

River Raec - Drenovo Interchange  
Road Project  
Republic Of Macedonia  
Biodiversity and Critical Habitats Assessment

# River Raec - Drenovo Interchange Road Project Republic Of Macedonia

## Biodiversity and Critical Habitats Assessment

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# Summary

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The European Bank for Reconstruction and Development (EBRD) is considering providing a sovereign loan to the Republic of Macedonia Public Enterprise for State Roads (PESR) for the construction of a number of roads in Macedonia. One such road development is a ca. 10 Km section of the A1 road, between the 'River Raec Bridge' and the 'Drenovo Interchange', which is included in the overall plan for the improvement of the national road network outlined in the Republic of Macedonia's National Transport Strategy (2007-2017), and is to be built over and along an existing road.

This project is being considered as a Category A Project in accordance with the EBRD's Environmental and Social Policy (ESP) of 2008. The EBRD's requirements are that all elements of the project will meet national environmental, social, health and safety laws and regulations, and be carried out in compliance with relevant EU environmental and social standards, as well as the EBRD's Environmental and Social Policy (ESP) and Performance Requirements (PRs) of 2008.

An Environmental Impact Assessment (EIA) has been prepared under the Macedonian Law of Environment. EBRD has conducted an appraisal of the available documentation and of the environmental and social risks of the Project. This has identified that a 3km section of the road project crosses the "Drenovo Gorge Monument of Nature" (a protected area under Macedonian law), and that some biological features which are affected by the project, including species and habitats of conservation importance, may constitute natural or critical habitat according to the criteria in PR6.

In order to ensure the adequate protection of these resources, a **Critical Habitats Assessment (CHA) was undertaken**. The objectives of the CHA are to identify, map and describe the natural habitats affected by the project, determine whether critical habitat is present according to the criteria in PR6, describe the potential effects arising from the construction and operation of the proposed road scheme, and develop a mitigation strategy based on appropriate use of avoidance, minimisation, restoration or offsetting measures as needed to ensure that there is no net loss (or preferably a net gain) of biodiversity as appropriate.

The assessment has found that **natural habitats cover over half the study area that is included in a ca. 1 km wide strip centred on the proposed road project on a total length of 15 Km<sup>1</sup>** (this is the study area), while the rest are modified (agricultural and urban) habitats. The western part of the project, in the Drenovo Gorge and in the Raec river valley, includes areas considered to be **critical habitat for the Egyptian Vulture (*Neophron percnopterus*)**, a globally endangered species (EN) which is experiencing rapid declines throughout its range. In Macedonia, it has gone from a minimum of 137 to only 21 pairs in three decades. The rocky habitats in Drenovo gorge and its northern plateau are also considered to be **critical habitat for the *Carinigeradrenovoensis***, a **single-site endemic snail** (for which this CHA has generated new knowledge on its restricted distribution - ca. 120 ha - and densities). These **rocky habitats further support rare chasmophytic vegetation**, with some restricted range plant species, and a large bat roost, with 6 bat species listed in Annex II and IV of the EU Habitats Directive. Near the Western end of the gorge, a **petrifying spring was also considered critical habitat** (Priority Habitat 7220\* under the Habitats Directive).

This CHA confirms the biodiversity richness of the Raec river valley, and Drenovo gorge and its close surroundings in particular, which are clearly eligible for designation under international protected

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<sup>1</sup>The project to be financed by EBRD begins at River Raec bridge at its western extremity to the so called "Drenovo interchange". The study area considers a longer stretch of road, going up north to a grassland unit next to Kamen Dol.

area networks such as the Emerald (Bern Convention) or Natura 2000 (EU) networks. **Under PR6, these areas should be avoided, unless the project is considered to be justified for imperative reasons of overriding public interest and that there are no alternatives. If so, then any impacts would have to be appropriately mitigated to achieve no net loss or a net gain for the features that trigger such designation.**

During the feasibility and conceptual planning stage, two groups of alternative alignments were considered, from which two alternative routes have been selected for further comparison and analyses. Alternative 1, which is aligned close to the existing Prilep - Gradsko road (A1), going through DrenovoGorge, and Alternative 2, which takes a more southerly line and follows the right bank of the Raec River. According to the EIA, the selection of the Alternative 1 was driven by accordance with the Physical Plan of the Republic of Macedonia (2004-2020), and better connections with the existing road network, and higher quality road safety features. As a result, **scope for avoidance of the gorge was constrained by the fact that this alternative, and the remainder of the route, were already established when this CHA was undertaken.** An assessment of alternatives was not included in the scope of this CHA.

Within these constraints, measures to avoid and minimise impacts on sensitive features and biological resources have been identified. These include measures to avoid disturbance of Egyptian vultures breeding in Drenovo gorge, to minimize the project's net footprint on rocky habitats, and to minimise any additional fragmentation of the river valley caused by building the road in Drenovo gorge. **Implementation of avoidance and reduction measures will ensure that residual impacts on critical habitats for the Egyptian vulture and endemic snail will not be significant.** Following a precautionary approach, a staged and adaptive offset strategy has been proposed as a response should monitoring reveal impacts on the Egyptian vulture.

**Significant residual impacts are likely on the river corridor and dry grasslands (natural habitats), and cliffs and rocky slopes harbouring chasmophytic vegetation (critical habitat).** A set of measures have been designed to address these residual impacts and ensure that, **through appropriate biodiversity offsets, the project will lead to a no net loss, or preferably a net gain, outcome for these natural and critical habitats.** These include the restoration of the river corridor up- and down-stream of Drenovo gorge, and the restoration of degraded grasslands in the area around the project. Suitable opportunities for offsetting residual impacts on cliffs and rocky habitats are very limited in the surrounding area, and the proposed offset will be implemented where possible.

Overall, the volume and complexity of the offsets required to achieve no net loss and net gain outcomes for biodiversity affected by the project reflects the high value of the natural and critical habitats found in the study area, and in particular in Drenovo gorge.

In summary, given the constraints of following the route selected in the EIA (Alternative 1), it is feasible that **the biodiversity management plan and offset strategy outlined in this CHA could ensure that the project does not cause a net loss of natural habitats or critical habitats.** This will however require long term monitoring and adaptive management by PESR. Measures are identified within a Biodiversity Management Plan (BMP) and a Biodiversity Offsetting Management Plan (BOMP) which will be incorporated into the Construction Environmental & Social Management Plan (CESMP) and Operational Environmental & Social Management Plan (OESMP).

#### Key conclusions:

- ☞ The proposed road, following Alternative 1 laid out in the EIA, will affect natural habitats, of which several are critical habitats.
- ☞ Implementation of the biodiversity management plan and offset strategy outlined in this CHA could ensure that the project does not cause a significant net loss of natural habitats or critical biodiversity features.

# I. Introduction

As part of the overall plan for the improvement of the national road network, outlined in the Republic of Macedonia's National Transport Strategy (2007-2017), the Public Enterprise for State Roads (PESR) is planning to upgrade parts of state road A1 between Gradsko and Prilep, a section of Pan-European Corridor X (E-75). The construction of a new expressway from the River Raec Bridge to Gradsko (junction with A1) is one component of this program. This includes a section between the 'River Raec Bridge' and the 'Drenovo Interchange': the 'Project' described and discussed in this document. The location of the Project on Corridor X is shown below.

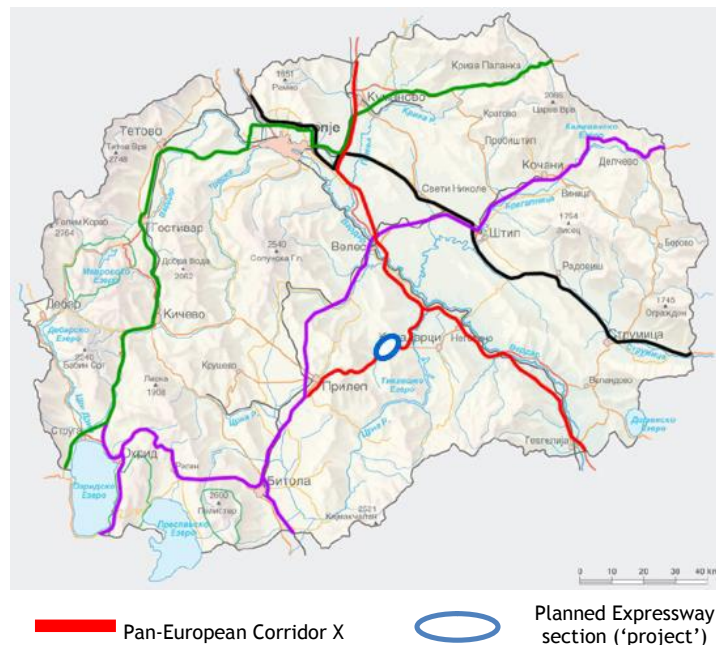


Figure 1. Location of Project on Pan-European Corridor X (E-75) (source: PROSTOR DOO, 2014).

The European Bank for Reconstruction and Development (EBRD) is considering providing a sovereign loan to the Republic of Macedonia Public Enterprise for State Roads (PESR) for the construction of a number of roads in Macedonia. These include the proposed project, which is being considered as a Category 'A' Project in accordance with the EBRD's Environmental and Social Policy (ESP) of 2008. The EBRD's requirements are that all elements of the project will meet national environmental, social, health and safety laws and regulations, and with relevant EU environmental and social standards, as well as the EBRD's Environmental and Social Policy (ESP) and Performance Requirements (PRs) of 2008.

## Justification for a Critical Habitat Assessment

An Environmental Impact Assessment (EIA) has been prepared under the Macedonian Law of Environment. EBRD has conducted an appraisal of the available documentation and of the environmental and social risks of the Project. This has identified that a 3km section of the road project crosses the "Drenovo Gorge Monument of Nature" (a protected area under Macedonian law), and that some biological features which are affected by the project, including species and habitats of conservation importance, may constitute natural or critical habitat according to the criteria in PR6. These included *Carinigeradrenovoensis*, an endemic snail, and the Egyptian vulture (*Neophron percnopterus*), an endangered bird, as well as several natural habitats potentially listed under Annex I of the Habitats Directive (including dry grasslands and rocky vegetation). The EIA does not mention works in the river itself, but this is highly likely.

In order to assess whether or not these species and habitats are, in fact, at risk, and ensure their adequate protection, and meet the requirements of EBRD's ESP, a Critical Habitats Assessment



(CHA) was required. The objectives of the CHA were to identify, map and describe the natural habitats affected by the project, determine whether critical habitat is present according to the criteria in PR6, describe the potential effects arising from the construction and operation of the proposed road scheme, and develop a mitigation strategy based on appropriate use of avoidance, minimisation, restoration or offsetting measures, as needed to ensure that there is no net loss or a net gain of biodiversity as appropriate.

The assessment of critical, natural and modified habitats was carried out on the basis of critical habitat definitions and criteria, following international best practice, and the ‘spirit’ of the EU Habitat and Bird directives, as required by PR6 (for EBRD projects located in non-EU countries). To this end, BIOTOPE provided a team of international biodiversity experts for this CHA, which was supported by local Macedonian experts on flora and molluscs and other invertebrates.

## II. Study area, habitats and species

See annex 2

### Study area

The study area is a ca. 1 km wide strip on a total length of 15 km from Raec river bridge in the west to a last unit of grasslands beyond “Drenovo interchange”, centred on the axis of the selected alternative 1, covering 1557 ha.

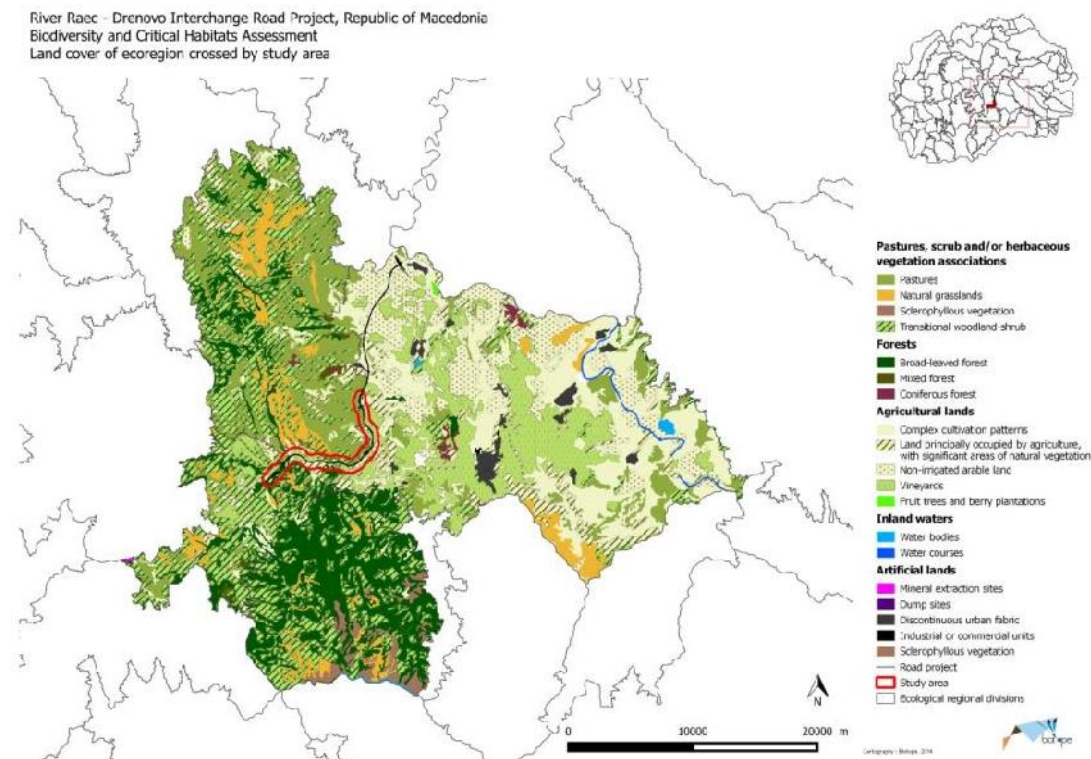


Figure 2. Map of the wider ecological landscape and its habitat types, with the study area highlighted in red.



The maps, and field surveys, also cover the axis of alternative 2 as described in the EIA. Mapping on a ca. 2km wide strip centred on the axis of the proposed route was also undertaken, on the basis of field data and Corine land-cover maps<sup>2</sup>. Data on vegetation and habitat types in the broader landscape were based on Corine land-cover data. More details can be found in Annex 1.

## Approach and methodology for data collection

*See annex 1*

Habitat characterization and mapping was undertaken through compilation of existing data (including Corine Land Cover maps) and field surveys, which were carried out in June and July 2014.

Habitats were mapped on the basis of homogeneous units of vegetation, identified through recurring associations of plant species (phytosociology). Each habitat present in the study area has been coded according to EUNIS (European Nature Information System) habitat types<sup>3</sup>, Palearctic habitats classification<sup>4</sup>, Annex I of the EU Habitats Directive and its natural habitat types of community, and the Convention on the conservation of European wildlife and natural habitats of 1996.

