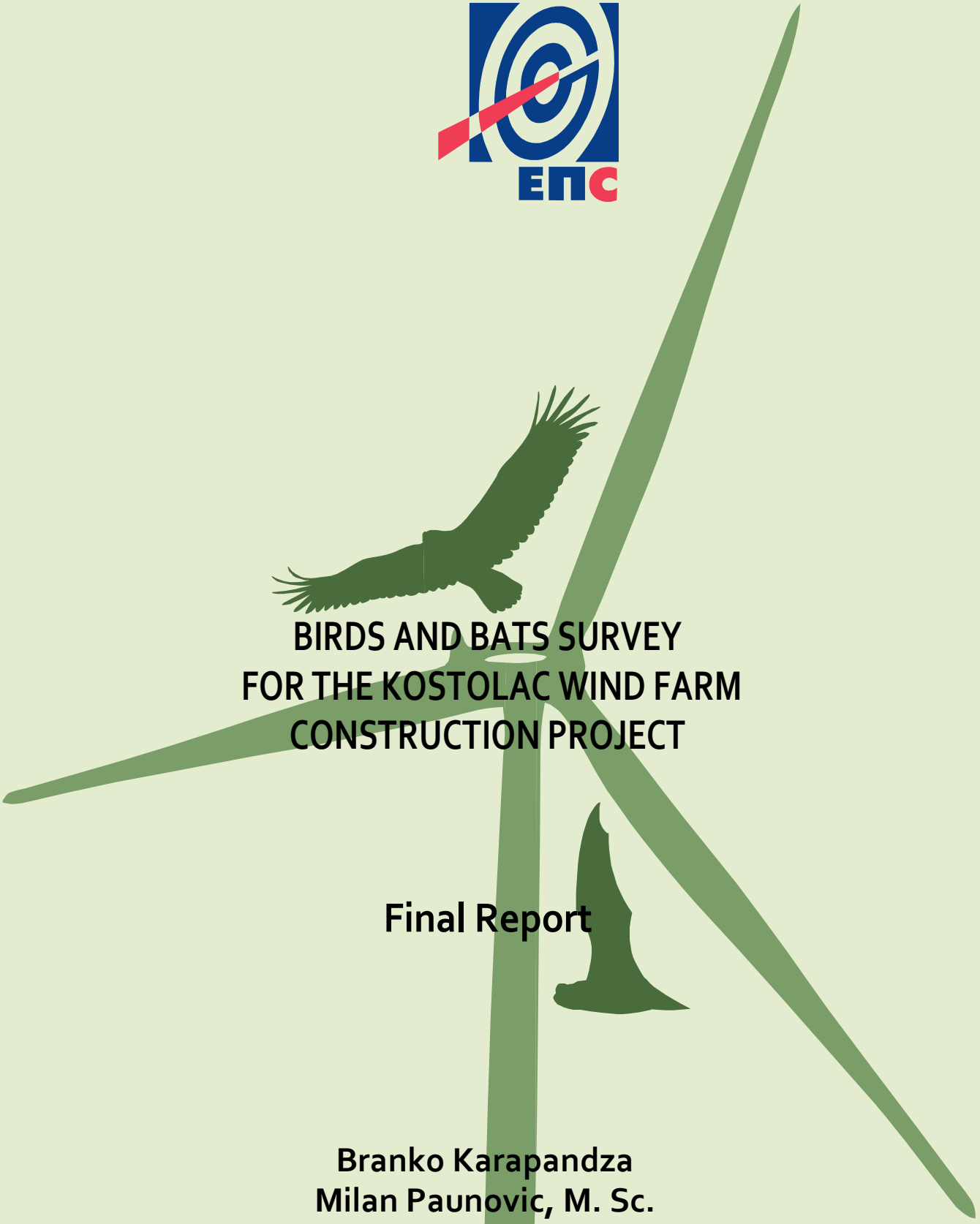

BIRDS AND BATS SURVEY FOR THE KOSTOLAC WIND FARM CONSTRUCTION PROJECT

Final Report

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Belgrade, November 2015

Fauna C&M

netinvest

Project: **Birds and Bats Survey for the Kostolac Wind Farm Construction Project**

Report title: **Final report**

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INTRODUCTION

In line with the Contract (№ 2189/21-14, dated 30 October 2014) signed between the Public Enterprise Electric Power Industry of Serbia as the Employer and the consortium composed of NETINVEST d.o.o. and FAUNA C&M as a the Service Provider, the Service Provider has undertaken to deliver a Final Report and the attached draft Study. The Study presents the collected and analysed results of the one-year birds and bats fauna survey from November 2014 to November 2015 for the Kostolac Wind Farm Construction Project, and will be an integral part of the Kostolac Wind Farm Project Environmental Impact Assessment Study.

This Final Report provides an overview of activities implemented as part of the *Birds and Bats Survey Project* for the *Kostolac Wind Farm Construction Project*. The Service Provider has previously delivered to the Employer the *Existing Documentation Analysis Report*, as well as the *First, Second, Third and Fourth Quarterly Reports describing the implemented services*, approved by the Employer without any objections (Nos 2189/27-14, 1331/1—15,1331/3-15,1331/5-15 and 1331/7-15).

The Birds and Bats Survey Project for the Kostolac Wind Farm Construction Project began with the delivery of the existing documentation and input data in the possession of EPS to the Service Provider, i.e. the relevant planning and project documentation: Geotechnical Field Investigations Project for Wind Farm Development at Kostolac, Preliminary Feasibility Study with the General Design for the Kostolac Wind Farm Development, the corresponding Opinions of the Nature Conservation Institute of Serbia (№020-2014/2 dated 25 August 2011) and adequate digital plans and maps.

Sometime later, or immediately upon arrival i.e. approval, the following documented were delivered: a document containing KfW's recommendations i.e. *Baseline Survey of Birds and Bats at a Wind Farm.docx*, together with the Conditions and Data for the Kostolac Wind Farm Construction Technical Documentation Development (№ 14207/1 dated 8 December 2014) and the Nature Conservation Conditions for the technical documentation development for the Kostolac Wind Farm construction (№ 020-2775/2 dated 29 December 2014) of the Nature Conservation Institute of Serbia.

