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PHASE II OF WIND FARM BANIE SUPPLEMENTARY REPORT

RAMBOLL ENVIRON

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SUPPLEMENTARY REPORT

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APPENDICES

1. INTRODUCTION

Banie wind farm project of up to 192MW was originally developed as the following subprojects:

- a group of 13 wind turbine generators (WTGs) in the vicinity of the Sosnowo village (Banie 1A subproject), Banie commune (*gmina)*, Gryfiński county (*powiat*), Zachodniopomorskie voivodeship;
- a group of 2 WTGs in the vicinity of the Piaseczno village (Banie 1B subproject), Banie commune, Gryfiński county, Zachodniopomorskie voivodeship;
- a group of 24 WTGs in the vicinity of the Tywica, Lubanowo, Baniewice and Swobnica villages (Banie 2 subproject), Banie commune, Gryfiński county, Zachodniopomorskie voivodeship;
- development of a group of 3 WTGs in the vicinity of Żelechowo village (Widuchowa subproject), Widuchowa commune, Gryfiński county, Zachodniopomorskie voivodeship;
- a group of 21 WTGs in the vicinity of Rokity, Kozielice and Siemczyn villages (Kozielice 1 subproject), Kozielice commune, Pyrzycki county, Zachodniopomorskie voivodeship;
- a group of 22 WTGs in the vicinity of Mielno Pyrzyckie and Trzebórz villages (Kozielice 2 subproject), Kozielice commune, Pyrzycki county, Zachodniopomorskie voivodeship;
- a group of 11 WTGs in the vicinity of Linie, Stare Chrapowo and Nowe Chrapowo villages (Bielice subproject), Bielice commune, Pyrzycki county, Zachodniopomorskie voivodeship.

Due to the decisions taken by the Company, the Project was divided into 3 separate phases. Construction of the first Phase of 50MW has already been accomplished and this part of the Project is currently tested. Construction of the Phase II of 56 MW has been commenced in mid-January 2016 and is expected to be completed by the end of June 2016. The Phase III of up to 142MW will potentially be constructed in the future, depending on, *inter alia*, the electricity market conditions, renewable energy support scheme and possibility for project financing.

Each of the abovementioned subprojects, apart from the WTGs, consists also of auxiliary infrastructure of access roads, assembly yards and underground steering and power transmission cabling connected to three dedicated electrical substations.

The subprojects were subject to environmental impact assessment (EIA) procedures, which were conducted by competent authorities based on the relevant EIA reports prepared by independent environmental consultants and were granted appropriate environmental decisions. The EIA reports were reviewed by Ramboll Environ Poland (previously ENVIRON Poland) and assessed against requirements of the EIA directive, national environmental law and good industry practice as per IFC Environment Health and Safety Guidelines for Wind Energy. The review indicated in general satisfactory quality of the reports, however, some shortcomings were also identified.

This report has been prepared in order to address the identified shortcomings of the EIA reports and assess related environmental and social risks as well as to address cumulative issues that had not been fully assessed in the individual EIA processes for each permitted wind farm.

2. ALTERNATIVE WIND FARM CONFIGURATIONS

The EIA directive[1] as well as the Polish environmental legislation[2], the EIA report prepared for certain developments should discuss the major reasonable alternatives studied by the developer and indicate the main reasons for selecting the chosen option. As identified by Ramboll Environ within the course of the ESDD, all EIA reports prepared for the Banie and Kozielice 1 subprojects addressed this requirement and were judged as fit for purpose by the Competent Authority. In line with best practice, Ramboll Environ recommended additional issues to be included including the need for more detailed justification of the issue. Therefore, below is provided additional comment on this issue.

The EIA report for the Banie and Kozielice 1 subprojects were drawn up in 2008 and 2009 respectively, when the commune master plans and local zoning plans were already approved by the local authorities. While the master plan draws general directions for the commune development, the local zoning plans constitute acts of a local law, which have to be taken into account at the stage of development planning.

For the Banie subproject the local zoning plans were approved by the Commune Council in April 2005 and for Kozielice 1 and Kozielice 2 in September 2004.