Specific field surveys were carried out, to provide detailed information on:

- Dry grasslands, across the study area, to identify them in relation to the EU Annexes to the Habitats Directive
- Chasmophytic vegetation in Drenovo gorge, to identify them in relation to the Annexes to the EU Habitats Directive
- Distribution and abundance of the endemic snail (*Carinigeradrenovoensis*), in and around Drenovo Gorge

Data on the Egyptian vulture (*Neophron percnopterus*) was provided by an independent survey, for the purpose of this CHA (VELEVSKI, 2014), and referenced herein. Data from the EIA and published literature was also used in the assessment. Detailed information on methods and survey results can be found in Annex 1.

## The project in context

The proposed road is located along the Raec river valley, in the Middle Vardar Valley ecological region (as defined by MELOVSKI et al. 2013). The Raec river is a tributary to the Crna river in the wider Vardar river catchment. The region is dominated by limestone and other carbonate bedrocks and is characterized by a mild continental climate with a strong Mediterranean influence originated from the Vardar river valley. The proposed road is at a biogeographical crossroads: it is set within the 'Continental' biogeographical area, but only 50 km north of the 'Mediterranean' area, and less than 10km east of the 'Alpine' area.

The ecological richness of Raec river valley has already been identified in different international nature conservation programs. Specifically, the study area is included in:

- The northern part of the Important Plant Area (IPA): 'Tikveš Lake and Raec gorge';
- The Important Bird Area (IBA) MK021 'Gradsko - Rosoman - Negotino' in its extreme southwestern part and mainly in IBA MK023 'Raec river Valley' in a large western part including Drenovo gorge and Raec valley in the study area;
- The Key Biodiversity Areas (KBA)<sup>5</sup> 'Central Vardar' (same as IBA MK021 for this CHA) and 'Lake Tikvesh-Raec' (same as IPA 'Tikveš Lake and Raec gorge' and IBA MK023 for this CHA).

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<sup>2</sup>inventory of land cover in 44 classes at a scale of 1:100 000; European Environmental Agency, last update 2006 (see details of sources in Annex 1).

<sup>3</sup>European Environment Agency, 2012

<sup>4</sup>DEVILLERS *et al.*, 1999-2001

<sup>5</sup>Following MELOVSKI, 2012.



Key Biodiversity Areas are generally treated as critical habitat. It is therefore important to ensure that their main designated features remain viable and that site integrity is maintained, as per the EU requirements of the Habitats Directive. Specifically, the species for which IBA MK023 has been designated include the Black stork (*Ciconianigra*), Lesser Kestrel (*Falco naumanni*), Long-legged Buzzard (*Buteorufinus*), Black-headed Bunting (*Emberizamelanocephala*), and the Egyptian vulture (*Neophronpercnopterus*). The vulture, the buzzard and the stork are breeding in Drenovo Gorge.

The project intersects the following officially designated sites:

- The northern part of the proposal of Area of Special Conservation Interest (ASCI) MK0000028 'Raechkalisura' ('Raec'), as part of the Emerald Network for which implementation is led by the Council of Europe under the Bern Convention;
- Inside the study area, the road project passes through, for ca 1.5 km, a protected natural heritage: 'Gorge Drenovska' (Drenovo gorge), Monument of Nature under Macedonian Law on Natural Rarities.

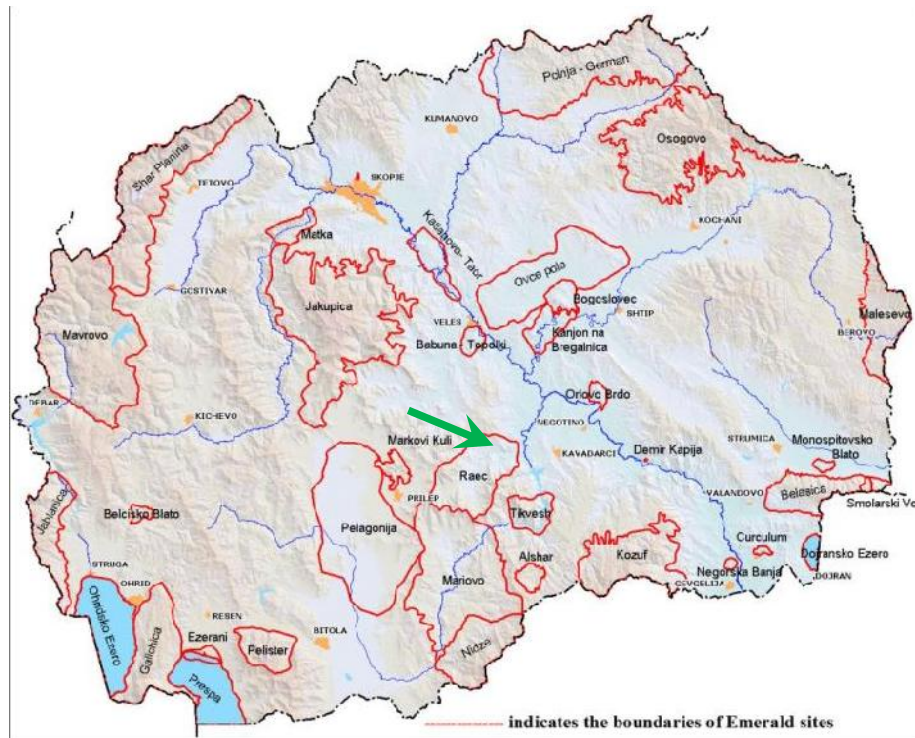


Figure 3. Emerald network in Macedonia. Project study area intersects 'Raec' site in southern central part of this map (green arrow). Source: The European environment - state and outlook 2010.

Located in the centre of the study area, Drenovo Gorge is a natural amphitheatre about 1.5 km long formed by the Raec river. Its ecological significance lies in 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, and in the diverse micro-climate conditions created by the diverse aspects of the cliffs and slopes, and of course by the river that crosses the gorge from west to east.

**Main findings:** Although the Raec river valley and Drenovo gorge, where the road is planned, are a mosaic of natural and modified habitats, with existing infrastructure and human settlements, and therefore not pristine wilderness areas, they have been identified at national and international levels as a biodiversity-rich area, including key biodiversity areas. The Drenovo gorge itself is designated as a national Monument of Nature in Macedonia.



## Vegetation and associated flora

See annexes 3, 4 and 5

☞ The mapping of habitats was carried out on a ca. 1 km wide strip centred on the axis of the project (alternative 1), on a total length of 15 km from Raec river bridge in the west to a last unit of grasslands beyond “Drenovo interchange”. It covers 1557 ha.

28 elementary types of vegetation have been identified on the study area during field surveys:

- 16 natural habitat types (7 habitats were already clearly identified in EIA), including 10 habitats of Community interest listed in Annex I of the EU Habitat Directive and 7 habitats of pan-European interest under the Council of Europe’s Resolution No. 4;
- 12 modified (mainly agricultural) habitat types.

This proportion is similar to that of the wider landscape, as documented in a strip ca. 2 km wide centred on the axis of the proposed road (using field data and Corine Land Cover data) and in the wider region (on the basis of CLC data). Natural habitats listed in Annex I of the EU Habitats Directive, in particular, are widespread in the wider landscape and ecoregion. Details of these results can be found in Annexes 3, 4 and 5.



Figure 1. Grasslands in the centre of the study area. © BIOTOPE, June 2014

Field surveys carried out for this CHA have generated new information, not found in the EIA:

See annex 3 & 4

- Analysis of the floristic (phytosociological) composition of local grasslands has shown that these are calcareous steppe-like grasslands (habitat of Community interest 6210, listed in annex I of the EU Habitat Directive but not a priority habitat in this case as it is not an important site for orchids<sup>6</sup>) and not pseudo-steppe vegetation as identified in the EIA (which

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<sup>6</sup>According to EU guidance, important orchid sites are sites that are important on the basis of one or more of the following three criteria: (a) the site hosts a rich suite of orchid species; (b) the site hosts an important population of at least one

would be a priority habitat in this case: 6220\*). These grasslands all have a long history of cultivation and/or pastoral use (grazing & cutting of hay), but this does not lower their conservation value. In fact, the agricultural systems that produce and maintain such grasslands are rapidly disappearing, taking the grasslands and their specific communities of species with them.

- Shrublands in the study area are considered as progressive stages of natural reforestation of those dry grasslands (following abandonment of cultivation, mowing or grazing or decreases in the intensity or frequency thereof) and not as a degraded form of natural forests;
- Many tributaries of the Raec river, mainly temporary, flow down from the hills in the eastern part of the study area. These small valleys, in addition to some dry ravines ('dols'), often covered in dense shrubby vegetation, create natural corridors from the plateau to the Raec floodplain.
- Non-riparian natural forests are all considered as Oriental Hornbeam woods. On the basis of field surveys carried out for the purposes of this CHA, the habitat 'Moesian white oak woods'<sup>7</sup>, which is listed in annex I of the EU Habitat Directive as a priority habitat, and identified in the EIA, is unlikely to be present in the study area: although some *Quercus pubescens* and *Q. virgiliana* trees may be found, no large stands really dominated by these oaks have been detected.
- Rocky habitats in the study area appear to be only found on vertical north-facing cliffs in the Drenovo gorge. Nevertheless, as this habitat is distributed in very small, widely distributed patches, and often mixed with (rocky) grasslands, all open habitats in rocky areas of the Drenovo gorge were mapped as rocky habitats.
- A petrifying spring is found in the north-western entrance of Drenovo gorge, with different original plant communities, and listed as a priority habitat (7220\*) in annex I of the EU Habitat directive, and of pan-European interest;



Figure 2. Left: petrifying spring at the western entrance of Drenovo gorge. Right: catchment of petrifying spring clearly

orchid species considered not very common on the national territory (c) the site hosts one or several orchid species considered to be rare, very rare or exceptional on the national territory.

<sup>7</sup>Described in EUIS as "thermophilous, sub-Mediterranean *Quercus pubescens* and *Quercus virgiliana* woods of the southern Dinarides, the Balkan Range, and neighbouring regions".





**Main findings:** Grasslands (and associated mosaic habitats such as shrublands and garrigues) cover 34% of the study area (530 ha). They are not pseudo-steppe vegetation but calcareous steppe-like grasslands, a non-priority habitat of community interest (6210) listed in Annex I of the EU Habitats Directive. A petrifying spring has been found at the Western entrance to Drenovo gorge. It is listed as a priority habitat (7220\*) in Annex I of the Habitats Directive.

In addition to the habitats described above, 25 plant species of conservation significance have been found during vegetation surveys in grasslands and rocky habitats on the study area. These include *Alyssum doerfleri*, *Helianthemum marmoreum* and *Verbascum herzogii*, which are endemic to Macedonia. No plants listed in Annex II or IV of the Habitats Directive have been found in the study area.

Two invasive plant species are present: Locust tree (*Robinia pseudacacia*), mainly in the riparian forest, and Tree-of-heaven (*Ailanthus altissima*), at the bottom of cliffs in Drenovo gorge.

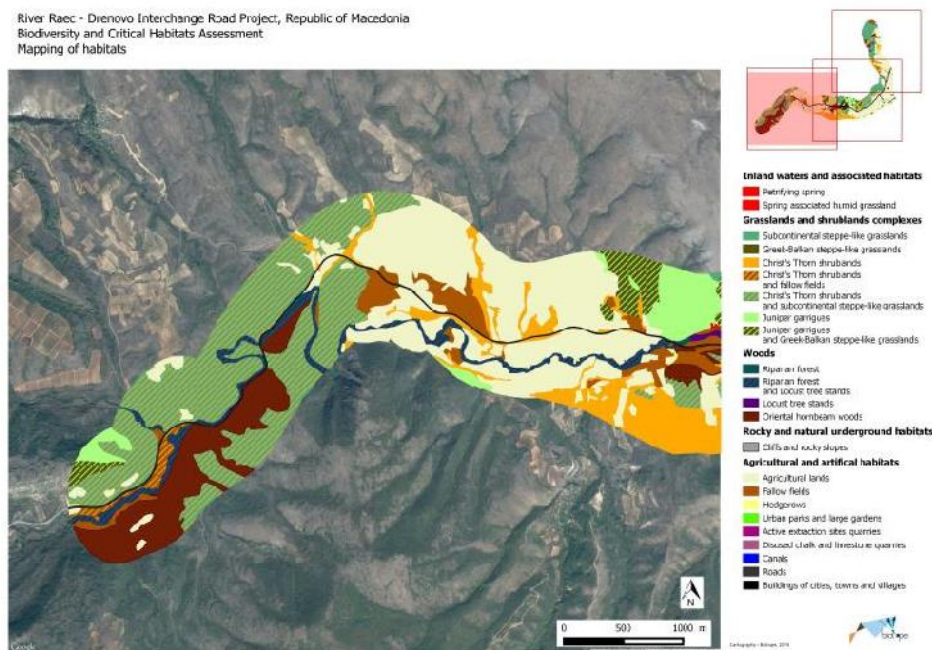
Non-urban and non-agricultural habitats surveyed in the study area are composed of viable assemblages of plant and animal species of native origin. For the most part, human activity has not modified these areas and/or their primary ecological functions and species composition.

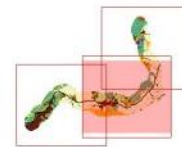
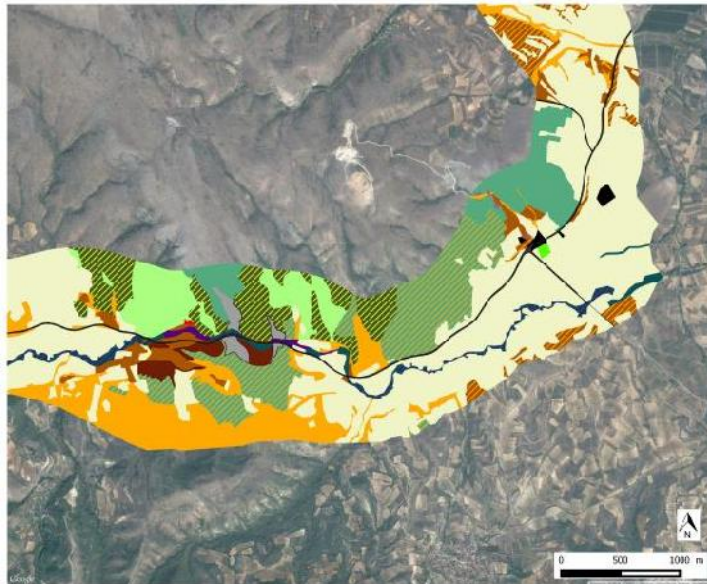
**Conclusions:** Over half the study area is composed of natural habitats (875 ha; 56% of total area), while modified (agricultural) habitats cover the remainder (646 ha; 42%). Villages, and an existing road, already fragment the landscape.

This proportion is similar to that of the wider ecoregion (see Annex 4).