A specific quality of the planned Kostolac wind farm is that its locations, mostly reclaimed overburden dump sites, are fully covered by the scope of the Kostolac Coal Basin Spatial Plan of Special Purpose (Official Gazette RS, № 1/2013) stipulating that "at the area planned for electricity generation activities, wind energy utilization is (also) planned".

At the beginning of this survey, the Service Providers made a recommendation, accepted by EPS, to apply the ***preventive planning*** principle throughout the Kostolac Wind Farm Project, aimed at bats and birds protection, meaning that negative impacts of project construction and operation should be prevented or reduced to a minimum even during the design/planning phase. This is the most effective way to prevent the harmful effects of projects (Paunovic et al. 2011) and even wind farm projects (Rodrigues et al. 2015), on birds and bats. By applying the principles of preventive planning at the onset of this survey, as a result of the findings and recommendations of the preliminary conflicts analysis undertaken during the preparation of the *Preliminary Report about the Conducted Analysis of the Existing Documentation*, wind farm plan was changed (Figure 3), i.e. positions of individual wind turbines were significantly altered (Figure 42).

Most birds and bats species are protected in Serbia under the Nature Protection Act (Official Gazette RS, № 36/2009a, 88/2010b, 5/2010), while Serbia has ratified all the international conventions regulating the birds and bats protection, of which the most important are the Convention on the Conservation of European Wildlife and Natural Habitats, the so-called Berne Convention (Official Gazette RS, № 102/2007) and the Convention on the Conservation of Migratory Species of Wild Animals, the so-called Bonn Convention (Official Gazette RS, № 102/2007b), also covering most bird species and all species of bats.

The impact of wind farm projects on birds and bats has been recognized by a number of relevant international organizations and agreements, which have in recent years developed several documents providing instructions and guidance relating to this issue. The most important and the most relevant of these documents for Serbia and Europe are the guidelines of the European Commission (European Commission 2010) which includes birds and bats, the report of the Council of Europe and the Berne Convention (Langston and Pullan 2003, Gove et al. 2013) for birds, and for bats, the EUROBATS guidelines (Rodrigues et al. 2008), whose revised version was adopted during the course of this survey (Rodrigues et al. 2015). Guidelines and standards relating to the assessment of the wind farms impact on bats are provided under a separate section of the national guidelines (Paunovic et al. 2011).

The relevant scientific and professional publications do not provide concrete information on birds and bats relating to the narrow zone of the Kostolac Wind Farm. For this reason, this survey also furnishes the first data for this area.

MATERIAL AND METHODS

The underlying methodology of this birds and bats survey was designed on the basis of the Terms of Reference, making an integral part of the Tender Documentation for the public procurement (JP Elektroprivreda Srbije 2014) and became an integral part of the Contract (№ 2189/21-14, dated 30 October 2014).

Bird fauna survey and the potential wind farm impact analysis largely follow the relevant guidelines (European Commission 2010, Langston and Pullan 2003, Gove et al. 2013, Scottish Natural Heritage 2014), taking into account the specificities of the regional bird fauna (Paunovic et al., 1995, Vašica 1995, Puzović et al. 1999; Puzović ed. 2000; Puzović et al. 2006b, 2009; Tucakov et al. 2005, 2009, Tucakov & Vučanović 2008, Vučanović et al. 2010, Šćiban et al. 2012) and the specific characteristics of the location (Puzović et al., 2008 Puzović 2007, 2008). The concept of bat survey and the methods used, results analysis, as well as the suggestion of harmful effects prevention and mitigation measures, for the most part follow the appropriate standard instructions and recommendations (Mitchell-Jones 2004 Mitchell-Jones and Carlin, 2009, Limpens 2010, Hundt 2012, Rodrigues et al. 2008, 2015) and the national methodological guidelines (Paunovic et al. 2011), taking into account the specificities of the wind farm project, the regional specificity of the bat fauna (Paunovic et al. 2004, 2011; Karapandza and Paunović 2010) and the specific qualities of the investigated locations.

Thus defined, birds and bats surveys fully meet, and in some respects go beyond, the methodological requirements set by the Nature Conservation Institute of Serbia under the Nature Protection Conditions for the Kostolac Wind Farm construction technical documentation development (№ 020-2775/2 dated 29 December 2014).

Methodology of this study largely satisfies, and in some respects even exceeds, the recommendations by the KfW for birds and bats surveys throughout the wind farm development projects (*Baseline Survey of Birds and Bats at a Farm Wind.docx*). Any discrepancies are explained in detail and clarified in memos and reports approved by EPS without any objections (№ 2189/27-14 dated 19 November 2014, № 1331/1-15 dated 23 February 2015 and № 1331/3-15 dated 18 May 2015).

This survey consisted of two main groups of activities: **fieldwork** and **cabinet work**. **Fieldwork** involved terrain reconnaissance, identification of itineraries, transects and census points, biotope state identification, field studies of birds and bats, as well as photographic documentation of habitats and species representatives. **Cabinet work** consisted of research and study of the relevant literature, documents and legal regulations, survey methodology identification, database creation and updates, computer analysis of recorded ultrasonic bat signals, photographic documentation organization, analysis of data and reporting.

According to the KfW's recommendations, birds and bats surveys were also carried out inside the control area, in addition to the wind farm location. Control area (Figure 1) was defined in accordance with the KfW's recommendations to the maximum possible extent allowed by the field situation and the specific wind farm location.

Methods used and realized schedule of this survey with days and hours of engagement are shown in Table 1.

Table 1. Overview of the realized schedule of field activities and methods by month. Numbers indicate the number of field working days.

