

River Raec - Drenovo Interchange
Road Project
Republic Of Macedonia

Biodiversity and Critical Habitats Assessment
Annexes 1 to 9

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Annexes

Annex 1 - Methodology for data collection	4
Annex 2 - The Ecological Context	8
Annex 3: Phytosociological data	12
Annex 4 - Habitat types	19
Annex 5 - Rare or threatened flora	25
Annex 6 - Rare or threatened fauna	28
Annex 7 - Species of EU directives	34
Annex 8 - Mitigation Measures	39
Annex 9 - Offsetting Measures	44

Annex I - Methodology for data collection

Team and Expertise

Table 1. Team involved in the CHA	
<i>Function</i>	<i>BIOTOPE</i>
BIOTOPE team	
Team leaders	Eng. Réналd BOULNOIS, senior consultant, ecologist specialized in ecological impact assessment of development projects Dr. Fabien QUÉTIER, senior consultant, specialized in the design of No Net Loss and Net Gain solutions
Botany / Phytosociology	Dr. Michel-Ange BOUCHET, botanist, specialized in Mediterranean flora and habitats
Malacology	Dr. Vincent PRIÉ, malacologist, member of the IUCN SSC Specialist Group on molluscs;
Ornithology	Xavier RUFRAY & Mathieu GENG, ornithologists, specialized in bird conservation
Additional local experts	
Malacology	Emilija STOJKOSKA: malacologist, museologist - senior curator at National Institution Natural History Museum of Macedonia - Skopje Marjan KOMMENOV, independent entomologist, PhD student, Department of Biology, Faculty of Science, University of Novi Sad, Serbia
Botany / Phytosociology	Pr. Mitko KOSTADINOVSKI: Botanist, Professor at Institute Of Biology, Faculty Of Natural Sciences And Mathematics - Skopje

Note: in the framework of this Critical Habitat Assessment, Dr. Metodija VELEVSKI, local expert, realized a survey on the presence of the Egyptian Vulture in the study area upon request of PROSTOR, company for planning, projecting and engineering (VELESKI, 2014).

Areas of analysis & study area

Table 2. Study areas	
Direct footprint of the project and associated works and accesses	<p>Area within which the project is technically and economically feasible.</p> <p>Study area of the fine integration of the project (including work and related facilities) with respect to issues and constraints related to natural habitats.</p> <p>In this Critical Habitat Assessment (CHA), we considered a 100 m wide strip to quantify the direct impacts on natural habitats, corresponding to the future road and its dependencies during construction and exploitation.</p>
Study area	<p>Area potentially affected by other effects than direct footprint, including various disturbances during the construction period (dust, noise, pollution, deposits and loans of materials, creating tracks, vehicle washing, clearing, hydraulic changes, base camps...).</p> <p>A complete baseline survey was completed through:</p> <ul style="list-style-type: none"> • Inventory of plant and animal species; • Mapping of habitats; • Identification of conservation issues and designations <p>The expertise is based primarily on field observations, with inputs from the EIA and other published references.</p> <p>Supplementary analyses have been carried out at a landscape scale on the basis of CORINE LAND COVER (CLC; inventory of land cover in 44 classes at a scale of 1:100 000; European Environmental Agency, last update 2006). The first one is on a strip 2 km wide centred on selected road axis (alternative 1), the second one corresponds to land use in ecological regions crossed by the project (see below).</p> <p>In this Critical Habitat Assessment (CHA), we considered a 1 km wide strip study area to estimate project impacts on natural and modified habitats</p>
Ecological region	<p>Area of remote and induced effects, taking into account all ecological units potentially affected by the project at a landscape scale.</p> <p>Investigations focus on species and habitats sensitive to those effects, areas of concentration and flow of wildlife and the main biodiversity spots.</p> <p>The expertise is based on information from literature, consultation of local specialists and field observations.</p> <p>In this Critical Habitat Assessment (CHA), we considered a recent study (MELOVSKI et al., 2013) that provides useful information on ecological regions within Macedonia, based on geomorphology, traditional views of the spatial units, land uses and biogeographic criteria (see Annex 2).</p>

Survey methods

❖ *Habitats mapping and flora*

Habitat characterization and mapping field survey was carried out from 19th to 24th of June 2014, with complementary on southern part of the gorge and in forests of western part of the study area on 22nd and 23rd of July.

The vegetation (by its inclusiveness synthesizing ecosystem conditions and functioning) is considered the best indicator of a natural habitat and therefore allows identifying it.

Field survey to recognize homogeneous patterns of vegetation has been conducted throughout the study area in order to identify and map the habitats on a phytosociological basis.

Phytosociology provides for all plant communities a classification which is the basis of codifications mentioned below. The basic unit of this classification is association; defined plant associations are then structured into integrating levels (association <alliance <order <class).

Each habitat present on the study area has been coded according to the following typologies:

- EUNIS (European Nature Information System) habitat types (European Environment Agency, 2012; updated and available on line here: <http://eunis.eea.europa.eu/habitats-code-browser.jsp>? With correspondances with following classifications);
- Palearctic habitats classification (DEVILLERS *et al.*, 1999-2001 PHYSIS Data Base. 1996, last updated 1999. [edited ETC/BD]);
- Annex I of Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora - consolidated version 01/01/2007 and its: natural habitat types of community interest whose conservation requires the designation of special areas of conservation (available here: http://ec.europa.eu/environment/index_en.htm) and its interpretation manual: EUROPEAN COMMISSION / DG ENVIRONMENT, 2013. Interpretation Manual of European Union Habitats. EUR 28. Nature ENV B.3. Available online here: http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/Int_Manual_EU28.pdf;
- Convention on the conservation of European wildlife and natural habitats, 1996. Resolution No. 4 listing endangered natural habitats requiring specific conservation measures, revised annex 1 (2010). Available online here: <https://wcd.coe.int/ViewDoc.jsp?id=1475213&Site=&BackColorInternet=B9BDEE&BackColorIntranet=FFCD4F&BackColorLogged=FFC679>

Because of habitat diagnosis uncertainty, phytosociological surveys were carried out on grasslands and rocky habitats. Results are available in Annex 3.

❖ *Endemic snail Carinigera drenovoensis*

In the framework of this CHA, *Carinigera drenovoensis* field surveys were conducted in two steps:

- First field surveys were conducted on the 16th and 17th of June 2014 for a first characterization of its habitat and a first delineation of the species distribution at the bottom of the cliff and on the northern plateau of Drenovo gorge.
- Complementary field surveys were conducted on the 18th, 19th, 20th and 21st of July for a complementary delineation of distribution area around Drenovo gorge (searching for suitable geological outcrops) and in the southern part of the Drenovo gorge (in the framework of project alternatives analysis).

During the first survey weather was cloudy and rainy on the first day, and mostly rainy with storms on the second. These challenging meteorological conditions were perfect for finding snails.

During the second survey time was very hot and sunny.

Each time snails have been sought after by sight on the rocks and the crevices (live specimens) and on the litter at the foot of the cliffs (mainly shells). On each site, snails were sought after for about 5 to 30 min, depending on local density of shells. Determinations were based on WELTER-SCHULTES, 2012. Taxonomy follows FALKNER, BANK *et al.* 2001.

❖ *Egyptian Vulture*

Note: the following text is an extract from VELEVSKI, 2014.

The field work was performed on 08.06.2014, 13.06.2014 and 14.06.2014, from prominent viewpoints, with duration between 6 and 8 hours. Binoculars (12x50) and telescope (20-60x80) were used, with active search of the visible space for estimated >80% of the time. At the beginning of every survey, the content of the nests known from earlier studies was checked.

All observations were noted on 1:25000 topographic maps, and are shown using ArcView 10.1.



Figure 1. Agricultural landscape in the northeastern part of the study area. © BIOTOPE, June 2014



Figure 2. Cliff of Drenovo gorge including Egyptian Vulture nest and bat cave

Annex 2 - The Ecological Context

Ecological regions

Note: the codes and names of regional divisions in the text below follows MELOVSKI et al., 2013.

The study area takes place along the valley of river Raec in the Middle Vardar Valley region (616). More precisely, it crosses the following natural sub-regions:

- Extreme north (in Drenovska Klisura) of Galchin-Orle region (code 51249) which encompasses several small mountains and hills;
- Eastern part (to Drenovska Klisura) Raec Valley region (code 61663) which represents the broader region around the valley along the small river Raec, dominated by lowland which gradually ascends toward neighboring mountains;
- South-eastern border of Klepa low limestone mountainous region (code 61664);
- South-western border of Tikvesh region consisted in Vardar valley plain and gently sloping surrounding terrain and associated hills (code 61662).

In the study area, all those regional divisions are dominated by limestones and other carbonate bedrocks. It is characterized by a mild continental climate but with a strong Mediterranean influence originated from valley of Vardar river.

In this context, the Drenovo Gorge (Drenovska Klisura), little canyon formed by the riverbed of Raec river in the center of the study area, is an original ecological zone because of:

- The nature of the habitats supported by this geomorphological formation, mainly dominated by rocky habitats: cliffs - including deep caves and semi-caves - rocky slopes and summit outcrops;
- The diverse micro-climate conditions created by the diverse expositions of the cliffs and slopes and of course by the river that crosses the gorge from west to east.

The study area follows, from its western part to Drenovo interchange, the valley of river Raec. Then Raec reaches the Crnariver valley (confluence about 2 km in the east from Drenovo interchange), tributary of Vardar river.

A lot of tributaries, mainly temporary, flow down from the hills in the eastern part of the study area. Those small valleys from north(-west) to south(-east), in addition to some dry ravines (local 'dols'), create natural corridors from the plateau to the Raec floodplain with fresher climate and often covered by a dense shrubby vegetation.

Three springs have been detected in the area, two at the eastern exit of Drenovo gorge very close to the river Raec, and a petrifying one at the north-western entrance of the gorge. All appear of good quality water and are well-known from local people.

Recognised and designated conservation areas

The road project intersects different sites of conservation interest.

❖ *Important Plants Areas*

Important Plant Areas were identified in Macedonia using European IPA criteria as developed by NGO Plantlife International in collaboration with various international plant conservation networks (MELOVSKI et al., 2012).

The study area is located in the northern part of Important Plant Area 'Tikveš Lake and Raec gorge'.

This area is known for its botanical richness in a diversified landscape including forests, grasslands, inland cliffs and rocky outcrops.

Seven plant species of pan-european interest are mentioned in this IPA (MES, 2008).

❖ *Important Bird Areas*

Identification of the Important Bird Areas (IBAs) is an initiative implemented by NGO BirdLife International at the global level, aiming to conserve a network of sites that are particularly important for the conservation of birds.

The project intersects two Important Bird Areas (IBA; VELEVSKI et al., 2010):

- It enters IBA MK021 'Gradsko - Rosoman - Negotino' in its southwestern part;
- It takes place in IBA MK023 'Raec river Valley' ('Dolina na reka Raec' in Macedonian) in a large western part including Drenovo gorge and Raec valley in the study area;

Those two sites belong to central Macedonia and wider Vardar valley region. They are dominated by agricultural lands with large parts of steppe-like grasslands and surrounded by small mountains suitable for a large diversity of birds with unfavourable status at a pan-european scale.

❖ *Key Biodiversity Areas*

Key Biodiversity Areas (KBAs) are defined as sites of global significance for biodiversity conservation, and thus are intended to capture the world's most important natural heritage. They are identified and delineated through a defined methodology (Langhammer et al. 2007 in MELOVSKI et al., 2012), which includes to an extent, that used to identify Important Birds Areas and Important Plant Areas.

The project intersects:

- the KBA Central Vardar (# 8 in MELOVSKI et al., 2012) that corresponds in our study area to IBA MK021;
- and the KBA Lake Tikvesh-Raec (# 21 in MELOVSKI et al., 2012) that corresponds to IPA 'Tikveš Lake and Raec gorge' and IBA MK023 (see IPA and IBA above).