Following the national regulations, namely the Spatial Planning Act of March 23, 2003, both the commune master plan and local zoning plans shall be adopted by the local authorities in line with a procedure, which among others, require public participation and a forecast of environmental impact (strategic environmental impact assessment). In the legal framework in force at the time when the local zoning plans were preceded, consideration of rationale alternative solutions was not required by the act. Therefore, the local zoning plans considered only one variant of wind farm configuration, where the WTGs were located at specific locations. It is understood that these locations were selected taking into account possible impacts on human beings and wild nature and that the process of selection was conducted twice: the first time at during establishment of the communes master plans and the second one during establishment of the local zoning plans. Therefore, although not in such a detailed way as during the EIA procedures, the locations were selected to match environmental, social and potential business needs.

As the local zoning plans introduced specific locations for the WTGs the options for rationale development alternatives become limited to consideration of different technical solutions, i.e. WTGs dimensions, model and capacity, or to reduce the number of WTGs. However, in 2008 and 2009 when the EIA reports were worked out, the WTGs available on the market were characterized by a very similar technical characteristics and parameters. Therefore consideration of rational technical alternatives in fact would lead to very similar results as the variant analyzed in the EIA reports, which considered installation of 2.5 MW WTGs, i.e. of the largest capacity available those times. As the noise emission of WTGs in general rises along with an increase of a capacity it can be concluded, that the most "noisy" model of WTG available was considered, i.e. the reports analyze the worst case scenario from the acoustic point of view.

Change of WTGs dimensions, i.e. hub high or rotor diameter can be also considered as variant solutions. However, selection of these parameters depends on availability of WTGs and even more on wind characteristics in the project development area. The dimensions of WTGs selected for analysis matched the best the wind conditions at the sites, planned capacity of WTGs and expected

[1] Directive of the European Parliament and the Council No. 2011/92/EU on the assessment of the effects of certain public and private projects on the environment with further amendments

[2] The Act on the Environmental Information Disclosure and Environment Protection, Public Participation in Environment Protection and on the Environmental Impact Assessment of October 3, 2008 with further amendments
and before November 2008 the Environment Protection Act of April 27, 2001 with further amendments

productivity of the wind farms. Any other dimensions would likely affect the predicted productivity, hence cannot be considered as rational alternatives.

Conclusion

Although lack of detailed analysis of rational alternatives in the EIA reports is considered a non-compliance issue, in Ramboll Environ opinion it does not affect accuracy of the completed environmental impact assessments of the Banie and Kozielice wind farms. As described above, the studied variants take into account the analyses of the highest capacity WTGs available these times, which match the wind conditions at the sites. The locations of the WTGs were established during the procedures of communes' master plans and local zoning plans approvals and could not be changed. Therefore analysis of any other variant different by the type of WTG, its dimensions or number cannot be considered rational as would affect the aim and business target of the developments.

3. IMPACT ON ARCHITECTURAL AND CULTURAL HERITAGE

The EIA reports for the Banie and Kozielice Subprojects discussion of the potential impact on architectural and archaeological heritage is limited. This issue is discussed below.

The impact on architectural monuments can be considered at the stage of construction, operation and decommissioning of the wind farms. During the construction and decommissioning, as far as the WTGs or their infrastructure is not located at the monuments' area the negative impacts do not occur. During operation of the wind farms, the impact is in practice limited to visual effects which disturb perception of historical monuments.

The following architectural monuments are present in the Banie commune present:

Location	Monument/Object	Monuments Register number	Distance and direction to the nearest WTGs	Visibility assessment
Babinek	Church cemetery	160	2.5 km	Visibility limited by forest. Low risk of impoverishment of the visual values.
Babinek	Mansion park (park dworski)	1048	2.6 km	Visibility limited by local buildings and trees. Low risk of impoverishment of the visual values
Babinek	Church (kościół św. Anny)	160	2.5 km	Visibility limited by local buildings and trees. Low risk of impoverishment of the visual values
Banie	Old Town area (teren Starego Miasta)	70	1.8 km	Visibility limited by local buildings and trees. Low risk of impoverishment of the visual values
Banie	Chapel (kaplica św.Jerzego)	1019	1.9 km	Visibility limited by forest. Low risk of impoverishment of the visual values.
Banie	Jewish cemetery (cmentarz żydowski)	946	1.4 km	Visibility limited by trees and local buildings. Low