Activities/methods \ Period		2014		2015											Working	
		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	days	hours
Terrain reconnaissance		4													4	36
Birds	Census in points		3	3	3	3	3	3	3	3	3	3	3	3	36	322
Birds	Nesting investigation*					1	3	3	3	3					13	104
Bats	Shelter investigation*		1						1	1		1			4	87
Bats	Manual activity detection***					~~3~~	4	4	4	4	4	4	4	4	32	251
Bats	Automatic activity detection					~~4~~	4	4	4	4	4	4	4	4	32	341

* Nesting surveys were carried out throughout the nesting season, by engaging an additional researcher, but also throughout the census in points method when these working days have not been included.

** Potential shelters were investigated during the special working days, simultaneously with the manual detection of bat activity along transects when these working days have not been included.

***Working days planned for manual and automatic activity detection in March (when they could not be realized because the bat activity had not started yet), with the Employer's approval under the Second Quarterly Report (№ 1331/3-15 dated 18 May 2015), have been reassigned to more extensive detection activities inside the control area throughout the remaining survey period.

Figure 1. Layout of the birds' survey VPs inside the investigated area - wind farm site (white translucent areas) and control sites (red line areas). Source: Google Earth 2013 with the modification, Branko Karapandza, original.

Birds' survey

Underlying assumptions and implementation of this birds' survey, in terms of the applied field investigations methods, are fully aligned with all relevant guidelines (European Commission 2010, Langston and Pullan 2003, Gove et al. 2013, Scottish Natural Heritage 2014) and entirely satisfy, while in terms of the schedule and the level of detail of collected data, go beyond the requirements set by the Nature Conservation Institute of Serbia under the Nature Protection Conditions (№ 020-2775/2 dated 29 December 2014).

Birds' survey lasted from December 2014 to November 2015 and included all growth stages. The investigations were conducted by applying the census method on vantage points (Figure 1), 7 - 5 at the wind farm location, and 2 inside the control area. All the bird species living and/or residing at the location were recorded, according to the above-mentioned vantage points. In particular, target species were specially recorded and considered, i.e. those already considered, based on the international experience, to be particularly vulnerable and disadvantaged by the wind farm construction and operation. In their case, apart from quantity, length of retention was recorded, together with the flight altitude range and direction, behaviour and other characteristics.

Field methodology of this bird fauna survey largely meets the KfW's recommendations (*Baseline Survey of Birds and Bats at a Farm.docx Wind*), with the exception of **radar** only use. In accordance with standard guidelines followed by the KfW's recommendations (Langston and Pullan 2003, European Commission 2010, Gove et al. 2013, Scottish Natural Heritage 2014) radar is only recommended as a method complementary to the visual method and only under the long-term poor visibility conditions and the expected high nocturnal activity of important species. Given that no such weather conditions and no such characteristics of the composition and activities of the bird fauna were expected at the location, the use of radar was not planned as part of the survey methodology, as it was not considered necessary.

In terms of the birds' survey data processing and analysis, the applied methodology fully complies with the most relevant guidelines (European Commission 2010, Langston and Pullan 2003) and fully meets the requirements set by the Nature Conservation Institute of Serbia under the Nature Protection Conditions (№ 020-2775/2 dated 29 December 2014). For the most part, KfW's recommendations and guidelines of the Scottish Natural Heritage (2014) were applied, with the exception of only applying the **collision risk calculation model** defined by the Scottish Natural Heritage (2000). Using this, or any other similar model was not foreseen, as this and similar models involve many approximations and simplifications, as indicated by their authors (Scottish Natural Heritage 2000, 2014), and do not provide nearly as satisfying reliable predictions of the collision risk based on the survey data (e.g. Gove et al. 2013, American Wind Wildlife Institute 2015).

Bats' survey

Underlying bats' survey methodology, both in terms of the field investigation method, as well as data processing and analysis, fully complies with the relevant national (Paunovic et al. 2011) and international (Rodrigues et al. 2008, 2015) guidelines and fully meet the Nature Protection Conditions (№ 020-2775/2 dated 29 December 2014) and KfW's recommendations. In terms of the schedule, i.e. investigations intensity, this survey meets, but also goes beyond the nature protection conditions and KfW's recommendations, necessary to meet adequate, higher international standards (Rodrigues et al. 2008, 2015) also referred by the KfW's recommendations. This bats' survey was fully implemented by applying the best practice principles (Battersby *comp*. 2010).