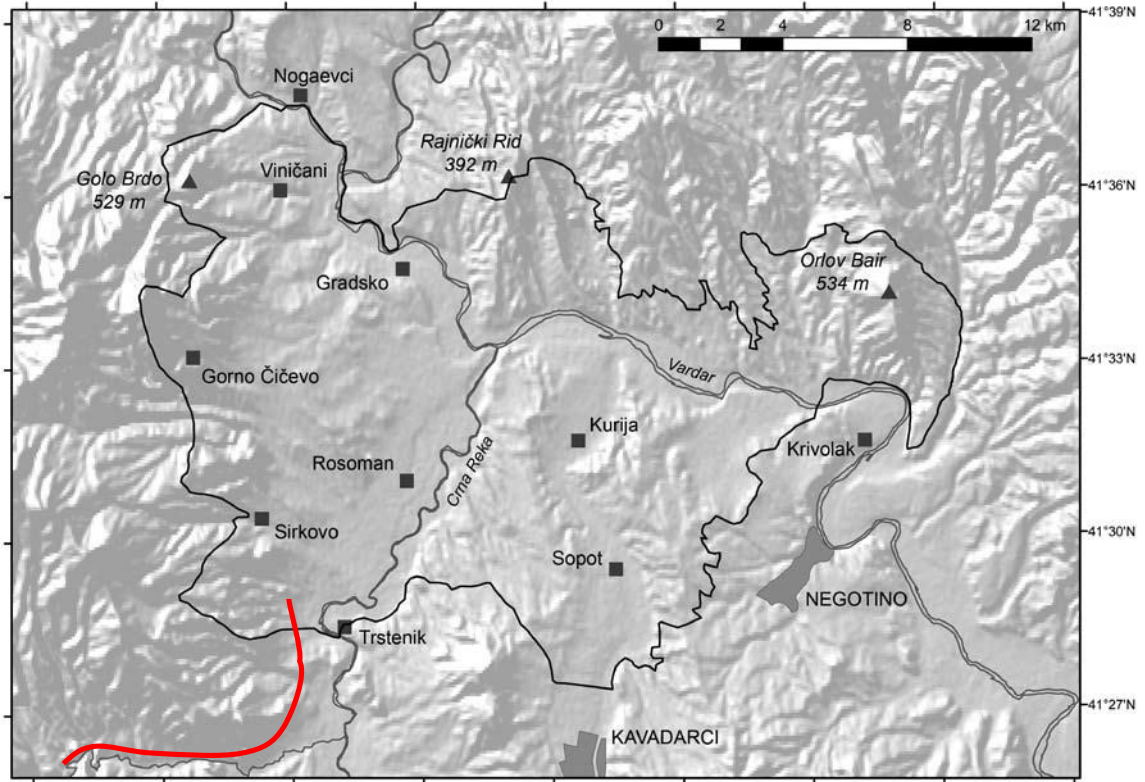


Figure 3. Important Bird Area (IBA) 'Gradsko - Rosoman - Negotino' and indicative location of the project (red). (Birdlife)

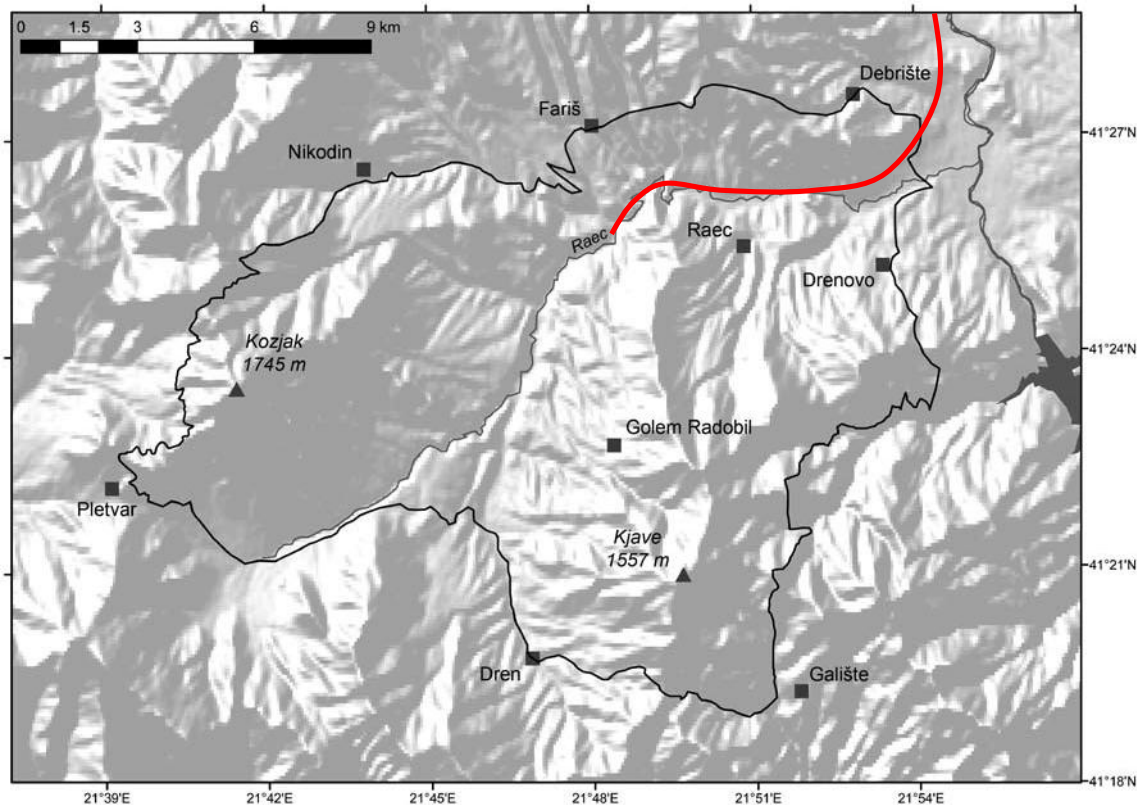


Figure 4. Important Bird Area (IBA) 'Raec River Valley' and indicative location of the project (red). (Birdlife)



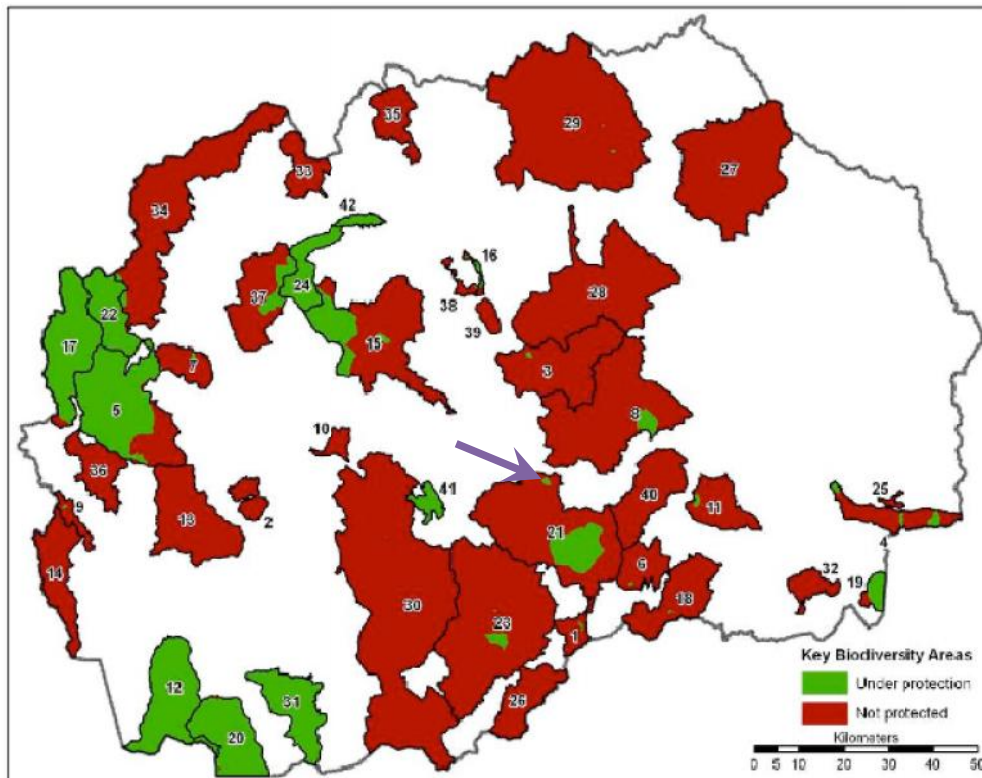


Figure 5. Key Biodiversity Areas in Macedonia, as identified from the Important Plant Areas and Important Bird Areas (source: MELOVSKI et al., 2012). Project study area takes place mainly in KBA # 21 and enters KBA # 8. Violet arrow indicates Drenovo gorge protected site in Macedonia.

❖ ***Emerald network***

The Emerald Network is an ecological network made up of Areas of Special Conservation Interest (ASCI). Its implementation was launched by the Council of Europe as part of its work under the Bern Convention, with the adoption of Recommendation No. 16 (1989) of the Standing Committee to the Bern Convention.

Setting-up the Emerald Network at national level is considered as one of the main tools for the Contracting Parties to comply with their obligations under the Bern Convention.

The project intersects the northern part of the proposal of ASCI MK0000028 ‘Raechka klisura’ (‘Raec’; Officially Nominated Candidate Emerald Site).

❖ ***National protected natural heritage***

The road project passes through a protected natural heritage : Gorge Drenovska (Drenovo gorge), Monument of Nature under Macedonian Law on Natural Rarities, later confirmed by the Spatial Planning of the republic of Macedonia and in accordance with the Law on Protection of the Nature and the Environmental Law.

The selected route (alternative 1) passes through this natural monument (meeting International status IUCN III on natural monuments) within a length of ca. 3 km.



Annex 3: Phytosociological data

To ascertain the classification of some habitat types, phytosociological surveys were undertaken. Results are presented below. All species identification realized or confirmed by Pr. Mitko KOSTADINOVSKI.

	Kamen Dol, 20.06.2014 (M.K. relevee)	Kamen Dol 21.06.2014 (I relevee)	Kamen Dol 21.06.2014 (II relevee)	Kamen Dol 21.06.2014 (III relevee)	Drenovska Gorge, 21.06.2014 (I relevee)	Drenovska Gorge, 21.06.2014 (IIa relevee)	Drenovska Gorge, 21.06.2014 (IIb relevee)
Relevé number	1	2	3	4	5	6a	6b
ASTRAGALO-MORINETUM MICEVSKI 1971							
<i>Polygala rhodopaea</i>					+		
BRACHYPODIO-ONOBRYCHETUM PINDICOLAE MICEVSKI 1971							
<i>Neotostema apulum</i>		+	+	+			
<i>Filago pyramidata</i>	+			+			
<i>Dasypyrum villosum</i>	+	1		+			
<i>Arenaria leptoclados</i> (var. <i>viscidula</i>)	+	+	+				
PETRRORHAGIO-CHRYSOPOGONETUM GRYLLI ass.nova							
<i>Linaria simplex</i>					+		
<i>Trifolium scabrum</i>	+	+	+				
<i>Orlaya daucorlaya</i>	+	+					
<i>Petrorhagia illyrica</i> subsp. <i>haynaldiana</i>	+	+	+	+			
<i>Convolvulus canthabrica</i>			+	+			
<i>Satureja montana</i> subsp. <i>pisidica</i>					1		
<i>Nigella arvensis</i>			+		+		
<i>Euphorbia taurinensis</i>							+
<i>Petrorhagia prolifera</i>	+	+	+				+
<i>Trigonella gladiata</i>		+					
<i>Achillea coarctata</i>	+			+			
<i>Clinopodium suaveolens</i> (= <i>Acinos</i>)	+			+			

	Kamen Dol, 20.06.2014 (M.K. relevee)	Kamen Dol 21.06.2014 (I relevee)	Kamen Dol 21.06.2014 (II relevee)	Kamen Dol 21.06.2014 (III relevee)	Drenovska Gorge, 21.06.2014 (I relevee)	Drenovska Gorge, 21.06.2014 (IIa relevee)	Drenovska Gorge, 21.06.2014 (IIb relevee)
Relevé number	1	2	3	4	5	6a	6b
<i>suaveolens</i>)							
<i>Parentucellia latifolia</i>			+	+			
SILENO-THYMETUM CILIATOPUBESSENTIS Matevski et al. 2007							
<i>Paronychia macedonica subsp. macedonica</i>					+	+	+
<i>Haplophyllum albanicum</i>					*		
ANTHYLLIDO-CENTAURETUM GRBAVACENSIS ass. Nova							
<i>Centaurea grbavacensis</i>					*		
<i>Cerastium decalvans subsp. dollineri</i>					*		
ASTRAGALO-HELIANTHEMETUM MARMOREI. ass. Nova							
<i>Achillea agaretifolia subsp. aizoon</i>						+	
<i>Galium oreophilum</i>						+	+
<i>Alyssum corymbosoides</i>		+	+		+		
SATUREJO-THYMION							
<i>Agropyron cristatum</i>						+	
<i>Thymelaea passerina</i>	+	+	+				
<i>Trachynia distachya</i>	4	1	+	5			
<i>Linum corymbulosum</i>			+	+			
Suball.Saturejo-Thymenion							
<i>Centaurea tymphaea</i>	+	+		+	+		
<i>Asteriscus aquaticus</i>				+			
<i>Polygala monspeliaca</i>		+		+			
<i>Onobrychis caput-galli</i>	+						
<i>Phleum phleoides var. blepharodes</i>		2					
Suball.Diantho-Silenenion							
<i>Thymus parnassicus</i>							+
<i>Stachys iva</i>						+	+