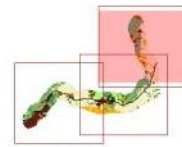
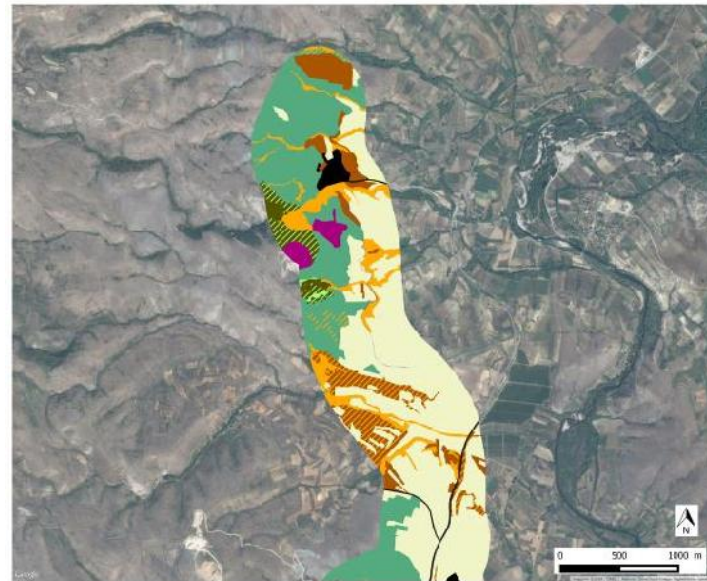
The maps below show the location of natural and modified habitats in the study area, a ca. 1km wide strip centred on the proposed road. Higher resolution maps are available in the Annexes.

River Raec - Drenovo Interchange Road Project, Republic of Macedonia  
Biodiversity and Critical Habitats Assessment  
Mapping of habitats





- Inland waters and associated habitats**
- Petrifying spring
- Spring associated humid grassland
- Grasslands and shrublands complexes**
- Subcontinental steppe-like grasslands
- Greek-Balkan steppe-like grasslands
- Christ's Thorn shrublands
- Christ's Thorn shrublands and fallow fields
- Christ's Thorn shrublands and subcontinental steppe-like grasslands
- Juniper garigues
- Juniper garigues and Greek-Balkan steppe-like grasslands
- Woods**
- Riparian forest
- Riparian forest and locust tree stands
- Locust tree stands
- Oriental hornbeam woods
- Rocky and natural underground habitats**
- Cliffs and rocky slopes
- Agricultural and artificial habitats**
- Agricultural lands
- Fallow fields
- Hedgerows
- Urban parks and large gardens
- Active extraction sites quarries
- Disused chalk and limestone quarries
- Canals
- Roads
- Buildings of cities, towns and villages



- Inland waters and associated habitats**
- Petrifying spring
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- Christ's Thorn shrublands and subcontinental steppe-like grasslands
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- Juniper garigues and Greek-Balkan steppe-like grasslands
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- Locust tree stands
- Oriental hornbeam woods
- Rocky and natural underground habitats**
- Cliffs and rocky slopes
- Agricultural and artificial habitats**
- Agricultural lands
- Fallow fields
- Hedgerows
- Urban parks and large gardens
- Active extraction sites quarries
- Disused chalk and limestone quarries
- Canals
- Roads
- Buildings of cities, towns and villages

## Fauna

See annex 6

Overall, at least 49 animal species with unfavourable conservation status have been observed or documented in the study area: 7 invertebrates, 1 fish, 4 reptiles, 30 birds and 7 mammals. These species include 15 bird species observed in the study area that are listed in annex I of the EU Bird Directive (most of them are breeding -including the Black Stork, *Ciconianigra*, in Drenovo gorge), as well as 17 other animal species that are breeding and/or foraging in the study area that are listed in annex II of EU Habitat Directive as species of community interest 'whose conservation requires the designation of special areas of conservation'. These include 3 invertebrates, 1 amphibian, 4 reptiles and 9 mammals (including the wolf, *Canis lupus*, the otter, *Lutralutra*, marbled polecat, *Vormelaperegusna*, and several bat species). 33 animal species, including most of the former, are



listed in annex IV of the EU Habitats Directive as species of community interest ‘in need of strict protection’.

The Raec river, in and upstream of the gorge, could be suitable habitat for the Pelagonia trout (*Salmo pelagonicus*), which is considered vulnerable (VU) in Europe and is endemic to the lower Vardar - Crna river system. *Grossuanaserbicascupica*, a subspecies of freshwater snail endemic to Macedonia, has been observed in the springs near the Eastern exit of Drenovo Gorge.

A cave within the south-facing cliff of Drenovo gorge is used by more than 1000 individuals of bats of different species as a roost during both breeding and wintering seasons (on the basis of observations by E. STOJKOSKA). These include Blasius’s Horseshoe Bat (*Rhinolophus blasii*), the Greater Horseshoe Bat (*Rhinolophus ferrumequinum*), the Mediterranean Horseshoe Bat (*Rhinolophus euryale*), Lesser Horseshoe Bat (*Rhinolophus hipposideros*) and Schreiber’s bat (*Miniopterus schreibersii*). None of these species is classified as globally endangered (EN) or critically endangered (CR) but most are vulnerable (VU) in Europe and five of these are listed in Annex II of the EU Habitats Directive. Although their movements have not been documented, it is likely that they feed in the Raec river valley and in particular along the river and riparian forest edges. This is particularly true of the four *Rhinolophus* species. The greater mouse-eared bat (*Myotis myotis*) also uses the river, as evidenced by rest perches under the bridges of the existing road.

**Main findings:** a cave in Drenovo gorge has been found to host a large colony of at least 5 bat species listed in Annex II of the EU Habitats Directive.

The animal species of conservation concern include a globally endangered bird, the Egyptian vulture (*Neophron percnopterus*) and an endemic snail (*Carinigeradrenovoensis*), for which more details are provided below.

#### Single site endemic snail *Carinigeradrenovoensis*

To our knowledge, *Carinigeradrenovoensis* was first described 1961 and had not been studied since, prior to this CHA. It is still only known from its type locality (where it was first described): “the cliffs bordering the Raec River, near the village of Drenovo in Macedonia” (BRANDT 1961). During this survey, this is also where the species was found. Its local area of distribution is limited to the limestone outcrops. The species is not found on places where geology changes to shale / schist or altered orange soils. The total known area of distribution of the species covers ca. 120 ha. This snail is most abundant on the cliffs (especially north-facing). It has also been found on the plateau above the gorge, under the rocks on small outcrops.



Figure 3. Endemic snail of Drenovo gorge *Carinigeradrenovoensis*. Live specimen (total length: ca. 15 mm) in rocky habitats facing south © BIOTOPE, June 2014

The small size of individual specimens, the cryptic behaviour of the species, and the irregular distribution of its micro-habitats, means that only indicative density-values can be given:

- High densities (ca. 5 live specimens and 20 shells per m<sup>2</sup>) on north-facing cliffs and rocky habitats;
- Medium densities (ca. 2 live specimens and 5 shells per m<sup>2</sup>) at the bottom of the cliffs and on south-facing scree slopes;
- Low densities (no live specimens observed, and 2 shells per m<sup>2</sup>) on rocky outcrops on the summits of the cliffs (north and south) and the northern plateau.

In every case, densities are higher in cooler micro-habitats, particularly in deep thin crevices within the rocks. The dispersal capacity of the snail is unknown, but probably very limited. The existing road, the river and unfavourable (non-rocky) habitats, which cut across the snail's known distribution, probably act as barriers to the species, limiting gene flow.

With the exception of a narrow ravine supporting a small temporary stream, no living individuals or even dead shells have been observed in the direct vicinity of the existing road (southern limit of the road in the gorge). The species is also absent from the south-facing slopes of the southern part of the gorge probably because conditions are too hot and dry, and due to lack of rocks with deep thin crevices.

☞ **Main findings:** Limestone outcrops in cliffs inside Drenovo gorge (Drenovska Klisura) and on the plateau above the gorge are the only known habitat of the restricted range, endemic, snail *Carinigera drenovoensis*. The survey carried out for this Critical Habitat Assessment has described in more detail the strong relationship between the density of this little known mollusc and geological and micro-climatic parameters, and has updated its distribution, now estimated at ca. 120 ha.

#### Egyptian Vulture (*Neophron percnopterus*)

The Egyptian vulture is the smallest European vulture, and is classified as globally Endangered (EN) species. In Europe, the species is migratory, wintering south of the Sahara. Birds leave Europe in late August and September, and return between February and March, to breed.



Figure 4. Egyptian Vulture, adult © BIOTOPE

The Egyptian vulture nests in cliffs, especially where sheltered caves or holes command wide views. The species is highly philopatric: it returns to the same territory year after year. The presence of conspecifics plays an important role in selecting nesting sites: new pairs are more likely to settle in areas close to where other pairs from the same species are present.

The Egyptian vulture is faithful and remains bound its entire life to the same partner. The pair is already formed at arrival from migration. The nest, built by both sexes, consists in a light to bulky pile of branches (150 cm diameter, 20-70 cm high) covered with thick layer of rubbish. Usually solitary and often well dispersed, nests are reused in successive years.




The age of first breeding is probably 4-5 years. Eggs are laid during the second half of April (approximately). Incubation, by both sexes, starts with the first egg and lasts 42 days. Clutch size is often 2 eggs. The young are cared for and fed by both parents in the nest. At the end of the 70-90 day fledging period, parents continue to feed the young for about 35 days and stop just before the post-nuptial migration to Africa.

The Egyptian vulture forages on open terrains in the surrounding countryside: grasslands, steppes, savannas, edge of the marshes and even waste deposits (land-fills), roadsides or the edge of cities. The foraging area of pairs often covers less than 12 km<sup>2</sup>. It feeds mainly on dead animals and organic waste, but it is not exclusively a scavenger. It complements its diet with insects, small reptiles, frogs, young birds, eggs and ripe fruit.

Based, in particular, on the presence of at least 5 pairs of Egyptian Vultures in the region from Drenovo Gorge to (approximately) peak Kozjak, over the 2003-2008 period, the Raec river valley has been identified as an Important Bird Area of Global importance (IBA code MK023). However, the population decreased to only two pairs in 2011. The reasons for such a strong decline are unknown but the wilful poisoning of stray dogs (by local people), on which the vulture subsequently feeds, has been suggested as a key factor. Over the long term, and in comparison to other areas in Macedonia, the entire region of the Klepa Mountain and the Raec river valley has shown one of the most stable trends for the Egyptian Vulture nesting in Macedonia.

The independent survey carried out by VELEVSKI (2014) confirmed the presence of one breeding pair of Egyptian Vultures in Drenovo Gorge. Results of this survey suggest that this territory 'Drenovo 1' has one of the safest nesting sites known in Macedonia (chamber within a cave). It belongs to a range of three known territories. The other two have been recently abandoned. *Note: in order to reduce the risk of disturbance and persecution of this species, no precise map or location data will be provided in this public report, or its annexes.*


 **Main findings:** The Egyptian Vulture (*Neophron percnopterus*) is classified as globally Endangered (EN). The species has experienced a dramatic recent decline in Macedonia, from a minimum of 137 to only 21 pairs in three decades. The Raec river valley is one of the strongholds of the species in SW Europe and has been identified as an important bird area of global importance (IBA code MK023).

# III. Critical Habitat Assessment

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See annexes 4, 5, 6 & 7

The Raec river valley and Drenovo gorge, where the new road is planned (over an existing road), have been identified at national and international levels as a biodiversity-rich area. The Drenovo gorge itself is designated as a national Monument of Nature in Macedonia. Field surveys in the study area have identified and mapped large areas of natural habitats, some of which are of European interest and listed in Annex I of the EU Habitats Directive. Data compiled for the EIA and this CHA, including field surveys, shows that numerous (25) plant and (49) animal species of conservation significance (including 32 of European community interest<sup>8</sup>) are present in the study area. Details can be found in Annexes 4, 5, 6 and 7.

 **Conclusions:** This CHA confirms the biodiversity richness of the Raec river valley, mainly in Drenovo gorge and its close surroundings. The area is clearly eligible for designation under international protected area networks such as the Emerald (Bern Convention) or Natura 2000 (EU) networks.

In this context, natural habitats were assessed to determine if they could be considered critical for either the habitat type itself or particular species of plants or animals. Specific attention was given to the endemic snail, *Carinigeradrenovoensis*, and the Egyptian vulture.


## Assessment of Natural Habitats

See annex 4

Natural habitats listed in Annex I of the EU Habitats Directive and found in the study area include the river itself (3260), its riparian forest (92A0), the petrifying spring and associated aquatic vegetation (7220\* & 3140), humid grasslands (6410), dry grasslands (6210) and cliffs and rocky slopes (8210), including caves (8310).

Habitats are listed in Annex I of the EU Habitats Directive on the basis of (i) the level of threat they face (danger of disappearance in their natural range), or (ii) their small range (intrinsically restricted or following regression, or (iii) because they present outstanding examples of typical characteristics of one or more of the biogeographical regions identified in the Directive<sup>9</sup>. Habitats that are in danger of disappearance, and for which a particular responsibility for their conservation lies in the EU, are considered priority habitats and indicated by an asterisk (\*) in Annex I.

Of the natural habitats listed in Annex I and present in the study area, only the petrifying spring is considered a priority habitat (7220\*). On this basis, it has been considered a critical habitat.

 **Conclusions:** The petrifying spring found at the Western entrance of Drenovo gorge is a critical habitat.

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<sup>8</sup>Animal species listed in Annex I of the Birds Directive and Annex II of the Habitats Directive, which require the designation of 'special protection areas' (SPA) and 'special areas of conservation' (SAC), respectively. In the European Union, SPAs and SACs form the 'Natura 2000 network', where projects have to follow a two-step appropriate assessment (under articles 6[3] and 6[4] of the Habitats Directive) to be permitted.

<sup>9</sup>EU Biogeographical regions: Alpine, Atlantic, Black Sea, Boreal, Continental, Macaronesian, Mediterranean, Pannonian and Steppic.

*Grossuanaserbicascupica*, a subspecies of freshwater snail endemic to Macedonia, was observed in one of the springs at the Eastern entrance to Drenovo Gorge. The taxonomy of the species remains uncertain, and this anecdotal evidence was insufficient to consider the springs as critical habitat for this species.

The cliffs and rocky slopes found in the study area are not considered priority habitats in the EU Habitats Directive. In the study area, however, they do harbour several species of conservation significance, including the single-site endemic snail *Carinigeradrenovoensis* (see below), and plant species endemic to Macedonia and the Balkans which form widespread but dispersed chasmophytic (rock-dwelling) plant communities. None of these species have been assessed by IUCN, nor is their conservation status considered unfavourable. These chasmophytic communities are rare in the wider landscape, and in the ecoregion. On this basis, we considered cliffs and rocky slopes as critical habitats. In addition, the singular character of Drenovo Gorge has been recognized through its designation as a Natural Monument under Macedonian law.

☞ **Conclusions:** The cliffs and rocky slopes of Drenovo Gorge are a critical habitat harbouring chasmophytic (rock-dwelling) plant communities of conservation significance and rare invertebrates, including *Carinigeradrenovoensis*.



Figure 5. Chasmophytic vegetation in Drenovo gorge, with *Ramondanathaliae* (dark green leaves) and *Achillea aegeratifolia* (white leaves) © BIOTOPE, July 2014

The other natural habitats found in the study area are considered to be widespread and not in danger of disappearance in the broader ecoregion (but their structure and function are threatened from changes in management). Grasslands, in particular, are widespread in the study area and cover 20% (21 058 ha) of the middle Vardar valley ecoregion (MELOVSKI et al. 2013). On this basis, dry grasslands in the study area are not considered critical natural habitats.