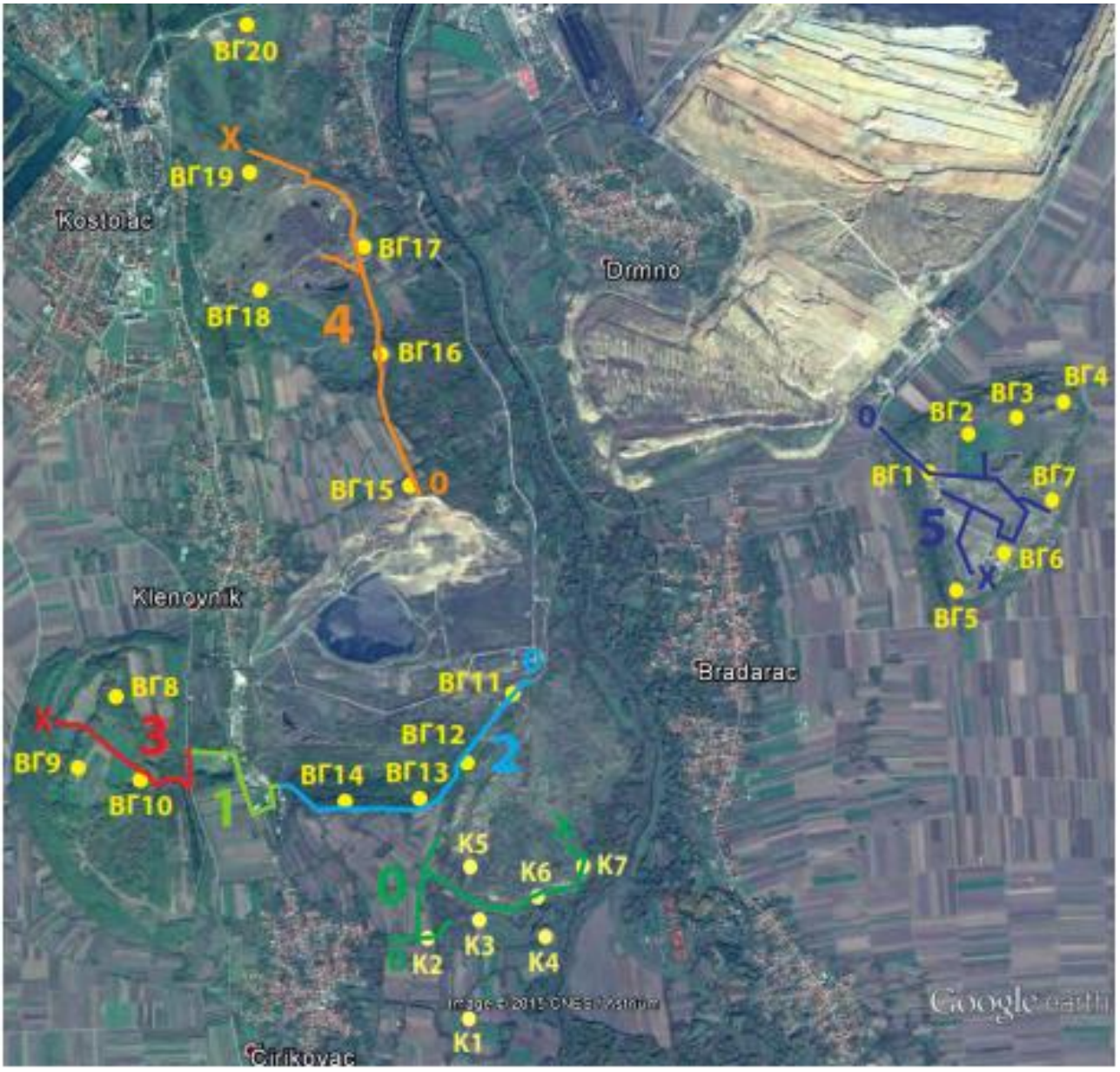

Figure 2. Transect positions (wind farm locations - 2, 3, 4 and 5, immediate vicinity - 1, inside control area - 0) and census points (on locations – VG01-VG20 wind turbine locations, inside control area - K1-K7) for bats' survey.

Source: Google Earth 2014 with the modification, Branko Karapandza, original.

RESULTS AND DISCUSSION

The investigated wind farm location is situated inside an originally forest and marshy area which has long ago been largely altered into agricultural land or agrobiocenoses. The actual wind farm location, as well as the major part of the control area, result from a much more drastic and more recent anthropogenic activity - surface coal mining and overburden dumping, which did not only completely eliminate the vegetation at a given moment, but also transformed the relief. Current vegetation at the location is the result of interactions between the natural process of spontaneous colonization and succession and planning and re-cultivation activities lasting from the moment of mine/dump site closure, therefore, at most a few decades, with the most common ruderal plant communities in different succession stages. Based on the preliminary environmental impact assessment at the beginning of this survey, it was estimated that the wind farm locations have different cryptic and trophic potential for birds and bats, which is clearly shown in Table 2, along with the respective evaluation of the control area and its surroundings.

Table 2. Preliminary evaluation of cryptic and trophic potential of the Kostolac wind farm locations control area and its surroundings, for birds and bats.

Location	Birds		Bats	
	cryptic	trophic	cryptic	trophic
Cirikovac	moderate	moderate	low - moderate[1]	moderate
Petka	high	high	low	high
Klenovnik	high	low - high[2]	low	low - high[2]
Drmno	low	low	low	low
Control area	moderate[3]	moderate - high[3]	moderate - high[3]	moderate - high[3]
Surroundings	high[4]	low[5] - high[4]	high[4]	low[5] - high[4]

[1] along the boundary (Cirikovac OCM management building compound)
[2] inside the area of aquatic and wetland habitats of the closed Klenovnik OCM and along the northern boundary
[3] along the boundary (forest, aquatic and wetland habitats in the valleys of Mogila and Mlava rivers)
[4] preserved aquatic, wetland and forest habitats (mostly in river valleys), settlements
[5] zone of intense current mining and power generation activities

This survey established that on the wind farm location and in the immediate vicinity, representatives of 120 species of birds and at least 19 species of bats were present. Since many of them were recorded in extremely small numbers and only marginally on the sites, this result may be characterized as expected. However, due to the relatively large number of species, it is significant for the fauna of this area. The narrow investigated area of the wind farm location is dominated by species favouring ruderal open habitats and very dense scrubs and bushes, while in some parts, there are also species preferring aquatic and wetland habitats. Although the surroundings contain previously identified and important birds (and bats) habitats, *Labudovo Okno* special protected area and Mogila and Mlava river valleys, as well as ecological corridors of international importance (Danube and Velika Morava), this has no significant impact, as these habitats, unlike the wind farm location, possess ecological resources required to meet all the basic needs of birds and bats.

Birds' survey

When considering the total number of species on all VPs inside the investigated location per month, migratory activity throughout the spring and growth in the number of types from January, peaking in April (n = 71) may be noticed, while, on the other hand, roaming, autumn migrations and wintering from August to December are less prominent, peaking in August (n = 62) (Table 15). The number of target species per month completely follows the trend of the total number of species. Consequently, most of them were registered in April (n = 7) and August (n = 7) (Table 3). Since most of the target species belong to diurnal birds of prey, termination of territoriality and beginning of the roaming period and migration in the second half of August, explains the growth in the number of target species recorded in the second half of the year. Inside the control area, the trend is similar to the investigated area, but with a smaller number of species.

Table 3. Number recorded species per month and vantage point inside the investigated area.

