of brake lining
Nickel	Diesel fuel and petrol, lubricant oils, protective metal coats, wear and tear of brake lining and asphalt surfaces
Vanadium	Fuel additives
Titanium	Paint for road markings
Manganese	Movable parts of the engine
Sodium, calcium and chlorides	Salts for defrosting
Sulphates	Road subgrade, fuel and salts for defrosting

5.5.2.2 Determining the amount of pollutants

Main presumptions of critical importance for calculation of the concentration of pollutants may be classified in the form of following conclusions:

- highest concentrations of pollutants were registered in the waters coming off the roads during winter months when salt dispersal is most intensive;
- concentrations of most pollutants are directly subject to the duration of dry weather periods before rain and to the traffic load. Highest concentrations are reached in the first 5 - 10 minutes of rainfall, and then abruptly fall afterwards;
- concentrations of suspended particles are proportionate to the intensity of rainfall and the highest concentrations are reached during the highest flow;
- loss of water because of the sprinkling when the vehicles pass by do not exceed 10 % of total quantity;
- scattering of the material from the road surface during the dry period due to air drifts because the vehicles pass by do not have any considerable effect on lowering of concentration;

- pollution of waters by coming off the road surface can be considerable and that is why it is necessary to make a thorough analysis and identify the need for any mitigation measures;
- Accident pollution is a specific phenomenon and is not included in the above stated. The relationship towards these occurrences is specifically analyzed in the chapter on possible chemical accidents.

In agreement with the above stated and based on international experience arising from 20-year research, the estimate was made of the emissions of contaminants produced during the operation of the motorway route under observation for the traffic load in the planning period, and the results are shown in a tabular form.

Table 5.5.2.2 – 01 Amounts of pollutants, per unit of area, which the forecast traffic emits during a year, by sector

Motorway sections / Pollutants	Prosek - Cr. Reka	Cr. Reka - Pirot	Pirot - Dimitr.	Northern Dim. bypass road
	(kg/ha/year)	(kg/ha/year)	(mg/l)	(kg/ha/year)
Suspended particles	234.55	229.77	111.67	246.22
BOD5	10.51	10.30	/	11.04
COD	79.26	77.65	/	83.20
Total organic carbon	40.44	39.61	/	42.45
Nitrates	1.59	1.55	/	1.66
Total phosphorus	0.21	0.21	0.616	0.22
Oils and grease	3.64	3.57	/	3.82
Copper	0.02	0.02	0.05	0.02
Iron	4.04	3.96	0.16	4.24
Lead	0.07	0.07	0.10	0.07
Zinc	0.13	0.13	0.19	0.13

To draw the conclusions, apart from the spatial characteristics of the relevant sections of the road, hydrogeological characteristics of corridors, characteristics of the flow of crossed water courses and pollutant concentrations in runoff water from the pavement, the drainage concepts must be defined.

The concept of drainage from the E–80 motorway is an important element from the perspective of possible effects in terms of pollution, of both waters and soil.

The compliance with high EU environmental protection criteria specifies that runoff water from the future road from Prosek to the Bulgarian border should be evacuated controllably and treated before being discharged into recipients. This would ensure a certain degree of protection against pollution not only of recipients, but also of wells, i.e. water supply sources.

The envisaged solution for the road runoff drainage system will be of enclosed/controlled type. Rainwater will be evacuated from the road by the following system: drains – shafts – collectors. Water has to be evacuated using watertight elements only.

Retention ponds placed near recipients are places where pavement runoff waters are accumulated. On the section Prosek - Crvena Reka of the E–80 Niš – Dimitrovgrad Motorway, 38 retention ponds are envisaged, water from which will be discharged through treatment facilities into recipients. Oils, naphtha, and oil derivatives will be removed by using coalescent filters. The retention ponds will be lined with a clayey material in order to avoid the infiltration of polluted waters into the water-permeable floor. Such a drainage concept allows certain protection against the pollution of surrounding soil, but leads to the

concentration of pollution in the areas of retention ponds, because of which it is necessary to plan periodic discharge of contents from sedimentation tanks and separators. The retention ponds are sized for 100-year waters in order to avoid any risk of outflow due to flooding, and thus outflow of polluted waters over the surrounding terrain.

The retention ponds with separators and sedimentation tanks are located along the given E–80 road, on its left and right sides, at the lowest points of pavement or terrain, as close to recipients as possible, depending on the method of conducting polluted water to the retention pond.

In Sector 1, from Prosek to Crvena Reka, 38 retention ponds are envisaged.

In Sector 2 to Čiflik, 17 retention ponds are envisaged.

In Sector 3 Čiflik – Stan. - Pitot, 39 retention ponds are envisaged.

In Sector 4, from Pirot to Dimitrovgrad, i.e. "the northern bypass road" (Sector 5), 23 more retention ponds are envisaged.

Then we calculated the amount of polluting substances that will be accumulated in a 1-year period in each of retention ponds, without elaborating on the impact of these quantities of pollutants in pavement runoff waters on the quality of water in recipients, because these waters will be treated before being discharged.

Riparian waters and waters from motorway slopes, being unpolluted, are directly discharged into the collector by open channels, ensuring that they do not flow over arable land and surrounding ground.

Out of water engineering structures on the northern Dimitrovgrad bypass road, there are, along the already mentioned drinking water reservoir, a purification system, biodisk, (km 93 + 850 - km 94 + 000) on the left bank of the Nisava River, 230 km from the bypass road route.

In order to protect systems of wells located in that area (km 99 + 550 and km 99 + 600) about 140 m away from the newly designed bypass road, against runoff waters from the pavement of the future road, certain measures have to be taken. The system of wells is the basic source of water supply for Dimitrovgrad currently present, which is envisaged for the future usage as well.

The concept of pavement drainage on the northern Dimitrovgrad bypass road is based on the cross drainage of rainwater into shafts with covers / grates, which are primary recipients, and the encased rainwater drainage system in the stopping lane of the motorway, and then their discharge into stormceptors, depending on grounds conditions.

Thus, the evacuation of pavement runoff waters will be of controlled type. In other words, the entire discharge from the given section will be controllably evacuated to shafts and enclosed rainwater drainage systems, wherefrom all water goes to stormceptors, as treatment facilities, where the waters will be treated as required, and then discharged into the Nisava River, as recipient.

In order to move and evacuate all particles from the pavement, it is necessary to have rain of minimum intensity of 5.4 mm/h (15 l/s/ha) for at least 10 minutes. Taking care of statistical indicators for precipitation regimes in the meteorological station Dimitrovgrad, for the calculation of the highest possible concentration of pollutants, we adopted the period of accumulation (dry period) of 15 days with rain of minimum duration of 10 minutes. Quantities of polluting substances, per unit of area, emitted by forecast traffic in one day, total quantities of pollutants in the dry period (15 days) per unit of area and meter of length of the motorway route, are given in Table T 5.5.2.2 - 02.

Table T 5.5.2.2 - 02 Daily and cumulative quantities of pollutants

Polluting substances	(g/ha/day)	(g/ha)	g/m'
Suspended particles	674.57	10118.49	10.827
BOD5	30.24	453.59	0.485
COD	227.96	3419.35	3.659
Total organic carbon	116.30	1744.57	1.867
Nitrates	4.56	68.39	0.073
Total phosphorus	0.60	9.07	0.010
Oils and grease	10.47	157.01	0.168
Copper	0.05	0.70	0.001
Iron	11.62	174.25	0.186
Lead	0.20	2.93	0.003
Zinc	0.37	5.51	0.006

The problems of incidental pollutions are not quantifiable in this way, primarily because these are individual cases dispersed in space and time.

The structure of porosity of rock masses existing in the analyzed area is intergranular, fissured-fractured, and fractured. Water permeability of rock masses was quantified based on hydraulic conductivity coefficients ranging from $k_f > 1.1 \times 10^{-2}$ cm/s to $k_f < 1 \times 10^{-7}$ cm/s, which indicates water permeable, semi-permeable, and poorly permeable to impermeable rock masses.

Highly permeable deposits of alluviums, proluviums, and river terraces, the motorway route passes over, may be the zones of risks when speaking of the pollution of groundwater, particularly in case of accidents.
Exploratory drillings, structural penetrations, and excavations show that groundwater level in the investigated area, all along the route of the newly designed motorway, range from several meters to the groundwater level at the very ground surface. It should be mentioned that groundwater levels in some exploratory boreholes drilled in alluviums of rivers and streams are rather high, and considering a good water permeability ($k_f = 1.1 \times 10^{-2} - 2.0 \times 10^{-3}$ cm/s) of overlying layers, these locations may present a potential risk in terms of pollution of sources for individual water supply, immediately next to the road, particularly in cases of traffic accidents involving vehicles that transport oil derivatives and other hazardous substances. These locations are indicted on the maps of the Natural basis, and are recorded in Tables T 5.5.2.2 - 03 and T 5.5.2.2 - 04 at the following chainage points:

Table T 5.5.2.2 - 03 Locations of potential pollution hazard

Chainage	A*	B*	C*	D*	E*
km19 +	Spring, yield capacity 20 l/min.	al	120	0	marked

630					
km 19 + 650	Well	al	175	0	marked
km 25 + 530	Tapped spring, yield capacity20 l/min.	d	127	30	poor
km 32 + 360	Spring, yield capacity 2 l/min.	T_1^{1-2}	143	- 30	none
km 38 + 580	Well	Pl	27	-5	poor
km 38 + 950	Tapped spring, yield capacity1 - 2 l/min.	d	43	0	marked
km 39 + 020	Permanent seepage area	T_1	118	10	none
km 39 + 250	Tapped spring	d	135	- 10	none
km 39 + 800	Permanent seepage area	Pl	32	5	poor
km 40 + 090	Permanent seepage area	Pl	123	- 15	none

Table T 5.5.2.2 - 04 Locations of potential pollution hazard

Chainage	A*	B*	C*	E*
km 95 + 450	Tapped spring	$K_{1\ PS,LC,K}^{2}$	~ 60	marked
km 96 + 475	Spring	$d^{g,dr}$	~ 125	/
km 99 + 600	Wells	$al^{g,p,s}$	~ 140	/

*
A – Hydrogeological occurrences and structures
B – Stratigraphic code;
C – Distance from the motorway (m);
D – Difference in elevation between the road and the hydrogeological occurrence or structure (m);
E – Impact of the road with respect to the lithological composition and distance.

Nevertheless, within hydrogeological properties of the terrain it may be expected that the overlying layer, by its water-permeability properties, has characteristics of an aquifuge on most of the motorway route. Since there are no recorded larger organized groundwater intake structures in the immediate vicinity of the motorway route, and, based on the proposed method of draining pavement runoff waters, it may be concluded that the infiltration of pavement runoff waters under the ground surface will be substantially hindered, or practically impossible.

The water courses intersected by the motorway route will be bridged. Since polluted water from the pavement may easily get into a water course, at all places of intersection between the planned road and watercourses, negative impacts on the quality of water in them are possible.

Bridges make a substantial risk when speaking of the pollution of water courses, particularly in case of accidents, and when an accident occurs, remediation possibilities are very low.

The basic attitude resulting from the environmental impact analysis is that pavement runoff waters are polluted. According to the Law on Waters, rainwater discharged into a water course shall be treated at least to the quality of water corresponding to the category of the water course.

A high cost of treatment indicates a need to design the drainage system so that only polluted water is treated. The drainage of riparian waters and waters from slopes on parts of the route on embankment and in shallow cuts will be performed through ditches lined with concrete at gradients under 0.5 % and over 4.0 %. In cuts, or side cuts, on the riparian side, drain channels are designed to gather water from slopes, not allowing it to mix with water from the pavement. These waters, as well as perennial and periodic streams, are passed through the motorway roadbed by means of bridges and culverts.

According to the Terms of Reference, the adopted concept is the concept of drainage with a controllable, mostly enclosed system for draining rainwater from paved surfaces and their treatment before the discharging into open natural or man-made water streams. Such a requirements is in compliance with the Decree on permissible emissions and treatment of waste matter from motorways, parking areas, and motor vehicle repair shops (EU Standard EN 858-1).

Within an internal system it is necessary to solve surface drainage of all pertaining facilities (rest areas, ramps, junctions, ingress and egress arms, and other operational surfaces) and all structures (viaducts, bridges) on the route of the newly designed motorway section.

The system for runoff water accumulation and treatment comprises watertight retention ponds (108 retention ponds envisaged) with a clay bottom, and treatment facilities for the separation of floating and sedimentation of bulky material.

The system of rainwater drainage from the road surface requires continuous cleaning of its elements. Monitoring of retention ponds and plans in the operation phase is a very important element to ensure proper and efficient functionality. This provides for appropriate protection of the surrounding soil against pollution, considering that with time the pollution concentrates at retention pond locations. With that in mind, it is important to plan periodic emptying of sedimentation tanks and separators.

As opposed to other sections of the E–80 motorway where retention structures were applied, this section is envisaged only with stormceptor-type treatment systems. Their locations and size are dictated by the positions of recipients and ground configuration.

Based on previous experiences, the estimate is that the stormceptor itself functions as sand trap and slurry sedimentation tank, and has a possibility of retaining the high-impact pollution with hydrocarbons of 100 mg/l. Moreover, within the sedimentation process, heavy metals are separated.

On bridges, in addition to crash barriers and raised curbs, the plan should contain bridge drains to receive all rainwater from the road surface of the bridge and through flexible connections, lead into appropriate drain pipes, attached to the bridge cantilever or appropriate support, to be specified in the final design.

Within the internal system, surface drainage of all auxiliary structures (lay-by, junctions, ingress and egress arms, as well as other traffic surfaces) and all structures (viaducts, bridges, tunnels) along the route of the newly designed motorway.