☞ **Conclusions:** Dry grasslands found in the study area, and identified as subcontinental steppe-like grasslands and greek-balkan steppe-like grasslands (habitat type 6210 in Annex I of the EU Habitats Directive), are not considered critical.

The Raec river is currently in good condition, and could provide, in and upstream of Drenovo gorge, suitable habitat for the Pelagonia trout (*Salmo pelagonicus*), a vulnerable (VU) species with a restricted range (<20 000 Km<sup>2</sup>) that is threatened by the introduction of alien trout species. There is no confirmed presence of the species in the study area, or up- and down-stream of the study area,

but the species is present in the Crna river basin (to which the Raec river is a tributary). There is not sufficient evidence to conclude that the river is a critical habitat for this species.

👉 **Conclusions:** the Raec river, in the study area, is not a critical habitat.

Riparian forests in the study area are degraded by stands of *Robiniapseudoacacia* (covering over 45 ha within a ca. 1 km strip centred on the axis of the proposed road). On this basis, they were not considered as critical habitat. They are not, however, modified to the extent that they could be considered modified habitat.

👉 **Conclusions:** the riparian forests, along the Raec river, in the study area, are degraded and not a critical habitat.

Agricultural areas and villages, although considered as modified habitat, nevertheless harbour some species of concern. These include 4 nesting bird species with unfavourable conservation status in Europe (one of which is listed in Annex I of the EU Birds Directive) and 2 bat species listed under Annex IV of the EU Habitats Directive. These modified habitats were not considered critical for these species.

### Assessment of *Carinigeradrenovoensis* habitat

Field investigations carried out in the framework of this CHA have found that the global distribution of this endemic species includes the Drenovo gorge to its southern summit and a large central part of the northern rocky plateau. Based on our present understanding of the species, the gorge could sustain the entire population of this restricted range species. For this reason, the rocky habitat associated with *Carinigeradrenovoensis* considered to be critical habitat.

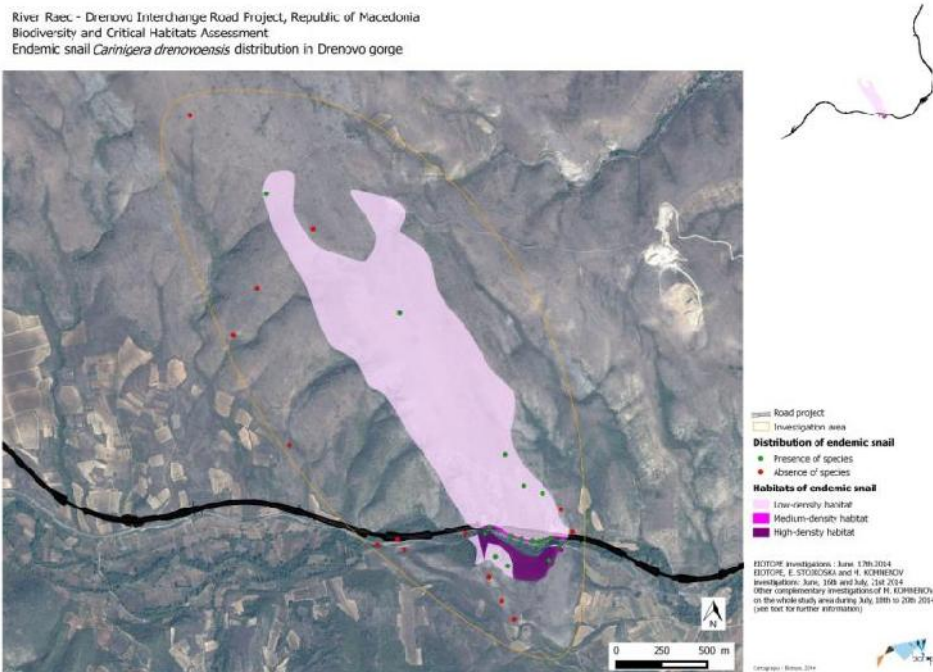


Figure 6. Critical habitat for the restricted range and single site endemic snail *Carinigeradrenovoensis*



☞ **Conclusions:** The rocky habitats in Drenovo gorge and its northern plateau are a critical habitat for the restricted range and single-site endemic snail *Carinigera drenovoensis*.

### Assessment of Egyptian Vulture (*Neophronpercnopterus*) habitat

Because the Egyptian vulture is highly philopatric and has strong conspecific relationships in recruitment patterns, the occupied 'Drenovo 1' territory and the two other recently abandoned territories must be considered significant from a conservation standpoint. If habitat quality remains unaltered, these territories should be among the first reoccupied by the species during a process of population recovery.

Data shows that the current pair nesting in the gorge has a home-range that extends from the Farish Gorge (about 5 km west) to the Kavadarci dumping site (about 10 km east) along the Raec river valley, covering ca. 8300 ha.

A large western part of the study area, including Drenovo gorge, is included in the Important Bird Area MKO23 'Raec river Valley'. The identification of this IBA was based in particular on the presence (in 2008) of at least five pairs of Egyptian Vultures in the area. This IBA can be considered as a management unit for this local population of the species. It contains nationally/regionally important concentrations of the species, and as found in this CHA, it could play an important role in the recovery of the species.

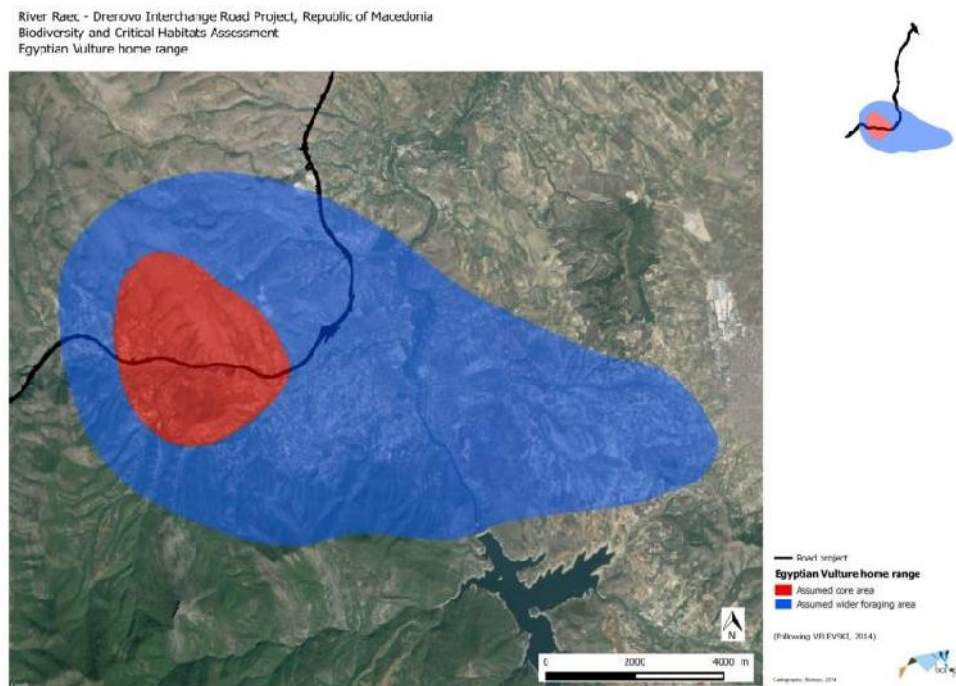


Figure 7. Critical habitat for the globally endangered Egyptian vulture (*Neophronpercnopterus*).

The results of the dedicated survey carried out in the framework of this CHA indicate that the study area is included in the wider home range of the Egyptian Vulture breeding pair of Drenovo gorge. The Drenovo gorge is the centre of its core home range. Although the whole IBA could be considered as critical habitat for the species, this CHA highlights the fact that there is a known and occupied nesting site in the immediate vicinity of the selected alternative. The core area, around the nesting cliff, is indicated in the maps.

☞ **Conclusions:** The large western part of the study area which is included in the recognized Important Bird Area MK023 and is considered as critical habitat for the Egyptian Vulture, a globally endangered species (EN) which is experiencing rapid decline throughout its range. The pair breeding in Drenovo Gorge is of particular concern and its core range is highlighted in the maps of critical habitat.

## IV. Critical habitats

The synthesis table below provides information about the natural habitats found in the study area and those that are considered critical.

Table interpretation: EUHDA1: EU Habitat Directive annex 1; EUHDA2: EU Habitat Directive annex 2; EUHDA4: EU Habitat Directive annex 4; EUBDA1: EU Bird Directive annex 1.

Table 1. Synthesis of Critical Habitat Assessment Results		
<i>Habitat</i>		<i>Justification of critical or non-critical habitat designation</i>
<b>Inland waters and associated habitats</b>		
River	NATURAL HABITAT	1 habitat of Pan-European interest in an average condition Unconfirmed presence of the vulnerable (VU) and restricted range Pelagonia trout ( <i>Salmo pelagicus</i> ) European otter, near threatened (NT) in Europe and the Mediterranean Basin, EUHDA2, EUHDA4
Riparian forest	NATURAL HABITAT	1 habitat of pan-European interest in degraded condition European otter, near threatened (NT) in Europe and the Mediterranean Basin, EUHDA2, EUHDA4
Temporary streams	NATURAL HABITAT	2 butterflies near threatened (NT) in Europe 1 butterfly EUHDA2&EUHDA4, and 1 butterfly EUHDA4 1 amphibian EUHDA2& EUHDA4, and 4 amphibians EUHDA4
Petrifying spring (including aquatic vegetation and humid grasslands associated with the spring)	CRITICAL HABITAT	Rare and original habitat type, in good condition, listed as priority habitat 7220* under EUHDA1 4 habitats of pan-European interest 1 fern species rare in Macedonia 1 reptile rare in Macedonia, EUHDA2, EUHDA4
Other springs (x2)	NATURAL HABITAT	1 fern species rare in Macedonia 1 Macedonian endemic aquatic mollusc sub-species <i>Grossuana serbica scupica</i>



**Table 1. Synthesis of CriticalHabitat Assessment Results**

<b>Habitat</b>		<b>Justification of critical or non-critical habitat designation</b>
<b>Grasslands and shrubland mosaics</b>		
Subcontinental steppe-like grassland Greek-Balkan steppe-like grasslands	NATURAL HABITATS	1 habitat of pan-European interest (grasslands), listed in Annex I of the HD, but widespread in Macedonia. 8 plant species of biogeographical significance <sup>10</sup> 3 reptile species near threatened (NT) or vulnerable (VU) in Europe / Mediterranean Basin Unconfirmed presence of Marbled polecat( <i>Vormelaperegusna</i> ), a vulnerable (VU)mammal in Europe and Mediterranean Basin 12 nesting bird species with unfavourable conservation status in Europe, and foraging habitat for 13 other bird species with unfavourable conservation status in Europe
Christ's Thorn shrublands Juniper garrigues (spontaneous colonization of grasslands)		3 reptiles EUHDA2, EUHDA4 8 reptiles EUHDA4 2 mammals EUHDA2, EUHDA4 5 nesting birds EUBDA1, and 9 other bird species EUBDA1 (foraging habitat)

<sup>10</sup>regional and national endemics, species at edge of their distribution, including Mediterranean rarities and steppe specialists.



**Table 1. Synthesis of CriticalHabitat Assessment Results**

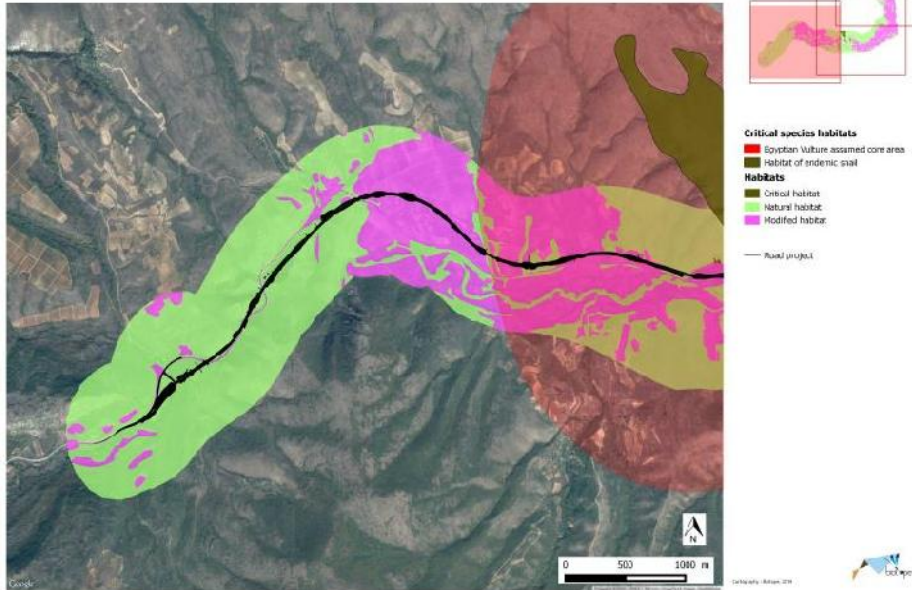
<b>Habitat</b>		<b>Justification of critical or non-critical habitat designation</b>
<b>Woodland</b>		
Oriental hornbeam woods	NATURAL HABITAT	8 nesting birds with unfavourable conservation status in Europe 1 insect EUHDA2 & EUHDA4, & 1 insect EUHDA2 2 mammals EUHDA4 3 nesting birds EUBDA1
<b>Cliffs and rocky habitats (including underground habitats)</b>		
Cliffs and rocky slopes (chasmophyticvegetation)	CRITICAL HABITAT	<i>This habitat is found within critical habitats of the Egyptian vulture and endemic snail - see below</i> 2 habitats of pan-European interest in good condition, which are very rare in the eco-region 18 plant species of biogeographical significance <sup>11</sup> (including 3 Macedonian endemics <sup>12</sup> ) 4 nesting birds EUBDA1, and 3 other nesting bird species with unfavourable conservation status in Europe A cave, used as a roost by bats, is a habitat of pan-European interest in good condition. More than 1000 individuals of 6 species (EUHDA2, EUHDA4) breeding and wintering in the cave
Full known distribution of the snail <i>Carinigeradrenovoensi</i>	CRITICAL HABITAT	<i>Carinigeradrenovoensi</i> is a restricted range, single-site endemic species, whose only known population is found in rocky habitats in Drenovo gorge, including rocky grasslands on the plateau to the north of the gorge.
Important Bird Area MK023, and in particular the core foraging area and nesting site of the Egyptian vulture ( <i>Neophronpercnopterus</i> )	CRITICAL HABITAT	The Egyptian vulture is a globally endangered (EN) raptor species with rapidly declining populations in Macedonia. The IBA recently held 3 breeding pairs. The last remaining pair breeds in Drenovo gorge.