Month		Control area				Wind farm location								
		VP6	VP7	Total		OT1	OT2	OT3	OT4	OT5	Total			
				All	Target						All	Target	All	Target
December		8	11	17	1	13	17	8	8	6	28	4	30	4
January		12	19	25	2	21	18	12	19	12	38	4	42	5
February		5	14	15	1	25	17	8	8	10	33	4	34	5
March		10	22	24	2	30	27	19	19	11	45	5	48	5
April		20	35	39	2	48	39	25	32	24	71	7	74	7
May		19	34	37	2	40	32	18	32	14	65	2	68	3
June		15	32	36	2	43	31	24	23	11	59	4	64	4
July		18	28	31	3	45	27	24	27	21	58	4	59	4
August		25	31	39	2	43	26	24	25	18	61	7	66	7
September		22	34	42	2	34	32	26	20	16	53	5	60	5
October		24	21	32	2	37	31	28	22	19	54	6	57	6
November		18	20	27	2	23	17	14	20	22	37	3	41	4
Total	All	60	77	89		88	87	72	79	58	119		120	
	Target	4	6		8	9	8	9	6	7		16		17

Generally speaking, the most common flight altitude range of most species is up to 50 m - 300 findings, while from 50 to 200 m - 178 findings (Table 4). The maximum daily number of registered target species is really small (see table in Annex 1), therefore one cannot talk about their concentration inside the investigated area. Of the total of 513 recorded flights of target species, 178 were inside the critical altitude zone from 60 to 180 m above the surface, which is only about 35%. The largest number of target species flights - 65% was recorded inside the high-altitude zone up to 50 m and above 200 m from the surface, not critical when it comes to the potential turbine rotor blades impacts.

Table 4. Overview of the number of target species flights by vantage point and altitude ranges.

Species	VP1			VP2			VP3			VP4			VP5			VP6			VP7			TOTAL			
	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K		<	K	>	Σ
Buteo buteo	18	25	13	24	23	5	10	24	4	17	24	3	25	21	3	8	20	1	7	10	1	109	147	30	286
Falco tinnunculus	7			44	4		18	2		24	3		50	7					5			148	16	0	164
Circus aeruginosus	5			3			2	1		3			2			1						16	1	0	17
Accipiter nisus	3						1			1			1			1			2			9	0	0	9
Circus cyaneus	2						1			1	1		3									7	1	0	8
Falco subbuteo		1			1		2	1			1			1		1						3	5	0	8
Casmerodius albus	4																					4	0	0	4
Ciconia ciconia		1			1			1												1		0	4	0	4
Accipiter gentilis				1	1															1		1	2	0	3
Pernis apivorus					1	1																0	1	1	2
Grus grus			2																			0	0	2	2
Ciconia nigra															1							0	0	1	1
Cygnus olor									1													0	0	1	1
Haliaeetus albicilla																				1		0	1	0	1
Circus pygargus				1																		1	0	0	1
Falco vespertinus													1									1	0	0	1
Falco columbarius							1															1	0	0	1
Total flights per range	39	27	15	73	31	6	35	29	5	46	29	3	82	29	4	11	20	1	14		1	300	178	35	513
Total flights	81			110			69			78			115			32			28			513			
% critical flights	33%			28%			42%			37%			25%			63%			46%			35%			
Number of target species	9			8			9			6			8			4			6			17	9	5	

The most sensitive survey subjects are birds of prey belonging to the endangered species. For this reason, they are under the strict protection regime. Of the 17 target species, 12 of them belong to the diurnal birds of prey. Larger birds of prey such as eastern imperial eagle *Aquila heliaca*, or booted eagle *Aquila pennata* and saker falcon *Falco cherrug* have not been recorded inside the investigated location during the surveys, while the white-tailed eagle *Haliaeetus albicilla* was observed only once around VP7 in the control area.

However, the presence of a large number of specimens of small rodents (*Rodentia*) and insectivores (*Lipotyphla*) in agrocoenoses of the investigated location attracts a larger number of diurnal birds of prey such as buzzard, common kestrel and harrier. For this reason, they are dominant, as evidenced by the increasing number of the members of these species of birds relative to other target species (Table 28). From the diurnal birds of prey, most frequent are the buzzard *Buteo buteo* and common kestrel *Falco tinnunculus*, while individual flights of the western marsh harrier *Circus aeruginosus* are relatively frequent. The hawk *Accipiter gentilis* and sparrowhawk *Accipiter nisus* are constantly present in small numbers. The Eurasian hobby *Falco Subbuteo* is also constantly present in small numbers, however, only during the warmest part of the year.

Bats' survey

This survey unequivocally established that bats are always present at wind farm locations, in the immediate vicinity, as well as inside the control area, although on the actual locations, particularly outside urban zones and at greater distances from them, in smaller numbers. In the larger part of the wind farm location area, very low to moderate activity was registered, with the exception of only a few very specific ecological zones where the activity is high, even very high, as well as in the specific ecological entities in the immediate vicinity of the location and the control area.

Almost more than 83% of all flights/contacts registered on transects cover only 3 species: *Pipistrellus kuhlii*, *Pipistrellus nathusii* and *Nyctalus noctula*, while in census points, where due to the specific methodology, flights have not been identified on the species level, 84% of all registered flights on wind turbine points (inside the control area as much as 95%) cover only 2 groups of species: *Pipistrellus/Hypsugo/Miniopterus spp*. and *Nyctalus/Vespertilio spp*. On some transects and/or their parts and/or in certain periods, high, even very high activity of members of these 3 types was registered, while for all of them at the location and/or in the immediate vicinity some important ecological functions were also recorded. Therefore, these three species may be at least to some extent significant for this study, i.e. they may be influenced by the wind farm project. All other species were recorded, both on the transects and the census points, in a far smaller number, the majority only sporadically. As a result, their small number does not point out to the great importance of the location for their populations.

Table 5. Assessment of importance (high, moderate, low, negligible) of ecological functions, activity intensity and relative abundance/number of members of different bat species on wind farm locations.