	Kamen Dol, 20.06.2014 (M.K. relevee)	Kamen Dol 21.06.2014 (I relevee)	Kamen Dol 21.06.2014 (II relevee)	Kamen Dol 21.06.2014 (III relevee)	Drenovska Gorge, 21.06.2014 (I relevee)	Drenovska Gorge, 21.06.2014 (IIa relevee)	Drenovska Gorge, 21.06.2014 (IIb relevee)
Relevé number	1	2	3	4	5	6a	6b
<i>Inula aschersoniana</i>					1	1	
<i>Verbascum herzogii</i>					*	*	
<i>Hippocrepis glauca</i>			+				
SATUREJION MONTANAE							
Suball.Koelerio-Festucenion dalmaticae							
<i>Stipa capillata</i>		+		+			
ASTRAGALO-POTENTILLETALIA							
<i>Potentilla pedata (var. pinnatifida)</i>			+	+			
<i>Astragalus onobrychis</i>	+						
<i>Aegilops neglecta</i>	+			+			
<i>Bromus squarrosus</i>	+	+	+		+		
<i>Erysimum diffusum</i>	+			+			
<i>Sideritis montana</i>				*			
<i>Minuartia verna subsp. collina</i>							
<i>Scabiosa triniifolia</i>		+					
<i>Stipa pulcherrima</i>							
<i>Asperula aristata subsp. scabra</i>	+	+	+	+	+		
<i>Asperula purpurea</i>					1	+	+
<i>Fumana procumbens</i>					+		
<i>Hypericum rumeliacum</i>	+	+	+	+	+	+	
<i>Salvia ringens</i>					+		
<i>Ziziphora capitata</i>				*			
<i>Pterocephalus plumosus</i>					*		
<i>Haplophyllum suaveolens</i>		*					
<i>Goniolimon tataricum</i>			+				
<i>Velezia rigida</i>	+		+	+			
<i>Trifolium striatum</i>		+					
<i>Dianthus gracilis subsp. armeroides</i>	+						

	Kamen Dol, 20.06.2014 (M.K. relevee)	Kamen Dol 21.06.2014 (I relevee)	Kamen Dol 21.06.2014 (II relevee)	Kamen Dol 21.06.2014 (III relevee)	Drenovska Gorge, 21.06.2014 (I relevee)	Drenovska Gorge, 21.06.2014 (IIa relevee)	Drenovska Gorge, 21.06.2014 (IIb relevee)
Relevé number	1	2	3	4	5	6a	6b
<i>Bupleurum apiculatum</i>			+	+			
<i>Crucianella graeca</i>			*				
FESTUCO-BROMETEA							
<i>Xeranthemum annuum</i>	+	+	2				
<i>Trigonella monspeliaca</i>	+						
<i>Chrysopogon gryllus</i>		4	+				
<i>Sanguisorba minor</i>	+	+	+	+			
<i>Bothriochloa ischaemum</i>	1	1		2			
<i>Eryngium campestre</i>	+	+	+	+	+		
<i>Koeleria splendens</i>		+					
<i>Teucrium chamaedrys</i>			*				
<i>Allium flavum</i>			+	+		+	
ELYNO-SESLERIETEA							
<i>Asyneuma limonifolium</i>		+			+		
CISTO-MICROMERIETEA							
<i>Teucrium capitatum</i> (<i>Teucrium polium</i> subsp. <i>capitatum</i>)	2	+	2	2	+		
DRYPETEA							
<i>Euphorbia myrsinites</i>	+			+		+	
KOELERIO-CORYNEPHORETEA							
<i>Trifolium arvense</i>	+	+					
ARTEMISIETEA VULGARIS							
<i>Carthamus lanatus</i>	+			1			
TUBERARIETEA GUTTATAE, TUBERARIETALIA GUTTATAE, TUBERARION GUTATAE							
<i>Crupina vulgaris</i>	+		+	+	+		
<i>Galium divaricatum</i>	+	+	+				
THERO-BRACHYPODIETEA RAMOSI							

	Kamen Dol, 20.06.2014 (M.K. relevee)	Kamen Dol 21.06.2014 (I relevee)	Kamen Dol 21.06.2014 (II relevee)	Kamen Dol 21.06.2014 (III relevee)	Drenovska Gorge, 21.06.2014 (I relevee)	Drenovska Gorge, 21.06.2014 (IIa relevee)	Drenovska Gorge, 21.06.2014 (IIb relevee)
Relevé number	1	2	3	4	5	6a	6b
<i>Medicago minima</i>	+	+		+			
<i>Helianthemum salicifolium</i>	+	+	2	1			
<i>Psilurus incurvus</i>	+		+				
<i>Trifolium campestre</i>	+	+	+				
<i>Poa bulbosa</i>	+	+					
<i>Vulpia ciliata</i>	+						
<i>Trifolium angustifolium</i>		+					
<i>Taeniatherum caput-medusae</i>		+	+				
STELLARIETEA MEDIAE							
<i>Avena barbata</i>			+				
Other species							
<i>Juniperus oxycedrus</i>					+		
<i>Plantago lanceolata</i>	+			+			
<i>Asplenium ruta-muraria</i>							+
<i>Anthemis arvensis</i>	+						
<i>Draba lasiocarpa</i>					*		
<i>Lolium rigidum</i>		*					
<i>Cynodon dactylon</i>		*					
<i>Paliurus spina-christi</i>					+		
<i>Verbascum sinuatum</i>	+			+			
<i>Bupleurum commutatum</i>		+					
<i>Thesium divaricatum</i>					+		
<i>Tragopogon pratensis</i>	+			+			
<i>Alyssum strigosum</i>	*						
<i>Marrubium peregrinum</i>	*						
<i>Cynosurus echinatus</i>					*		
<i>Carlina corymbosa</i>				1			

	Kamen Dol, 20.06.2014 (M.K. relevee)	Kamen Dol 21.06.2014 (I relevee)	Kamen Dol 21.06.2014 (II relevee)	Kamen Dol 21.06.2014 (III relevee)	Drenovska Gorge, 21.06.2014 (I relevee)	Drenovska Gorge, 21.06.2014 (IIa relevee)	Drenovska Gorge, 21.06.2014 (IIb relevee)
Relevé number	1	2	3	4	5	6a	6b
<i>Herniaria incana</i>	+						
<i>Muscari comosum</i>					+		
<i>Clinopodium alpinum subsp. majoranifolium</i>						+	
<i>Crepis setosa</i>	+						
<i>Micromeria juliana</i>	+		+				
<i>Knautia integrifolia (f. laeta)</i>	+						
<i>Orlaya daucoides</i>	+						
<i>Catapodium rigidum</i>	+						
<i>Hieracium praealtum subsp. bauginii</i>		+					
<i>Daucus carota</i>				+			
<i>Ceterach officinarum</i>							+
<i>Allium guttatum</i>	+	+	+				
<i>Onopordon acanthium</i>	+						
<i>Euphorbia phymatosperma subsp. cernua</i>	+			+			
<i>Dianthus viscidus subsp. viscidus (the bigger one)</i>		+					
<i>Thymus pseudoatticus</i>	+						
<i>Thymus tosevii</i>			+				
<i>Valerianella sp. (Valerianella dentata?)</i>				+			
<i>Hippomaratum cristatum (the big yellow Umbelliferae)</i>			+				
<i>Geranium rotundifolium</i>					+		
<i>Helianthemum hymetium</i>					+		
<i>Sedum acre</i>					+	+	+
<i>Sedum dasyphyllum</i>							+
<i>Potentilla sp.</i>						+	
<i>Ailanthus altissima (juv.)</i>						+	
<i>Alyssum saxatile</i>							+

	Kamen Dol, 20.06.2014 (M.K. relevee)	Kamen Dol 21.06.2014 (I relevee)	Kamen Dol 21.06.2014 (II relevee)	Kamen Dol 21.06.2014 (III relevee)	Drenovska Gorge, 21.06.2014 (I relevee)	Drenovska Gorge, 21.06.2014 (IIa relevee)	Drenovska Gorge, 21.06.2014 (IIb relevee)
Relevé number	1	2	3	4	5	6a	6b
<i>Alyssum desertorum</i>		*					
<i>Picris pauciflora</i>					+		
<i>Alyssum dorfleri</i>						*	
<i>Stipa epilosa</i>						+	
No herbarium specimen							
<i>Goniolimon sp.</i>		+					
<i>Minuartia sp.</i>							+
<i>Sedum album</i>							+
<i>Seseli sp.</i>							+
<i>Sedum rubens</i>							+
<i>Centaurea graeca</i>							+

* taxa out of relevés

Annex 4 - Habitat types

Habitat types found on study area

28 elementary types of habitats have been identified on the study area. 16 correspond to natural habitats (7 habitats were already clearly identified in EIA), 12 to modified habitats.

Habitats types with a code under the Habitats Directive classification are those listed in Annex I.

On the maps, some complex that mix different types of vegetation types have been identified as mosaic habitats.

Table 3. Elementary habitat types on the study area

<i>Habitat designation on the study area reported on the maps</i> (EUNIS habitat designation)	<i>EUNIS code</i> (2012)	<i>Paelearctic classification</i> (2001)	<i>EU HD classification</i> (EUR28, 2013)	<i>COE Resolution No. 4, revised annex 1</i> (2010)
Natural habitats				
Inland waters and associated habitats				
Petrifying spring (EUNIS: Petrifying springs with tufa or travertine formations)	C2.121	54.121	7220*	C2.12
Other springs (EUNIS: Hard water springs)	C2.12	54.12	(none)	C2.12
Spring associated aquatic vegetations (EUNIS: Lime-rich oligotrophic vegetation of spring brooks)	C2.19	24.42	3260 (3140)	(none)
Spring associated aquatic vegetations (EUNIS: Submerged carpets of stoneworts in oligotrophic waterbodies)	C1.14	24.44	3140	C1.14
River (EUNIS: Hiporithral streams)	C2.22	24.13	3260	(none)
Temporary streams (EUNIS: Reedbeds normally without free-standing water)	D5.1	53.1	(none)	(none)
Grasslands				
Spring associated humid grassland (EUNIS: Continental oligotrophic humid grassland)	E3.5	37.33	6410	E3.5
Subcontinental steppe-like grasslands (EUNIS: Perennial calcareous grasslands and basic steppes)	E1.2	34.3	6210 (not priority in this case)	E1.2
Greek-Balkan steppe-like grasslands (EUNIS: Helleno-Balkan Savory <i>Satureja montana</i> steppes)	E1.21	34.311	6210 (not priority in this case)	E1.2

Table 3. Elementary habitat types on the study area

Habitat designation on the study area reported on the maps (EUNIS habitat designation)	EUNIS code (2012)	Paelearctic classification (2001)	EU HD classification (EUR28, 2013)	COE Resolution No. 4, revised annex 1 (2010)
Shrublands				
Christ's Thorn shrublands (EUNIS: Moesian broom fields)	F3.29	31.848	(none)	(none)
Juniper garrigues (EUNIS: Eastern prostrate juniper <i>Juniperus oxycedrus</i> garrigues)	F6.25	32.55	(none)	(none)
Woods				
Riparian forest (EUNIS: Mediterranean white willow <i>Salix alba</i> galleries)	G1.1121	44.1	92A0	G1.11
Oriental hornbeam woods (EUNIS: Helleno-Balkanic oriental hornbeam woods)	G1.7C22	41.822	(none)	G1.7C
Rocky and natural underground habitats				
Cliffs and rocky slopes (EUNIS: Illyrio-Helleno-Balkanic cinquefoil <i>Potentilla</i> cliffs)	H3.2A	62.1A13	8210	(none)
Cave (EUNIS: Cave interior)	H1.2	65	8310	H1
Modified habitats				
Hedgerows	FA	84.2	(none)	
Vineyards	FB.4	83.21		
Broadleaved deciduous forestry plantations	G1.C	83.32		
Locust tree stands (spontaneous)	G1.C3	83.324		
Fruit orchards	G1.D	83.1		
Disused chalk and limestone quarries	H3.2F	86.41		
Cropland	I1	82		
Fallow fields	I1.5	87.1		
Urban parks and large gardens	I2.1	85		
Buildings of cities, towns and villages	J1	86.2		
Active extraction sites quarries	J3.2	86.31		
Canals	J5	89		

Notes on characterization of habitats and their conservation status

This chapter provides some explanations about characterization of particular habitats on the study area that might be different from EIA interpretation.

❖ *Petrifying spring*

This habitat occurs in western entrance of Drenovo gorge, at the bottom of a rocky and shrubby slope upon to a local rarely used pathway. Its catchment is clearly visible on aerial imagery. The spring creates in its close surroundings a variety of habitats characteristic of base-rich oligotrophic waters which are all of pan-european interest. This complex of habitat of great conservation value is in good conservation state.

❖ *Grasslands*

Our relevés show that those vegetations belong to *Festuco-Brometea* phytosociological class that is characteristic of dry calcareous grasslands.

Those steppe-like grasslands belong to southern dry grasslands on carbonate bedrocks from the central parts of the Republic of Macedonia, in the wider Macedonian steppe region, under strong influence of sub-Mediterranean climate along Vardar river valley (Class: *Festuco-Brometea*; Order: *Astragalo-Potentilletalia*; Alliance: *Saturejo-Thymion*; Suball.: *Saturejo-Thymenion* following MATEVSKI *et al.*, in prep. and KOSTADINOVSKI, com. pers., 2014). This type of grasslands are secondary habitats originated in centuries of grazing (and sometimes cultivating) after preliminary clearing of the former forests. They are found in a large eastern part of the study area, from the eastern exit of Drenovo gorge to Kamen Dol in the north-east.