<sup>11</sup> regional and national endemics, species at edge of their distribution, including Mediterranean rarities and steppe specialists

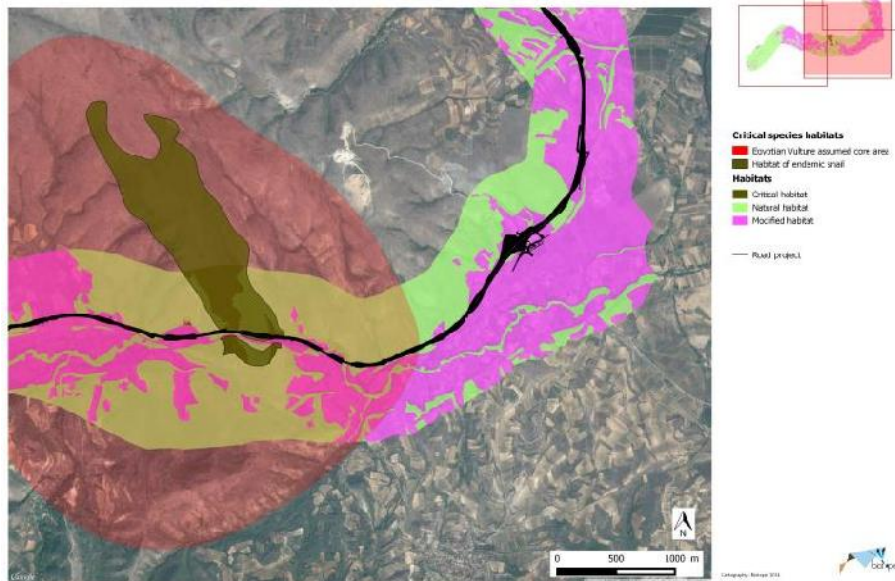
<sup>12</sup> *Alyssum doerfleri*, *Helianthemummarmoreum* and *Verbascumherzogii* - none of which have been assessed by IUCN

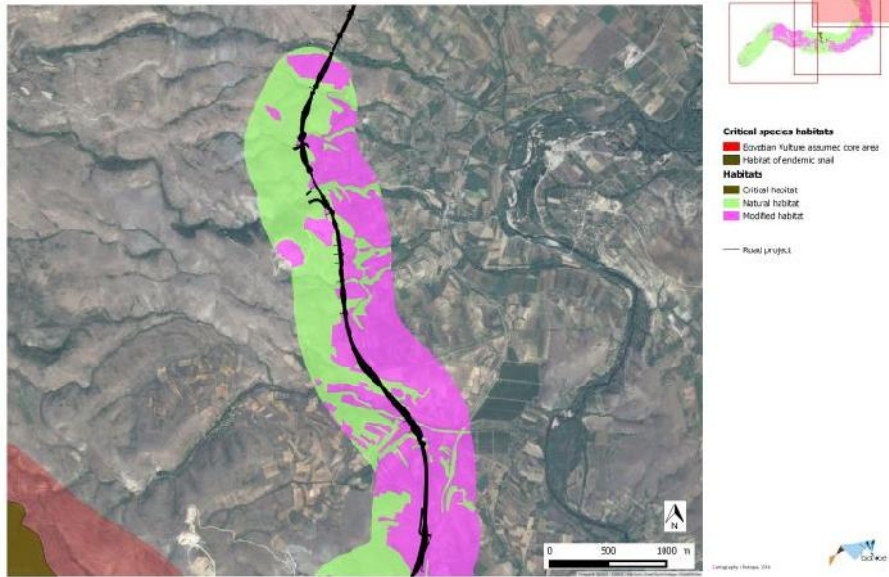
The maps below illustrate the location of critical habitat in the study area. Maps 1 and 2 are fully included in the important bird area MK023 which should be considered as critical for the Egyptian vulture. To improve the usability of the maps, only the core area around the nesting cliff has been highlighted.

River Raec - Drenovo Interchange Road Project, Republic of Macedonia  
Biodiversity and Critical Habitats Assessment  
Mapping of critical habitats and species



River Raec - Drenovo Interchange Road Project, Republic of Macedonia  
Biodiversity and Critical Habitats Assessment  
Mapping of critical habitats and species





## V. Key risks for natural and critical habitats

The proposed expressway has several foreseeable damaging effects on the natural habitats and critical habitats identified in this assessment. Some of these are limited to the construction phase, while others will continue during operations. The project's footprint is understood here to include the area used during construction of the new road as well as operations once the road has been built. Only residual impacts have been quantified, and are available in the synthesis table (next section).

### Natural Habitats

**River:** The river could be permanently affected by modifications in its profile from the building of bridges, pillars and embankments (under the project footprint), and from changes in the substrate of the river bed following deposition of sediments released during construction. Diversions of water flows during construction could affect the river temporarily, and also lead to mortality of aquatic species (including the Pelagonia trout, *Salmopelagonicus*, if it is present). Pollution during construction and from traffic on the road (waste waters, oil leaks, etc.) pose a potential risk to aquatic life in the river.

**Riparian forest:** The riparian forest could be permanently affected by the project's footprint (loss of habitat), and by changes in the river's hydrology (water-table and flooding regime) induced by the project. The forest serves as a corridor for species traveling up- and down river and bridges on the river could impair (partially) this function (fragmentation, with increased mortality from collisions), both at ground level for some terrestrial species (including small mammals) and at canopy level for flying species (bats, birds).

Temporary streams and springs: Temporary streams could be permanently affected by the project's footprint (loss of habitat), and their roles in connecting the river valley with the surrounding landscape impaired by the project (fragmentation, with increased mortality from collision). Springs could be permanently affected by the project's footprint (loss of habitat). The critical petrifying spring is dealt with below.

Grasslands and shrubland mosaics, and oriental hornbeam woods could be permanently affected by the project's footprint with loss of habitat, some of which may be temporary for grasslands if seed-banks are conserved during construction. Some of the animal species these habitats harbour could suffer increased mortality from the road's traffic, as well as habitat loss.

## Critical Habitats

Petrifying spring: The petrifying spring and associated aquatic vegetation are not included in the project's footprint so no loss of habitat is expected. It could, however, be impacted by pollution (including in its catchment area). Easy access could cause increased visitation and trampling of fragile flora and geological features.

Cliffs and rocky slopes, and the endemic snail's habitat, could be affected by the project's footprint (loss of habitat), including any works aimed at stabilizing steep slopes using exogenous materials (boulders or stones that are not sources locally, concrete / shotcrete projections, etc.) and by dust deposits from construction and air pollution during operation.

Results of surveys suggest that the river and the existing road already acts as a functional barrier to movement of the snail across the Gorge. However an intensive monitoring survey across seasons has not been carried out. The possibility that the Project might add to long-term genetic isolation of populations either side of the Gorge cannot be excluded. The cave above the river could be affected by the project's footprint and its quality as a breeding and wintering bat roost affected by disturbance (noise and vibrations from blasting, mining, excavations), and impaired access to feeding areas (fragmentation, with increased mortality from collisions) if the road is built between the cave and the river.

Egyptian vulture: The Egyptian vulture breeding site in Drenovo Gorge is currently accustomed to traffic on the existing road. The nest could, however, be abandoned if the project causes excessive disturbance (noise, vibrations, people) when birds return from migration in spring, or during incubation or rearing of chicks (leading to unsuccessful breeding attempts). The potential for the gorge to attract additional nesting pairs could also be impaired due to disturbance by the project. Mortality on the road, from the bird feeding on road-killed animals, could also affect the species.



Figure 8. Cave interior with bats in Drenovo gorge © Emilija STOJKOSKA, 2013



## VI. Mitigation Strategy and Biodiversity Management Plan

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The project will potentially result in impacts on a range of natural habitats, including a critical petrifying spring habitat and critical rocky habitats, which are critical to at least two species: *Carinigeradrenovoensis*, an endemic snail, and *Neophronpercnopterus*, a globally endangered raptor. Other natural habitats which could be affected by the project include dry grasslands, the Raec river and associated riparian corridor, dry grasslands. A large bat roost located near the river highlights the need to maintain connectivity between the river and the surrounding landscape, as well as along the river itself.

Conformity with PR6 requires that the project follows the mitigation hierarchy and that appropriate mitigation measures are put in place to ensure no net loss and preferably a net gain of biodiversity value. Moreover, given its location within critical habitat, conformity with PR6 will be conditional to there being no measurable adverse impacts or likelihood of such which could affect the status of the petrifying spring and rocky habitats, or impair the importance of the habitats critical to the survival of *Carinigeradrenovoensis* and *Neophronpercnopterus*. Taking a precautionary approach, the project must not lead to a reduction in the population of these species or a loss in area of their habitat such that the persistence of a viable and representative host ecosystem is compromised.

The focus on this mitigation strategy and biodiversity management plan (BMP) is on the natural and critical habitats identified in the scope of this CHA. The full breadth of mitigation measures required for the full extent of the upgrading of parts of state road A1 between Gradsko and Prilep is not considered in this report and BMP. The specific measures proposed in this CHA will be further addressed in a standalone BMP to be completed prior to construction.

The alternatives analysis is outside the scope of this CHA, however the local EIA concluded that the Drenovo gorge could not be avoided for technical, economical and/or safety reasons. In this context, this CHA presents mitigation measures aimed at avoiding and minimizing residual impacts on natural and critical habitats from the selected alternative, and offsetting any residual impacts that could not be avoided or reduced, so as to ensure, where appropriate, that no net loss and preferably a net gain of biodiversity values can be achieved.

The CHA only deals with measures specifically aimed at addressing impacts on natural and critical habitats within the study area. Additional mitigation measures are planned for the whole road project, and are described in the EIA, targeting wildlife and ecosystems. These include, but are not limited to the hiring of an environmental engineer during construction, implementation of pollution control measures, the visual demarcation (tape) of the construction area to ensure that limits to the project's footprint are respected by contractors, ensuring that the clearing of vegetation prior to construction is carried out in winter or autumn, i.e. outside the breeding season of most wildlife, and the management of construction materials to avoid the spread of invasive species. The numerous culverts, planned for temporary streams, may act as underpasses to enable the safe passage of some animal species. No fencing is planned, however, to ensure that animals are directed towards these safe underpasses. Specific measures for avoiding and minimizing impacts on critical and natural habitats from the proposed road project (Alternative 1) are summarized as follows.

### Mitigation measures targeting Natural Habitats

**River:** The construction & operation footprint will be minimized, in particular during construction and the associated channelling of water flow within the river-bed to allow access or construction (e.g. using coffer dams around piling works); and the riverbed will be cleaned (evacuation of waste materials and equipment) and the riverbed's level and substrate granulometry restored to its state prior to construction (as documented in photographs and measurements).

Riparian forest:The construction & operation footprint will be minimized and access to these area by personnel prohibited, with training provided to contractors and their staff (delimitations to the construction site will be made visible using e.g. tape or other means), and the continuity of riverine habitats will be re-established after construction by ensuring that the base of pillars, bridge support structures and embankments are suitable for longitudinal wildlife travel (this could mean building tiered river-banks by installing boulders - smooth cement structures are not appropriate); the conservation status of the riparian forest within Drenovo gorge will be enhanced through the removal of exotic *Robiniapseudacacia* trees and saplings (cutting and killing stumps), on both banks of the river, within the construction and operations footprint. This measure, where undertaken on the construction and operations footprint of the road is considered as mitigation. If applied outside this area, it will be considered as an offset providing additional conservation gains for this habitat.

Temporary streams, and springs:The construction and operation footprint will be minimized and access to personnel prohibited, with training provided to contractors and their staff (delimitations to the construction site will be made visible using e.g. tape or other means).

Grasslands and shrubland mosaics, and oriental hornbeam woods: The construction & operation footprint will be minimized and access to personnel prohibited, with training provided to contractors and their staff (delimitations to the construction site will be made visible using e.g. tape or other means).

## Mitigation measures targeting Critical Habitats

Petrifying spring:the spring will be avoided, and access to this area by personnel prohibited; training will be provided to contractors and their staff (delimitations to the construction site will be made visible using e.g. tape or other means). Support with the local community will be sought to keep a fence and sign in place permanently in order to raise awareness on this special habitat type.

Cliffs and rocky slopes, and the endemic snail:Footprint will be minimized by avoiding cliffs and rocky slopes by using bridge-like structures, and ensuring that the construction footprint is no larger than the operation footprint, and by prohibiting access to the area by personnel, with training provided to contractors and their staff (delimitations to the construction site will be made visible using e.g. tape or other means); this means that no excavations or quarrying will be undertaken in the rocky habitats for the purpose of construction (with sanctions put in place for non-compliance, to be included in contract design). Dust deposits will be avoided by watering construction sites in dry weather. No concrete / shotcrete projections will be used within the gorge (if needed, stabilization and rock-fall prevention can be achieved through metal nets). Any materials used for the external surface of embankments and walls must be sourced from the same geology as the gorge (but no fill-materials may be sourced from Drenovo Gorge itself) and these must include cracks and ledges that can favour subsequent colonization by chasmophytic plants. Invasive *Ailanthus altissima* trees (including saplings) will be eliminated (uprooting all individuals) from the base of the cliffs and rocky slopes when clearing vegetation prior to construction works (this measure is therefore limited to the construction and operations footprint). No planting will be undertaken on the embankments above or below the road within the gorge to ensure that chasmophytic vegetation can recolonize.

Results of surveys suggest that the river and existing road already acts as a functional barrier to movement of the snail across the Gorge. However an intensive monitoring survey across seasons has not been carried out. The possibility that the Project might add to long-term genetic isolation of populations either side of the Gorge cannot be excluded. Although, it is concluded that these populations should have sufficient suitable habitat available for them to remain viable with the road in place, this will have to be monitored during operation (MON04). The parameters of the monitoring and the monitoring protocol for *Carinigeradrenovoensis* will include the number (abundance) and extent of distribution of the species on both sides of the road, the apparent health of a sample of snails. A standard, scientifically robust and repeatable, monitoring protocol will be drawn up and included in the BMP. Dust deposits, together with standard air quality, will be monitored during construction and the first year of operation, to establish whether this monitoring has to be continued to year 5 of operation (if significant dust deposits have occurred during year 1).