Species	Shelters	Flight corridors	Hunting territories	Migration inflow	Migration corridors	Activity intensity	Relative abundance/ number
Pipistrellus kuhlii	*not present*	seasonally moderate	seasonally moderate	*not migrating*		seasonally and locally very high	very high
Pipistrellus nathusii	negligible	low	low	negligible	probably negligible	occasionally moderate	moderate
Nyctalus noctula	negligible	low to negligible	locally moderate	negligible	probably negligible	occasionally and locally high	low to moderate
Hypsugo savii	*not present*	potentially moderate	potentially moderate	*not migrating*		potentially high	potentially high to moderate
Other species	*not present*	negligible	negligible	negligible	negligible	negligible	negligible

Based on the data collected throughout this survey and previous knowledge of the immediate and wider environment, ecological functions of the wind farm site landscape for bats was analysed, together with its immediate surroundings. This established that bats use this area and existing habitats, and that they are significant for the present bats (Figure 3, Table 5).

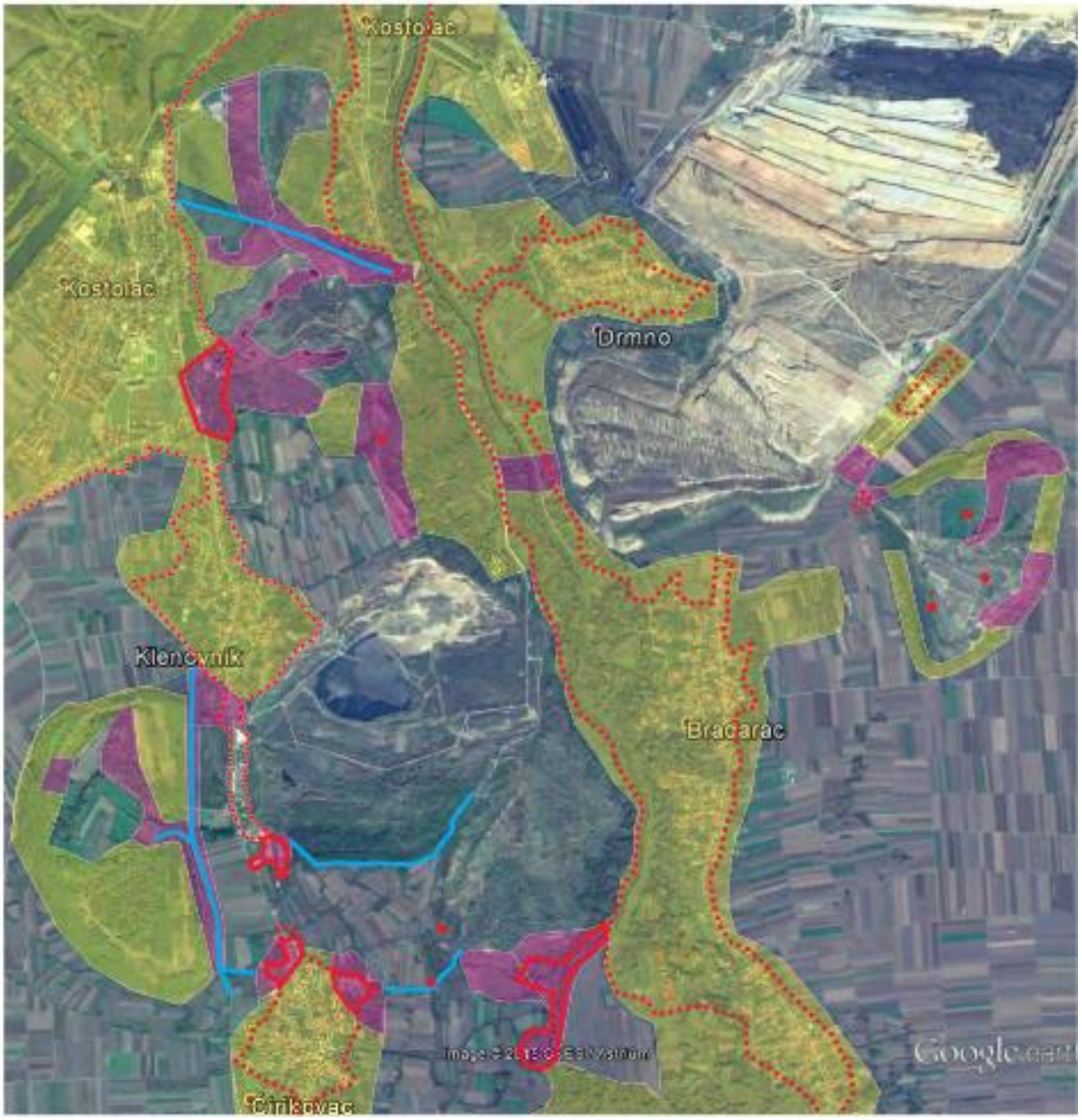

Figure 3. Ecological functions of the Kostolac wind farm landscape, its immediate surroundings and the control area for bats (light blue line - flight corridors, translucent pink/yellow areas - most important registered/potential hunting territories, red dots - registered individual shelters, areas framed by full/dotted red lines - registered/potential shelters areas).
Source: Google Earth 2014 with the modification, Branko Karapandza, original.

CONCLUSIONS: IMPACT ANALYSIS AND RISK ASSESSMENT

Birds

Collected and analysed data allow us to assess the birds' impact of the wind farm construction and operation. Guided by the recommendations based on international experience (Langston and Pullan 2003, European Commission 2010, Gove et al. 2013) target and selected other species were analysed according to the respective potential wind farm impact.

Table 6. Impact assessment (XXX - high negative impact, XX - moderate, X - small, 0 - no impact) of wind farm construction and operation on the target bird species. Number of species members at the investigated location is descriptive.