5.6 Impacts on social/cultural environment

5.6.1 Impact on population

The construction of the E–80 Niš - Bulgarian border motorway will have a stimulating effect on a better traffic and economic connection of the Republic of Serbia and its surroundings, as well as on a faster development of the region served by this corridor. This corridor and the regional traffic network will ensure better connections between the south-eastern Serbia and the western, central, and southern Serbia and the Timok-Danube area. Intensification and connection of traffic flows in the corridor will have impact on the strengthening of economic and other functions of Niš that is even now the most crucial node in Serbia, after Belgrade, and on the development of Pirot, Bela Palanka, and Dimitrovgrad, centers on the route of the Niš – Bulgarian border corridor.

As an integral part of the optimum road link between the European road network and the Asian road network it is of major importance in the communication of Europe with the Near East over the territory of the Republic of Serbia, and in the connection of the countries of West Europe and the Alpine area with the countries of South-East Europe and the Asian area.

The newly designed E–80 Niš - Dimitrovgrad motorway is the factor of integration of national and regional areas, but is also the factor of disintegration of the local area.

The social aspect of the construction and operation of the planned road includes the study of possible adverse consequences on a set of features comprising population, their holdings and settlement contents. Population for the purposes of quantification means the features comprising a demographic and socio-economic structure, and settlement contents means developed facilities, including the existing settlements along the route.

The general goal of social development is to improve the quality of life for citizens, particularly to improve the quality of services and accessibility of public services, which is achieved by the construction of this road. The route of the future road has a function to connect the macro regional center Niš with the regional center Pirot and the municipal centers Bela Palanka and Dimitrovgrad in an area that has been burdened with existing and planned infrastructural facilities.

From the point of view of the interests of specific social groups as users of the space and structures thereon, the construction of this motorway may have a two-fold impact on the socio-economic environment and economic development of the area under study. There are two basic stakeholder populations. One comprises the users of the road for the purposes of freight and passenger transport, and the other the owners of the land on which the analyzed section is to be built.

Road construction may cause the deterioration of the living conditions in the settlement and its zones. These adverse impacts are manifested in the case the road corridor intersects (divides) developed parts of a settlement, i.e. disintegrates the local space. We face such a

problem in Crvena Reka settlement. On the north-east, this settlement has contact with a railway line and the M - 1.12 main road. The newly designed motorway runs at the distance of 400 m from existing infrastructural facilities and spatially divides the settlement serving facilities into two sub-units. Due to its favorable "roadside" position, this settlement grew into a minor gravity center for the western part of the Bela Palanka ravine. The passing of the motorway will jeopardize functional links between the parts of the settlement, which may be hindered or completely cut off.

The newly designed motorway has the opposite effect on Glogovac village. The road route tangents this settlement, offering a possibility for spatial and economic development. Having in mind the fact that Glogovac is a highly emigrational area with a large number of elderly households, the construction of this road will offer realistic possibilities for a demographic turn of events.

Jelašnica and Prosek are settlement of a compacted type, physiognomically connected. The motorway was routed so as not to disturb much the functional organization of these settlements. The communication with the mining colony, presently located on the right side of the motorway, is ensured by a bridge over the displaced regional road R - 241a at km 19 + 931.83 and a bridge over the Kunovacka River and a local road at km 20 + 602.55. The road construction would call fro the displacement of a minor metal-processing plant.

Almost entire traffic gravitating toward Bulgaria is directed to the existing southern bypass road that has already evolved into an urban road. The newly designed bypass road will give to inhabitants of Dimitrovgrad and surrounding settlements much higher safety, since the existing road will be relieved only for local traffic. The social group only transiting through that area without stopping by will also benefit substantially from traffic safety, since they will avoid any longer stay in the town core.

A part of negative effects will be present only in that part of local features that are related to necessary interventions within private properties. It is a fact that the basic activity of population in this area is agriculture, and that the surfaces occupied with the road construction will be a lost resource for good. From the aspect of sociological impacts, there are marked negative impacts in this case.

The intensification of transport on main routes will enable the strengthening and further development of specialized centers, such as: spa centers (Niška Banja, Ostrovičke Terme, Banja Topilo), freight-transport centers (Niš, Pirot), border centers (Gradina), tourist and sports&recreation centers (Mt. Stara planina, Mt. Suva planina, Mt. Seličevica, Sinjevačka klisura gorge, Jelašnička klisura gorge, and other zones of natural value and immovable cultural assets).

5.6.1.1 Mitigation measures

Settlements will be protected against negative impacts of the motorway expressed through the effects of noise, vibrations, air pollution, and risks of accidents, by the construction of the E–80 motorway bypass road out of the boundaries of building land of Nis, Pirot, and Dimitrovgrad, and by ensuring technical measure for protection against noise, vibrations, and air pollution of all residential buildings located at distance less than 300 m from the motorway route.

In the technical document development stage and prior to the commencement of works, it is necessary to sanction, by administrative measures, any individual construction in the immediate vicinity of the motorway. This will prevent the adverse impacts to which such structures would be exposed, and subsequent mitigation measure requirements. Residential construction in the zone of the future road route should be prohibited.

5.6.2 Impact on population health

The impact of the planned motorway E–80 Niš – Dimitrovgrad on the health of the population includes the impact on the population in settlements along the motorway as well as on drivers and other participants in the traffic (assistant drivers, passengers, pedestrians). These impacts include exposure to noise, vibrations and air pollution (oil combustion and exhaust fumes).

Traffic noise is characterized by a level of 40-100 dB(A) meaning all signs of harmful effect of noise may be found.

Physiological, non-specific effects of noise are reflected in the change of heart and respiratory rate and frequency. Noise causes changes in the cardiovascular system: mostly leads to the lowering of the blood pressure, and only at high frequency noise levels increase of the blood pressure is reported, sometime accompanies with heart rate disorders and chest pain.

Noise adversely affects the functioning of the endocrine glands (thyroid, pineal, pituitary and adrenal glands), and also secretory and motor functions of the stomach. Changes in the blood have also been observed: hyper- and hypo- glycaemia, and eosinphilia. Under the influence of the noise the first changes (prior to the changes in the auditory analyzer) occur in the brain in the form of the spasm of blood vessels of the brain. The consequence is the increase of pressure in brain blood vessels, and if prolonged, functional changes in the central nervous system, particularly its vegetative functions. Persons exposed to noise suffer from headaches, buzzing in the ears, dizziness, increased irritability and emotional instability. There is a close connection between the general fatigue and exposure to noise. In addition, noise adversely affects concentration and communication during work as well as rest.

In acute exposure to noise of significant intensity, auditory sensitivity is reduced (auditory effects of noise). In intensive and extended noise there is a high risk of hearing impairment. Auditory trauma is most commonly progressive, occurs with the exposure of noise exceeding 80 dB. In terms of vision, dilatation of pupilla, narrowing of the field of vision and reduced speed of perception may occur.

The impact of vibrations on the human body depend on physical properties such as frequency, amplitude, acceleration, energy, size of contact area, tissue structure, routes of spreading. The higher the amplitude, the greater vibration impact. Vibration frequency is of greatest importance when it comes to the biological effect. People with coronary artery disease, hyper- and hypo-tension, middle ear diseases, ovarian cycle disorders are more sensitive.

The effect of vibration on the body may be reduced to two types of effect: physical (mechanical, thermal) and biological (effect on the auditory and vestibular system,

proprioceptors and mechanoreceptors). Vibrations reduce the sensitivity to pain, temperature and touch (particularly sensitive are fingers and toes and the abdominal area).

The effects of vibrations may be local and general. Thus, vibrations causing irritation of peripheral nerve endings may affect the central nervous system, endocrine glands, as well as the function of cells and tissues of other organs. General vibrations cause disorders in the vegetative-vascular centre and vestibular system. Vibrations may have multiple effects on the body, in particular the central nervous system, peripheral nervous system and joint&muscle system. Vibrations may cause disorders such as: coronary and cerebral circulation disorders, gastritis, ulcer, trophic disorders of the skin and deep tissue, hearing impairment (reduced perception for low-frequency sound waves, increased sensitivity to noise), vestibular system disorders (dizziness, movement coordination disorder), visual function disorder (vision impairment, diplopia).

5.6.2.1 Mitigation measures

- In terms of population protection, and for the purposes of monitoring air pollution, the Monitoring project needs to be developed.
- Due to pollution of the soil that is the consequence of road operation, it is necessary to provide minimum road protection area that will not be cultivated. Considering the expected pollutant concentrations, this belt need not be wider than the road. The grass from the maintenance of green areas must not be used as animal feed. Herbicides may not be used as weed killers.
- The ban on residential construction in the road protection area of the motorway is recommended.

5.6.3 Impact on cultural monuments

The analysis of the explored area, as well as the inspection of the existing documents within the as-built analysis identified 44 structures that belong to the category of cultural monuments. As already mentioned, a large number of archeological sites are located in the immediate vicinity of the designed road route. Apart from direct threat by the rod as such, cultural and historical monuments along the planned route are exposed to traffic impacts such as air, soil, water pollution, noise and vibrations. The boundaries of the cultural monuments' protective zones are determined depending on the type of structure and amount of information on its location and dimensions, and a 40m radius.

The identification of impacts of the planned road on these structures is a task that demands precise information on buildings themselves and on indicators related to the motorway. Some of the mentioned registered sites are uninvestigated spatial units for which there are neither basic information on their precise location, particularly not data on significance of these sites and necessary degrees of protection.

Preconditions of the Institut for the protection of Cultural Monuments of Serbia are given in App. D – References (416/2 од 28.09.2001.)

Directly affected sites are those located on the motorway route itself, and these are:

Livade site (at km 42 + 950)
Mađilika (at km 63 + 600),

Sites at km 82+100 and 83+000
Selište site on the bypass road

Other immovable cultural assets which are not located on the highway route itself are:

No.	area	site name	period
19	Krst-Zapis	Ciflik	cross made of sandstone, erected in 1906
20	Crvencevo	Crvencevo	ancient period
22	Gradiste	Stanicenje	ancient period

It is necessary to perform archaeological probing, to identify the sites prior to the beginning of construction of the newly designed route. Other sites are located at 100-200m from the road centerline, and most of adverse impacts may be avoided.

The Law on Cultural Assets obligates the investor and contractor to provide for and ensure archaeological intervention in the case they come across new, non-recorded sites. This involves the immediate discontinuation of works and notifying the competent Cultural Monument Protection Institute about the discovery. This certainly requires occasional archaeological supervision during construction. The investor is obligated to provide funds for all envisaged works – archaeological probing, occasional archaeological supervision, protection o/f the archaeological intervention, etc.

5.6.3.1 Measures of protection of cultural monuments

The conditions listed by the Republic Cultural Monument Protection Institute from Belgrade, include the following mitigation measures:

- No excavation, demolition, alteration or any works that may harm the properties of the cultural monument may be carried out.
- Until the measures of protection for Natural Cultural Assets (NCA) and their surroundings, no construction or spatial development without prior approval of the competent cultural monument protection service may be carried out.
- Republic Cultural Monument Protection Institute and authorized expert must be timely notified of the commencement of earth and other works at the archeological site or in its immediate vicinity, in order to timely perform all the necessary preparations until the archeological exploration license is obtained.
- Identified sites must be marked and secured (with a protective railing or other means of protection) to avoid damage in the course of road construction.

5.7 Cumulative impacts

Existence of other structures in the subject area of the Prosek – Dimitrovgrad highway, as well as possible construction and use of the new ones, may result in increase of intensity of impacts occurred due to construction and use of the highway. Due to this reason, already analyzed impacts, categorized as those of minor significance, by superposing may reach the intensity which exceeds the stated limits. Data on possibility of occurrence of these cumulative impacts were collected by noting of presence of these structures within the impact zone of prospective road.

Construction of a motel and highway maintenance centre is stated for the km 28 + 700. Noise and emissions of air pollutants generated by these supporting structures, together with quantities of pollutants emitted from the highway, may lead to exceeding of allowed maximum values, what would be subject to the EIAs for these structures.

Immediately upon the exit of the tunnel, on km 32+400, construction of the rest areas is planned for both sides of the motorway. They, by rule, represent source of huge quantities of solid communal garbage. The situation is similar for the rest areas on km 36+300 and km 47+300. Near Sukovo Village, on the right side, on km 86+950, there is a chemical dye factory located in the zone of impacts. Potential cumulative impacts may occur by synergy of pollutants from both of the pollution sources in the air. At the entry of Pirot basin, on km 78+350, the highway crosses over the main railroad Nis – Dimitrovgrad and it is positioned in parallel to it on 250 to 300m of distance. At the location of the bridge across the Jerma River, on km 88+600 to km 93+600, the highway is located at 50 to 100m of distance in relation to the railroad. At this part of the section cumulative impacts are manifested through increased noise level, as analyzed through modelling of impacts within the EIA. In the zone of Dimitrovgrad, no significant impacts are expected.

5.8 Trans-boundary effects

In some cases, activity subject to EIA preparations may be of so wide range that it impacts the quality of living environment of other, primarily neighbouring, countries. For this reason, within the environmental impact assessment, it is necessary to have the analysis of risk of transfer of impacts beyond the borders of the country subject to the project implementation. The procedure itself is subject to the Espoo (EIA) Convention on EIA, which has not been signed and ratified in the Republic of Serbia.

Transfer of negative impacts beyond the borders of the particular country may result from high intensity of impacts, immediate vicinity of the impacts source in relation to borders of other countries or specific conditions of the impacts transfer. Results of the impacts modelling for the road Prosek – Dimitrovgrad indicated that transfer of these impacts is limited to the impact zone, which is in the boundaries of 500 m on the left and right side of the highway. Road position is such that, except in the border area of Dimitrovgrad, the road is not located immediately close to the border of Bulgaria. Configuration of terrain subject to the highway construction is such that disables trans-border transfer of impacts. This primarily refers to network of watercourses that inflow into the Nisava River, which belongs to the Black Sea watershed, but flows from Bulgaria towards Serbia. Potential accidents that may cause bigger pollution of rivers would be transferred in reverse direction in regards to the border. The only impact that may result in degradation of living environment condition on the global level is air pollution, i.e. emission of air pollutants causing greenhouse effect due to combustion of oil derivates serving as petrol for traffic participants.