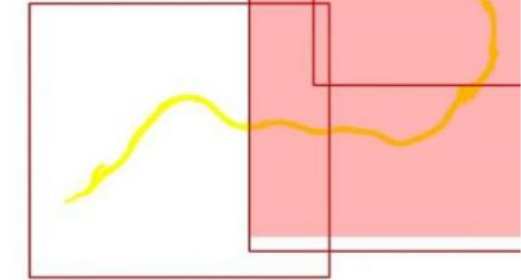
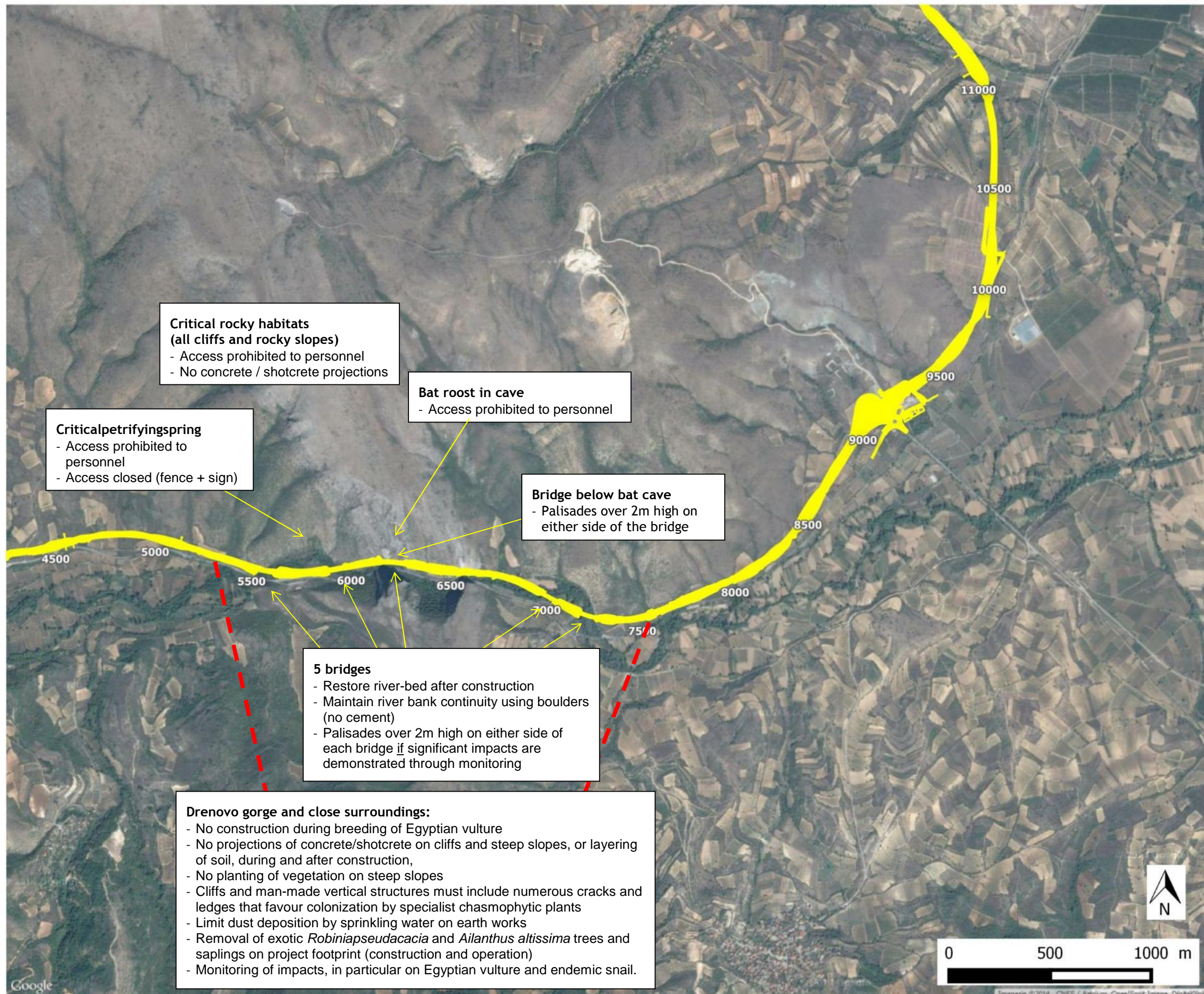
Access to the cave above the proposed road, where multiple bat species roost, will be prohibited, with training provided to contractors and their staff (delimitations to the construction site will be made visible using e.g. tape or other means), and sanctions put in place for non-compliance (to be included in contract design). To ensure that bats can access the river valley, continuous high palisades will be put in place on the bridge below the cave (wind resistant metal wire mesh, at least 2m high above the road's rail - the higher the better). Similar palisades could be built on the other 4 bridges that cross the river in the gorge if monitoring shows that there are significant impacts on wildlife. This monitoring involves (1) assessment of population levels in the cave, and (2) a study of the movements of bats between the cave and the river valley, and along the river valley (using 2D or 3D acoustic trajectography). Simple counts of corpses offer an unreliable assessment of impacts due to lost corpses (from scavengers or other causes) and are not appropriate.

*Egyptian vulture*: disturbance to the breeding pair from noise, vibration, and people will be avoided by stopping all activity related to construction that generates disturbance in excess of the current level of disturbance from the existing road (from mid-March to end of July) should continuous monitoring confirm that a breeding pair has settled in the gorge. Failure to breed will trigger a staged offset strategy to improve the conservation status of the species.

Critical habitats are concentrated in Drenovo Gorge. Mitigation measures to be implemented in Drenovo Gorge are mapped below. The resulting residual impact is described in the following section.



River Raec - Drenovo Interchange Road Project, Republic of Macedonia  
 Biodiversity and Critical Habitats Assessment  
 Location of project mitigation measures



— Road project





## VII. Residual Impacts

See annex 8

Conformity with PR6 requires that the project follows the mitigation hierarchy and that appropriate mitigation measures are put in place to ensure no net loss and preferably a net gain of biodiversity value. Moreover, given its location within critical habitat, conformity with PR6 will be conditional to there being no measurable adverse impacts or likelihood of such which could affect the status of the rocky habitats and petrifying spring, or impair the importance of the habitats critical to the survival of *Neophronpercnopterus* and *Carinigeradrenovoensis*. Taking a precautionary approach, the project must not lead to a reduction in the population of these species or a loss in area of their habitat such that the persistence of a viable and representative host ecosystem is compromised. Although the extension of the direct destruction of habitats beyond the final road might be limited during construction, a precautionary approach was followed and all areas within a 100 m wide strip centred on the planned road's axis were considered to be permanently or temporarily destroyed. Generic mitigation measures, such as the revegetation, after construction, of bare / reworked surfaces with local indigenous species will be implemented and are not detailed in this assessment.

Habitat	Key facts and risks	Dedicated Mitigation measures (BMP)	Residual impact taking into account the BMP
<b>Critical habitats</b>			
Habitat of the Egyptian Vulture ( <i>Neophronpercnopterus</i> )  Project construction area included in a CRITICAL HABITAT for this species	<p>Drenovo gorge is a critical nesting area for the species. A large part of the study area is included in the foraging area of the pair settled in the gorge, of which 110 ha are within a 100 m wide strip centred on the axis of the proposed road (1% of total assumed home range):</p> <ul style="list-style-type: none"> <li>▪ 40 ha included in home range core area (3% of extent of this zone);</li> <li>▪ 70 ha included in wider foraging area (1% of extent of this zone).</li> </ul> <p>Key risks to the species include disturbance during construction and operations, which could lead to unsuccessful breeding attempts or the nesting site being abandoned altogether, and collision mortality from feeding on road-kills, particularly for young birds due to the proximity of the road to the nest.</p> <p>Current levels of disturbance from the existing road are compatible with the species.</p>	<p>Disturbance will be avoided by restricting construction during breeding (MIT02). Monitoring of breeding success or failure will be undertaken twice a week, between March 15<sup>th</sup> and September 15<sup>th</sup>, during construction (MON01) and for 5 years after the road has been put in operation (MON02) - depending on monitoring results.</p>	<p><b>NO SIGNIFICANT RESIDUAL IMPACT</b></p> <p>With proposed mitigation measures in place, the project is not expected to lead to a reduction in the population of the species or a loss in area of their habitat such that the persistence of a viable and representative host ecosystem is compromised.</p> <p>In case mitigation measures fail, and significant impacts are observed following monitoring, a specific offset strategy will be triggered.</p>
Single-site endemic snail <i>Carinigeradrenovoensis</i>  Project construction area included in a CRITICAL HABITAT for this species	<p>The habitat of the species is located in the rocky habitats of the gorge, and in rocky grasslands. Project construction works situated in medium- (bottom of the rocky slopes facing south) and low- population density (rocky slopes facing south) parts of the species range.</p> <p>Direct destruction by the project, on 50m on either side of the axis of the planned road, could reach 4 ha (3% of the known distribution of the species which totals ca. 120 ha), including:</p> <ul style="list-style-type: none"> <li>- 0.1 ha in high density population zone (2% of total extant of the zone);</li> <li>- 0.5 ha in medium-population density zone (100% of total extent of the zone);</li> <li>- 3.4 ha in low-population density (3% of total extent of the zone), most of which are dry (rocky) grasslands.</li> </ul> <p>The area located under the project's operations footprint covers 1,5 ha including:</p> <ul style="list-style-type: none"> <li>- 0.2 ha in medium-population density zone;</li> <li>- 1.3 ha in low-population density.</li> </ul> <p>During construction, the habitat could also suffer from dust deposits.</p>	<p>The area of snail habitat lost will be minimized by locating access roads and other works related facilities in agricultural (modified) habitats (MIT01). Works within the gorge, where rocky habitats are concentrated, are constrained by the presence of cliffs and steep slopes. The project is designed to limit its footprint on these habitats.</p> <p>No habitat will be lost due to cement / shotcrete projections for stabilizing slopes as lower impact alternatives are available (MIT07). In addition, slopes above and below the road will be stabilized and not planted after construction, and no soil added. The outer surface of vertical embankments and walls will be designed to include cracks and ledges that favour colonization by chasmophytic vegetation (MIT10). There will be no smooth, artificial, surfaces with the exception of the driving and emergency lanes and water evacuation channels.</p> <p>Any risk of spreading invasive <i>Ailanthus altissima</i> will be minimized by removal of the species (prior to construction and without machinery) from the operations and construction footprint in Drenovo Gorge (MIT03). This will also enhance the quality of the habitats where no direct impacts are planned.</p>	<p><b>NO SIGNIFICANT RESIDUAL IMPACT</b></p> <p>Taking a precautionary approach, the project will not lead to a reduction in the population of the species or a loss in area of their habitat such that the persistence of a viable and representative host ecosystem is compromised.</p>

Habitat	Key facts and risks	Dedicated Mitigation measures (BMP)	Residual impact taking into account the BMP
<p>Cliffs and rocky slopes (chasmophytic vegetation), including a large bat roost</p> <p>Project construction area includes this CRITICAL HABITAT</p>	<p>Rocky habitats found in Drenovo gorge, with 8 ha in a ca. 1000 m wide strip centred on the axis of the planned road, are rare in the wider region. It harbours a range of chasmophytic species of conservation significance, high densities of the single-site endemic <i>Carinigeradrenovoensis</i>, and breeding sites for the endangered Egyptian vulture (see above).</p> <p>Direct destruction by the project: 1.3 ha in a 100 m wide strip (16% of the extent of the habitat in a 1 km wide strip), and 0.4 ha under final project footprint. The habitat could also be degraded by dust deposits during construction and the spread of <i>Ailanthus altissima</i> by machinery and materials.</p> <p>A cave, situated ca. 80 m above the bottom of the cliff and the northern limit of the road project, above the river, is used as a breeding and wintering roost by several bat species. Risks to the roost included disturbance during construction, and increased mortality from collisions. In particular, Bats feed in the riparian forest and could suffer increased mortality from collisions with traffic in going back and forth between the cave and the river.</p>	<p>Dust deposits will be minimised through watering of the construction sites during dry and/or windy weather (MIT04). This will be monitored during construction, and the first year of operation.</p> <p>Impacts on the local snail population will be monitored during operations (5 years), to ensure that its viability has not been affected by the road (MON04).</p> <p>The capacity of the bats to move between their breeding and wintering roost and the river valley will be maintained by installing palisades on the bridge on the Raec river that separates the cave from the river (MIT08).</p>	<p>LOW RESIDUAL IMPACT</p> <p>Less than 2 ha of this critical habitat will be destroyed, and with post-construction restoration aimed at recreating favourable conditions for recolonization by the typical assemblage of species, the likelihood of measurable adverse impacts which could affect the status of cliffs and rocky slopes is low.</p> <p>→ OFFSETTING REQUIRED to ensure No Net Loss</p>
<p>Petrifying spring complex (including associated aquatic vegetation and humid grasslands)</p> <p>Project construction area includes this CRITICAL HABITAT</p>	<p>The petrifying spring located at the north-western entrance of the Drenovo gorge, alongside and on a local pathway, is a priority habitat (7220*) in Annex I of the Habitats Directive.</p> <p>The habitat is not directly impacted by the road project, but could suffer from increased visits and trampling by people and vehicles. It is protected from air pollution by the riparian forest along the Raec river.</p>	<p>The planned road will not directly impact the petrifying spring, which will be fenced off to people and vehicles during construction (MIT01)</p>	<p>NO SIGNIFICANT RESIDUAL IMPACT</p> <p>Taking a precautionary approach, the project will not lead to any measurable adverse impacts, or likelihood of such, which could affect the status of the critical petrifying spring habitat.</p>
<b>Other natural habitats</b>			
<p>River, and riparian forest, forming a natural corridor for wildlife</p> <p>Project construction area includes this NATURAL HABITAT</p>	<p>The road project follows the Raec river valley and 10 crossings are planned. It is unknown if the restricted range Pelagonia trout (<i>Salmo pelagonicus</i>) is present in the river. The riparian forest is present alongside a large western part of the road project in the study area and particularly in the Drenovo gorge. It is degraded by stands of Locust trees (<i>Robinia pseudoacacia</i>) and fragmented by the existing road.</p> <p>Direct destruction by the project could reach ca. 9 ha in a 100 m wide strip (19% of the extent of the habitat in a ca. 1 km wide strip), 1.3 ha under the final project's footprint.</p> <p>The river bed could be impacted by the construction of 10 bridges, a bridge-like structure on piles (in Drenovo Gorge) and by embankments. These structures could impair travel on river banks by small mammals, including the otter (<i>Lutra lutra</i>), and by animals flying along the forest canopy (including bats).</p> <p>Although the river corridor is already fragmented by the existing road (2 bridges), it will be further fragmented by the proposed road.</p>	<p>Construction in the river and the adjoining riparian forest will be minimized by locating access roads and other works related facilities in agricultural (modified) habitats (MIT01). In Drenovo Gorge, however, avoidance of critical cliff and rocky slope habitats means that several bridge-like structures will be built over the river and riparian forest - causing direct destruction of a significant area of habitat.</p> <p>Measures will be taken to restore the river and the riparian forest after construction (MIT05 &amp; MIT06), but habitat loss, and an increase in fragmentation from new obstacles across the valley remain significant.</p> <p>The increase in fragmentation will be mitigated by maintaining a safe passage for bats between the river valley and a major roost in the cliff above the river in Drenovo gorge using palisades on one of the bridges (MIT08), and by ensuring that river banks can still be used by small mammals (MIT09). Impacts will be monitored to ensure that these measures are sufficient if additional structures are needed on the other 4 bridges in the Gorge (MON03).</p>	<p>MEDIUM RESIDUAL IMPACT</p> <p>The project will lead to measurable adverse impacts, or likelihood of such, which could affect the status of the river and riparian forest as a corridor for wildlife movement, and its quality as a feeding ground for several species.</p> <p>→ OFFSETTING REQUIRED to ensure No Net Loss</p>
<p>Temporary streams</p> <p>Project construction area includes this NATURAL HABITAT</p>	<p>Temporary streams are habitats associated to hills in the eastern part of the study area. They allow movement by small vertebrate fauna, including amphibians, bats and mammals (including unconfirmed marbled polecat (<i>Vormelaperagusna</i>), between the hills and the Raec river valley.</p> <p>This habitat will be crossed 16 times by the project (15 times with a culvert structure and 1 time with a bridge structure). Small vertebrates will be able to cross the road safely at these points (but will be temporarily impaired during construction). However, some increase in mortality is expected as animals cross the road outside these underpasses. Mortality on the existing road will be reduced through lower traffic.</p>	<p>The loss of temporary spring habitat will be minimized by locating access roads and other works related facilities in agricultural (modified) habitats (MIT01).</p>	<p>NO SIGNIFICANT RESIDUAL IMPACT</p> <p>Taking a precautionary approach, the project will not lead to any measurable adverse impacts, or likelihood of such, which could affect the status of the temporary streams as movement corridors for wildlife in the landscape.</p>