A lot of local variations can be found on the field, depending mainly on exposure, soil depth and intensity of grazing. Most rocky grassland communities (close to Alliance: *Saturejo-Thymion*; Suball.: *Diantho-Silenenion* following MATEVSKI *et al.*, in prep. and KOSTADINOVSKI, com. pers., 2014) are found on the rocky slopes of Drenovo gorge and in the higher part of the hills with shallow soil in the eastern part of the study area.

All those grasslands are coded under EUNIS E1.2 (Subcontinental steppe-like grasslands on deeper soil) or E1.21 (Greek-Balkan steppe-like grasslands on shallow soils) and EUR28 6210 - that is not priority in this case (not important sites for orchids) - .

Regarding the large areas covered by the habitat, its conservation state on the study area is good.

Note: this is different from the diagnosis of EIA where it is considered that the grasslands belong to *Thero-Brachypodietalia* which is a priority habitat of pan-european interest.

❖ *Shrublands*

Christ's Thorn shrublands (EUNIS F3.29; Alliance: *Eryngio campestris - Paliurion spinae-christi* on deeper soils and mainly former fields) and Juniper garrigues (EUNIS F6.25; Alliance: *Pruno tenellae-Syringion*, Association: *Pistacio terebinthi-Juniperetum oxycedri* on more shallow fields and mainly former pastures) are considered as progressive stages of reforestation of dry grasslands (following MATEVSKI *et al.*, 2008 and KOSTADINOVSKI, com. pers., 2014).

Note: this is different from diagnosis of EIA where it is considered that the shrublands are a degraded form of local forests (EUNIS code G1.7C22 in a degraded form).

Note: some habitats with shrublands in mosaic have been identified.

❖ *Woods*

After field investigations, local non riparian forests are all considered as Oriental hornbeam woods (EUNIS G1.7C22).

Note: the Moesian white oak woods (EUNIS G1.7372) cited in EIA and priority habitat of pan-European interest appears not to be present in the study area as no large stands really dominated by oak have been detected; this does not exclude local presence of high oak trees.

❖ *Riparian forests*

After field investigations, true riparian forests are rare on the study area because of invasion by Locust tree (*Robinia pseudacacia*). (EUNIS G1.1121; EUR28: 92A0). Considering its unfavourable conservation state, this habitat (and of course mosaics with Locust tree associated) of prime importance in ecological landscape functionality is only considered as a natural habitat.

❖ *Temporary streams*

After field investigations in the hills of the study area, temporary streams are mainly occupied by shrublands (see above) and sometimes, in mosaic, with Reed (*Phragmites australis*) or Common Clubrush (*Scirpus lacustris*) or Reedmace (*Typha sp.*) beds belonging to Alliance *Phragmition australis* (EUNIS D5.1).

This habitat is not the habitat of European interest mentioned in EIA (Alliance: *Paspalo-agrostidion*; EUNIS C2.5; EUR28: 3290).

❖ *Rocky habitats*

Real rocky habitats on the study area appear to be only found on vertical northfacing cliffs in Drenovo gorge (Alliance: *Ramondion nathaliae* characterized by *Ramonda nathaliae* and *Achillea ageratifolia* with high abundance following STEVANOVIĆ et al., 2014). All other rocky vegetations are rocky grasslands.

Nevertheless, as this habitat is punctual and often mixed with rocky grasslands, all open habitats in rocky areas of Drenovo gorge were mapped as rocky habitats.

Regarding their characteristic species composition, the conservation state of the rocky habitats on the study area is good, excepted at the bottom of the cliffs facing south in Drenovo gorge where the invasive species Tree-of-heaven *Ailanthus altissima* occurs and attempts to climb local cliffs thanks to deep crevices where it can root.

Mapping results on the study areas

The following table provides the surfaces of habitats in a ca. 1 km wide strip centred on alternative 1 road project axis (ca. 450 m buffer). This buffer includes the axis of the other alternative (2) of the road project. It covers 1557 ha.

Table 4. Habitats mapping results in a ca. 1 km wide strip centred on the road project (axis of alternative 1)		
<i>Habitats</i>	<i>Area (in ca. 450 m buffer)</i>	<i>%</i>
Natural habitats	875 ha	56%
Petrifying spring	<1 ha	<1%
Spring associated humid grassland	<1 ha	<1%
Subcontinental steppe-like grasslands	144 ha	9%
Greek-Balkan steppe-like grasslands	3 ha	<1%
Christ's Thorn shrublands	105 ha	7%
Christ's Thorn shrublands and fallow fields	38 ha	2%
Christ's Thorn shrublands and subcontinental steppe-like grasslands	304 ha	20%
Juniper garrigues	62 ha	4%
Juniper garrigues and Greek-Balkan steppe-like grasslands	78 ha	5%
Oriental hornbeam woods	82 ha	5%
Riparian forest	3 ha	<1%
Locust tree stands	3 ha	<1%
Riparian forest and Locust tree stands	44 ha	3%
Cliffs and rocky slopes	8 ha	1%
Modified habitats	681 ha	44%
Fallow fields	74 ha	5%
Hedgerows	1 ha	<1%
Agricultural lands	571 ha	37%
Buildings of cities, towns and villages	9 ha	1%
Canals	2 ha	<1%
Active extraction sites quarries	8 ha	1%
Disused chalk and limestone quarries	1 ha	<1%
Roads	14 ha	1%
Urban parks and large gardens	1 ha	<1%
TOTAL	1557 ha	100%

It is mainly dominated by natural habitats (875 ha; 56% of total coverage) including all critical habitats (156 ha; 10% of total coverage, mainly grasslands). Agricultural modified habitats cover a large other part of this study area (646 ha; 42%). Grasslands and associated mosaic of shrublands and garrigues cover 530 ha (34% of the study area).

Supplementary analyses have been carried out at a landscape scale on the basis of CORINE LAND COVER (CLC; inventory of land cover in 44 classes at a scale of 1:100 000; European Environmental

Agency, last update 2006). The first one is on a strip 2 km wide centred on selected road axis (alternative 1), the second one corresponds to land use in ecological regions crossed by the project (MELOVSKI, 2013).

Table 5. Land cover results in a 2 km wide strip centred on the road project (axis of alternative 1)

<i>Land cover type</i>	<i>1 km wide strip coverage (BIOTOPE, 2014)</i>	<i>2 km wide strip coverage (BIOTOPE, 2014 + CLC, 2006)</i>
Grasslands (including mosaics)	530 ha; 34%	866 ha; 30%
Shrublands	204 ha; 13%	439 ha; 15%
Woods	132 ha; 8%	327 ha; 11%
Other natural habitats	10 ha; <1%	(no available data at this scale)
Agricultural areas	646 ha; 42%	1247 ha; 43%
Other artificial habitats	35 ha; 2%	(no available data at this scale)
TOTAL	1557 ha; 100%	2924 ha; 100%

Land cover in a 2 km wide strip study area is the same as in the study area, largely dominated by both grasslands (including mosaics) and agricultural lands.

Table 6. Land cover synthesis of the ecological regional divisions crossed by the road project

<i>Land cover type</i>	<i>Ecological regional divisions total coverage (CLC, 2006)</i>
Grasslands (including mosaics)	21 058 ha; 20%
Shrublands	20 975 ha; 19%
Woods	17 509 ha; 16%
Other natural habitats (water bodies and water courses)	538 ha; <1%
Agricultural areas	44 989 ha; 42%
Other artificial habitats	2 517 ha; 2%
TOTAL	107 586 ha; 100%

Land cover in a wider ecological landscape is also dominated by natural habitats (56%) and agricultural lands (42%). As an indicative value, grasslands and associated mosaics coverage on study area (1 km wide strip: 530 ha) represents about 3% of the total coverage of this type of land cover in the wider landscape.

Note: at the scale of 1:100 000 (CLC, 2006), rocky habitats are not detected in the ecological regions. This result means that this type of habitat doesn't cover areas more than 25 ha (description threshold of CLC) in the local ecological regions; in Drenovo gorge, rocky habitats are integrated in local grassland areas.

Annex 5 - Rare or threatened flora

25 species of biogeographical significance (including endemics) have been found during the vegetation survey in grasslands and rocky habitats on the study area.

Table 7. Flora species of biogeographical significance (including endemics) observed on the study area (BIOTOPE and KOSTADINOSKI, 2014)	
<i>Habitats on the study area</i>	<i>Species</i>
Springs (Petrifying and other springs) EUNIS: C2.121, C2.12 (1 species)	Rare species in Macedonia <i>Adiantum capillus-veneris</i> (Mediterranean element)
Cliffs and rocky grasslands in Drenovo gorge EUNIS: H3.2A, rocky grasslands included in E1.21 (18 species)	Balkan endemic species <i>Achillea agaretifolia subsp. aizoon</i> <i>Alkanna stribrnyi</i> (mentioned in EIA; LASOY DOO, 2013) <i>Cerastium decalvans subsp. dollineri</i> <i>Draba lasiocarpa</i> <i>Inula aschersoniana</i> <i>Phelipaea boissieri</i> (also mentioned in EIA; LASOY DOO, 2013) <i>Polygala rhodopaea</i> <i>Ramonda nathaliae</i> (also mentioned in EIA; LASOY DOO, 2013) Southern balkans elements <i>Asperula purpurea</i> <i>Centaurea grbavacensis</i> <i>Centaurea tymphaea</i> <i>Galium oreophilum</i> <i>Haplophyllum albanicum</i> <i>Paronychia macedonica subsp. macedonica</i> <i>Salvia ringens</i> <i>Satureja montana subsp. pisidica</i> <i>Stachys iva</i> Macedonian endemic species <i>Alyssum doerfleri</i> <i>Helianthemum marmoreum</i> (also mentioned in EIA, LASOY DOO, 2013) <i>Verbascum herzogii</i> Rare species in Macedonia <i>Juniperus excelsa</i> (Mediterranean element, also mentioned in EIA, LASOY DOO, 2013)

Table 7. Flora species of biogeographical significance (including endemics) observed on the study area (BIOTOPE and KOSTADINOSKI, 2014)

<i>Habitats on the study area</i>	<i>Species</i>
Subcontinental steppe-like grassland E1.2 Greek-Balkan steppe-like grasslands E1.21 (8 species)	Balkan endemic species
	<i>Scabiosa triniifolia</i>
	Southern balkans element
	<i>Centaurea tymphaea</i>
	Southern balkans mountain elements
	<i>Hypericum rumeliacum</i>
	<i>Dianthus gracilis subsp. armeroides</i>
	<i>Bupleurum apiculatum</i>
	<i>Crucianella graeca</i>
	Steppic species
	<i>Astragalus parnassi</i>
	<i>Morina persica</i>

17 other plant species of conservation interest are mentioned in literature in Raec area (KOSTADINOVSKI, com. pers., 2014) but were not observed during the field survey: *Acer heldreichii subsp. visiani*, *Anchusa serpentinicola*, *Anthemis meteorica*, *Armeria vandasii*, *Centaurea kosaninii*, *Centaurea rufidula*, *Eryngium serbicum*, *Fritillaria graeca*, *Fritillaria gusichiae*, *Fritillaria macedonica*, *Galium rhodopaeum*, *Hedysarum macedonicum*, *Heptaptera macedonica*, *Melampyrum heracleoticum*, *Orchis coriophora*, *Salvia jurisicii*.



Figure 6. Two endemics flowering during the field survey of this CHA and both present in Drenovo gorge: *Ramonda nathaliae* on the left, Balkan endemic and relict of tropical climates, in cliffs facing north, and *Verbascum herzogii*, Macedonian endemic, on the right, present at the bottom of the cliffs facing south.



Figure 7. Two steppe species rare in Macedonia and found in grasslands on the study area. Left: *Morina persica*. Right: *Astragalus parnassi*.



Figure 8. Two Mediterranean species rare in Macedonia and found on the study area. Left: *Adiantum capillus-veneris* present in fresh climate conditions next to springs. Right: *Juniperus excelsa* on the southern summit of Drenovo gorge.

Annex 6 - Rare or threatened fauna

The table hereunder presents the fauna species with unfavourable conservation status at a European, Mediterranean and/or Macedonian level. Key facts about the knowledge of those species on the study area are presented, including opportunistic observations during the field surveys.

Note that no legal status is considered in this analysis.