Species	Impact				
	Disturbance	Barrier effect	Direct collision	Loss of habitat	Number
Cygnus olor	0	X	X	0	extremely small
Casmerodius albus	X	X	0	0	extremely small
Ciconia nigra	0	X	X	0	extremely small
Ciconia ciconia	X	X	XX	0	extremely small
Pernis apivorus	0	X	0	0	small
Circus cyaneus	0	0	X	0	small
Circus pygargus	0	X	X	0	small
Circus aeruginosus	0	0	0	0	small
Accipiter gentilis	0	0	X	0	small
Accipiter nisus	0	0	X	0	small
Haliaeetus albicilla	X	0	0	0	extremely small
Buteo buteo	0	0	XX	0	high
Falco columbarius	0	0	0	0	extremely small
Falco vespertinus	0	0	0	0	extremely small
Falco subbuteo	X	0	X	0	small
Falco tinnunculus	X	0	X	0	high
Grus grus	0	X	X	0	small

Inside the investigated location, no strong negative impacts were established. From target species, storks and herons would be subject to the highest cumulative impact, followed by buzzards, red-footed falcons, including swans, together with other selected species such as the European bee-eaters, field larks and starlings. Although tables clearly demonstrate impact intensities for individual species, it should be noted that the number of members of most of these species is relatively small, and therefore without any significant impact.

Table 7. Impact assessment (XXX - high negative impact, XX - moderate, X - small, 0 - no impact) of wind farm construction and operation on the target bird species. Number of species members at the investigated location is descriptive.

Species	Impact				
	Disturbance	Barrier effect	Direct collision	Loss of habitat	Number
Coturnix coturnix	0	0	0	0	medium
Columba palumbus	0	0	0	0	small
Streptopelia decaocto	0	0	0	0	small
Streptopelia turtur	0	0	0	0	small
Merops apiaster	X	X	XX	0	medium
Alauda arvensis	0	0	X	X	high
Hirundinidae	0	X	X	0	high
Corvidae	0	0	0	0	high
Turdus pilaris	0	0	X	0	small
Sturnus vulgaris	0	X	X	0	medium
Fringillidae	0	0	0	0	medium
Emberizidae	0	0	0	0	medium

In particular, it should be noted that in the project period, i.e. throughout its winter part, there were no extreme winter conditions, and therefore aquatic surfaces of the neighbouring rivers, Danube, Mlava and Mogila were not frozen. For this reason, migratory and wintering flocks of waterfowl and other aquatic habitats have not moved, resulting in the absence of the expected flights of these birds i.e. their flocks. However, if in the future, extreme winter conditions take place, flights of these birds may be expected. Therefore, this observation should be taken into account when possible prevention and mitigation measures are planned.

On the other hand, possible positive impacts of the wind farm and associated infrastructure on certain bird species should be emphasized. Thus, construction of transmission lines representing the necessary ancillary infrastructure may have a significant impact on breeding populations of those bird species of birds finding transmission lines convenient for nesting (Puzović 2007, 2008). As already established, many species gladly nest on transmission lines, such as sparrows *Passer spp*., starlings *Sturnus vulgaris*, raven *Corvus corax*, crow *Corvus cornix*, magpie *Pica pica*. Raven nests are used by birds of prey such as common kestrel *Falco tinnunculus*, buzzard *Buteo buteo*, Eurasian hobby *Falco subbuteo*, even saker falcon *Falco cherrug*, and rarely by eastern imperial eagle *Aquila heliaca*.

Maintenance of the area around the base of wind turbine towers in the form of grass cutting may increase the number of nesting pairs of species disturbed by tall grass, such as the pipit *Anthus spp*., motacilla *Motacilla sp*. and lark *Alaudidae*.

Bats

Based on the field data gathered throughout this survey (Table 5, Figure 3) and the knowledge of environmental and bionomic characteristics of the species (Dietz et al., 2009, Karapandza and Paunovic 2010, Paunovic et al. 2011, Rodrigues et al. 2015), and bearing in mind the current and potential impacts of wind farm projects on bats (Paunovic et al. 2011, Rodrigues et al. 2008, 2015, Eurobats 2015b), it is possible to reliably estimate the impact of a particular wind farm project on bats and assess the risk and potential significance of each of these factors (Table 8). The impact of ultrasound emitted by wind turbines was not considered, as well as the loss of the hunting territory due to wind farm avoidance, given that the literature suggests that these impacts are not significant (Rodrigues et al. 2015).

Table 8. Possible impacts of the Kostolac wind farm project on local and migratory bat populations (potentially) present at the location and assessment of their importance (high, moderate, low, negligible, none). Numbers explained in detail in the text.

Species	Throughout project implementation		Throughout project operation		Population
	Loss of shelter due to construction	Loss of hunting territories due to construction	Loss/disturbance of flight corridor	Direct death (crash, barotrauma)	
Pipistrellus kuhlii	none	low	low	moderate	Local
Pipistrellus nathusii	negligible	negligible	low	moderate	
Nyctalus noctula	negligible	negligible	negligible	moderate to high	
Hypsugo savii	none	none	none	potentially moderate to high	
Other species	negligible or none	negligible	negligible	negligible	
Pipistrellus nathusii	negligible	negligible	negligible	negligible	Migratory
Nyctalus noctula	negligible	negligible	negligible	negligible	

HARMFUL IMPACTS PREVENTION AND MITIGATION MEASURES

The most effective way to prevent harmful project impacts (Paunovic et al. 2011) and even wind farm projects impacts (Rodrigues et al. 2015) on birds and bats is to apply the principle of *preventive planning* aimed at protecting bats and birds, meaning that the negative impacts of project development and operation are prevented or reduced to a minimum even during the design/planning stage.

Upon the recommendation of the Service Provider, EPS accepted the principle of preventive planning and implemented it from the very start of this survey - as a result of the findings and recommendations of the preliminary conflict analysis undertaken throughout the preparation of the *Preliminary Report about the Conducted Analysis of the Existing Documentation*. This resulted in the change of the wind farm plans i.e. the change of wind turbine towers locations at the start of this survey (Figure 4), directly aimed at preventing adverse birds and bats impacts of the project.