6. ANALYSIS OF ALTERNATIVES

The preparation of the design documentation was preceded by the General Design of the E–80 Motorway prepared by the Highway Institute in 1996. Multicriterial evaluation of the alternative versions of the corridor is excuted. Maximum priority is given to the expences of construction and traffic safety , then expences of exploitation, and lower priority is given to the spatial consequences and environment. Regarding the corridor impact - maximum calibration is given to the noise, pollution and biodiversity impact, while vibrations and visual impact were considered as the lower priority.

Specific details about the procedures of the multicriterial evaluation of the alternatives are implied in the General Design of the motorway E – 80.

The General Design was the basis for the preparation of the Spatial Plan of the infrastructural corridor Niš – Bulgarian border. The Spatial Plan is a long-term planning document elaborating on the Spatial Plan of the Republic of Serbia, defining planning solutions, guidelines, and rules for usage, organization, development, and protection of space, and construction, reconstruction, and operation of main and regional infrastructural systems in the territory of the Plan by 2020. The Spatial Plan was prepared by the Institute of Urban Planning, Nis, in 2001.

This planning document defines the corridor of the future motorway route and proposes its variants.

Variant solutions were proposed on the following sections:

- Bela Palanka – Pirot
- Sukovo junction – Bulgarian border

6.1 Bela Palanka – Pirot Section

There are four variant solutions proposed for the given section:

- Variant I (valley route, according to the General Design of the E–80 Motorway)
- Variant II (valley route, bypassing Pirot)
- Variant III (hilly route, southern)
- Variant IV (hilly route)

The Spatial Plan for the area of infrastructure corridor Nis - Bulgarian border ("Official Gazette of RS", No. 86/2009) which includes E-80 Highway section Ciflik – Stanicenje – Pirot (“Valley Route Alternative”, see pic 2 of this document) is adopted on 21st October 2009.

<u>Variant I – valley route, according to the General Design of the E–80 Motorway</u>

From Bela Palanka to the ingress to Pirot, the Motorway follows the valley of the Nisava River. After bypassing Bela Palanka, the Motorway corridor crosses a local road, a high-speed railway line, the Nisava River, and then flows into the corridor of the existing M1.12 road to the west of Čiflik village. After this intersection, the Motorway corridor overlaps

entirely with the existing road route all the way to "Sarlah" tunnel at ingress in Pirot. After appearing out of "Sarlah" tunnel, the future Motorway corridor fits into the route of the existing bypass road. After intersecting the high-speed railway line, the Motorway corridor follows, on the northern side, the route of the regional road Nis – Dimitrovgrad all the way to Sukovo. The linking between the M-9 main road and the Motorway in the west is achieved over the existing tunnel "Sarlah", and in the east, it is possible only by passing through the town and using streets.

Variant II – valley route, bypassing Pirot

The Motorway corridor on its part from Bela Palanka to the egress from "Sarlah" tunnel, has the identical position as in Variant I. After appearing out from the tunnel, the Motorway bypasses Pirot from its southern side, to the south of the existing bypass road and high-speed railway line.

The link with Pirot is achieved over "Pirot-West" and "Pirot-East" junctions.

The link between the M-9 main road and the Motorway is achieved over an existing street, through the existing "Sarlah" tunnel and a newly designed road toward "Pirot-West" junction, taking the existing bypass road toward "Pirot-East" junction.

Variant III – hilly route, southern

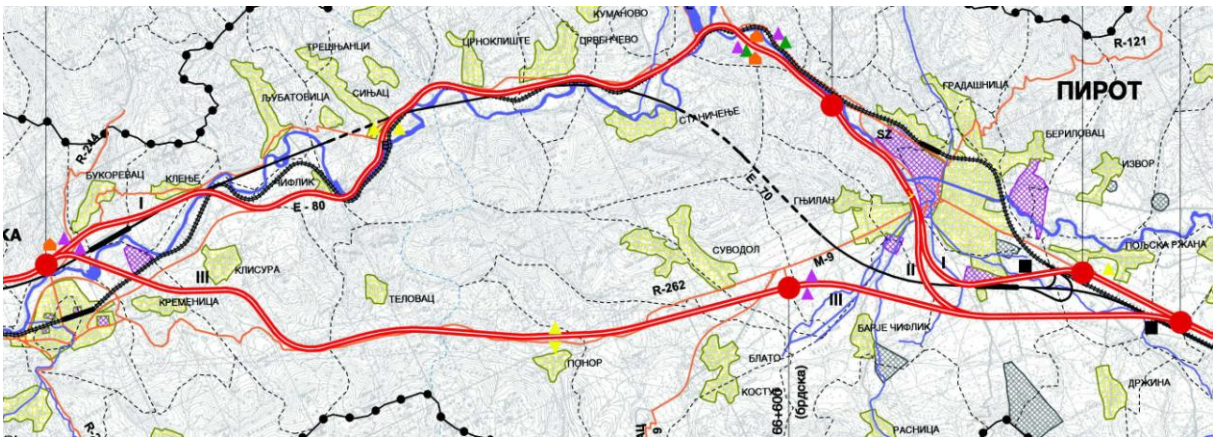
From Bela Palanka, the Motorway corridor takes a turn to the southeast into the Nisava River valley where it intersects the R 244 regional road, the high-speed railway line, the Nisava River, the existing Niš - Dimitrovgrad railway line, after which it goes onto the slope of Grncarev del hill. After getting on the slope, the Motorway is on a hilly terrain, taking a straight route between Klisura and Kremenica villages, therefrom turning southward to Zanoga saddle. On the slopes of Zanoga, the Motorway flows into the corridor of the existing regional road R-262 and follows it to behind its intersection with the M-9 main road in the northeast from Blato village where the Motorway goes down to the valley bypassing Pirot from the southern side, out of boundaries of the Pirot Master Plan.

In a wider territory of Pirot, the Motorway intersects several local roads and water streams, and immediately in front of "Pirot – East" junction, it intersects the high-speed railway line.

At km 77+000 (at km 82+000 by chainage in the General Design for the valley route), to the west of Veliki Jovanovac village, the Motorway joins the route defined in the General Design.

Representatives of the Serbian Ministry for Capital Investments and local government made a decision to adopt Variant IV (Hilly route, Klenje – Ponor – Pirot) as the best solution for the Motorway route on this section.

The proposed variant solutions from the Spatial plan of the infrastructural corridor Niš – Bulgarian border are shown in Fig. 6.1 - 0.1.



6.2 Sukovo Junction – Bulgarian border Section

The Spatial plan for "Sukovo junction - Bulgarian border" Section proposes three variant solutions:

Variant I (according to the General Design of the E–80 Motorway)

According to the solution specified in the General Design, the Motorway route after Sukovo junction follows the Nisava River stream to the ingress in the urban area of Dimitrovgrad, where it crosses the Nisava River, intersects the existing railway line Niš – Dimitrovgrad, the regional road Niš – Dimitrovgrad, and streets in the town. After multiple intersections, the route extends over the northern slop of Mrtvina hill all the way to its intersection with the existing route at "Gradina" border crossing. On the part bypassing Dimitrovgrad the Motorway takes a viaduct, 246 m long, over "Čuj petl" residential area, intersects the town cemetery and affects the only green oasis in the surroundings of Dimitrovgrad. Dimitrovgrad is connected to the Motorway over Dimitrovgrad junction located in the west of the town core.

Variant II (North)

From km 96 + 180, the E–80 Motorway route bypasses Dimitrovgrad and suburbs on its northern side across stable, infertile, and undeveloped land, which does not affect the existing functions of the town and its future spatial development. In the zone of the border crossing, the Motorway joins the existing road.

Variant III (South)

According to this variant, at km 96 + 000 the Motorway takes a turn to the south, intersects the regional road Niš – Dimitrovgrad, crosses the Nisava River, and intersects the high-speed railway line, and then enters a tunnel, about 3,500 m long, that passes under Mrtvina hill and bypasses Dimitrovgrad from its southern side, thus avoiding all intersections with streets, the construction of any high viaducts, and eliminating any pollution from exhaust gases and noise.

Junctions are planned in the west of the town core and near "Gradina" border crossing.

The Serbian Ministry for Capital Investments and representatives of the local government of Dimitrovgrad Municipality agreed to reject Variant I because of the collision of the

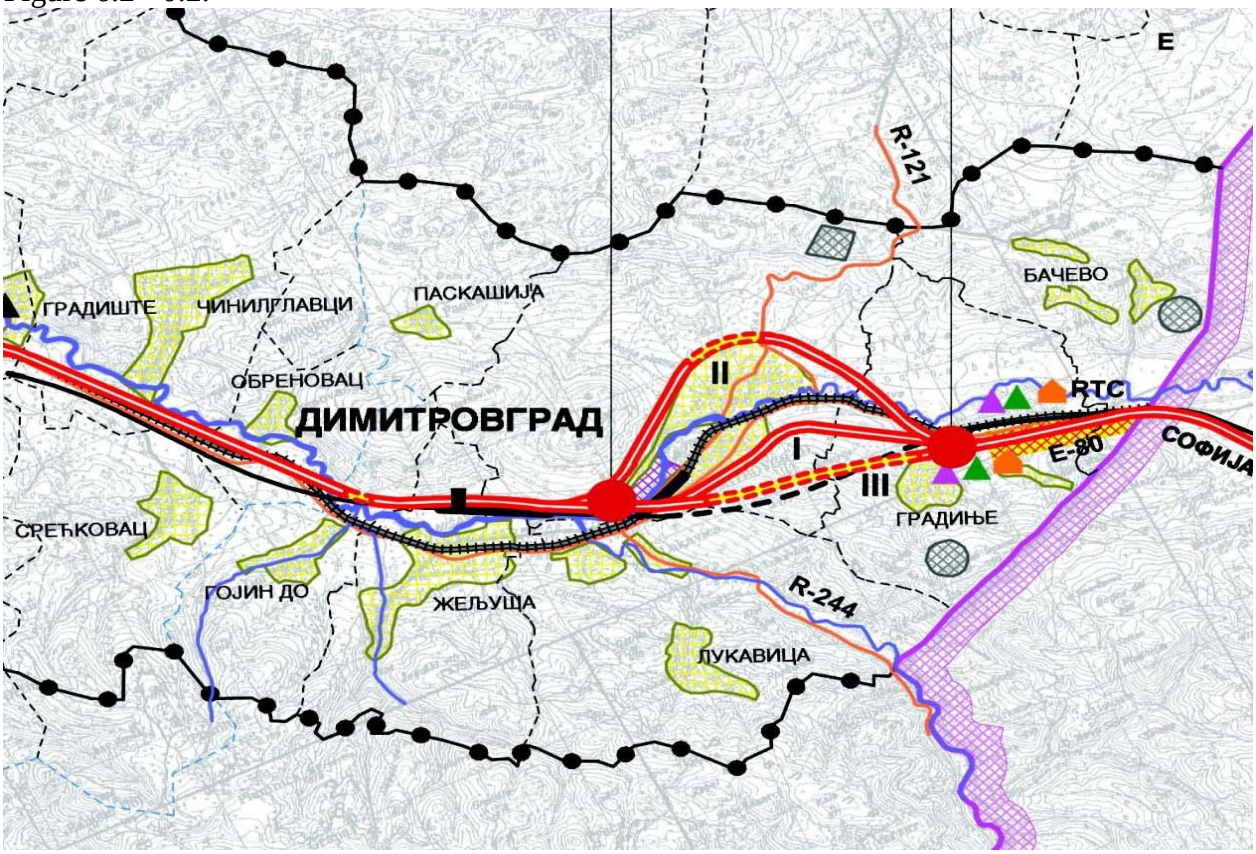
Motorway with the town cemetery and the green oasis in the vicinity of Dimitrovgrad. The Highway Institute and CIP Institute of Transportation prepared design documentation for this Motorway variant in 2002.

After an evaluation conducted by experts from the Highway Institute and CIP Institute of Transportation, Variant III was rejected because of a high price of the construction of a complex structure (tunnel).

Representatives of the Serbian Ministry for Capital Investments and local government made the decision to adopt Variant II as the best solution for Dimitrovgrad Municipality.

The proposed variant solutions from the Spatial plan of the infrastructural corridor Niš – Bulgarian border are shown in Fig. 6.2 - 0.2.

Figure 6.2 - 0.2.



Data source: Spatial plan of the infrastructural corridor Niš – Bulgarian border.

7. ENVIRONMENTAL MANAGEMENT PLAN

7.1 Mitigation Measures

Modern road planning, design and construction process set demanding requirements and strict criteria with regard to rational use of natural resources and environmental protection.

Environmental Impact Analysis of the Highway E-80, Nis – Bulgarian border shows that this road will impact the present state of the environment within the researched corridor. In order to minimize negative changes in the environment, highway design, construction and operation should be performed in compliance with the following requirements:

7.1.1 Regulations

Environmental regulations represent the combination of all measures required under the relevant planning documents. This group includes legal measures and measures provided for under other ordinances, norms, standards and relevant regulations which set forth this issue.

The specific issue concerning the highway – environment relationship is not under the scope of a particular regulation, regardless of its importance. The overall issue of said relationship has been treated under the Law on Environmental Protection (Official Gazette of the Republic of Serbia No. 135/04) which brought about the basic statutory provisions proscribing required preparation of special research studies, which present an integral part of planning and design documents with reference to the issue of environmental protection.