Table 8. Other rare or key fauna species on wider study area		
Species name	IUCN red list status and status in Macedonia	Habitats and other available data on study area
Molluscs		
<i>Carinigera drenovoensis</i>	Drenovo gorge signe-site endemic	See main report.
<i>Grossuana serbica subsp. scupica</i> Radoman, 1973, (Hydrobioidea: fam. Orientalinidae)	Macedonian endemic sub-species	Observed by E. STOJKOSKA during the field survey of this study (2014) in the springs near river Raec at the eastern exit of Drenovo Gorge (Drenovska Klisura)
Insects		
Clouded Apollo <i>Parnassius mnemosyne</i>	NT in Europe (VAN SWAAY et al., 2010)	Mentioned in EIA (LASOY DOO, 2013)
Eastern Festoon <i>Zerynthia cerisy</i>	NT in Europe (VAN SWAAY et al., 2010)	Habitats: riverside of streams and temporary water flows.
Escher's Blue <i>Polyommatus escheri</i>	LC in Europe (VAN SWAAY et al., 2010) but declining in Europe Rare in FYR Macedonia (MICEVSKI et al., 2009)	Observed on study area (Drenovska Klisura) (Turner 1964 and Schaidler & Jakšić 1989 in MICEVSKI et al., 2009) together with its host plant (MICEVSKI et al., 2009). Habitats: following the ecology of its main host-plant (<i>Astragalus monspesullanus</i>) in open pioneer habitats (grasslands and rocky grasslands), sometimes at forest edges
Greater Capricorn Beetle <i>Cerambyx cerdo</i>	NT in Europe (NIETO & ALEXANDER, 2010) Common in Mediterranean Basin	Mentioned in EIA (LASOY DOO, 2013) Habitats: woods (saproxylic beetle)
Long-horned beetle <i>Morimus (asper) funereus</i>	VU (IUCN global redlist, 1996-2014, but needs taxonomic updating; not mentioned in NIETO & ALEXANDER, 2010)	Mentioned in EIA (LASOY DOO, 2013) Habitats: woods (saproxylic beetle)
Fishes		
Pelagonia Trout <i>Salmo pelagonicus</i>	VU in Europe Endemic from lower Vardar (Crna system) and upper Aliakmon drainages (Macedonia and Greece) (KOTTELAT & FREYHOF, 2007)	Species mentioned in Crna River catchment (to which belong Raec River) (MACEDONIAN MINISTRY OF AGRICULTURE, FORESTRY AND WATER MANAGEMENT, 2010; , confirmed par MNHN / fishbase.org) Suitable river habitat in the gorge and in the upper part of the stream. Habitat probably no more suitable in the agricultural lands after the gorges (eastern part of the study area)

Table 8. Other rare or key fauna species on wider study area

<i>Species name</i>	<i>IUCN red list status and status in Macedonia</i>	<i>Habitats and other available data on study area</i>
Reptiles		
European Pond Terrapin <i>Emys orbicularis</i>	NT in Europe NT in Mediterranean Basin Appears rare in Macedonia (STERIJOVSKI et al., 2014)	Observed by BIOTOPE (June 2014, one adult) Habitat on the study area: small wetland in the vicinity of a petrifying spring and riparian forest of Raec river Presence confirmed in literature (STERIJOVSKI et al., 2014)
Four-lined Snake <i>Elaphe quatuorlineata</i>	NT in Europe NT in Mediterranean Basin	Mentioned in EIA (LASOY DOO, 2013) Habitat on the study area: open grasslands
Hermann's Tortoise <i>Testudo hermanni</i>	NT in Europe NT in Mediterranean Basin	Mentioned in EIA (LASOY DOO, 2013) Observed by BIOTOPE (June 2014, one adult) Presence confirmed in literature (STERIJOVSKI et al., 2014) Habitats on the study area: open grasslands and associated sparse rocky and shrubby habitats
(Mediterranean) Spur-thighed Tortoise <i>Testudo graeca</i>	VU in Europe NT in Mediterranean Basin	Mentioned in EIA (LASOY DOO, 2013) Habitats on the study area: open grasslands and associated sparse rocky and shrubby habitats
Birds		
Egyptian Vulture <i>Neophron percnopterus</i>	Endangered (EN) at a global level	See main report.
Levant Sparrowhawk <i>Accipiter brevipes</i>	SPEC2 (concentrated and rare in Europe)	Mentioned in EIA (LASOY DOO, 2013) Observed by BIOTOPE in 2014 foraging on the study area above Raec riparian forest downstream of Drenovska Klisura Nesting habitat on the study area: forests. Foraging habitats: forest in mosaic with open habitats and agricultural lands.
Rock Partridge <i>Alectoris graeca</i>	SPEC2 (concentrated and depleted in Europe)	Mentioned in EIA (LASOY DOO, 2013) Habitats on the study area: open and rocky habitats
Golden Eagle <i>Aquila chrysaetos</i>	SPEC3 (not concentrated in Europe but rare in Europe)	Mentioned in EIA (LASOY DOO, 2013) Not breeding on the study area, only foraging (VELEVSKI, com. pers., June 2014)
Long-legged Buzzard <i>Buteo rufinus</i>	SPEC3 (not concentrated in Europe but declining in Turkish part of its range)	Mentioned in EIA (LASOY DOO, 2013) One pair is having a nest on the cliffs in Drenovska Klisura (VELEVSKI, 2014) Nesting habitat on the study area: cliffs. Foraging habitats: open dry habitats, steppes and grasslands, rocky terrains

Table 8. Other rare or key fauna species on wider study area

<i>Species name</i>	<i>IUCN red list status and status in Macedonia</i>	<i>Habitats and other available data on study area</i>
Black Stork <i>Ciconia nigra</i>	SPEC2 (concentrated and rare in Europe) Unfavourable status in Macedonia (VELEVSKI et al., 2007)	Mentioned in EIA (LASOY DOO, 2013) One pair is breeding in the entrance of a cave in the Cliffs of Drenovska Klisura (VELEVSKI, 2014 and BIOTOPE, June 2014) Nesting habitat on the study area: cliffs (like in all Macedonia). Assumed foraging habitats: open habitats (pastures and small wetlands associated to local temporary streams).
Short-toed Snake-eagle <i>Circaetus gallicus</i>	SPEC3 (not concentrated in Europe but rare in Europe)	Mentioned in EIA (LASOY DOO, 2013) Not breeding on the study area, only foraging (VELEVSKI, com. pers., 2014) Nearest known breeding territories about 10 km north or 15 km south (VELEVSKI & GRUBAC, 2008).
Tawny Pipit <i>Anthus campestris</i>	SPEC3 (not concentrated in Europe but rare in Europe)	Mentioned in EIA (LASOY DOO, 2013) Habitat: open habitats, meadows, pastures
Eurasian Nightjar <i>Caprimulgus europaeus</i>	SPEC2 (concentrated and depleted in Europe)	Mentioned in EIA (LASOY DOO, 2013) Habitats: open habitats in forest-dominated landscapes
European Roller <i>Coracias garrulus</i>	SPEC2 (concentrated and vulnerable in Europe)	Mentioned in EIA (LASOY DOO, 2013) Observed by BIOTOPE (June 2014) Nesting habitat: shaft cavity, often in riparian forests. Foraging habitats: open dry habitats (grasslands).
Common Quail <i>Coturnix coturnix</i>	SPEC3 (not concentrated but depleted in Europe)	Mentioned in EIA (LASOY DOO, 2013) Habitats: open dry habitats (grasslands).
Ortolan Bunting <i>Emberiza hortulana</i>	SPEC2 (concentrated and depleted in Europe)	Mentioned in EIA (LASOY DOO, 2013) Observed by BIOTOPE (June 2014) Habitats: dry grasslands and associated shrubby habitats
Black-headed Bunting <i>Emberiza melanocephala</i>	SPEC2 (concentrated and depleted in Europe)	Mentioned in EIA (LASOY DOO, 2013) Observed by BIOTOPE (June 2014) Habitats: dry grasslands and associated shrubby habitats
Lesser Kestrel <i>Falco naumanni</i>	SPEC1 (species of global conservation concern, VU at a global level) Endangered species in Macedonia (BIRDLIFE, 2012)	Mentioned in EIA (LASOY DOO, 2013) Observed by BIOTOPE (June 2014) Nesting habitats: roofs of old houses, cliffs. Foraging habitats : open dry habitats (grasslands, rocky habitats)
Common Kestrel <i>Falco tinnunculus</i>	SPEC3 (not concentrated but declining in Europe)	Mentioned in EIA (LASOY DOO, 2013) Observed by BIOTOPE (June 2014) Nesting habitats: villages and habitations ; cliffs in Drenovska Klisura. Foraging habitats : all open dry habitats (grasslands, rocky habitats)
Crested Lark <i>Galerida cristata</i>	SPEC3 (not concentrated but depleted in Europe)	Mentioned in EIA (LASOY DOO, 2013) Observed by BIOTOPE (June 2014) Habitats : open dry habitats (mainly grasslands)

Table 8. Other rare or key fauna species on wider study area

Species name	IUCN red list status and status in Macedonia	Habitats and other available data on study area
Eurasian Hoopoe <i>Upupa epops</i>	SPEC3 (not concentrated but declining in Europe)	Mentioned in EIA (LASOY DOO, 2013) Observed by BIOTOPE (July 2014) Nesting habitats: shaft cavity. Foraging habitats: open dry habitats.
Red-backed Shrike <i>Lanius collurio</i>	SPEC3 (not concentrated but depleted in Europe)	Mentioned in EIA (LASOY DOO, 2013) Observed by BIOTOPE (June 2014) Habitats: dry grasslands and associated shrubby habitats
Woodchat Shrike <i>Lanius senator</i>	SPEC3 (not concentrated but depleted in Europe)	Mentioned in EIA (LASOY DOO, 2013) Observed by BIOTOPE (June 2014) Habitats: dry grasslands and associated shrubby habitats
Calandra Lark <i>Melanocorypha calandra</i>	SPEC3 (not concentrated but depleted in Europe)	Mentioned in EIA (LASOY DOO, 2013) Habitats: dry grasslands
European Bee-eater <i>Merops apiaster</i>	SPEC3 (not concentrated but depleted in Europe)	Mentioned in EIA (LASOY DOO, 2013) Observed by BIOTOPE (June 2014) Nesting habitats: loose vertical soils. Foraging habitats: open habitats mainly in the vicinity of temporary streams (richness in big insects)
Black Kite <i>Milvus migrans</i>	SPEC3 (not concentrated but declining in Europe)	Mentioned in EIA (LASOY DOO, 2013) Observed by BIOTOPE (June 2014) Nesting habitats: forests. Foraging habitats: mainly riverine open habitats and human dumps
Northern Wheatear <i>Oenanthe oenanthe</i>	SPEC3 (not concentrated but declining in Europe)	Mentioned in EIA (LASOY DOO, 2013) Habitats: open dry habitats (grasslands)
Common Scops-owl <i>Otus scops</i>	SPEC2 (concentrated and declining in Europe)	Mentioned in EIA (LASOY DOO, 2013) Habitats on the study area: sparse or clear parts of the forests
House Sparrow <i>Passer domesticus</i>	SPEC3 (not concentrated but declining in Europe)	Mentioned in EIA (LASOY DOO, 2013) Habitats: villages and habitations
Grey Partridge <i>Perdix perdix</i>	SPEC3 (not concentrated but declining in Europe)	Mentioned in EIA (LASOY DOO, 2013) Habitats: open dry habitats (grasslands)
Eurasian Green Woodpecker <i>Picus viridis</i>	SPEC2 (concentrated and depleted in Europe)	Mentioned in EIA (LASOY DOO, 2013) Habitats: forests and associated open habitats. Human gardens.
European Turtle-dove <i>Streptopelia turtur</i>	SPEC3 (not concentrated but declining in Europe)	Mentioned in EIA (LASOY DOO, 2013) Habitats on study area: forests and associated open or shrubby habitats.
Barn Swallow <i>Hirundo rustica</i>	SPEC3 (not concentrated but declining in Europe)	Mentioned in EIA (LASOY DOO, 2013) Habitats on study area: forests and associated open or shrubby habitats.