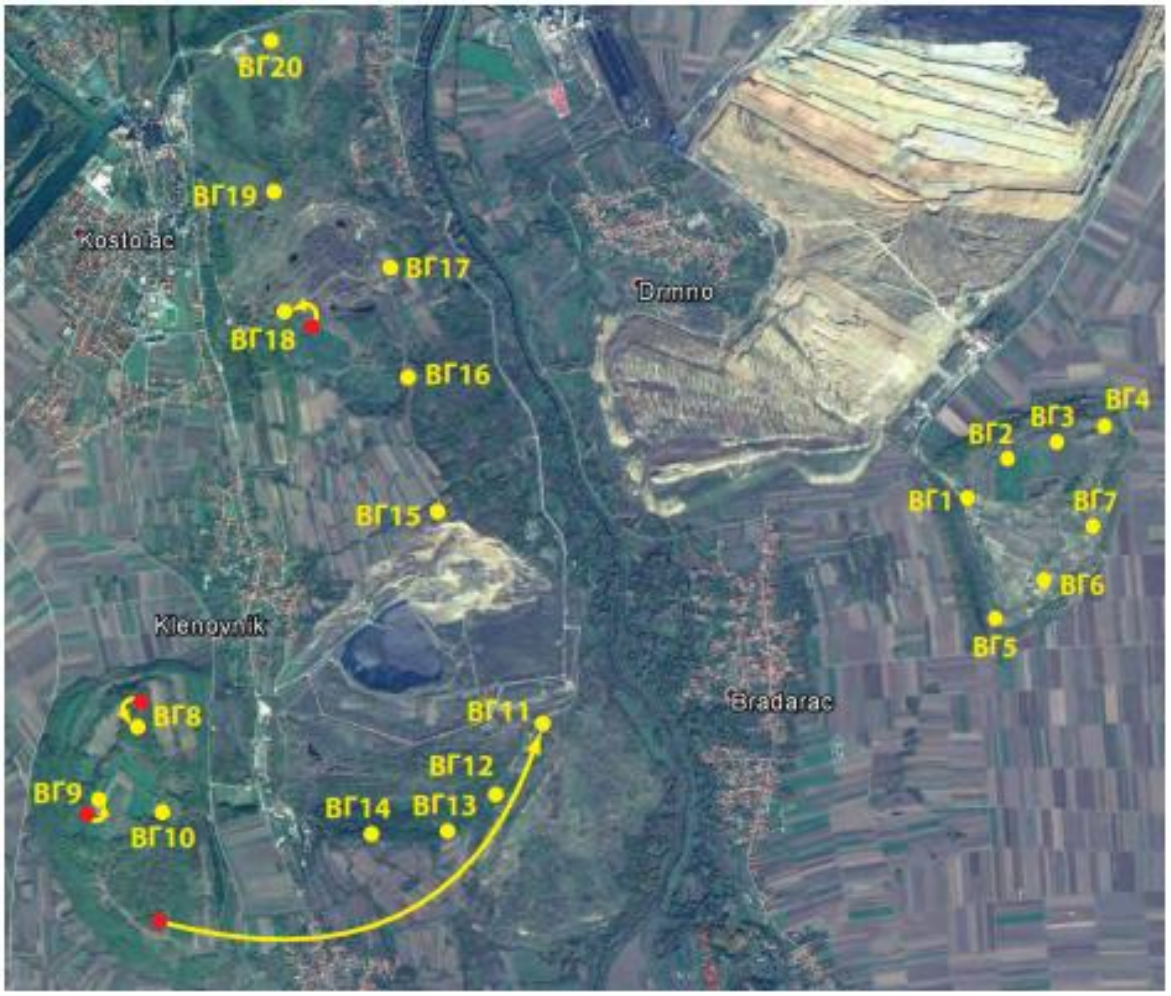

Figure 4. Changes to the wind farm plan as a result of the preliminary conflict analysis at the start of the survey (red - position of wind turbines according to the General Design, i.e. prior to survey, yellow - the position of wind turbines after the initial recommendations of this survey).
Source: JP EPS and Google Earth 2014, Branko Karapandza, original.

Based on the results of this survey and extensive analysis, standard guidelines and recommendations (European Commission 2010, Langston and Pullan 2003, Gove et al., 2013 Scottish Natural Heritage 2014; Paunovic et al 2011, Rodrigues et al. 2008, 2015), and in accordance with the Nature Protection Conditions (№ 020-2775/2 dated 29 December 2014) of the Nature Conservation Institute of Serbia, it was estimated that:

- Majority of the measures necessary to prevent adverse wind farm impacts have already been implemented under **preventive planning** of wind turbine positions aimed at birds and bats protection.

- All wind turbine positions defined by the current plan (Figure 3) are **fully eligible for construction and operation** with the application of certain **general measures**, detailed previously, in order to reduce the concentration of insects in their surroundings, i.e. safety zones of effective 200 m radius, and whenever possible and in the wider area between the wind turbine positions: use of lighting not attracting insects, turning off the lighting not prescribed for safety reasons, and, in particular, **removing and preventing the growth of woody**, shrubby and weed **vegetation**, as well as not allowing water retention in the immediate vicinity of wind turbines.

- On the ***Cirikovac*** location along the main gravel road, but not near the access roads leading to individual wind turbines, at the end of wind farm construction low and narrow linear vegetation structures should be formed, and maintained during operation (avenues of low trees or high hedges).

- As a precaution, at the Klenovnik and Drmno locations, during the nights between 1 March and 30 September, when temperatures higher than 7° C and wind speed lower than 7 m/s (while this measure may be further refined depending on the technical characteristics of the wind farm operating system and post-construction monitoring findings) curtailment/feathering should be planned, but not be implemented if not indicted by post-construction monitoring.

- After project commissioning, **post-construction survey** should be carried out for a period of two years, to monitor the changes in the birds and bats fauna and their ecological functions on locations, and in particular the fatality rate.

- As a precaution, possible installation of an **automatic bird detection** system should be considered, together with the wind turbine shutdown/dispersal. However, it should not be implemented if this is not proven necessary by the post-construction survey results.

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