The following environmental protection measures and requirements are prescribed under the Law on Environmental Protection (Official Gazette of RS No. 135/04):

- preventive measures
- environmental protection requirements
- hazardous material mitigation measures
- programs and plans

The following regulations have also been used for the research:

- Law on Environmental Protection (Official Gazette of RS No. 135/04);
- Law on Environmental Impact Assessment (Official Gazette of RS No. 135/04);
- Law on Planning and Construction (Official Gazette of RS No. 47/03, 34/06)
- Water Law (Official Gazette of SRS (Federal Republic of Serbia) No. 46/91, 67/93, 53/93,48/94, 54/96);
- Road Law (Official Gazette of SRS No. 46/91, 52/91, 52/91, 67/93, 48/94, 42/98, 101/05);
- Law on Urban and Spatial Planning (Official Gazette of SRS No. 44/95);
- Law on Occupational Safety (Official Gazette of SRS No. 42/91);
- Law on Occupational Safety - supplement (Official Gazette of SRS No. 53/93);
- Law on Cultural Heritage Preservation (Official Gazette of SRS No. 28/77, 34/81, 71/94);
- Law on Cultural Heritage Preservation – supplement (Official Gazette of SRS No. 47/87,);
- Law on Water Supply Sources Protection (Official Gazette of SRS No. 27/77);

- Law on Agricultural Land (Official Gazette of RS No. 49/92, 53/93, 67/93, 48/94, 46/96, 62/06,)
- Law on Spatial Planning of the Republic of Serbia; Chapter 5. Tourism and Environmental Protection and Natural and Cultural Heritage Protection (Official Gazette of RS No. 13/96);
- Forest Law (Official Gazette of RS No. 46/96, 83/92, 53/93, revision 67/93, 48/94, 54/96);
- Regulation on Contents of Environmental Impact Assessment (Official Gazette of RS No. 69/05);
- Regulation on Road Design (Official Bulletin of SFRJ (Socialist Federal Republic of Yugoslavia) No. 35/81);
- Regulation on Fuel Transport (Official Bulletin of SFRJ, No. 26/85);
- Regulation on Hazardous Substances in Water (Official Gazette of FRS No. 31/82, 46/91);
- Regulations on Methods of Defining Sanitation Zones and Areas of Drinking Water Supply Facilities (Official Gazette of FRS No. 33/78.);
- Regulation on Limit Values, Pollution Concentration Measuring Methods, Criteria for Determining Measuring Points and Data Recording (Official Gazette of RS No. 54/92, 30/99, 19/06);
- Regulation on Allowed Environment Noise Levels (Official Gazette of RS No. 54/92),
- Regulation on Method and Minimal Number of Wastewater Quality Tests (Official Gazette of RS No. 47/83, 13/84, 46/91)
- Regulation on Chemical Risk and Environment Pollution Assessment, Preparation Measures and Remediation Measures (Official Gazette of RS No. 60/94, 63/94)
- Regulation on Waste Oil Management (Official Gazette of RS No. 60/08)
- Regulation on Classification of Inter-Republic Watercourses, International Waters and the Sea of Yugoslavia (Official Bulletin of SFRJ, No. 3/68).
- Order on Water Categorization (Official Gazette of RS No. 31/82).
- Order on Road and Railroad Transportation of Hazardous Substances (Official Gazette of RS No. 53/02)
- Order on Organizing and Training Civil Defense Units and on Mitigation Measures and Rescue of Civilian Population and Material Assets (Official Bulletin of Federal Republic of Yugoslavia, No. 54/94).

Taking into consideration that a large portion of specific environmental relationships particular to road construction has not been defined under local regulations, therefore, regulations and guidelines of other countries which have been verified by the international public have been used for this paper. Especially guidelines covering the general aspects of the issue have been used, Merkblatt zur Umweltver-träglichkeitsstudie in der Strassenplanung, specially concerning the issue of noise (Richtlinien für den Lärmschutz an Strassen, RLS - 90) and the issue of air pollution (Merkblatt über Luftverunreinigungen an Strassen, Mlus - 92).

7.1.2 Mitigation Measures in the Event of Accidents

Considering the potential of accidents to vehicles which transport hazardous substances, special mitigation measures are necessary. A number of measures planned under the scope of general environmental protection have their full purpose and provide considerable reliability to the entire system and in the event of pollution caused by accidents.

The most important aspects of mitigation measures in the event of accidents, i.e. car accidents and failure taking place on highways, are:

- Good organization of on-site emergency teams;
- Good supply of equipment for operations in the event of accidents;
- Good supply of special clothing and other protective equipment which enables operation under such circumstances;
- Quick decision-making during on-site emergency operations.

The places where vehicles carrying hazardous substances are most likely to drive off the road in case of accidents are embankments over 5.0 m high. Such places are to be secured with guardrails.

Bridges are a great risk as regards water pollution. In such cases, when any failure has already occurred, the chances of remediation are not very high, and therefore analysis should be focused on precautionary measures so as to prevent pollutants from reaching the surface water. Such precautionary measures are speed limits, raised curbs and guardrails.

Special activities performed in the event of accidents to vehicles carrying hazardous substances also fall under precautionary measures. In that respect, disposal of specific amounts of sorbents and proper equipment should be planned in the road maintenance headquarters.

Measures provided for under the procedures described above are requirements which must be met so as to reduce the impacts of the new highway to an acceptable measure.

7.1.2.1 Mitigation Measures in Case of Oil and Petroleum Product Spillage

In the event of accidental spillage of oil and petroleum products from tank vehicles during road transport, the following measures should be taken:

- Close up damaged tanks
- Collect the pollutant which is flowing out;
- Pump out the material which remained in the damaged tanks;
- Build trenches to collect the spilled material;
- Broadcast affected areas on the ground with sorbent, remove material which has collected on the surface, replace saturated soil and move it to a disposal site, in accordance with Regulation on Criteria for Defining Locations and Organizing Waste Material Disposal Sites;
- Remove contaminated layers of soil and backfill with uncontaminated soil.
- Pump out contaminated water from wells near the spillage;
- Crops having ground decontaminating properties should be grown on affected agricultural areas for 2 to 3 years crops (which may not be used for food during that period).

7.1.2.2 Emergency Response Entities (Chemical Accident)

Depending on the rate of accident (chemical accident), emergency response entities on the level of a municipality, town or the republic, are:

- Internal affairs departments, communications, transport, utility services;
- Fire department and special technical teams and remediation teams;
- (Eco)Toxicological laboratories, analytical laboratories, stationary and mobile analytical units;
- Hydrometeorological institutes and measuring stations;
- Ambulance teams, institutes of public health, stationary health institutions with toxicology departments;
- Serbian military authorities, services, units and teams (special task unit ABHO for nuclear, biological and chemical defense, technical service, transport, etc.)
- Civil defense units and headquarters.

All entities transporting hazardous substances undertake to prepare for measures and actions to prevent potential chemical accidents and remedial actions. Party in charge of planning for chemical accident prevention for the transport of hazardous substances should be the company management, i.e. respective authorities, administrations, municipalities, etc.

7.1.3 Environmental Mitigation Plans and Technical Solutions

7.1.3.1 Mitigation Measures during Construction

A number of measures are required during the construction of the planned highway so as to minimize potential environmental impacts. Such measures are as follows:

- For the purpose of construction accident prevention, an organization registered for such activity, which is the subject of this document, should be hired for construction. Such organization must have a person present on site, which is authorized for construction management, passed their license exam and with qualifications in accordance with other requirements under the Law on Planning and Construction. The authorized person and all parties participating in construction shall observe the regulations, standards and norms for their line of work and the Law on Occupational Safety and the Law on Occupational Health and Safety.
- The Contractor undertakes to prepare the Report describing the health and safety measures on site, which is prepared as a separate document and is based on the Detailed Design or the As Built Design. Such Report is to be signed by the professional who prepared it. Report describing the health and safety measures on site will be provided for by the Contractor (Construction Manager) and verified by the Client's agent or the Supervising Engineer, after which commencement of work will be allowed.
- The Contractor is allowed to commence work only when the construction site is arranged in accordance with the terms under Regulation on Occupational Safety for Construction Works (Official Gazette of RS, No. 53/97). The company will prepare a notice informing the relevant labor inspection about commencement, in accordance with occupational safety regulations will include information set forth under Article 237, Regulation on Occupational Safety for Construction Works. The Contractor will also submit the Report describing the health and safety measures on site to the labor inspection together with the notice of construction.
- The Client undertakes to provide for engineer supervision during construction.
- The site should take up a minimal area which is necessary for site functioning, whereas, special care should be taken when choosing the location so as not to choose an area with prominent flora and fauna and avoid unnecessary loss of a biotope;
- Strict protection of all areas outside immediate construction zone, which means that the

areas outside the highway section may not be used as permanent or temporary stock piling areas, borrow pits, parking areas or equipment repair areas;
- Topsoil collection and keeping on ordered disposal sites so as to reuse the topsoil for reclamation and biological protection;
- Handling oil and petroleum derivatives during construction and supplying such material to equipment will be performed on a special designated place and with maximum mitigation measures so as to prevent spillage. All oil and petroleum derivative packaging must be collected and taken to controlled disposal sites;
- Opening unmonitored access roads to particular parts of the construction site will be prohibited;
- Equipment will be parked only of designated places. On such parking locations, special mitigation measures will be taken to prevent soil pollution with oil and petroleum derivatives. Should soil become polluted with oil leakage or in some other manner, request will be made for removal of such layer of soil and conveyance to a waste disposal site;
- Systematical collection of solid waste which is common for construction and the presence of workers in construction site zone (food packaging, other types of solid waste) and disposal on respective waste disposal sites;
- Cleaning equipment and vehicles will be forbidden in the construction site zone as well as washing concrete mixers and uncontrolled removal of remaining concrete to any areas outside the line of the road;
- Upon completion, all borrow pits and waste disposal sites will be reclaimed according to special reclamation projects so as to prevent further soil degradation and improve the visual effect.

7.1.3.2 Technical Measures during Operation

Specific procedures to be performed during highway operation phase should be defined with respect to appropriate mitigation measures. Technical measures during operation include all activities concerning highway maintenance, which require the following:

- Provide the highway with respective road surface marking and traffic signs, which include all forms of necessary restrictions and notices;
- Prepare particular operation plans for winter maintenance procedures while having in mind environmental protection;
- The embankment slopes require landscaping so as to provide visual effects improvement and reduction of surface erosion effects, also planning all reclamation measures of green zones along the lanes;
- Some highway sections require planting of decorative, colorful vegetation in order to break the monotony. If possible, for landscaping use autochthonous species which are common for such area and make sure that the selection should not be high value species as regards natural values;
- Due to soil pollution resulting from highway operation, provide a minimal protective area which is not to be uncultivated. Considering the expected pollutant concentrations, such an area should not be more than 5 m wide from the road edge. The grass cultivated for road area maintenance may not be use for feeding of cattle. No herbicides may be used to destroy weeds;
- Minimize salinization effect on the soil surrounding the highway due to winter maintenance with sodium chloride by substituting it with other substances having similar or better defrosting effect. In case sodium chloride is used for maintenance, precise time

planning and disposal of quantities is highly important;

- Any highway appurtenances should be designed and constructed in accordance with the basic function of this road and Environmental Impact Assessment prepared beforehand;
- Road vegetation maintenance in parallel with maintenance of road signs and markings, public road buildings and guardrails, winter maintenance etc. incorporate a set of measures implemented during highway operation so as to provide the optimal traffic conditions.
- Appurtenant structures should be provided with solid waste containers for prevention of soil pollution in the highway zone during operation. The containers must be emptied by the relevant company and deposited to a respective solid waste disposal site.

7.1.3.2.1 Mitigation Measures in the Tunnel

Road tunnel falls within the category which requires artificial ventilation. Ventilation system has been designed so as to provide:

- air quality with respect to the allowable harmful substances in vehicle exhaust gas
- smoke extraction under emergency situations (tunnel fire)

The tunnel will be furnished with a longitudinal ventilation system with jet fans and reversible action for two-way extraction of exhaust gas from the tunnel.

The tunnel will be interconnected with emergency exit passageways for passengers in the event of accidents, i.e. fire in one of the tunnel lines. Considering that the tunnel has another tunnel tube which runs in parallel along the entire tunnel length, smoke extraction can be done in the manner prescribed by the requirements in case of tunnel fire (PIARC, Fire and Smoke Control, 1995, Europe Working Group). Tunnel tubes are interconnected over passenger emergency exit passageways in the event of fire. The entrances to these passageways will be equipped with door preventing smoke from the tunnel on fire to reach the other tunnel, which will be used under such circumstance for emergency exit of passengers. These passageways will also be ventilated. Tunnel smoke extraction is limited to the possibilities of the ventilation system, which will adjust, in the event of fire, for one-way traffic in all lanes.

In the event of fire, ventilation system should be automatically controlled, if there is no central supervisory control system. If there is such system, then the operator will take control of the ventilation system in order to regulate smoke extraction. This system also enables automatic control over time programs and manual and remote control. Make sure that all installations and tunnel wall cladding meet fire requirements and do not put the passengers at risk during evacuation.

Tunnel ventilation can be constructed so as to meet all terms of reference as regards assuring air quality and also smoke extraction requirements. The tunnel will be fitted out with sensors for detection of hazardous substances in the exhaust gas, which automatically control the ventilation system in accordance with planned operating modes. Sensors for fire detection in the tunnels are also planned.

The noise issue is a subject under the Tunnel Preliminary Design where it has been concluded that the measures to be taken in that respect will be defined under the Detailed Design. Considering that the tunnel holds the main noise sources, first the fans, following

which are the vehicles, special care should be given to that issue. Reversible jet fans will be selected based on the best output concerning noise levels. In case that detailed acoustic analysis, which would be conducted under the Detailed design, should show that additional mitigation measures are necessary, special tunnel wall cladding with high sound absorption coefficient might be used.

7.1.4 Other Measures

7.1.4.1 General Environmental Mitigation Measures

General environmental mitigation measures include global knowledge in this area, which is appropriate to the global strategy and local spatial requirements and characteristics of the planned road.