Table 8. Other rare or key fauna species on wider study area

<i>Species name</i>	<i>IUCN red list status and status in Macedonia</i>	<i>Habitats and other available data on study area</i>
Northern House-Martin <i>Delichon urbica</i>	SPEC3 (not concentrated but declining in Europe)	Mentioned in EIA (LASOY DOO, 2013) Habitats on study area: forests and associated open or shrubby habitats.
Semi-aquatic and terrestrial Mammals		
Eurasian Otter <i>Lutra lutra</i>	NT in Europe NT in Mediterranean Basin	Species mentioned on the study area in the EIA (LASOY DOO, 2013). Local presence confirmed in literature (POLEDNIK et al., 2008). Habitats on study area: Raec river, local (temporary) tributaries, riparian forest
Marbled polecat <i>Vormela peregusna</i>	VU in Europe VU in Mediterranean Basin Species rare and little known in Macedonia. Only few locations are known from Vardar valley and from Eastern Macedonia (MIRIĆ et al., 1983 in KRYSTUFEK & PETKOVSKI, 2003).	Species mentioned on the study area in the EIA (LASOY DOO, 2013). A local study have been undertaken asking ca. 60 local inhabitants about their knowledge of the species. No result have been obtained even by local hunters. Habitats on study area: open grasslands and associated shrubby habitats / forest edges
Bats		
Blasius's Horseshoe Bat <i>Rhinolophus blasii</i>	VU in Europe NT in Mediterranean Basin Rare in Macedonia with restricted distribution (NASTOV & MICEVSKI, 2010)	Species mentioned on the study area in the EIA (LASOY DOO, 2013). Confirmed by STOJKOSKA (com. pers., 2014) Breeding and roosting habitat on study area: caves; foraging habitats: surroundings natural and agricultural habitats in a 1 to 10 km radius
Greater Horseshoe Bat <i>Rhinolophus ferrumequinum</i>	NT in Europe NT in Mediterranean Basin Widespread and common in Macedonia (NASTOV & MICEVSKI, 2010)	Species mentioned on the study area in the EIA (LASOY DOO, 2013). Confirmed by STOJKOSKA & STOFILOVSKA, 2013 (2 individuals observed in main local cave). Breeding and roosting habitat on study area: main local cave; foraging habitats: surroundings natural habitats in a 1 to 15 km radius
Mediterranean Horseshoe Bat <i>Rhinolophus euryale</i>	VU in Europe VU in Mediterranean Basin Widespread and common in Macedonia (NASTOV & MICEVSKI, 2010)	Species observed by STOJKOSKA & STOFILOVSKA, 2013 (30-40 individuals observed in main local cave). Breeding and roosting habitat on study area: main local cave; foraging habitats: surroundings natural habitats in a 1 to 15 km radius
Lesser Horseshoe Bat <i>Rhinolophus hipposideros</i>	NT in Europe NT in Mediterranean Basin Widespread and common in Macedonia (NASTOV & MICEVSKI, 2010)	Species observed by STOJKOSKA & STOFILOVSKA, 2013 (only 1 individuals observed in main local cave). 1 individual found dead on the existing road during the field survey of this study (BIOTOPE, July, 2014). Breeding and roosting habitat on study area: main local cave; foraging habitats: surroundings natural habitats in a 1 to 10 km radius

Table 8. Other rare or key fauna species on wider study area

<i>Species name</i>	<i>IUCN red list status and status in Macedonia</i>	<i>Habitats and other available data on study area</i>
Schreiber's bat <i>Miniopterus schreibersii</i>	NT in Europe NT in Mediterranean Basin Widespread and common in Macedonia (NASTOV & MICEVSKI, 2010)	Species observed by STOJKOSKA & STOFILOVSKA, 2013 (ca. 500 individuals observed in main local cave). Breeding and roosting habitat on study area: main local cave; foraging habitats: surroundings natural habitats in a 1 to 30 km radius

Annex 7 - Species of EU directives

The table below lists the species listed in the main annexes of EU directives:

- EU directive 92/43/CEE on the conservation of natural habitats and of wild fauna and flora

Annex II: animal and plant species of community interest whose conservation requires the designation of special areas of conservation (DHA2);

Annex IV: animal and plant species of community interest in need of strict protection (DHA4).

- EU directive 2009/147/EC on the conservation of wild birds

Annex I: endangered bird species which require protection of habitats, especially through the establishment of a coherent network of Special Protection Areas (SPAs) (DOA1)

No plant species of European community interest has been observed or is mentioned on the study area. Numerous animal species have, however, been found. These are listed below.

Table 9. Species of European directives observed on the study area				
Species	DHA2	DHA4	DOA1	Habitats and other available data on study area
Invertebrates				
Greater Capricorn Beetle <i>Cerambyx cerdo</i>	x	x		Mentioned in EIA (LASOY DOO, 2013) Habitats: woods (saproxylic beetle)
Long-horned beetle <i>Morimus (asper) funereus</i>	x			
Clouded Apollo <i>Parnassius mnemosyne</i>	x	x		Mentioned in EIA (LASOY DOO, 2013) Habitats: riverside of streams and temporary water flows.
Southern Festoon <i>Zerynthia polyxena</i>		x		
Amphibians				
Yellow-bellied Toad <i>Bombina variegata</i>	x	x		Mentioned in EIA (LASOY DOO, 2013) Habitats: riverside of streams and temporary water flows.
Green Toad <i>Pseudepidalea (Bufo) viridis</i>		x		
European Tree Frog <i>Hyla arborea</i>		x		
Agile Frog <i>Rana dalmatina</i>		x		
Greek Stream Frog <i>Rana graeca</i>		x		

Table 9. Species of European directives observed on the study area

<i>Species</i>	<i>DHA2</i>	<i>DHA4</i>	<i>DOA1</i>	<i>Habitats and other available data on study area</i>
Reptiles				
European Pond Terrapin <i>Emys orbicularis</i>	x	x		Observed by BIOTOPE (June 2014, one adult) Habitat on the study area: small wetland in the vicinity of a petrifying spring and riparian forest of Raec river Presence confirmed in literature (STERIJOVSKI et al., 2014)
Spur-thighed Tortoise <i>Testudo graeca</i>	x	x		Mentioned in EIA (LASOY DOO, 2013) Habitats on the study area: open grasslands and associated sparse rocky and shrubby habitats
Hermann's Tortoise <i>Testudo hermanni</i>	x	x		Mentioned in EIA (LASOY DOO, 2013) Observed by BIOTOPE (June 2014, one adult) Presence confirmed in literature (STERIJOVSKI et al., 2014) Habitats on the study area: open grasslands and associated sparse rocky and shrubby habitats
Four-lined Snake <i>Elaphe quatuorlineata</i>	x	x		Mentioned in EIA (LASOY DOO, 2013) Habitat on the study area: open grasslands and associated sparse rocky and shrubby habitats
Balkan Green Lizard <i>Lacerta trilineata</i>		x		
Green Lizard <i>Lacerta viridis</i>		x		
Caspian whipsnake <i>Dolichophis (Coluber) caspius</i>		x		
European Cat Snake <i>Telescopus falax</i>		x		
Dahl's Whip Snake <i>Platyceps (Coluber) najadum</i>		x		
Nose-horned Viper <i>Vipera ammodytes</i>		x		
Aesculapean Snake <i>Zamenis longissimus</i> (<i>Elaphe longissima</i>)		x		
European Ratsnake <i>Zamenis (Elaphe) situla</i>		x		
Birds				
Black Kite <i>Milvus migrans</i>			x	Mentioned in EIA (LASOY DOO, 2013) Observed by BIOTOPE (June 2014) Nesting habitats: forests. Foraging habitats: mainly riverine open habitats and human dumps

Table 9. Species of European directives observed on the study area

<i>Species</i>	<i>DHA2</i>	<i>DHA4</i>	<i>DOA1</i>	<i>Habitats and other available data on study area</i>
Black Stork <i>Ciconia nigra</i>			x	Mentioned in EIA (LASOY DOO, 2013) One pair is breeding in the entrance of a cave in the Cliffs of Drenovska Klisura (VELEVSKI, 2014 and BIOTOPE, June 2014) Nesting habitat on the study area: cliffs (like in all Macedonia). Assumed foraging habitats: open habitats (pastures and small wetlands associated to local temporary streams).
Calandra Lark <i>Melanocorypha calandra</i>			x	Mentioned in EIA (LASOY DOO, 2013) Habitats: dry grasslands
Egyptian Vulture <i>Neophron percnopterus</i>			x	See main report.
European Nightjar <i>Caprimulgus europaeus</i>			x	Mentioned in EIA (LASOY DOO, 2013) Habitats: open habitats in forest-dominated landscapes
European Roller <i>Coracias garrulus</i>			x	Mentioned in EIA (LASOY DOO, 2013) Observed by BIOTOPE (June 2014) Nesting habitat: shaft cavity, often in riparian forests. Foraging habitats: open dry habitats (grasslands).
Golden Eagle <i>Aquila chrysaetos</i>			x	Mentioned in EIA (LASOY DOO, 2013) Not breeding on the study area, only foraging (VELEVSKI, com. pers., June 2014)
Lesser Kestrel <i>Falco naumanni</i>			x	Mentioned in EIA (LASOY DOO, 2013) Observed by BIOTOPE (June 2014) Nesting habitats: roofs of old houses, cliffs. Foraging habitats : open dry habitats (grasslands, rocky habitats)
Levant Sparrowhawk Accipiter brevipes			x	Mentioned in EIA (LASOY DOO, 2013) Observed by BIOTOPE in 2014 foraging on the study area above Raec riparian forest downstream of Drenovska Klisura Nesting habitat on the study area: forests. Foraging habitats: forest in mosaic with open habitats and agricultural lands.
Long-legged Buzzard <i>Buteo rufinus</i>			x	Mentioned in EIA (LASOY DOO, 2013) One pair is having a nest on the cliffs in Drenovska Klisura (VELEVSKI, 2014) Nesting habitat on the study area: cliffs. Foraging habitats: open dry habitats, steppes and grasslands, rocky terrains
Ortolan Bunting <i>Emberiza hortulana</i>			x	Mentioned in EIA (LASOY DOO, 2013) Observed by BIOTOPE (June 2014) Habitats: dry grasslands and associated shrubby habitats
Red-backed Shrike <i>Lanius collurio</i>			x	Mentioned in EIA (LASOY DOO, 2013) Observed by BIOTOPE (June 2014) Habitats: dry grasslands and associated shrubby habitats

Table 9. Species of European directives observed on the study area

<i>Species</i>	<i>DHA2</i>	<i>DHA4</i>	<i>DOA1</i>	<i>Habitats and other available data on study area</i>
Rock Partridge <i>Alectoris graeca</i>			x	Mentioned in EIA (LASOY DOO, 2013) Habitats on the study area: open and rocky habitats
Short-toed Snake-eagle <i>Circaetus gallicus</i>			x	Mentioned in EIA (LASOY DOO, 2013) Not breeding on the study area, only foraging (VELEVSKI, com. pers., 2014) Nearest known breeding territories about 10 km north or 15 km south (VLELEVSKI & GRUBAC, 2008).
Tawny Pipit <i>Anthus campestris</i>			x	Mentioned in EIA (LASOY DOO, 2013) Habitat: open habitats, meadows, pastures
Mammals (including bats)				
Gray Wolf <i>Canis lupus</i>	x	x		Species mentioned on the study area in the EIA (LASOY DOO, 2013). Local presence confirmed in literature (KRYSTUFEK & PETKOVSKI, 2003). Habitats: wide range of natural habitats, mainly hilly landscapes
Wild Cat <i>Felis silvestris</i>		x		Species mentioned on the study area in the EIA (LASOY DOO, 2013). Habitats: woods
Eurasian Otter <i>Lutra lutra</i>	x	x		Species mentioned on the study area in the EIA (LASOY DOO, 2013). Local presence confirmed in literature (POLEDNIK et al., 2008). Habitats on study area: Raec river, local (temporary) tributaries, riparian forest
Marbled Polecat <i>Vormela peregusna</i>	x	x		Species mentioned on the study area in the EIA (LASOY DOO, 2013). A local study have been undertaken asking ca. 60 local inhabitants about their knowledge of the species. No result have been obtained even by local hunters. Habitats on study area: open grasslands and associated shrubby habitats / forest edges
Blasius's Horseshoe Bat <i>Rhinolophus blasii</i>	x	x		Species mentioned on the study area in the EIA (LASOY DOO, 2013). Confirmed by STOJKOSKA (com. pers., 2014) Breeding and roosting habitat on study area: caves; foraging habitats: surroundings natural and agricultural habitats in a 1 to 10 km radius
Mediterranean Horseshoe Bat <i>Rhinolophus euryale</i>	x	x		Species observed by STOJKOSKA & STOFILOVSKA, 2013 (30-40 individuals observed in main local cave). Breeding and roosting habitat on study area: main local cave; foraging habitats: surroundings natural habitats in a 1 to 15 km radius

Table 9. Species of European directives observed on the study area

<i>Species</i>	<i>DHA2</i>	<i>DHA4</i>	<i>DOA1</i>	<i>Habitats and other available data on study area</i>
Greater Horseshoe Bat <i>Rhinolophus ferrumequinum</i>	x	x		Species mentioned on the study area in the EIA (LASOY DOO, 2013). Confirmed by STOJKOSKA & STOFILOVSKA, 2013 (2 individuals observed in main local cave). Breeding and roosting habitat on study area: main local cave; foraging habitats: surroundings natural habitats in a 1 to 15 km radius
Lesser Horseshoe Bat <i>Rhinolophus hipposideros</i>	x	x		Species observed by STOJKOSKA & STOFILOVSKA, 2013 (only 1 individuals observed in main local cave). 1 individual found dead on the existing road during the field survey of this study (BIOTOPE, July, 2014). Breeding and roosting habitat on study area: main local cave; foraging habitats: surroundings natural habitats in a 1 to 10 km radius
Schreiber's bat <i>Miniopterus schreibersii</i>	x	x		Species observed by STOJKOSKA & STOFILOVSKA, 2013 (ca. 500 individuals observed in main local cave). Breeding and roosting habitat on study area: main local cave; foraging habitats: surroundings natural habitats in a 1 to 30 km radius
Greater Mouse-eared Bat <i>Myotis myotis</i>	x	x		Species mentioned on the study area in the EIA (LASOY DOO, 2013). Confirmed by STOJKOSKA & STOFILOVSKA, 2013 (ca. 500 individuals observed in main local cave). Breeding and roosting habitat on study area: main local cave; foraging habitats: surroundings natural habitats in a 1 to 30 km radius
Whiskered Myotis <i>Myotis mystacinus</i>		x		Species mentioned on the study area in the EIA (LASOY DOO, 2013). Breeding and roosting habitat on study area: woodlands, maybe human settlements; foraging habitats: surroundings natural habitats in a 1 to 10 km radius
Nathusius' Pipistrelle <i>Pipistrellus nathusii</i>		x		Species mentioned on the study area in the EIA (LASOY DOO, 2013). Breeding and roosting habitat on study area: human settlements; foraging habitats: surroundings natural habitats in a 1 to 20 km radius. Migratory species.
Common Pipistrelle <i>Pipistrellus pipistrellus</i>		x		Species mentioned on the study area in the EIA (LASOY DOO, 2013). Breeding and roosting habitat on study area: human settlements; foraging habitats: surroundings natural habitats in a 1 to 15 km radius.