<i>Habitat</i>	<i>Key facts and risks</i>	<i>Dedicated Mitigation measures (BMP)</i>	<i>Residual impact taking into account the BMP</i>
Other springs (x2)  Project construction area includes this NATURAL HABITAT	These springs are very small habitats located at the eastern exit of the Drenovo gorge, in the direct vicinity of the river and very close one to another.  The planned road will not impact the springs directly. Risks include destruction by vehicles and trampling by people.	The planned road will not directly impact the petrifying spring, which will be fenced off to people and vehicles during construction (MIT01)	<b>NO SIGNIFICANT RESIDUAL IMPACT</b>  Taking a precautionary approach, the project will not lead to any measurable adverse impacts, or likelihood of such, which could affect the status of these isolated springs.
Steppe-like grasslands, including mosaics with Christ's Thorn shrublands and Juniper garrigues  Project construction area included in these NATURAL HABITATS	Dry grasslands are abundant in the wider eco-region, and form a mosaic with shrublands, which are degraded grasslands colonized by shrubs (and not degraded forests). Together, they cover over 730 ha in a ca. 1 km wide strip centred on the axis of the planned road.  Grasslands are present along the road in the eastern part of the study area (beyond Drenovo gorge), with shrublands very abundant along the planned road.  The planned road is set on the limit of this habitat, but could destroy up to 40 ha of dry grassland and associated mosaics with shrubs (degraded grasslands) in 20 places within a 100 m wide strip centred on the axis of the planned road (8% of the extent of grasslands within a ca. 1 km wide strip), 13.3 ha under the final project footprint.  The planned road could destroy up to 23 ha of shrublands and garrigues in 25 places within a ca. 100 m wide strip centred on the axis of the road project (11% of the extent of the shrublands in a ca. 1 km wide strip, and 3% of the mosaic of grasslands and shrublands), 7.3 ha under the final project footprint.	The areas of natural grassland, shrubland and woodland habitats destroyed by the project will be minimized by locating access roads and other works related facilities in agricultural (modified) habitats (MIT01).  Culverts and bridge structures over temporary streams will create 16 underpasses along the planned road, offering safe passage to wildlife associated with grasslands, shrublands and woodlands.	<b>LOW RESIDUAL IMPACT</b>  Taking a precautionary approach, the project will lead to a loss of ca. 13 ha of dry grassland habitat and less than 30 ha of degraded grassland habitat, which will not affect the status of grasslands in the wider ecoregion, where they remain abundant.  → OFFSETTING REQUIRED to ensure No Net Loss
Oriental hornbeam woods  Project construction area included in this NATURAL HABITAT	These woodlands are present in large areas mainly in the western part of the project including the southern part of Drenovo gorge. They are widespread in the ecoregion, and beyond.  Direct destruction by the project could reach 8 ha in 3 places within a 100 m wide strip centred on the axis of the proposed road (10% of the extent of the local Oriental hornbeam woods in a 1 km wide strip), 2.7 ha under the final project footprint.		<b>NO SIGNIFICANT RESIDUAL IMPACT</b>  Taking a precautionary approach, the project will lead to a loss of less than 10 ha of woodland, which will not affect the status of these woodlands in the wider ecoregion, where they remain abundant.

## VIII. Offsetting Strategy and Biodiversity Offsetting Management Plan

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As the analysis of residual impacts on natural habitats and critical habitats has shown, some residual impacts are significant. Conformity with PR6 requires that the project follows the mitigation hierarchy and that appropriate mitigation measures are put in place to ensure no net loss and preferably a net gain of biodiversity value. In the context of the proposed road project, where avoidance by re-routing has been considered impossible in the EIA and is not within the scope of this CHA, this means that any residual loss of biodiversity must be offset by generating equivalent gains elsewhere, so as to achieve at least no net loss, and preferably a net gain.

The project will result in significant residual impacts for the following natural and critical habitats:

- Cliffs and rocky slopes (chasmophytic vegetation) in Drenovo Gorge (critical habitat), with significant loss of area;
- The river and riparian forest (natural habitats), forming a natural corridor for wildlife, with significant loss of area and increased fragmentation;
- Steppe-like grasslands, including mosaics with shrubby habitats (natural habitats), with significant losses of area.


In addition to the above, and given the high risks associated with disturbance to the endangered Egyptian vulture, a targeted response has been planned for in case mitigation measures should fail, causing the project to impact significantly on the species.

This CHA outlines four offset strategies aimed at ensuring that in building the proposed road following Alternative 1, PESR will not lower, and in fact try to enhance (net positive impact):

- the conservation status of chasmophytic vegetation, in Macedonia;
- the conservation status of dry grasslands, in the wider landscape;
- the capacity of the Raec river valley to function as a wildlife corridor;
- the breeding population of Egyptian vultures in the ecoregion.

It is the responsibility of PESR to ensure that these outcomes are achieved, but the actual implementation of the measures can be outsourced to competent contractors, with performance-based contracts and independent auditing of on the ground ecological outcomes. Road building companies can be requested to include offset initiation or implementation in the bids for the work if the offset requirements (on par with mitigation measures) are included in the tender documents.

International best practice indicates that offsets should be initiated, and ideally completed, before residual impacts occur, and not once construction is completed. However, in this case, offsets are planned as responses to failures of mitigation measures, if these are demonstrated by monitoring. For example, offsets targeting the Egyptian vulture will only be initiated if breeding failure is demonstrated, and hence not in advance of construction.

 **Conclusions:** Overall, the volume and complexity of the offsets required to achieve no net loss and net gain outcomes for biodiversity affected by the project reflects the high value of the natural and critical habitats found in the study area, and in particular in Drenovo gorge.

Offsets are detailed below for each of the natural and critical habitats for which residual impacts remain in spite of avoidance and mitigation measures.

## Chasmophytic vegetation: creation of new rocky habitats in recently abandoned quarries

Rocky habitats and their associated, specialized, chasmophytic vegetation are not readily restored, but there is some experience in achieving this (e.g. Cullen et al. 1984 in the UK, results of a LIFE project targeting endemic plant species [*Viola hispida* and *Biscutellaneustriaca*] on cliffs in France<sup>13</sup>). Although considerable efforts will be made to facilitate colonization by chasmophytic plant species of the slopes, embankments and vertical structures created by the road project in Drenovo gorge (MIT10), it is likely that a significant residual impact will remain. An adequate offset would recreate equivalent rocky habitat. Given that such habitats are rare in the Raec river valley, the most realistic way to achieve this, technically, is to create a viable chasmophytic plant community on a large recently created rock face<sup>14</sup>, by establishing the species that form these communities<sup>15</sup>. Recently abandoned quarries offer such opportunities, with the establishment of chasmophytic vegetation representing an additional conservation outcome to the typical rehabilitation measures taken on quarries (e.g. erosion control, aesthetic planting, or flooding).

The amount of rocky habitat to be created will be established following detailed monitoring of project impacts during construction, with a particular emphasis on rocky habitats and the endemic snail *Carinigeradrenovoensis*, to establish the actual footprint of the project on rocky habitats in Drenovo Gorge. The offset will be applied initially to 0.5 ha, reflecting the projected final footprint of the road project. It will be monitored for at least 10 years. This monitoring is an integral part of the offset.

To offset the loss of critical rocky habitats in Drenovo Gorge, PESR will ensure that, before construction begins, and then during construction:

- one or several calcareous (hard) rock quarries operating in Macedonia (but the closer to Drenovo Gorge the better) and totalling at least 2 ha of cliffs and rocky slopes are available for rehabilitation; the quarries are to be identified by an independent and qualified plant ecologist; availability can be achieved through direct ownership or contractual agreements by/with PESR or its subcontractors;

As construction begins, PESR will ensure that the following is achieved:

- favourable (rocky) habitat for chasmophytic species is generated or enhanced 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);
- propagules (seeds or gravel/soil containing seeds and/or specimens of chasmophytic plant species) are collected, under the supervision of a qualified plant ecologist, and prepared for seeding or transplantation;

Once the selected quarries have been prepared and sufficient propagules are available for transplantation, PESR will ensure that:

- specimens or seeds of chasmophytic plant species are transplanted to the favourable rocky habitats, using appropriate process - different methods can be trialled as part of the offset and their success documented;
- monitor the success or failure of transplantations, species by species, and adjust the design and execution of the transplants accordingly.

If successful, the rehabilitated quarries can be opened to the public to raise awareness on the

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<sup>13</sup> [http://www.cren-haute-normandie.com/life/doc/Laymans\\_report.pdf](http://www.cren-haute-normandie.com/life/doc/Laymans_report.pdf)

<sup>14</sup> An already established chasmophytic community cannot be used as an offset.

<sup>15</sup> Those listed in Annex 5



conservation value of the specialist rock dwelling flora of Macedonia. To avoid transforming the quarries into public parks or a flower garden, no irrigation will be permitted in the restored quarry.

This offset program (OFF01) can be contracted as appropriate. It will be audited independently, by qualified plant ecologists, against a set of performance criteria that will have been included in any terms of reference for the work. It is recommended that these terms of reference be prepared by the people (qualified ecologists) involved in the selection of the quarries to be restored. The same people cannot be involved in the restoration itself, but can be involved in auditing its performance.

### **Dry grasslands: restoration of >15 ha of degraded grasslands in the Raec river valley by removing encroaching shrubs**

The planned road is set on the limit of this habitat, but at least 13ha of dry grassland and associated mosaics with shrubs (degraded grasslands) could be destroyed as they lay under the project's final footprint. Given the high likelihood of success in restoring such grassland (from a mosaic to a full grassland state), a 1:1 area multiplier was used. The area to be restored was rounded up to 15 ha.

To offset this loss of natural dry grassland habitats, PESR will therefore fund the restoration of degraded grasslands on at least 15 ha, within the Raec river valley (OFF02). This can be done by removing shrubs that are colonizing species rich grasslands and forming mosaics, such as young trees, including young oaks, and shrubs, including *Paliurus spina-christi* and Junipers (but individuals of the rare *Juniperus excelsa* shouldn't be removed). It is important to consider that all of grasslands and shrublands are part of the same dynamic series of vegetation, representing progressive levels of degradation from grasslands to mosaics, and then to shrublands and garrigues.



**Figure 9.** Both *Paliurus spina-christi* shrublands (left) and Juniper garrigues (right) can be restored into dry grasslands, which have a higher biodiversity value, by removing large shrub patches. © BIOTOPE, June 2014

Degraded grasslands are abundant in the area, and there are numerous opportunities to undertake this offset successfully. In particular, PESR will focus on public land that is identified as grassland in cadastral maps, and engage with the State Enterprise for Grasslands to undertake the restoration. It is important, however, that PESR undertake adequate consultations with owners and local users of the grasslands and shrublands (including shepherds, hunters, etc.), as well as with government authorities in charge of conservation and stakeholders in academia, conservation.

The restored grasslands should be managed for long term conservation goals. It is recommended to establish a 10 year management plan for the restored grasslands and make the plan a binding (contractual) agreement between PESR and the State Enterprise for Forest (or any other

contractors or land-owner that PESR partners with for implementing this offset). PESR is free to negotiate the financial terms of this contract. Adequate execution of the offset will be audited against ecological performance criteria:

- The grassland selected for restoration must be degraded, as documented prior to the removal of shrubs through photographs and measurements of the densities (number of patches over 1m in diameter per square meter) and total cover (in m<sup>2</sup>) of shrubs.
- The same characteristics will be measured after removal of all shrub patches over 1m in diameter, in years 1 and 10, and documented through photographs, to demonstrate that restoration was effective.

The restored grasslands can be used for grazing livestock but chemical fertilisation, manuring, or irrigation should not be used in any new locations. As further colonization of the grasslands by trees and shrubs is likely, their removal will have to be undertaken a second time over the 10 year management period.

Should the project's residual impacts exceed 13.3 ha of dry grasslands, the area of grassland to be restored as an offset will be increased to ensure 1 ha restored for every ha lost. A specific report on the loss of dry grasslands following construction is expected from monitoring measures (MON00).

### **River & riparian woodlands: restoring of the Raec river valley as a wildlife corridor**

The road project will increase fragmentation of the river valley, potentially impairing up- and downstream movement of some terrestrial mammals such as the otter (*Lutra lutra*), which travel along river banks, and of birds and bats that fly at canopy height along the valley. Appropriate mitigation (MIT09) will ensure there are no significant and permanent residual impacts on the former. Concerning the latter, this would require fitting continuous high palisades on all the bridges that cross the Raec river, at least in Drenovo gorge (5 bridges). Only one bridge will be fitted (MIT08) and as a result, the project could significantly impair the movement of bats to the river valley and cause increased mortality from road collisions. To offset this potential residual impact, existing fragmentation could be reduced elsewhere along the river valley (in a 10 km radius around the large roost found in the cave above the river). Typically, this means retro-fitting existing structures. Another option is to favour bat species, in the same area, through other means.

To improve the area and quality of feeding habitats for bats, and to enhance the valley's capacity as a wildlife corridor, PESR will undertake a major restoration program in the Raec river valley, outside the footprint of the project road, and Concurrently with the start of construction. The content of this program is described below.

Bats use hedgerows to navigate and access foraging areas. To offset the road project's increase in the fragmentation of the riparian habitats used by bats, PESR will establish a continuous strip of riparian forest along the Raec river, between the bridge of river Raec and the "Drenovo" interchange (OFF03). Only indigenous trees will be used. It is recommended that PESR partner with the State Enterprise "Macedonia Forests" to undertake this work. The results will be audited independently by qualified ecologist.

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), PESR will fund the creation or rehabilitation of adequate passageways for small mammals (OFF04). 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.



Figure 10. Raec river valley in the western part of the study area © BIOTOPE, July 2014

In addition to increasing fragmentation of the river valley, in particular in Drenovo Gorge, the road project will lead to the loss of up to 9 ha of degraded riparian forest. At least 1.3 ha of riparian forest will be lost to the project's operations footprint.

An equivalent area of degraded forest should be restored to achieve a no net loss outcome. Specifically, PESR will remove all *Robinia pseudoacacia* trees and saplings found in the riparian woodlands of the Raec river valley, between the bridge of river Raec and interchange "Drenovo", and within the expropriation area and on public land. Individual trees and saplings will be cut and stumps killed. Cut trees and branches will be left in place, and not taken out of the forest, to create micro-habitats suitable for various animal species. This will be conducted in winter to limit disturbance to the habitat during the wildlife breeding season. This measure (OFF05) is an extension of MIT06 and both measures can be contracted jointly, within the broader restoration program outlined here.

To clear any uncertainties regarding the presence of the restricted range Pelagonia trout (*Salmo pelagonicus*) in the Raec river, PESR will fund a study (STU01) aimed at identifying the distribution of the species in the Raec river watershed, and its conservation status. Findings from the study will be used to adjust the river valley restoration program to favour the species. This could include working with local fishermen to stop introductions of alien trout species.

Should the project's residual impacts exceed 1.3 ha of riparian forest, the area of forest to be restored as an offset will be increased to ensure 1 ha restored for every ha lost. A specific report on the loss of riparian forests following construction is expected from monitoring measures (MON00).