- All activities announced within the general development policy at the level of the Republic of Serbia and which have been implemented through the highest planning documents, should be accepted with respect to rational environmental protection for the actual investment venture,
- Within the area of general development policy, provide due compliance with regulations having general importance with respect to limit values of particular impacts and also with regulations concerning the characteristics of the rolling stock with respect to noise level and exhaust gas quality,
- Enable constant monitoring of the environment in the highway zone by supplying data resulting from measurements,
- Enable continuous road maintenance,
- Provide timely plans for winter highway maintenance.

7.1.4.2 Administrative Environmental Mitigation Measures

Administrative environmental mitigation measures include a number of activities with respect to administrative arrangements which regulate specific issues, which, if not arranged in time, may cause certain negative consequences which are very hard to restore to acceptable limits. Such mitigation measures include the following activities:

- During the preparation stage of technical documents and before construction, administrative measures are needed to sanction potential individual construction in the close proximity of the highway. This prevents negative impacts to which such structures would be exposed and additional environmental protection requests. Further construction of residential buildings in the highway zone needs to be prohibited,
- Provide instruments, within consents issued by relevant authorities (relevant ministries), to have permanent monitoring of potential environmental impacts,
- Provide instruments, within agreement documents drafted by the Client together with contractors, stipulating the requirement to meet all prescribed mitigation measures during construction phase,
- Provide instruments to engage such entities for construction and operation works which have the qualified staff in order to meet the defined environmental protection requirements,
- Provide instruments with respect to professional improvement of professionals in the area of highway operation from the aspect of environmental protection under actual circumstances.

In addition to specified environmental mitigation measures, a number of other procedures and actions should be taken, which are mostly organizational and refer to mitigation of potential negative impacts.
Such measures represent an obligation to be met in order to reduce the environmental impacts to the new Highway E-80 to acceptable limits.

7.2. Monitoring

Monitoring design defines the monitoring program for each separate environmental element, respective statutory grounds referring to sampling and monitoring procedures, monitoring methods, sampling point locations, sampling time and period and duration of monitoring.

7.2.1 State of Environment before Construction

State of the environment with respect to dominant impacts existing in the analyzed area is marked with negative consequences which mostly are products of urbanization of the greater area.

Pollution of watercourses in this area (Vrastanica, Kosturska Reka, Kunovacka Reka, Studena, Petrova Reka, Temstica, Rogoz, Crvena Reka, River Nisava and a few streams), comes from improper wastewater and municipal water treatment, which are drained in those watercourses and agricultural measures taken in land farming.

When the sources of traffic noise are concerned, monitored research area is characterized by traffic on the present railway Nis - Dimitrovgrad, main roads M 1.12 and M 9 and regional roads P 241a and P 244.

Inspection of the current state at a specific time line during the preparation of this study, the conclusion has been made that specific negative impacts occur in water, soil and air.

Table 7.2.1 - 01 shows the current state outline of the environment in the zone affected by the new Highway E-80 which comes from the analysis of measurement results and field tests.

Table 7.2.1 - 01 Outline of present quality of the environment in the zone affected by the new Highway E-80

Analyzed Parameter	Present Quality
Water Quality	Diminished due to improper treatment of industrial and municipal wastewater
Air Quality	Air quality measurement results were not available
Noise	Subject area not suffering load from noise levels from the present traffic
Soil Quality	Slightly diminished, due to focusing on healthy food production, and traffic load is small on the local roads
Population Health	No negative impact to health of were not recorded
Meteorological Parameters and Climate	Not at risk
Vegetation	Not at risk
Animal population	Not at risk
Number and Concentration	Reduced population number, increased local migration

Analyzed Parameter	Present Quality
of the Population and Migrations	
Natural and Cultural Assets	Preserved

7.2.2 Parameters for Determining Harmful Impacts

Parameters which require measuring for each environmental segment where impact is expected, both during construction and operation, can be defined from inspection of the present state and impact assessment of the new highway.

Noise

The relevant parameter for determining noise pollution is the relevant noise level which is measured, calculated and assessed in accordance with the terms under the Regulation on Allowed Environment Noise Levels (Official Gazette RS, No.54/92).

Noise level measuring requires equipment which can give an insight into complete measurement results. Every aspect of the measuring procedure must meet the Regulation terms. Measurement report will be signed by a responsible professional.

Air Pollution

Considering that Highway E-80 will run through inhabited areas, significant negative impacts on air pollution are expected. A monitoring plan of environmental impact needs to be developed for the purpose of verification of the applied impact model, and also in order to determine the long-term air pollution trends. In addition, air quality monitoring results will serve as the basis for estimating the risk on the health and for investigation of citizen complaints, and also for data collection for alterations and supplements to spatial planning.

Measuring carbon monoxide (CO) and nitrogen dioxide (NO_2) measuring is recommendable in stage one of the monitoring program. If the measurement results show exceeded allowable concentration values, the list of pollutants should be extended by measuring the concentrations of nitrogen monoxide (NO), sulfur dioxide (SO_2), hydrocarbon (C_XH_Y) and lead (Pb) and solids (PM10).

Water

Relevant parameters for surface water impact assessment are: pH, concentration of oxygen dissolved in water, waste material, turbidity, concentration of organic compounds and mineral oils.

Relevant parameters for groundwater impact assessment are divided into geological-hydrogeological and to physicochemical and chemical parameters. The first group of parameters includes impacts to groundwater level, dynamics and quantity, whereas the second group includes impact to groundwater quality.

Soil

Relevant parameters for soil impact assessment are: pH, concentration of heavy metals, oils and organic substances.

Soils near roads having a high frequency of traffic, as in this case, are tested for hazardous and harmful substances, and, if necessary, for impaired chemical and biological properties.

Hazardous substances in accordance with Regulation on Allowable Quantities of Hazardous Substances in Soil and Irrigation Water are: cadmium, lead, mercury, arsenic, chromium, nickel and fluorine, whereas, harmful substances are copper, zinc and boron.

7.2.2 Measurement Program

Construction of a road such as said highway is an activity characterized by complex time and spatial schedule of the work, which makes selection of locations, methods and frequency of parameter measurement difficult.

Increase in the scope of research will be necessary if, during construction and monitoring of the environment, increase of negative impacts should be registered, and in order to get reliable results on the risks, causes of such increase and necessary measures to be taken so as to eliminate the negative impacts or reduced within the legally defined limits. If, in the event of new circumstances, there is a need to define new monitoring parameters, the parameters for quantification of the new state and the locations of the new sampling points will be set forth by the inspection service in charge of environmental protection.

Noise

Noise level will become increased during construction due to transport of bulk on heavy field vehicles (driving the material on site and off the site) and the use of construction equipment. Such sources of noise are temporary and they will last until completion.

Noise levels during needs to be controlled, when necessary, i.e. if any complaints arise about the exceeded noise level during construction. Regulation on Allowed Environment Noise Levels sets forth the measuring methods, selection of measuring points and time intervals of measurements.

Within noise monitoring during construction works, the following must be performed:

- measure zero state,
- measure highest noise levels (peaks) during construction,
- if allowed noise levels are exceeded during construction, necessary mitigation measures will be taken in agreement with the Owner.

During construction phase, noise should be controlled during construction. Noise level measuring must be performed in the residential buildings zone on the right side of the new highway from km 94 + 450 to km 94 + 800 and at km 95 + 550.

During operation, noise should be controlled for the purpose of efficiency control of the planned noise mitigation measures. Noise level measuring must be performed in five year intervals and in case of complaints by the local population. The places selected for noise monitoring during construction are the places of the most affected buildings on the following survey marks:

- km 20+360 – left side,
- km 20+740 – right side,
- km 39+730 – right side,
- km 39+730 – right side.
- km 54+460 – right in Ciflik community
- km 54+360 – left in Ciflik community
- km 59+800 – left in Crnokloiste community

Air

Air pollution monitoring during construction includes air quality impact assessment during construction performed in the vicinity of the populated areas. Additional monitoring of the construction site impact to air quality will be performed in the event of complaints from the local population.

Program of air quality measurement should include communities in the zone affected by the future highway: Prosek and Jelasnica from 20 +000 km to 21 + 000 km, Klenje at km 50 + 200 and Ciflik at km 54 + 400 km. Measurement of the concentration of air pollutants emitted from motor vehicles during the operation phase of the new Highway E-80 requires that all measuring stations are set up in the same way, because only then can an appropriate dispersion model be formed, which would provide quite reliable data on special distribution of air pollution in the impact zone.

Regulation on Limit Values, Pollution Concentration Measuring Methods, Criteria for Determining Measuring Points and Data Recording (Official Gazette of RS No. 54/92, 30/99, 19/06) also regulates, among other things, the criteria for determining measuring points. The number and distribution of measuring points within the network of measuring points depends on spatial density and time distribution of pollutants. The arrangement of the measuring points depends on the area where air quality is being tested, arrangement and type of pollution source, population density, terrain orography and meteorological conditions.

The following requirements need to be met when selecting the locations of air quality measuring stations:

- measuring point will be characteristic of the area selected according to the general plan,
- measuring station will be set up in such manner so that it gives comparable data with data from other measuring stations within the monitoring network.
- some physical requirements should be met.

During the first monitoring stage, which should last for 5 years, periodical air quality monitoring will be necessary (1 month per season), because, determining the air pollution trends requires measurement data for minimum five successive years.

Only if the periodical measurements show that further air quality monitoring is necessary, permanent air quality monitoring should be performed, i.e. monitoring stage two should begin.

Water

Water monitoring during construction includes water quality impact assessment during construction performed in close proximity to watercourses, i.e. water intakes.
Monitoring program includes parameters which are relevant for determining of the impact on surface water and groundwater.

For surface water, the program includes the following parameters: pH, concentration of oxygen dissolved in water, waste material, turbidity, concentration of organic compounds and mineral oils.

Samples are taken at the point in the surface water downstream the construction site. Monitoring program is performed in such a way, which allows said program to determine which construction works are affecting the surface water quality. Samples should be taken before commencement, at the moment when topsoil is stripped and excavation or backfilling of soil are performed. Sampling is done in monthly intervals.

In such cases when measurement results and the analysis indicate increased negative impact, additional measurements will be necessary, finding the deteriorated samples and taking the required mitigation measures. By the time the deteriorated sample is found, only work not affecting water pollution may be performed.

For groundwater, monitoring program during construction should be performed in accordance with the terms of reference, and in accordance with the basic characteristics of highway construction. Monitoring program during construction of Highway E-80 includes the period of site preparation works and the period of construction.
All measurement will start one month before site preparation works. Monitored parameters are divided into geological-hydrogeological and to physicochemical and chemical parameters. Basic and indicative parameter measurement for groundwater should be performed at lest four times a year at minimum two month intervals. Chemical and physicochemical parameter measurement should be performed quarterly. Sampling days will depend on the groundwater level, precipitation and other geological and hydrogeological parameters.

Surface water monitoring program during construction includes monitoring of the following parameters: pH, concentration of oxygen dissolved in water, waste material, turbidity, concentration of organic compounds and mineral oils, and then temperature, color and odor.

Local statutory regulations with regard to the manner of wastewater (effluent) control of quantity and quality prior to drainage/intake in the receptacle cannot be applied on quality control of treated storm water. Effluent composition is variable during one hydrological year, depending on the climate, traffic scope and structure. In addition, unlike most of European countries, not even emission standards have yet been set forth in Serbia. Therefore, in this specific case, only the impact of the future highway on receptacle water quality can be monitored using pollution concentrations standards.

The aim of water quality measurement of the receptacles (River Nisava with tributaries) is to provide an overview of treated wastewater effluents to the quality of water in the receptacle.

Testing program includes the parameters which provide insight into the present groundwater quality and the pollution level with substances originating from the highway. Testing program includes the flowing measurement:

- Field measurement: air and water temperature, pH, electrical conductivity, oxidation-reduction potential,
- Basic parameters: color, dissolved substances, total organic carbon, ammonia, nitrates, sulphates, chlorides, chemical and biological oxygen consumption,
- Indicating parameters: microelements, phenols, mineral oils, polycyclic aromatic hydrocarbons, aromatic hydrocarbons, pesticides.

When taking into account the hydrogeological characteristics of upper groundwater layers in the highway area, no large organized groundwater intakes were registered near the new highway and the planned traffic load is not sufficient for greater concentration emissions of waste substances which might put the surface water and groundwater quality at risk. In conclusion, pollution of said courses will not occur.

Soil

Considering that the information on soil quality is sparse and inadequate, preliminary testing should be performed first. During preliminary testing, sample points are chosen at random and the number of samples is small. The first and most important step in soil quality analysis is sampling. Not only the quality of the results depends on the sampling method, but also the conclusions related to the quality of analyzed soil.

Once take, soil sample is rarely reproducible, with regard to physical and chemical features of such sample. For example, the second sample taken from the same sampling point does not have to be identical to the first sample. Sampling depth depends on soil use and the impacts on such soil. Samples from cultivated soil are taken at 0 - 30 cm of depth and from soils where fruit is grown are taken from 0 - 30 cm and 30 - 60 cm of depth. Individual samples are then placed in a PVC container, mixed and stones and plants are removed. Samples prepared in this manner are placed in PVC bags, labeled and transported to the laboratory to be analyzed.

Soil monitoring within the impact zone of Highway E-80 should last minimum 5 years, whereas sampling should be preformed once in three months.

After preliminary tests, further testing is planned. First, the sampling point is determined. The number of samples depends on the preliminary testing and it is connected to the test object.

Soil monitoring program during construction includes relevant parameters for determining the environmental impact on the soil. There is a wide selection of pollutants arranged in two groups: heavy metals, grease and oils (residue from unburned fuel, lubricants and motor oils, anti-freezing agents, hydraulic liquids, etc).

Monitoring program is performed in such a way, which allows said program to determine which construction works are affecting soil quality. Samples should be taken before commencement, at the moment when topsoil is stripped and excavation or backfilling of soil are performed.

In such cases when measurement results and the analysis indicate increased negative impact, additional measurements will be necessary, finding the deteriorated samples and taking the required mitigation measures. By the time the deteriorated sample is found, only work not affecting soil pollution may be performed.