Annex 8 – Mitigation Measures

The measures described in the main report for each affected natural and critical habitat are presented individually below for use by PESR in project management and contracting. These include mitigation measures, and associated monitoring measures.

Mitigation measures

MIT01	<p>CONSTRUCTION PHASE <i>Expressway A1, from the bridge of river Raec to Drenovo interchange</i></p> <p>In the Drenovo gorge and on natural habitats, minimize the footprint of construction activities through appropriate location of access roads and other work related facilities in modified habitats.</p>
<p>This measure targets the natural habitats found in the vicinity of the road project, including critical cliffs and rocky slopes with rare chasmophytic (specialized rock-dwelling) vegetation, and critical habitat for the endemic snail (<i>Carinigera drenovoensi</i>) that is only found in Drenovo Gorge. It aims to limit the project's footprint on natural habitats, during construction and operation, and in particular on cliffs and rocky habitats.</p> <p>In the design of the construction works, existing access roads and other works related facilities will always be preferred.</p> <p>Whenever feasible, works, access roads and related facilities will be on agricultural land (modified habitat) rather than on natural habitats. Footprint will be strictly minimized on cliffs and rocky habitats in Drenovo gorge.</p> <p>To avoid vehicles or staff wandering out of designated areas, a temporary visible limit will be erected around the perimeter designated as the construction site, whenever it comes into contact with natural habitats (no painting on rocks). Access to the petrifying spring (north-western entrance of Drenovo gorge) will be closed off with a fence, and an explanation sign. The location of all access, facilities and fences will be assessed by a trained ecologist and enforced by a supervisor who will be responsible for maintaining these visible limits throughout the construction phase.</p> <p>Construction, vehicles and people will be prohibited from going beyond the designated limit. Contractors and staff will be trained about the meaning of these limits, and their justification.</p> <p>Contracts with contractors will include monetary sanctions to be applied in case their vehicles or staff penetrate rocky habitats and rocky slopes, including the cave above the river where bats roost, beyond the visible limits of the construction site.</p> <p><i>Note:</i> 'Access roads' mean all roads, tracks and footpaths going to the project construction area, and 'other works related facilities' mean all installations related to the construction of the road: base camp(s), vehicle maintenance and washing places, vehicle parking places, materials and construction equipment storage areas.</p>	

MIT02	<p>CONSTRUCTION PHASE <i>Expressway A1, from the bridge of river Raec to Drenovo interchange</i></p> <p>In Drenovo gorge, strictly avoid loud preparation / construction works when the Egyptian Vulture is breeding</p>																																				
<p>This measure targets the globally endangered Egyptian vulture for which Drenovo gorge is a critical habitat. It aims to minimize disturbance to breeding pairs of Egyptian vultures in Drenovo Gorge. If vultures are breeding in the gorge, noise, vibrations and activity must not exceed that of the existing road.</p> <p>This measure does not apply if monitoring shows that the vulture has not returned to the nesting site (result of monitoring MON01).</p> <p>If vultures are breeding in Drenovo Gorge, then avoid loud operations, mainly blasting and excavation, from March 15th to September 15th. Strict avoidance of blasting and excavation from March 15th to the end of July. See schedule proposal below.</p>																																					
<table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th>Jan.</th> <th>Feb.</th> <th>March</th> <th>April</th> <th>May</th> <th>June</th> <th>July</th> <th>Aug.</th> <th>Sept.</th> <th>Oct.</th> <th>Nov.</th> <th>Dec.</th> </tr> </thead> <tbody> <tr> <td style="background-color: #00ff00;"></td> <td style="background-color: #00ff00;"></td> <td style="background-color: #ff0000;"></td> <td style="background-color: #ff0000;"></td> <td style="background-color: #ff0000;"></td> <td style="background-color: #ff0000;"></td> <td style="background-color: #ff0000;"></td> <td style="background-color: #ffcc00;"></td> <td style="background-color: #ffcc00;"></td> <td style="background-color: #00ff00;"></td> <td style="background-color: #00ff00;"></td> <td style="background-color: #00ff00;"></td> </tr> <tr> <td colspan="7"> <p>Strict avoidance of loud working operations, mainly blasting, mining and excavations.</p> </td> <td colspan="5"> <p>Beginning of all construction works only after migration start depending on the results of continuous monitoring (MON01)</p> </td> </tr> </tbody> </table>		Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.													<p>Strict avoidance of loud working operations, mainly blasting, mining and excavations.</p>							<p>Beginning of all construction works only after migration start depending on the results of continuous monitoring (MON01)</p>				
Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.																										
<p>Strict avoidance of loud working operations, mainly blasting, mining and excavations.</p>							<p>Beginning of all construction works only after migration start depending on the results of continuous monitoring (MON01)</p>																														

MIT03	<p>CONSTRUCTION PHASE <i>Expressway A1, from the bridge of river Raec to Drenovo interchange</i></p> <p>In Drenovo gorge, elimination of <i>Ailanthus altissima</i> prior to the start of construction works.</p>
<p>This measure targets critical natural habitat: cliffs and rocky slopes, including critical habitat for the endemic snail (<i>Carinigera drenovoensi</i>) that is only found in Drenovo Gorge. Tree-of-heaven is an invasive plant species originated in Asia that is currently degrading the bottom of rocky habitats in Drenovo gorge. Construction works, by moving soil and plant parts around, could increase this degradation by spreading the plant to new locations in the gorge and river valley.</p> <p>All living individuals of <i>Ailanthus altissima</i> (including saplings) found in the expropriation area in Drenovo Gorge must be uprooted before the beginning of construction works.</p> <p>Removal of individual specimens of <i>Ailanthus altissima</i> must not be done with machinery.</p>	
MIT04	<p>CONSTRUCTION PHASE <i>Expressway A1, from the bridge of river Raec to Drenovo interchange</i></p> <p>In the Drenovo gorge, implement dust suppression measures to reduce dust deposits on nearby natural habitats</p>
<p>This measure targets critical natural habitat: cliffs and rocky slopes, including critical habitat for the endemic snail (<i>Carinigera drenovoensi</i>) that is only found in Drenovo Gorge. These habitats could be impacted by dust deposits during construction.</p> <p>In dry and/or windy weather, sprinkle water on uncovered soils and construction materials, on a regular basis, to stop dust formation.</p>	
MIT05	<p>CONSTRUCTION PHASE <i>Expressway A1, from the bridge of river Raec to Drenovo interchange</i></p> <p>In the Raec river, restore the profile and substrate of the river to its original condition after construction of pillars, bridges, and embankments affecting the riverbed.</p>
<p>This measure targets natural habitats in Drenovo gorge (river), and aims to achieve appropriate post-construction of the river's structure and hydrology. This measure complements MIT11 on river bank continuity.</p> <p>Work in river will be minimized through limited diversions of water flow and the use of minimal size coffer dams / sheets around piling works.</p> <p>At and near the planned structures, photographs of the river will be taken before construction, and measurements will be taken of its profile (width/depth/slope) and of the granulometry of sediments.</p> <p>Any materials or equipment used in diverting water away from construction areas will be removed once construction is complete.</p> <p>After construction is completed, restoration will be undertaken to achieve a profile and granulometry similar to that documented prior to construction.</p>	
MIT06	<p>CONSTRUCTION PHASE <i>Expressway A1, from the bridge of river Raec to Drenovo interchange</i></p> <p>In the riparian forest, along the Raec river, remove <i>Robinia pseudoacacia</i> trees (an exotic invasive) to enhance the conservation status of the habitat in the vicinity of the project</p>
<p>This measure targets a natural habitat: the riparian forests along the Raec river. Stands of <i>Robinia pseudoacacia</i>, an invasive tree species, degrade the natural riparian forest habitat and this measure aims to enhance the forest by removing them.</p> <p>Within the expropriation area, all individual trees and saplings of <i>Robinia pseudoacacia</i> will be located and cut, with the stumps killed. Fallen trunks and branches will not be removed, to provide micro-habitats to specialized species.</p> <p>This work will be overseen by a trained ecologist.</p>	

MIT07	<p>CONSTRUCTION & OPERATION PHASE <i>Expressway A1, from the bridge of river Raec to Drenovo interchange</i></p> <p>No concrete / shotcrete projections on cliffs and steep slopes</p>
<p>This measure targets critical natural habitat: cliffs and rocky slopes, including critical habitat for the endemic snail (<i>Carinigera drenovoensis</i>) that is only found in Drenovo Gorge. These habitats would be lost if covered in exogenous material such as concrete / shotcrete.</p> <p>No concrete / shotcrete projections on cliffs and steep slopes. Appropriate substitutes include wire nets and adequate removal of dangerous rocks, boulders and stones during operations.</p>	
MIT08	<p>CONSTRUCTION & OPERATION <i>Expressway A1, from the bridge of river Raec to Drenovo interchange</i></p> <p>In Drenovo gorge, on the bridge below the case, install a continuous high palisade along each side of the bridge, to prevent collisions with bats travelling between their roost in the cave and feeding grounds in the riparian forest.</p>
<p>This measure targets natural habitats in Drenovo gorge (riparian forest), and the critical rocky habitats where a large breeding and wintering bat roost has been found.</p> <p>To reduce bat collisions while they forage in riparian forest in the closest zones to the exit/entrance of the cave in Drenovo gorge, a set of continuous high palisades, at least 2m above the bridge rails, will be built (during construction) and maintained (during operations). The palisades can be built of any long-lasting and vibration and wind resistant material (including but not limited to wood panels, some plastics, and metal mesh within metal frames).</p> <p>Similar structures could be built on the other 4 bridges in Drenovo Gorge if monitoring (MON03) shows significant impacts on the bat population.</p>	
MIT09	<p>CONSTRUCTION & OPERATION <i>Expressway A1, from the bridge of river Raec to Drenovo interchange</i></p> <p>Design road structures so as to ensure animals can use the banks of the Raec river throughout the gorge</p>
<p>This measure targets natural habitats in Drenovo gorge (riparian forest), to ensure continuity of habitat for mammal species such as the European otter (<i>Lutra lutra</i>). Road structures, including bridges, pillars, and embankments must not block impair movement, on land, of small mammals, including in periods of high water.</p> <p>River banks will be avoided during construction.</p> <p>When river banks are destroyed or lose their function (due to an obstacle), an appropriate substitute will be put in place. This can consist of tiered banks made of large boulders located at the base of built structures. A continuous route must be available for small mammals even in high water.</p>	
MIT10	<p>CONSTRUCTION & OPERATION <i>Expressway A1, from the bridge of river Raec to Drenovo interchange</i></p> <p>In Drenovo gorge, ensure that any cliffs and slopes that remain after construction are stabilized, and that no exogenous soil and no planting of vegetation will impair subsequent colonization by chasmophytic vegetation. Where possible, small cracks and crevices should be favoured to facilitate colonization.</p>
<p>This measure targets critical habitats in Drenovo gorge (cliffs and rocky slopes), to ensure that as much rocky habitat can be created during road construction. Slopes above and below the road, including cliffs and walls, must be designed to facilitate colonization by rock-dwelling vegetation: exogenous material, including concrete (see MIT07) or soil must be used, and no planting must be undertaken.</p> <p>Small cracks and crevices (<5cm wide), and small ledges, must be favoured whenever possible for example in stabilizing slopes or designing the outside surface of retaining walls and other vertical structures (no smooth concrete).</p> <p>Invasive alien species, in particular <i>Ailanthus altissima</i>, must be controlled in Drenovo Gorge through regular roadside maintenance operations.</p>	