### Egyptian vulture: planned response in case mitigation fails

Although the absence of a breeding pair or an unsuccessful breeding attempt may not be the result of project related impacts - this could be the result of natural mortality, predation, poaching etc. - a worst case scenario requires that an adequate response be prepared. Monitoring during construction (MON01) and operations (MON02) will conclude on the level of residual impact of the road project on the breeding success of the Egyptian vulture in the gorge. This will determine the offsetting level for this species.

As a first approximation, the following situations are contemplated as part of this adaptive offsetting strategy:

- In case there is no breeding pair in the gorge the year the works are planned and before

they begin (beginning of MON01), no offsetting measures would be needed because there would be no relationship between the works and the absence of the Vulture.

- In case of breeding failure during construction phase (MON01) or one time during operation phase (MON02), the relationship between disturbance by works, traffic or road maintenance and breeding failure will have to be estimated. If an obvious link between the failure and any event during the works (e.g. non-expected blasting operation during the most sensitive period), a first stage of offsetting will be initiated (OFF06).
- In case of more than one breeding failure from the start of construction to the end of the fifth breeding season during operation phase (MON01 & MON02) that can be attributed to the project, the first stage of offsetting measures will be expanded into a second stage (OFF07).
- In case of continuous absence of the species on the study area of the project during the first five years of operation phase (and thus absence in Drenovo gorge breeding site), taking a precautionary perspective, a first level of offsetting measures would have to be undertaken.
- In case of continuous breeding success from road construction until the end of the first five years of operation (results of MON01 & MON02), no offsetting would be needed because of no significant disturbance by the traffic or the road maintenance will have been demonstrated. Non-significant residual impacts will have been confirmed.

In theory, any mortality or loss of reproductive output due to the project, measured in individual juveniles leaving the nest, would have to be offset bird for bird, to ensure that the project does not cause a decrease in the population of Egyptian vultures. Given the uncertainties inherent in such an approach, and until better knowledge is available to model population dynamics of the species in Macedonia, a precautionary approach is suggested. The main threat to the Egyptian vulture in Macedonia has been identified by GRUBAC, VELEVSKI & AVUKATOV (2014) to be the widespread use of poisoned baits aimed at stray dogs, foxes and wolves, which in turn poison the vultures as they feed on the dead canids. Offsets could aim to address this main threat, to contribute to stopping the decrease in the Egyptian vulture population and hopefully increase it.

Under this assumption, which would have to be adjusted and updated on the basis of actual monitoring results and population trends of the species in Macedonia, the first level of offsetting measure for the Egyptian Vulture (OFF04) could be to reduce the main threat for the species in the Important Bird Area 'Raec river Valley' (IBA MKO23): the use of poisoned baits to kill stray dogs, wolves and foxes. As an example, PESR would therefore fund the following actions, to be undertaken jointly:

- A new awareness raising campaign on alternatives to the use of poisoned baits;
- Active research of poisoning locations and rapid removal of dead wolves or dogs over a 5 years period;
- Study of the causes of vulture mortality and reproductive success in the IBA, including levels of poisoning.

The second level of offsetting (OFF05) could be to implement and mainstream alternatives to poisoning of stray dogs and foxes. Such alternatives would have been identified and tested during the first level offsetting program (OFF04). PESR would then fund their implementation and mainstreaming until breeding resumes in the gorge (end of impacts) or the population of the species in the 'Raec river Valley' (IBA MKO23) is restored. How this is measured would have to be agreed upon at the onset. A possible measure is proven and regular breeding (e.g. 3 successful attempts over 5 years).

Given that a broader scope and longer duration is likely for this second stage offset response, consultations with government authorities in charge of conservation and stakeholders in academia, nature conservation and land use is required. It is recommended to embed this program in the

Balkan Vulture Action Plan<sup>16</sup>, and consider it as an extension to Macedonia of the LIFE program “the return of Neophron”<sup>17</sup>, which was initiated in Bulgaria and Greece in 2011.

## IX. Net Impacts

Conformity with PR6 requires that the project follows the mitigation hierarchy and that appropriate mitigation measures are put in place to ensure no net loss and preferably a net gain of biodiversity value. Moreover, given its location within critical habitat, project conformity with PR6 will be conditional to there being no measurable adverse impacts or likelihood of such which could affect the status of the rocky habitats and petrifying spring, or impair the importance of the habitats critical to the survival of *Neophronpercnopterus* and *Carinigeradrenovoensis*. Taking a precautionary approach, the project must not lead to a reduction in the population of these species or a loss in area of their habitat such that the persistence of a viable and representative host ecosystem is compromised.

Although the extension of the direct destruction of habitats beyond the final road might be limited during construction, a precautionary approach was followed and all areas within a 100 m wide strip centred on the planned road’s axis were considered to be permanently or temporarily destroyed. Generic mitigation measures, such as the revegetation, after construction, of bare / reworked surfaces with local indigenous species will be implemented and are not detailed in this assessment. In spite of a wide range of mitigation measures, some significant residual impacts remain. These are addressed through offsetting measures, which are presented below.

<i>Habitat</i>	<i>Residual impact</i>	<i>Offsets</i>	<i>Net impact</i>
<b>Critical habitats</b>			
Habitat of the Egyptian Vulture ( <i>Neophronpercnopterus</i> )  Project construction area included in a CRITICAL HABITAT for this species	NO SIGNIFICANT RESIDUAL IMPACT  Taking a precautionary approach, the project will not lead to a significant reduction in the population of the species or a significant loss in area of their habitat such that the persistence of a viable and representative host ecosystem is compromised.	<i>Offsets required in case mitigation measures fail, and significant impacts are observed, a specific offset strategy will be triggered (OFF06 &amp; OFF07).</i>	NO NET LOSS OF CRITICAL HABITAT
Single-site endemic snail <i>Carinigeradrenovoensis</i>  Project construction area included in a CRITICAL HABITAT for this species	NO SIGNIFICANT RESIDUAL IMPACT  Taking a precautionary approach, the project will not lead to a significant reduction in the population of the species or a significant loss in area of their habitat such that the persistence of a viable and representative host ecosystem is compromised.	<i>No offsets required</i>	NO NET LOSS OF CRITICAL HABITAT

<sup>16</sup> <http://www.balkanvultures.net/>

<sup>17</sup> LIFE10 NAT/BG/000152 (2011 to 2016) - see <http://www.lifeneophron.eu/>



<b>Habitat</b>	<b>Residual impact</b>	<b>Offsets</b>	<b>Net impact</b>
<p>Cliffs and rocky slopes (chasmophytic vegetation), including a large bat roost</p> <p>Project construction area includes this CRITICAL HABITAT</p>	<p><b>LOW RESIDUAL IMPACT</b></p> <p>Direct destruction by the project: 1.3 ha in a 100 m wide strip (16% of the extent of the habitat in a 1 km wide strip), 0.4 ha under final project footprint.</p> <p>Less than 2 ha of this critical habitat will be destroyed, and with post-construction restoration aimed at recreating favourable conditions for recolonization by the typical assemblage of species, the likelihood of measurable adverse impacts which could affect the status of cliffs and rocky slopes is low.</p>	<p>At least 0.5 ha of rocky habitat, harbouring chasmophytic vegetation, will be created in one or several unused rock quarries (OFF01)</p>	<p><b>NO NET LOSS OF CRITICAL HABITAT</b></p> <p>Taking a precautionary approach, the project will not lead to a reduction in the population of the species or a loss in area of their habitat such that the persistence of a viable and representative host ecosystem is compromised.</p>
<p>Petrifying spring complex (including associated aquatic vegetation and humid grasslands)</p> <p>Project construction area includes this CRITICAL HABITAT</p>	<p><b>NO SIGNIFICANT RESIDUAL IMPACT</b></p> <p>Taking a precautionary approach, the project will not lead to any measurable adverse impacts, or likelihood of such, which could affect the status of the critical petrifying spring habitat.</p>	<p><i>No offsets required</i></p>	<p><b>NO NET LOSS OF CRITICAL HABITAT</b></p> <p>Taking a precautionary approach, the project will not lead to any measurable adverse impacts, or likelihood of such, which could affect the status of the critical petrifying spring habitat.</p>
<b>Other natural habitats</b>			
<p>River, and riparian forest, forming a natural corridor for wildlife</p> <p>Project construction area includes this NATURAL HABITAT</p>	<p><b>MEDIUM RESIDUAL IMPACT</b></p> <p>The project will lead to measurable adverse impacts, or likelihood of such, which could affect the status of the river and riparian forest as a corridor for wildlife movement, and its quality as a feeding ground for several species.</p> <p>At least 1.3 ha of degraded riparian forest will be lost.</p>	<p>A comprehensive set of measures is planned to enhance connectivity:</p> <ul style="list-style-type: none"> <li>- Restoration of riparian forests throughout the expropriation area (OFF03 &amp; OFF05)</li> <li>- Lifting obstacles to small mammal movements (OFF04)</li> </ul>	<p><b>NO NET LOSS OF NATURAL HABITAT</b></p> <p>Taking a precautionary approach, the project will not lead to any measurable adverse impacts, or likelihood of such, which could affect the status of the river and riparian forest as a wildlife corridor.</p>
<p>Temporary streams, and Other springs (x2)</p> <p>Project construction area includes this NATURAL HABITAT</p>	<p><b>NO SIGNIFICANT RESIDUAL IMPACT</b></p> <p>Taking a precautionary approach, the project will not lead to any measurable adverse impacts, or likelihood of such, which could affect the status of the temporary streams as movement corridors for wildlife in the landscape, or the status of the isolated springs</p>	<p><i>No offsets required</i></p>	<p><b>NO NET LOSS OF NATURAL HABITAT</b></p> <p>Taking a precautionary approach, the project will not lead to any measurable adverse impacts, or likelihood of such, which could affect the status of the temporary streams as movement corridors for wildlife in the landscape, or the status of the isolated springs</p>



<i>Habitat</i>	<i>Residual impact</i>	<i>Offsets</i>	<i>Net impact</i>
<p>Steppe-like grasslands, including mosaics with shrubby habitats such as Christ's Thorn shrublands and Juniper garrigues</p> <p>Project construction area included in these NATURAL HABITATS</p>	<p><b>LOW RESIDUAL IMPACT</b></p> <p>The planned road is set on the limit of this habitat, but could destroy up to 40 ha of dry grassland and associated mosaics with shrubs (degraded grasslands) in 20 places within a 100 m wide strip centred on the axis of the planned road (8% of the extent of grasslands within a ca. 1 km wide strip), 13.3 ha under final project footprint.</p> <p>The planned road could destroy up to 23 ha of shrublands and garrigues in 25 places within a ca. 100 m wide strip centred on the axis of the road project (11% of the extent of the shrublands in a ca. 1 km wide strip, and 3% of the mosaic of grasslands and shrublands), 7.3 ha under final project footprint.</p> <p>Taking a precautionary approach, the project will lead to a loss of less than 15 ha of dry grassland habitat and less than 10 ha of degraded grassland habitat, which will not affect the status of grasslands in the wider ecoregion, where they remain abundant.</p>	<p>At least 15 ha of degraded grasslands will be restored for biodiversity, in the close vicinity of the road project, by eliminating encroaching shrubs</p>	<p><b>NO NET LOSS OF NATURAL HABITAT</b></p> <p>Taking a precautionary approach, the project will not lead to any measurable adverse impacts, or likelihood of such, which could affect the status of the dry grasslands in the ecoregion.</p>
<p>Oriental hornbeam woods</p> <p>Project construction area included in this NATURAL HABITAT</p>	<p><b>NO SIGNIFICANT RESIDUAL IMPACT</b></p> <p>Direct destruction by the project could reach 8 ha in 3 places within a 100 m wide strip centred on the axis of the proposed road (10% of the extent of the local Oriental hornbeam woods in a 1 km wide strip), with 2.7ha under the final project footprint.</p> <p>Taking a precautionary approach, the project will lead to a loss of less than 3 ha of woodland, which will not affect the status of these woodlands in the wider ecoregion, where they remain abundant.</p>	<p><i>No offsets required</i></p>	<p><b>NO NET LOSS OF NATURAL HABITAT</b></p> <p>Taking a precautionary approach, the project will lead to a loss of less than 10 ha of woodland, which will not affect the status of these woodlands in the wider ecoregion, where they remain abundant.</p>

## X. Conclusions

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This Critical Habitat Assessment was carried out in the framework of EBRD's Performance Requirement (PR) 6 on biodiversity and natural resources. The planned expressway project is to be constructed and operated in a mosaic of modified, natural and critical habitats. The selected route (alternative 1 of the EIA) goes through the Drenovo gorge which is officially recognized as a Monument of Nature in Macedonia and is also a candidate Emerald site under Bern Convention.

No significant residual impacts are expected on several natural habitats, including temporary streams, small springs and the critical petrifying spring found at the western limit of Drenovo gorge. Through appropriate mitigation, it is concluded that the likely impacts of the proposed road on the endangered Egyptian vulture (*Neophron percnopterus*) can be avoided, though monitoring is required due to the conservation importance of the nesting location. The population of the single-site endemic snail *Carinigeradrenovoensis* will be irreversibly fragmented by the planned expressway. Results of surveys suggest that the river and existing road already acts as a functional barrier to movement of the snail across the Gorge. However an intensive monitoring survey across seasons has not been carried out. The possibility that the Project might add to long-term genetic isolation of populations either side of the Gorge cannot be excluded. However it is concluded that these populations should have sufficient suitable habitat available for them to remain viable with the road in place.

Natural habitats which may be impacted include the Raecriver and the adjoining riparian forest (destruction and fragmentation in Drenovo gorge) and mosaics of dry grasslands and shrublands. These impacts will be offset through several measures aimed at restoring the continuity of natural habitats along the Raecriver outside Drenovo gorge and by restoring degraded grasslands in the surrounding landscape.

The project will cause significant residual impacts on critical rocky habitats in Drenovo gorge (cliffs and rocky slopes that harbour chasmophytic plant communities), in spite of attempts to minimize its footprint on these habitats. This residual impact will be offset through the creation of rocky habitat and associated chasmophytic plant communities in newly formed rock structures, for example in a recently abandoned/closed quarries.

Given the constraints of following the route selected in the EIA (Alternative 1), the biodiversity management plan (BMP) and biodiversity offsetting management plan (BOMP) outlined in this Critical Habitat Assessment are designed to ensure that no net loss of natural habitats and critical habitats can be achieved. The magnitude and complexity of the offsets required to achieve no net loss and net gain outcomes for biodiversity affected by the project reflects the high value of the natural and critical habitats found in the study area, and in particular in Drenovo gorge.

Correct implementation and effectiveness of these measures is strongly tied to adequate supervision by qualified ecologists and independent auditing of ecological outcomes to be included in performance-based contracts for the execution of mitigation and offsetting measures.

### Key conclusions:

- ☞ The proposed road, following Alternative 1 laid out in the EIA, will affect natural habitats and critical habitats.
- ☞ The biodiversity management plan and offset strategy outlined in this CHA could ensure that the project does not cause a significant net loss of natural habitats or critical biodiversity features.

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*This list includes a selection of the documentation used in this critical habitat assessment; it is not exhaustive.*

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