Soil monitoring during highway operation, i.e. monitoring the impact of the future highway E-80 on soil quality should be performed within the limits of the highway zone.

Groundwater quality should be monitored in parallel with soil quality control. Groundwater quality control requires monitoring of pollutants which are not present in the soil, however, for the purpose of determining the impact which soil pollution has on groundwater. Groundwater sampling is performed using piezometers.

A. MITIGATION PLAN

Phase	Issue	Mitigating measure	Cost		Institutional responsibility		Comments (e.g. secondary impacts)
			Install	Operate	Install	Operate	
Construction	• **Material supply** *a) Asphalt plant* dust, fumes, workers health and safety, ecosystem disturbance	a) use existing asphalt plants; requirement for official approval or valid operating license	a) NA	a) NA	a) Asphalt plant	a) Asphalt plant	a)-c) to be specified in bid documents- Conditions for selection of subcontractors for material supply
	b) Stone quarry dust, workers health and safety, ecosystem disturbance	b) use existing stone quarries; requirement for official approval or valid operating license	b) NA	b) NA	b) Stone quarry	b) Stone quarry	
	c) Sand and gravel borrow pit disturbance of river bed, water quality, ecosystem disturbance	c) use existing borrow pits or buy material at licensed separations; requirement for official approval or valid operating license	c) NA	c) NA	c) Sand and gravel Contractor or Separation	c) Sand and gravel Contractor or Separation	
	• **Material transport** *a) Asphalt* dust, fumes	a) cover truck load	a) minimal	a) minimal	a) Truck operator	a) Truck operator	a)-d) to be specified in bid documents- Technical Specifications for realization of works
	b) Stone dust	b) wet or cover truck load	b) minimal	b) minimal	b) Truck operator	b) Truck operator	
	c) Sand and gravel dust	c) wet or cover truck load	c) minimal	c) minimal	c) Truck operator	c) Truck operator	
	d) Traffic management noise, vehicle exhaust, road congestion	d) haul material at off peak traffic hours; use alternative routes to minimize major traffic sites	d) NA	d) minimal	d) Transport manager; Truck operator	d) Transport manager; Truck operator	

	• **Construction site** *a) Noise disturbance to human and animal population and workers*	a) limit activities to daylight working hours (not between 8 p.m. and 7 a.m. or as agreed with public and authorities); equipment operating with noise mufflers	a) NA; minimal	a) NA; minimal	a) Construction Contractor	a) Construction Contractor	a)-k) to be specified in bid documents-Technical Specifications for realization of works

Phase	Issue	Mitigating measure	Cost		Institutional responsibility		Comments (e.g. secondary impacts)
			Install	Operate	Install	Operate	
	b) Dust	b) water construction site and material storage sites as appropriate	b) minimal	b) minimal	b) Construction Contractor	b) Construction Contractor	
	c) Vibrations	c) limit activities to daylight working hours (not between 8 p.m. and 7 a.m. or as agreed with public and authorities)	c) NA	c) NA	c) Construction Contractor	c) Construction Contractor	
	d) Traffic disruption during construction activity	d) traffic management plan with appropriate measures to redirect traffic that are easily seen or easy to follow; include traffic police	d) minimal	d) minimal	d) Construction Contractor	d) Construction Contractor	
	e) Reduced access to roadside activities	e) provide alternative access to roadside activities	e) depends on the way of access providing	e) minimal	e) Construction Contractor	e) Construction Contractor	
	f) Vehicle and pedestrian safety when there is no construction activity	f) appropriate lighting and well defined safety signs	f) minimal	f) minimal	f) Construction Contractor	f) Construction Contractor	
	g) Water and soil pollution from improper material	g) organize and cover material storage areas;	g) minimal	g) minimal	g) Construction Contractor	g) Construction Contractor	

	storage, management and usage	isolate concrete, asphalt and other works from watercourse by using sealed formwork; isolate wash down areas of concrete and asphalt trucks and other equipment from watercourse by selecting areas for washing that are not free draining directly or indirectly into watercourse h)					

Phase	Issue	Mitigating measure	Cost		Institutional responsibility		Comments (e.g. secondary impacts)
			Install	Operate	Install	Operate	
	h) Water and soil pollution from improper disposal of waste materials	i) dispose waste material at appropriate location protected from washing out, if possible at wetlands	h) depends on location	h) minimal	h) Construction Contractor	h) Construction Contractor	
	i) Potential contamination of soil and water from improper maintenance and fueling of equipment	j) proper handling of lubricants, fuel and solvents by secured storage; ensure proper loading of fuel and maintenance of equipment; collect all waste and dispose to permitted waste recovery facility	i) minimal	i) minimal	i) Construction Contractor	i) Construction Contractor	
	j) Destruction of crops, trees, meadows, etc.	k) ensure control of working zone and land acquisition; compensate damage	j) NA	j) depends on quantity of damage	j) Construction Contractor; Road Directorate	j) Construction Contractor; Road Directorate	
	k) Workers safety	l) provide workers with safety instructions and protective equipment; safe	k) minimal	k) minimal	k) Construction Contractor	k) Construction Contractor	

		organization of bypassing traffic					
Operation	• **Maintenance** *a) Noise disturbance to human and animal population and workers*	a) limit activities to daylight working hours (not between 8 p.m. and 7 a.m. or as agreed with public and authorities); equipment operating with noise mufflers	a) NA; minimal	a) NA; minimal	a) Maintenance Contractor	a) Maintenance Contractor	a)-d) to be specified in maintenance contract documents-Technical Specifications for realization of maintenance works
	b) Possible air, water and soil pollution dust, vehicle exhaust, fuel and lubricants spills	ensure proper handling of lubricants, fuel and solvents by secured storage; ensure proper loading of fuel and	b) minimal	b) minimal	b) Maintenance Contractor	b) Maintenance Contractor	

Phase	Issue	Mitigating measure	Cost		Institutional responsibility		Comments (e.g. secondary impacts)
			Install	Operate	Install	Operate	
		maintenance of equipment; collect all waste and dispose to permitted waste recovery facility; limit equipment operation speed; properly organize and cover material storage areas; isolate concrete, asphalt and other works from watercourse by using sealed formwork; isolate wash down areas of concrete and asphalt trucks and other equipment from watercourse by selecting areas for washing that are not free draining directly or indirectly into watercourse; dispose waste material at appropriate					

		location protected from washing out, if possible at wetlands					
	c) Vibrations	b) limit activities to daylight working hours (not between 8 p.m. and 7 a.m. or as agreed with public and authorities)	c) NA	c) NA	c) Maintenance Contractor	c) Maintenance Contractor	
	d) Workers safety	c) provide workers with safety instructions and protective equipment; safe organization of bypassing traffic	d) minimal	d) minimal	d) Maintenance Contractor	d) Maintenance Contractor	

Phase	Issue	Mitigating measure	Cost		Institutional responsibility		Comments (e.g. secondary impacts)
			Install	Operate	Install	Operate	
	• **Exploitation** *a) Increased volume and speed of traffic* noise, dust, vehicle exhaust, fuel and lubricants spills	a) installation of protection measures (noise barriers, planting hedges along roadside, etc); limit vehicle speed	a) depends on the way of protection	a) minimal	a) Contractor for environment protection works; Traffic police	a) Maintenance Contractor; Traffic police	
	• **Road safety** *a) Increased vehicle speed*	a) install appropriate traffic signs for speed limit	a) minimal	a) minimal	a) Maintenance Contractor	a) Maintenance Contractor	a)-b) to be specified in maintenance contract documents-Technical Specifications for realization of maintenance works
	b) *Erosion, rockfall, hazardous conditions*	b) install appropriate warning signs (rockfall, landslide, wet or slippery conditions,	b) minimal	b) minimal	b) Maintenance Contractor	b) Maintenance Contractor	

		dangerous curve, animal or pedestrian crossing, school, slow moving vehicles, merge), reflective markers to indicate steep edge or convex mirrors to see oncoming traffic at blind curves; locate warnings at points considered appropriate by good engineering practice or as agreed with public and authorities					

B. MONITORING PLAN

P120 hase	**What** *parameter is to be monitored?*	**Where** *is the parameter to be monitored?*	**How** *is the parameter to be monitored?/ type of monitoring equipment*	**When** *is the parameter to be monitored? (frequency of measurement or continuous)*	**Why** is the parameter to be monitored? (optional)	Cost		Institutional responsibility	
						Install	Operate	Install	Operate
Construction									
• **Material supply**									
a) Asphalt plant	a) possession of official approval or valid operating license	a) asphalt plant	a) inspection	a) before work begins	a)-c) assure plant compliance with environment, health and safety requirements	a) NA	a) NA	a) Plant Operator	a) Plant Operator
b) Stone quarry	b) possession of official approval or valid operating license	b) stone quarry	b) inspection	b) before work begins		b) NA	b) NA	b) Quarry Operator	b) Quarry Operator
c) Sand and gravel borrow pit	c) possession of official approval or valid operating license	c) sand and gravel borrow pit or separation	c) inspection	c) before work begins		c) NA	c) NA	c) Borrow pit or Separation Operator	c) Borrow pit or Separation Operator
• **Material**									

transport a) *Asphalt*	a) truck load covered	a) job site	a) supervision	a) unannounced inspections during work	a)-d) assure compliance of performance with environment, health and	a) NA	a) minimal	a) NA	a) Supervision Contractor
Phase	**What** *parameter is to be monitored?*	**Where** *is the parameter to be monitored?*	**How** *is the parameter to be monitored?/ type of monitoring equipment*	**When** *is the parameter to be monitored? (frequency of measurement or continuous)*	**Why** is the parameter to be monitored? (optional)	Cost		Institutional responsibility	
						Install	Operate	Install	Operate
b) *Stone*	b) truck load covered or wetted	b) job site	b) supervision	b) unannounced inspections during work	safety requirements and enable as little disruption to traffic as it is possible	b) NA	b) minimal	b) NA	b) Supervision Contractor
c) *Sand and gravel*	c) truck load covered or wetted	c) job site	c) supervision	c) unannounced inspections during work		c) NA	c) minimal	c) NA	c) Supervision Contractor
d) *Traffic management*	d) hours and routes selected	d) job site	d) supervision	d) unannounced inspections during work		d) NA	d) minimal	d) NA	d) Supervision Contractor
• **Construction site** *a) Noise disturbance to human and animal population and workers*	a) noise levels; equipment	a) job site; nearest homes	a) sound level detector at mobile laboratory;	a) once per week and on complain	a)-k) assure compliance of	a) NA	a) NA	a) Monitoring Contractor	a) Monitoring Contractor

			inspection		performance with environment, health and safety requirements and enable as little disruption to traffic as it is possible				
b) Dust	b) air pollution (solid particles, suspended solids, flying heavy metal particles)	b) at and near job site	b) mobile laboratory with necessary equipment	b) during material delivery and construction		b) NA	b) NA	b) Monitoring Contractor	b) Monitoring Contractor
c) Vibrations	c) limited time of activities	c) job site	c) supervision	c) unannounced inspections during work and on complain		c) NA	c) minimal	c) NA	c) Supervision Contractor
Phase	**What** *parameter is to be monitored?*	**Where** *is the parameter to be monitored?*	**How** *is the parameter to be monitored?/ type of monitoring equipment*	**When** *is the parameter to be monitored? (frequency of measurement or continuous)*	**Why** is the parameter to be monitored? (optional)	Cost		Institutional responsibility	
						Install	Operate	Install	Operate
d) Traffic disruption during construction activity	d) existence of traffic management plan; traffic patterns	d) at and near job site	d) inspection; observation	d) before works start; once per week at peak and non peak periods		d) NA	d) minimal	d) NA	d) Supervision Contractor
e) Reduced access to roadside activities	e) provided alternative access	e) job site	e) supervision	e) during construction		e) NA	e) minimal	e) NA	e) Supervision Contractor
f) Vehicle and	f) visibility and	f) at and near	f) observation	f) once per		f) NA	f) minimal	f) NA	f) Supervision

pedestrian safety when there is no construction activity	appropriateness	job site		week in the evening					Contractor
g) Water and soil pollution from improper material storage, management and usage	g) water and soil quality (suspended solids, oils, organic substances, heavy metals, pH value, water conductance)	g) runoff from site, material storage areas; wash down areas of equipment	g) gravity; observation; mobile laboratory with necessary equipment	g) during material delivery and construction, especially during precipitation (rain, snow, etc)		g) NA	g) NA	g) Monitoring Contractor	g) Monitoring Contractor
h) Water and soil pollution from improper disposal of waste materials	h) water and soil quality (suspended solids, oils, organic substances, heavy metals,	h) depository site	h) mobile laboratory with necessary equipment	h) once per week during construction and on complain		h) NA	h) NA	h) Monitoring Contractor	h) Monitoring Contractor