Monitoring measures

MON00	<p>CONSTRUCTION PHASE <i>Expressway A1, from the bridge of river Raec to Drenovo interchange</i></p> <p>Supervision of works by a trained ecologist during the construction phase</p>
<p>This measure targets all natural habitats, including critical habitat, along the proposed road project. Supervision necessary for the effective implementation of all mitigation measures, and to ensure compliance of contract terms by workers.</p> <p>A trained ecologist will advise on the limits of the construction site when natural habitats may be affected, and make them visible through e.g. tape or other means (no paint on rocks) - as required in MIT01.</p> <p>Weekly visits to the works, during construction, in Drenovo Gorge, will be carried out to check compliance with MIT01, in particular.</p> <p>Monitoring of dust deposits on rocky habitats and of air quality will be undertaken during construction.</p> <p>A detailed mapping of impacts will be produced, and a final synthesis report on residual impacts (including areas of critical and natural habitats lost) will be communicated to EBRD.</p>	
MON01	<p>CONSTRUCTION PHASE <i>Expressway A1, from the bridge of river Raec to Drenovo interchange</i></p> <p>In Drenovo gorge, regular (twice a week) monitoring of Egyptian vulture presence and behaviour will be undertaken from March 15th to September 15th, during the construction phase.</p>
<p>This measure targets the critical habitat of the Egyptian vulture. Disturbance is a key risk to the breeding success of the Egyptian vulture in Drenovo gorge. As per MIT02, work susceptible to disturb a breeding pair must be avoided between March 15th and September 15th. This monitoring measure aims to guide the implementation of MIT02.</p> <p>Between March 15th and September 15th, during construction, 1-day observation sessions, twice a week, by an independent and trained ornithologist will determine whether or not a pair (or several pairs) of Egyptian vultures settle(s) in Drenovo gorge upon return from migration (early spring, from March 15th onwards). If not, MIT02 does not apply. If so, then MIT02 applies and construction work will be informed of its effects on the behaviour, and breeding success or failure, of the Egyptian vulture, including the date of departure for outwards migration, after which work can resume. In case the nest remains unoccupied or is abandoned, offset measures will be implemented.</p> <p>A contract with an independent ornithologist (to be approved by EBRD) will be required in the tender documents for construction.</p>	
MON02	<p>OPERATION PHASE <i>Expressway A1, from the bridge of river Raec to Drenovo interchange</i></p> <p>In Drenovo gorge, monitoring of Egyptian Vulture breeding during the first 5 years of operation</p>
<p>This measure targets the critical habitat of the Egyptian vulture. This monitoring aims to control that the new road in operation phase does not disturb the breeding success of Egyptian Vultures in Drenovo gorge. If not, the monitoring would be stopped after 5 years. If the traffic disturbance is supposed to have a damaging effect on Vulture breeding, offset measures would be carried out (see offsetting strategy).</p> <p>An independent trained birdwatcher will undertake observations once a week, during a full day, over 5 breeding seasons, and report on the breeding behaviour of the vultures, and identify any likely causes of unsuccessful breeding.</p> <p>This monitoring measure will only be undertaken if the vulture is present (as established through MON01). This means that a 2-step contract will be necessary: (1) first assess whether vultures are breeding, and if so (2) monitor breeding success.</p>	
MON03	<p>OPERATION PHASE <i>Expressway A1, from the bridge of river Raec to Drenovo interchange</i></p> <p>In Drenovo gorge, monitoring of impacts on the bat population using the cave above the road</p>
<p>This measure targets the bats that breed and roost in the cave above the road, in Drenovo Gorge. The road will hinder bat movements between the cave and the road, and along the river valley. To establish whether additional mitigation is required (see MIT08), monitoring of actual impacts is required.</p> <p>This monitoring involves:</p> <ul style="list-style-type: none"> - Assessment of population levels in the cave before and during construction, and in the first 5 years of operation - A study of the movements of bats between the cave and the river valley, and along the river valley, using 2D or 3D acoustic trajectory photography, during the first year of operation. Ultrasound recording devices and Sonobatacoustic analysis software can be used for this purpose. <p>An independent trained bat specialist will undertake this monitoring, and identify any likely causes of population fluctuations and barriers to movement.</p>	

MON04	<p>OPERATION PHASE <i>Expressway A1, from the bridge of river Raec to Drenovo interchange</i></p> <p>In Drenovo gorge, monitoring of impacts on the endemic snail <i>Carinigera drenovoensis</i>, during the first 5 years of operation</p>
<p>This measure targets the restricted range endemic snail species <i>Carinigera drenovoensis</i>, in Drenovo Gorge. Although it is unlikely that the road will affect the viability of the local population of the snail, a precautionary approach requires that this be monitored.</p> <p>PESR will ensure that qualified ecologists are involved in the definition of an appropriate monitoring protocol and in its implementation during the first 5 years of operation.</p> <ul style="list-style-type: none"> - The monitoring and the monitoring protocol for <i>Carinigera drenovoensis</i> will include the number (abundance) and extent of distribution of the species on both sides of the road and the apparent health of a sample of snails. This will have to be undertaken prior to construction, and in years 1 to 5 of operation. - A standard, scientifically robust and repeatable, protocol will be drawn up and included in the BMP. - Monitoring reports will also include results from monitoring of dust deposits and air quality during the first year of operation. If significant dust deposits have occurred during year 1, then the monitoring of dust deposits and air quality will be extended to years 2, 3, 4 and 5 of operation. <p>An independent trained snail specialist will undertake this monitoring, and identify any likely causes of fluctuations in the snail population.</p>	

Annex 9 – Offsetting Measures

The offsets described in the main report for all affected natural and critical habitats are described individually below for use by PESR in project management and contracting.

OFF01	<p>CONSTRUCTION & OPERATION (10 years) <i>Expressway A1, from the bridge of river Raec to Drenovo interchange</i></p> <p>Creation of chasmophytic vegetation communities on over 0.5 ha of recently exposed rock faces in one or several limestone quarries in Macedonia</p>
<p>This measure targets critical rocky habitats in Drenovo gorge.</p> <p>Before construction can begin, quarries with available calcareous (hard) rock faces totalling over 2 ha will be identified and purchased, or granted access, for the creation of chasmophytic plant communities. The selection of appropriate quarries will be overseen by a qualified plant ecologist, who will prepare terms of reference for any preparatory work to create a diversity of micro-habitats (multiple aspects, angles and textures), and for the collection, transplantation and establishment of specimens and/or seeds of typical chasmophytic vegetation (including all Macedonian and Southern Balkan endemic species).</p> <p>As construction begins, generate or enhance favourable (rocky) habitat for chasmophytic species in the selected quarries by creating complex shapes (multiple orientations and vertical angles) with rough surfaces and abundant cracks and crevices of various size (from 1 cm to 5 cm), collect propagules of chasmophytic plant species, under the supervision of a qualified plant ecologist, and transplant them to a nursery for propagation.</p> <p>Once the selected quarries have been prepared and sufficient propagules are available, transplant specimens and/or seeds of chasmophytic plant species to the favourable rocky habitats in the quarry. Several techniques can be trialled and documented to achieve this.</p> <p>Monitor the success or failure of transplantations, species by species, and adjust the design and execution of the transplants accordingly.</p> <p>The new rocky vegetation will be protected through official designation and / or ownership by a recognized public or private conservation organisation.</p> <p>Should MON00 reveal that the loss of rocky habitats exceeds 0.5 ha, additional rock surfaces will be enhanced by extending OFF01 to other rock faces in the selected quarry.</p>	

OFF02	<p>CONSTRUCTION & OPERATION (10 years) <i>Expressway A1, from the bridge of river Raec to Drenovo interchange</i></p> <p>Restoration of >15 ha of degraded grasslands in the Raec river valley by removing encroaching shrubs</p>
<p>This measure targets natural dry grassland habitats. To offset this loss of natural habitats, at least 50 ha of degraded grasslands, with high densities and cover of shrubs must be restored by removing shrubs.</p> <p>Before construction begins, identify, photograph and describe degraded grasslands that are suitable for restoration ; this will be done by a qualified plant ecologist and take into account access to land by contacting land owners and land users. It is suggested to target public land designated officially as grassland (cadastre).</p> <p>Before construction begins, establish contracts with land owners and land users that include a 10 year management plan for restoring and managing the grasslands, with any payments conditional to grasslands remaining free of large shrubs during the 10 year period, and to the absence of fertilization, manuring or irrigation.</p> <p>Carry-out an independent audit of conformity with contract obligations, and with the restoration objective.</p> <p>Should MON00 reveal that the loss of dry grassland habitats exceeds 15 ha, additional surfaces of degraded grasslands will have to be restored, thereby extending OFF02.</p>	

OFF03	<p>CONSTRUCTION & OPERATION (10 years) <i>Expressway A1, from the bridge of river Raec to Drenovo interchange</i></p> <p>Establishment of a continuous strip of riparian forest along the Raec river, between the bridge of river Raec and Drenovo interchange</p>
<p>This measure targets natural riparian forest habitat in the Raec river valley, which will be fragmented by the planned road project.</p> <p>Improve the continuity of riparian forests along the Raec river, between the bridge of river Raec, and Drenovo interchange, by filling gaps where possible - without jeopardizing existing biodiversity features (e.g. wet meadows). Only indigenous trees will be used. This work will be overseen by a qualified ecologist.</p> <p>Audit results independently by comparing aerial photographs of the banks of the river before and after the measure has been put in place, and after 10 years (to be undertaken by a qualified ecologist).</p>	

OFF04	<p>CONSTRUCTION & OPERATION (10 years) <i>Expressway A1, from the bridge of river Raec to Drenovo interchange</i></p> <p>Rehabilitation of > 4 existing obstacles to small mammal movement along the banks of Raec river</p>
<p>This measure targets natural riparian forest habitat in the Raec river valley, which will be fragmented by the planned road project.</p> <p>In the Raec river valley, in and up-stream from Drenovo gorge, on at least 4 existing bridges or man-made structures that limit the use of river banks by wildlife (including fencing), create or rehabilitate adequate passageways for small mammals such as the otter (<i>Lutra lutra</i>). This can include the removal of structures that are no longer in use, the creation of tiered banks using soil and / or boulders at the base of bridges, culverts etc., the creation of underpasses, or any other suitable means.</p> <p>Audit results independently by comparing photographs of the modified structures before and after enhancement.</p>	

OFF05	<p>CONSTRUCTION & OPERATION (10 years) <i>Expressway A1, from the bridge of river Raec to Drenovo interchange</i></p> <p>Restoration of indigenous riparian forest vegetation in suitable places in the Raec river valley through the elimination of invasive <i>Robinia pseudoacacia</i> trees.</p>
<p>This measure targets natural riparian forest habitats.</p> <p>All <i>Robinia pseudoacacia</i> trees and saplings found in the riparian woodlands of the Raec river valley, in the expropriation area, between the bridge of river Raec and Drenovo interchange will be cut (and stumps killed). This will be conducted in winter to limit disturbance to the habitat during the wildlife breeding season. It will be overseen by a qualified ecologist</p> <p><i>This measure is an extension of MIT06 and both measures can be contracted jointly, and in coordination with OFF03.</i></p>	

Specific offset measures could be triggered in case MIT01 fails to achieve no net loss of critical Egyptian vulture habitat. These measures are described below but would need to be amended to fit the circumstances.

OFF06	<p>CONSTRUCTION & OPERATION (5 years) <i>Expressway A1, from the bridge of river Raec to Drenovo interchange</i></p> <p>Staged adaptive offset program for the Egyptian vulture</p>
<p>This measure targets critical habitat for the Egyptian vulture. Should MON01 reveal an unsuccessful breeding attempt in Drenovo Gorge during construction, which can be attributed to disturbance by the road project, including poor implementation of MIT02, a set of actions aimed at enhancing the conservation status of the Egyptian vulture in the 'Raec river Valley' IBA (IBA MKO23 - see map in Annex 2), and beyond that in Macedonia, will be undertaken. These should target the key limiting factors for the conservation or restoration of the species.</p> <p>As an example, the following actions could be undertaken jointly:</p> <ul style="list-style-type: none"> - Raise awareness on alternatives to the use of poisoned baits through a 5 year campaign in the local and national media (newspapers, television and internet); - Undertake active research of poisoning locations and rapid removal of dead wolves or dogs, across the 'Raec river Valley' IBA (IBA MKO23 - see map in Annex 2), over a 5 years period; - Identify and rank the causes of vulture mortality and reproductive success in the 'Raec river Valley' IBA (IBA MKO23 - see map in Annex 2), including measurements of the levels of poisoning in local wildlife <p>These actions can be contracted to competent professionals, and audited by independent qualified ecologists</p> <p>Should MON02 reveal that no pair breeds regularly in Drenovo Gorge after construction (at least 3 out of 5 years of post-construction monitoring), and that this can be attributed to disturbance by the road project, including poor implementation of MIT02 (i.e. the pair has fled the area permanently following construction), the duration of OFF06 would have to be extended.</p> <p>As an example, it could be continued until breeding resumes in the gorge or the population of the species in the IBA is restored (3 pairs, breeding regularly, 3 out of 5 years).</p>	

In parallel to the measures outlined above, the following study will be undertaken:

STU02	<p>OPERATION (1 year) <i>Expressway A1, from the bridge of river Raec to Drenovo interchange</i></p> <p>Study of the distribution and conservation status of Pelagonia trout (<i>Salmo pelagonicus</i>) in the Raec river watershed</p>
<p>This measure targets natural habitat, the Raec river, and specifically its potential role as critical habitat for the Pelagonia trout (<i>Salmo pelagonicus</i>). To clear any uncertainties regarding the presence of the restricted range Pelagonia trout (<i>Salmo pelagonicus</i>) in the Raec river, a targeted rapid assessment will be undertaken to:</p> <ul style="list-style-type: none"> - identify the distribution of the species in the Raec river watershed, and its conservation status; - formulate a conservation or restoration strategy for the species 	