Phase	**What** *parameter is to be monitored?*	**Where** *is the parameter to be monitored?*	**How** *is the parameter to be monitored?/ type of monitoring equipment*	**When** *is the parameter to be monitored? (frequency of measurement or continuous)*	**Why** is the parameter to be monitored? (optional)	Cost		Institutional responsibility	
						Install	Operate	Install	Operate
	pH value, water conductance)								
i) Potential contamination of soil and water	i) water and soil quality (suspended	i) job site; equipment maintenance	i) mobile laboratory with	i) once per week during construction		i) NA	i) NA	i) Monitoring Contractor	i) Monitoring Contractor

from improper maintenance and fueling of equipment	solids, organic compounds, lubricants, fuel, solvents, heavy metals, pH value, water conductance) ; procedures of work	facilities	necessary equipment; observation	and on complain					
j) Destruction of crops, trees, meadows, etc.	j) land acquisition	j) job site	j) supervision	j) during material delivery and construction		j) NA	j) minimal	j) NA	j) Supervision Contractor
k) Workers safety	k) protective equipment; organization of bypassing traffic	k) job site	k) inspection	k) unannounced inspections during work		k) NA	k) minimal	k) NA	k) Supervision Contractor
Phase	**What** *parameter is to be monitored?*	**Where** *is the parameter to be monitored?*	**How** *is the parameter to be monitored?/ type of monitoring equipment*	**When** *is the parameter to be monitored? (frequency of measurement or continuous)*	**Why** is the parameter to be monitored? (optional)	Cost		Institutional responsibility	
						Install	Operate	Install	Operate
Operation • **Maintenance** *a) Noise disturbance to human population and workers*	a) noise levels; equipment	a) job site; nearest homes	a) sound level detector at mobile laboratory; inspection	a) unannounced inspections during maintenance activities and	a)-d) assure compliance of performance	a) NA	a) NA	a) Monitoring Contractor	a) Monitoring Contractor

				on complain	with environment, health and safety requirements				
b) Possible air, water and soil pollution	b) air, water and soil quality (suspended solids, organic compounds, lubricants, fuel, solvents, heavy metals, pH value, water conductance)	b) job site; material storage areas; wash down areas of equipment; depository site; equipment maintenance facilities	b) mobile laboratory with necessary equipment	b) unannounced inspections during maintenance activities and on complain		b) NA	b) NA	b) Monitoring Contractor	b) Monitoring Contractor
c) Vibrations	c) limited time of activities	c) job site	c) supervision	c) unannounced inspections during maintenance activities and on complain		c) NA	c) minimal	c) NA	c) Supervision Contractor
Phase	**What** *parameter is to be monitored?*	**Where** *is the parameter to be monitored?*	**How** *is the parameter to be monitored?/ type of monitoring equipment*	**When** *is the parameter to be monitored? (frequency of measurement or continuous)*	**Why** is the parameter to be monitored? (optional)	Cost		Institutional responsibility	
						Install	Operate	Install	Operate
d) Workers safety	d) protective equipment; organization of bypassing traffic	d) job site	d) inspection	d) unannounced inspections during maintenance activities and on complain		d) NA	d) minimal	d) NA	d) Supervision Contractor

• **Exploitation** *a)* Increased volume and speed of traffic	a) vehicle emission; noise levels; air, water and soil quality (suspended solids, organic compounds, heavy metals, pH value, water conductance)	a) road section included in project	a) mobile laboratory with necessary equipment	a) once per month and on complain		a) NA	a) NA	a) Monitoring Contractor	a) Monitoring Contractor
• **Road safety** *a) Increased vehicle speed*	a) condition of traffic signs; vehicle speed	a) road section included in project	a) visual observation; speed detectors	a) during maintenance activities; unannounced	a)-b) enable safe and economical traffic flow	a) NA	a) minimal	a) NA; Traffic Police	a) Maintenance Contractor; Traffic Police
b) Erosion, rockfall, hazardous conditions	b) condition of hazard signs	b) road section included in project	b) visual observation	b) during maintenance activities		b) NA	b) minimal	b) NA	b) Maintenance Contractor

7.3 Institutional framework and responsibility

Environmental Issue	Measures taken or to be taken	Implementing organization	Responsible Organization
A. Design Phase			
1. Alignment	The alignment is selected from 2 alternatives so as to minimize the land occupation, air pollution, and noise impact on residences, to avoid unfavorable geological conditions and cultural relics.	Designing Unit	PE "Roads of Serbia"
2. Interference on People	12 passageways (including 8 overpasses) are designed for Prosek – Dimitrovgrad highway;	Designing Unit	PE "Roads of Serbia"
3.Soil Erosion	In slopes and suitable places along the roadside, bush grass will be planted, and retaining walls, water intercepting ditches, and masonry rubbles will be built to prevent soil erosion. Temporary and permanent drainage systems are designed to minimize the soil erosion and the impact on irrigation canals. The affected ponds should be re-excavated (relocated) affected pond (irrigation pond)	Designing Unit	PE "Roads of Serbia"
4. Dust/air Pollution	Besides the measures in Item 1, soil borrowing sites, waste disposal sites, and asphalt mixing sites are identified to concern with the environmental issues like dust and similar residences.	Designing Unit	PE "Roads of Serbia"
5. Water pollution	Sewage disposal facilities are designed at the 108 service areas of Prosek – Dimitrovgrad highway to treat the sewage before entering into public water source.	Designing Unit	PE "Roads of Serbia"
6. Noise	Besides the measures in Item 1, measures such as sound barriers, are identified and will be incorporated into the final design and tendering documents.	Designing Unit	PE "Roads of Serbia"
7. Cultural Relics	Survey has been made on the line. 4 archaeological site discovered along the alignment will be investigated prior to construction.	Institute for Protection of Cultural Monuments of the Republic of Serbia	Institute for Protection of Cultural Monuments of the Republic of Serbia

8. Flood	Bridges and culverts have been well designed for the purpose of the flood discharge (100 year flood frequency for bridges)	Designing Unit	PE "Roads of Serbia"
B. Construction Phase			
1. Dust/air pollution	Water should be sprayed during construction phase, in the line and soil mixing sites, asphalt mixing site, and temporary roads. In filling subgrade, water spraying is needed to solidify the material. After the impacting, water spraying should be regular to prevent dust. Vehicles delivering materials should be covered to reduce spills. Residences should be 500 m from downward wind direction of asphalt mixing sites. Mixing equipment should be well sealed and vibrating equipment should be equipped with dust-remove device. Operators should pay attention to their health.	Contractor	PE "Roads of Serbia"
2. Soil Erosion/Water Pollution	In slopes and other suitable places along the roadside, trees and grass should be planted. On sections with high filling and deep cutting, their slopes should be covered by concrete retaining walls and planted with grass. If existing irrigation and drainage system ponds are damaged, they should be rebuilt or recovered by suitable methods. In sections along the river, soil and stone will be properly disposed of so as not to block rivers, resulting in adverse impact of water quality. In building permanent drainage system, temporary canals and culverts will be built for the sake of irrigating drainage. All necessary measures will be taken to prevent soil works and stone works from impending the rivers and water canals or existing irrigation and drainage system. All justifiable measures will be taken to prevent the waste water produced in construction from entering into rivers and irrigation	Contractor	PE "Roads of Serbia"

	system		
3.Construction Camp	Sufficient measures will be taken in the construction camps i.e. provision of garbage tanks and sanitation facilities. Waste in septic tanks will be cleared periodically. Drinking water will meet Serbian National standards. Garbage will be collected in a tank and disposed off periodically. Special attention shall be paid to the sanitary condition of camps.	Contractor	PE "Roads of Serbia"
4. Noise	Noise standard of industrial enterprises will be strictly enforced to protect construction workers from damage. Workers in vicinity of strong noise will wear earplugs and helmets and their working time should be limited. In construction sites within 150 m where there are residences, noisy construction should be stopped from 22:00 to 6:00. Maintenance of machinery and vehicles should be enhanced to keep their noise at a minimum.	Contractor	PE "Roads of Serbia"
5. Conservation of Eco-resources	To preserve the forest, soil borrowing and building temporary camps are prohibited in forest lands. Arable lands should not be used as soil borrowing whenever possible. If needed, the topsoil (30 cm) should be kept and refilled after construction is over to minimize the impact on ecosystem and agriculture. Construction workers should be told to protect natural resources and wild animals. Hunting is prohibited. Construction vehicles should run at temporary accesses to avoid damaging arable lands and cattle-raising lands.	Contractor	PE "Roads of Serbia"
6. Accidental Risks	To ensure safe construction in the temporary accesses during construction, lighting devices and safety signal device will be installed. Meanwhile, traffic rules and regulations will be actively enforced in these temporary accesses.	Contractor	PE "Roads of Serbia"

	During construction, effective safety and warning measures will be taken to reduce accidents. The blasting time, signal and guarding will be regulated. The people and vehicles within blasting area should be removed in time. Prior to blasting, thorough inspection should be conducted. Safety lookout will be built to prevent people and vehicles from passing after blasting. Blasting will not be carried out during rush hours so as not to cause traffic jams. The management and use of blasting materials will be in strict conformity with the safety requirements for public safety.		
7. Cultural Relics	If valuable or invaluable articles such as fabrics, coins, artifacts, structures, or other geographic or archaeological relics are discovered, the local related department should be notified immediately. The excavation should be stopped until authorized department identifies articles. Archaeologists will supervise the excavation to avoid any damage to the relics.	Institute for Protection of Cultural Monuments of the Republic of Serbia	Institute for Protection of Cultural Monuments of the Republic of Serbia
8. Communications and Transportation	Local materials should be used as much as possible so as to avoid long distance transportation, esp. that of earth and stone. If there are traffic jammed during construction, measures should be taken to move the jam with the coordination of transportation and public security department. Temporary access should be built at the interchange of the highway and other roads. Materials may be delivered in advance in relatively leisurely season of traffic. A transportation plan of materials will be formulated to avoid delivery of them at peak hours, esp. on existing roads.	Contractor	PE “Roads of Serbia”
C. Operation Phase			

1. Accident of hazardous materials	Regional or municipal transportation bureaus will set up respective transportation coordination unit for hazardous substances. For delivery of hazardous substances, three certificates issued by transportation department are required-permit license, driving license and guarding license. Vehicles delivering hazardous substances will be printed with unified signs. Public security, transportation and firefighting departments will designate a special route for these vehicles. These vehicles can only harbored at designated parking lots. This project's hazardous substances will be administered by highway management department registration system. In case of spill of hazardous materials, report to the relevant departments at once and deal with it in accordance with the emergency plan.	Contractor	PE "Roads of Serbia"
2. Vehicle management	If the noise of vehicle is excessive, the vehicle is not permitted to run on this highway until the problem is solved. Exhaust inspection will be enhanced. Unqualified vehicles are not allowed to run on this highway. Public will be educated about the regulations on air pollution and noise of vehicles. Bulk cargo such as coal, cement, sand, etc. easily spilled or polluted over the highway, will be inspected; prohibited vehicles carrying these cargo, but not having protection measures, will be prohibited from running on this highway.	Traffic police or Ecological Inspection	Ecological Inspection or Ministry of Environment and Spacial Planning
3. Noise	According to monitoring results, at places with excessive noise, sound barriers or other measures will be adopted.	Traffic police or Ecological Inspection	Ecological Inspection or Ministry of Environment and Spacial Planning
4. Maintenance of Drainage	The drainage system will be periodically cleared so as to ensure	Contractor	PE "Roads of Serbia"

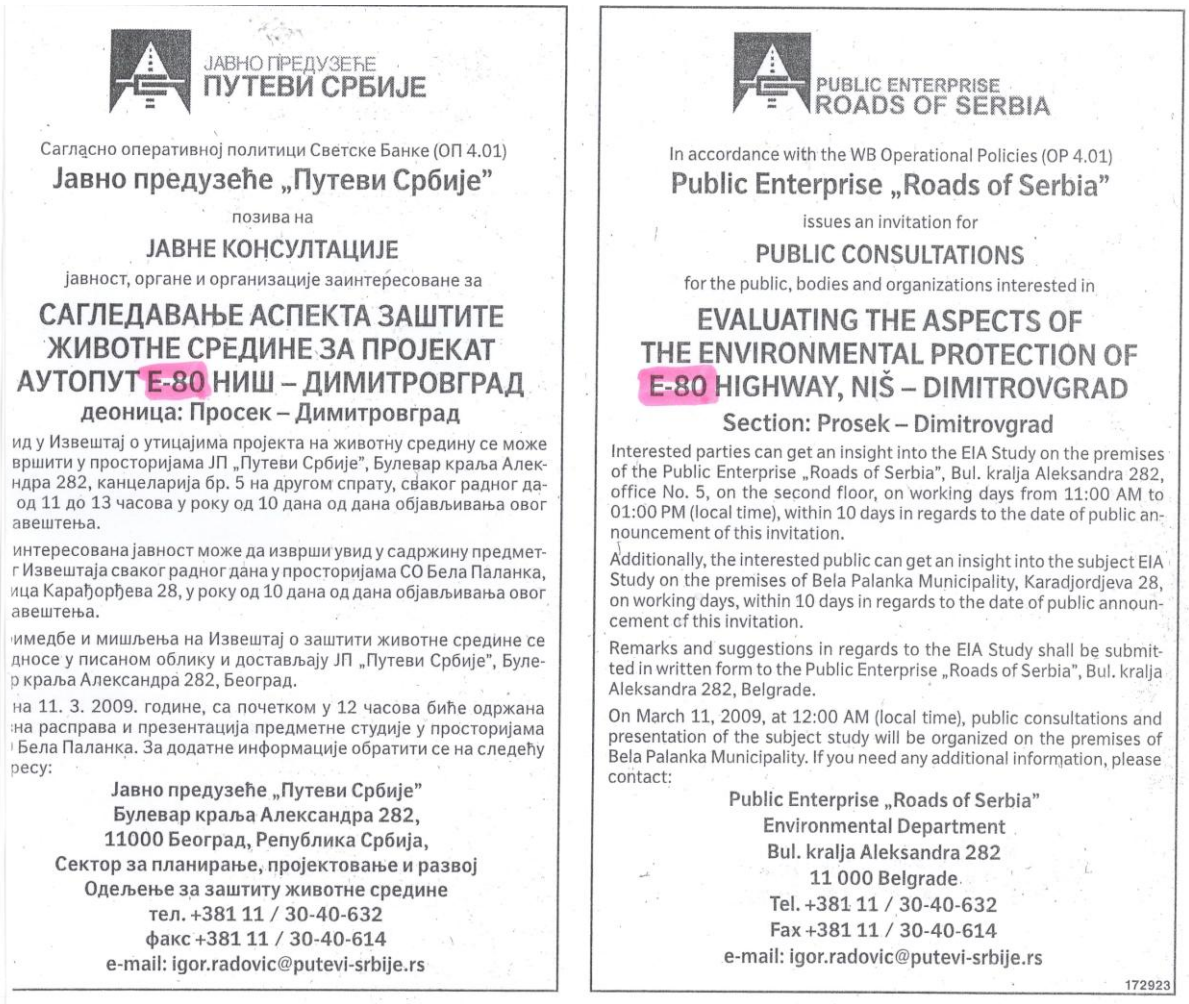
System	water flow.		
5. Others	Buildings are prohibited within 40 m of the road.	Constructional Inspection	Municipal Main Department for Construction
D. Environmental Monitoring			
1. Atmosphere	**A Construction Phase** (1) Monitoring item: CO, NO_2 (2) Monitoring Frequency: when needed, based on inhabitant reclamation (3) Length of time: 1day (4) Monitoring point: Main construction sites and materials transportation roads near the sensitive points. **B Operation Phase** (1) Monitoring item: NO_2, CO (2) Monitoring Frequency once in a year (3) Length of time: 30 days (4) Monitoring Points: defined in chapter 7.2 **C Monitoring Standard** Rulebook on marginal values, measurement methods of imission, measurement stations criteria and data records ("Official Gazette of RS" No. 54/92, 30/99, 19/06).	Contractor	PE "Roads of Serbia"
2. Noise	**A Monitoring Frequency** (1) Construction Phase: when needed, based on inhabitant reclamation (2) Operation Phase: once in five years **B Monitoring Points** (1) Construction Phase: Construction sites within 150 m, of which there are residences or sensitive units, waste disposal sites, delivery roads, quarries (2) Operation Phase: defined in chapter 7.2 **C Monitoring Standard** Rulebook on permitted noise level in the environmental ("Official Gazette of RS" No. 54/92)	Contractor	PE "Roads of Serbia"
3. Water quality	**A Monitoring item** (1) Construction Phase: pH, concentration dissolved O2, waste material, turbidness, oil, temperature, color, smell.	Contractor	PE "Roads of Serbia"

	(2) Operation Phase: pH, electrical permeability, oxygen reduction potential, temperature, color, dissolved substances, total organic carbon, ammonia, nitrates, sulphates, chlorides. **B Monitoring Frequency** (1) Construction phase: once in a month, during construction season (2) Operation phase: 4 times/year – Jan, Apr, July, Oct **C Monitoring Points:** (1) Construction Phase: downstream from the construction site (2) Operation Phase: defined in chapter 7.2 **D Monitoring Standard** Rulebook on Method and Minimal Number of Wastewater Quality Tests („Official Gazette of RS“, No. 47/83 and 13/84)		

11. PUBLIC CONSULTATION

In accordance with the WB Operational Policy (OP 4.01), the presentation of the EIA, together with public consultations on evaluating the aspects of Environmental Protection for the E-80 Highway Project, Nis – Dimitrovgrad (Bulgarian border), was organized on the premises of the Municipality of Bela Palanka on March 11, 2009.

Public Consultations commenced on February 25, 2009, when public announcements in Serbian and English were published in the daily newspaper "Politika", inviting the public, authorities and relevant institutions to get an insight into the EIA for the subject Project. Prior to announcement in the newspaper, the EIA was delivered to the Municipality of Bela Palanka and published on the PE "Roads of Serbia" web site. Representatives of the local self-government informed the public through their local media on the time and place of public consultations.



ЈАВНО ПРЕДУЗЕЋЕ
ПУТЕВИ СРБИЈЕ

Сагласно оперативној политици Светске Банке (ОП 4.01)
Јавно предузеће „Путеви Србије"
позива на
ЈАВНЕ КОНСУЛТАЦИЈЕ
јавност, органе и организације заинтересоване за
САГЛЕДАВАЊЕ АСПЕКТА ЗАШТИТЕ ЖИВОТНЕ СРЕДИНЕ ЗА ПРОЈЕКАТ АУТОПУТ Е-80 НИШ – ДИМИТРОВГРАД
деоница: Просек – Димитровград

ид у Извештај о утицајима пројекта на животну средину се може вршити у просторијама ЈП „Путеви Србије", Булевар краља Александра 282, канцеларија бр. 5 на другом спрату, сваког радног дана од 11 до 13 часова у року од 10 дана од дана објављивања овог авештења.

интересована јавност може да изврши увид у садржину предмет- г Извештаја сваког радног дана у просторијама СО Бела Паланка, ица Карађорђева 28, у року од 10 дана од дана објављивања овог авештења.

имедбе и мишљења на Извештај о заштити животне средине се дносе у писаном облику и достављају ЈП „Путеви Србије", Буле- р краља Александра 282, Београд.

на 11. 3. 2009. године, са почетком у 12 часова биће одржана на расправа и презентација предметне студије у просторијама Бела Паланка. За додатне информације обратити се на следећу есу:

Јавно предузеће „Путеви Србије"
Булевар краља Александра 282,
11000 Београд, Република Србија,
Сектор за планирање, пројектовање и развој
Одељење за заштиту животне средине
тел. +381 11 / 30-40-632
факс +381 11 / 30-40-614
e-mail: igor.radovic@putevi-srbije.rs

PUBLIC ENTERPRISE
ROADS OF SERBIA

In accordance with the WB Operational Policies (OP 4.01)
Public Enterprise „Roads of Serbia"
issues an invitation for
PUBLIC CONSULTATIONS
for the public, bodies and organizations interested in
EVALUATING THE ASPECTS OF THE ENVIRONMENTAL PROTECTION OF E-80 HIGHWAY, NIŠ – DIMITROVGRAD
Section: Prosek – Dimitrovgrad

Interested parties can get an insight into the EIA Study on the premises of the Public Enterprise „Roads of Serbia", Bul. kralja Aleksandra 282, office No. 5, on the second floor, on working days from 11:00 AM to 01:00 PM (local time), within 10 days in regards to the date of public announcement of this invitation.

Additionally, the interested public can get an insight into the subject EIA Study on the premises of Bela Palanka Municipality, Karadjordjeva 28, on working days, within 10 days in regards to the date of public announcement of this invitation.

Remarks and suggestions in regards to the EIA Study shall be submitted in written form to the Public Enterprise „Roads of Serbia", Bul. kralja Aleksandra 282, Belgrade.

On March 11, 2009, at 12:00 AM (local time), public consultations and presentation of the subject study will be organized on the premises of Bela Palanka Municipality. If you need any additional information, please contact:

Public Enterprise „Roads of Serbia"
Environmental Department
Bul. kralja Aleksandra 282
11 000 Belgrade
Tel. +381 11 / 30-40-632
Fax +381 11 / 30-40-614
e-mail: igor.radovic@putevi-srbije.rs

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*Announcement in daily newspaper ("Politika", February 25, 2009)

Public Consultations were concluded on March 11, 2009, in the period from 12 PM to 02 PM (local time), by the presentation of the subject EIA on the premises of the Municipality of Bela Palanka.

Presentation of the EIA for the E-80 Highway Project, Nis – Bulgarian border, was attended by the representatives of the Municipalities of Niska Banja and Bela Palanka, EIA Author,

WB representative, representatives of the PE "Roads of Serbia", local media representatives and the interested public. List of participants is included in this Report.

During the public consultations, there were no significant remarks given by the public in regards to environmental protection issues.

With regard to the social aspect of the project, the catering firm – the "Happy Star" Motel in Dimitrovgrad has sent an official letter to the Employer making a plea for the modification of design solution so as to avoid the demolition of this economic entity. The main objective is to prevent the job loss of more than 20 employees in this undeveloped region. The designers were presented with this issue and the aspect of avoiding the demolition of this structure will be included in the main design.

The most frequent questions asked at the Public Consultation were related to the crossings of the local and district roads with the highway. It was replied that this issue had been taken into account and that the design will encompass the construction of service roads.

The answer to the question related to the problem of noise in Niska Banja was that the construction of protection walls was envisaged by the design.

A certain number of questions was related to the location of borrow-pits and dumps. The Employer explained that the design envisages the disposal of surplus material on sites specially arranged for material disposal.

Mr. Slobodan Stamenkovic from the Directorate for Construction of Bela Palanka inquired about the protection of the spring Stulanovac in Crvena Reka. The Employer explained that this spring was by all means taken into account, as well as properly protected from the project's impact. The details of the solution which states the protection of this spring are presented in the Main Design of the E-80 Highway, Nis - Bulgarian border, in the chapter "Environmental Protection Measures", under the section 4.6.

Other remarks were not significant for the EIA issues.

List of Public Consultations Participants:

Name and Surname	Institution	Address and Contact Phone No.	e-mail
Zoran Stanković	physical entity	settlement Dolac, +381 18 857 032	-
Vladica Živković	Tourist Organization of Bela Palanka	Ljube Rađelovića 49 Bela Palanka, +381 18 853 080	tobp@ptt.yu
Srđan Igić	physical entity	Kosovskih junaka 88, Bela Palanka,	-
Miloš Pavlović	physical entity	Karađorđeva 48, Bela Palanka, +381 18 855 223	-

Dušan Živković	physical entity	Nikole Tesle 47, Bela Palanka, +381 64 301 48 28	doockey@ptt.rs
Slobodan Stamenković	PE Directorate for Construction of Bela Palanka	Karađorđeva 28, Bela Palanka, +381 18 855 058	-
Miroslav Lilić	PE Directorate for Construction of Bela Palanka	Karađorđeva 28, Bela Palanka, +381 18 855 058	sobelapalanka@bankerinter.net
Zoran Stanković	Municipal Government of Bela Palanka	Karađorđeva 28, Bela Palanka	-
Siniša Krstić	PE Directorate for Management and Development of Niška Banja	Sinđelićeva 3, 18205 Niška Banja, +381 18 548 580	bancarevo@yahoo.com
Tomislav Ilić	PE Directorate for Management and Development of Niška Banja	Sinđelićeva 3, 18205 Niška Banja, +381 18 548 580	toma_ilic@yahoo.com
Dragan Živković	Municipal Assembly of Bela Palanka	Karađorđeva 28, Bela Palanka, +381 18 855 183	sobelapalanka@bankerinter.net
Petar Colić	physical entity	B. Radičevića 11, Bela Palanka, +381 18 855 183	-
Miomir Đorđević	physical entity	Bela Palanka, +381 63 855 18 52	-
Slavoljub Dimitrijević	physical entity	Bela Palanka, +381 63 102 53 70	-
Letica Lilić	"Femid" JSC.	+381 61 132 96 59	sobelapalanka@bankerinter.net
Branko Marić	physical entity	+381 63 822 11 13	
Goran Stojanović	TV Bela Palanka	Karađorđeva, Bela Palanka, +381 63 470 380	fotomg@sezampro.co.yu

1. WB representative, Mr. Nikola Ille
2. Author of the EIA, Mr. Mikša B. Jovanović
3. PE „Putevi Srbije": Igor Radović, Mimoza Jeličić, Dušica Milinković

11.1 Public Consultations for E-80 highway section Ciflik – Stanicenje - Pirot

In accordance with Law on EIA ("O.G. of RS" No. 135/04, 36/09), public consultation for E-80 Highway sub-section Crvena Reka – Ciflik were held in Bela Palanka at October 7th 2008. There were no significant remarks in regards to environmental protection issues. EIA document for Crvena Reka – Ciflik is approved by the Serbian Ministry of environment and Spatial planning.

In accordance with OP/BP 4.01, from January to May 2009 Borrower has engaged an independent consultant to prepare Corridor Level EIA for E-80 highway from Nis to Dimitrovgrad (Bulgarian border) which consolidate and expand upon the sub-section EIAs, particularly with respect to cumulative impacts. That document was presented E-80 highway section from Prosek to Dimitrovgrad (Bulgarian border) as a proposed highway route, including subsection Ciflik – Ponor – Pirot ("Hilly route variant"), based on the Spatial Plan for the area of infrastructure corridor E-80 Nis - Bulgarian border which was on force till October 2009. The in-country disclosure of draft Corridor Level EIA was carried out in the period from February 25 (when the document was made publicly available on site and at the Client's web site) to March 11 and 12. On March 12th 2009 Public Consultations and presentation of the Corridor Level EIA were held in Bela Palanka.

Meanwhile, Government of the Republic of Serbia has adopted a new Spatial Plan for the area of infrastructure corridor E-80 Nis - Bulgarian border, which include "Valley Route Variant" was adopted at October 21st 2009 ("O.G. of RS" No. 86/09, 21st October 2009). K10DOO has engaged an independent consultant to prepare this Annex on Corridor Level EIA for E-80 highway from Nis to Dimitrovgrad (Bulgarian border) which is totally harmonized with the new Spatial plan and which present "valley route variant" as a final highway route alignment from Ciflik to Pirot.

Public consultation for E-80 Highway section Ciflik – Stanicenje – Pirot ("Valley Route Variant") were held in Pirot on April 21st 2010, simultaneously with the Public Consultation for this Annex on Corridor Level EIA.

Public announcements for Public Consultations on DRAFT Annex on Corridor Level EIA and DRAFT EMP for E-80 highway section Ciflik – Stanicenje – Pirot were published in the daily newspaper Politika on March 29th 2010, inviting the public, authorities and relevant institutions to have an insight into the EIA for the Project. Invitation is placed on K10DOO web site and PERS web site too.

Public announcements for Public Consultations on DRAFT EIA Study for E-80 highway section Crvena Reka - Ciflik – Stanicenje – Pirot were published in the daily newspaper Politika on March 19th 2010, inviting the public, authorities and relevant institutions to have an insight into the EIA for the Project. Prior to announcement in the newspapers, the EIA was delivered to the Municipality of Pirot. Representatives of the local self-government informed the public through their local media of the time and place of public consultations. Invitation was placed on K10DOO web site and PERS web site too.

Public consultation on EIA for E-80 sub–section Crvena Reka - Ciflik – Stanicenje - Pirot are part of EIA procedure prescribed by the Law on EIA. Public consultation on Annex on Corridor Level EIA were performed due to procedure prescribed within the World Bank Operational Policy (OP/BP 4.01). Nevertheless, in essence, both documents contain practically same information about environmental impact of the Project, proposed mitigation measures and monitoring program.