				risk of impoverishment of the visual values
Banie	Church (kościół M.B. Wspomożenia Wiernych)	995	1.7 km	Visibility limited by local buildings and trees. Low risk of impoverishment of the visual values
Banie	Tower (baszta Prochowa)	1023	1.6 km	Visibility limited by local buildings and trees. Low risk of impoverishment of the visual values
Baniewice	Church (kościół NSPJ)	996	1 km	Visibility limited by local buildings and trees. Low risk of impoverishment of the visual values.
Dłusko Gryfińskie	Church (kościół MB Królowej Polski)	952	<5 km (irrelevant)	Low risk of impoverishment of the visual values, due to the big distance to the nearest WTGs and visibility limited by trees and buildings.
Kunowo	Church cemetery	172	2.6 km	Visibility limited by local buildings and trees. Low risk of impoverishment of the visual values.
Kunowo	Church (kościół Św. Wojciecha)	172	2.6 km	Visibility limited by local buildings and trees. Low risk of impoverishment of the visual values.
Lubanowo	Mansion park (park dworski)	932	0.8 km	Visibility limited by local buildings and trees. High risk of impoverishment of the local values.
Lubanowo	Church (kościół Chrystusa Króla)	1001	0.9 km	Visibility limited by local buildings and trees. Low risk of the impoverishment of the visual values.
Otoki	Dutch windmill (wiatrak holenderski	948	2 km	Visibility limited by narrow strip of trees. High risk of the impoverishment of the visual values.
Piaseczno	Church (kościół MB Królowej Różańca Św.)	973	1.6 km	Visibility limited by local buildings and trees. Low risk of the impoverishment of the visual values.
Rożnowo	Mansion park (park dworski)	949	3.4 km	Visibility limited by local buildings and trees. Low risk of the

				impoverishment of the visual values.
Rożnowo	Church (kościół M.B. Częstochowskiej)	1179	3 km	Visibility limited by local buildings and trees. Low risk of the impoverishment of the visual values.
Sosnowo	Church (kościół Niepokalanego Poczęcia NMP)	981	0.58 km	Visibility limited by the trees. Medium risk of the impoverishment of the visual values.
Swobnica	Mansion park (park dworski)	760	1.8 km	Visibility limited by the buildings. Low risk of impoverishment of the visual values.
Swobnica	Church(kościół św. Kazimierza)	1025	0.84 km	Visibility limited by the trees. Medium risk of impoverishment of the visual values.
Swobnica	Castle (zamek)	760	1.8 km	Visibility limited by the trees. Low risk of impoverishment of the visual values.

Based on the above table, the Banie 1A, Banie 1B and Banie 2 subprojects will not affect the perception of the registered architectural heritages by the observers from the nearby local roads. Perception of the observers located adjacent to the heritages is not likely to be disturbed in any location. As presented above the possible visibility of the planned wind turbines from the monuments/objects' locations is, in most cases, limited by the natural barriers such as trees or man-made barriers, i.e. higher buildings.

Similarly in the Kozielice commune, the following architectural heritages are registered:

Location	**Monument/Object**	**Register number**	**Distance and direction to the nearest WTGs**	**Visibility assessment**
Czarnowo	church (kościół Ducha Św.)	531	3.8 km	Visibility limited by local buildings and trees. Low risk of the impoverishment of the visual values.
Kozielice	church (kościół św.Stanisława BM)	290	1.1 km	Visibility limited by trees and buildings. Low risk of impoverishment of the visual values.
Łozice	church cemetery	1114	1.4 km	Visibility limited by trees and buildings. Low risk of impoverishment of the visual values.
Łozice	church (ruins)	1114	1.4 km	Visibility limited by trees and buildings. Low risk of impoverishment of the visual values.

Rokity	church (ruins)	534	0.7 km	Visibility limited by forest. Low risk of impoverishment of the visual values.
Rokity	church cemetery	1179	0.7 km	Visibility limited by forest. Low risk of impoverishment of the visual values.
Tetyń	church (kościół MB Królowej Polski)	160	1.2 km	Visibility limited by trees and buildings. Low risk of impoverishment of the visual values.
Załęże	church (kościół Wniebowzięcia NMP)	152	4.5 km	Visibility limited by trees and buildings. Low risk of impoverishment of the visual values.

As presented in the table above, the Kozielice 1 and Kozielice 2 subprojects will not affect the perception of the registered architectural heritages by the observers from the nearby roads. Perception of the observers located adjacent to the heritages will not be disturbed in any location, because of already existing, in most cases, natural barriers such as trees or man-made barriers, i.e. higher buildings.

Unlike the architectural heritage, the archaeological heritage is subject to potential impact at the stage of construction. Based on the Banie and Kozielice Commune Development Master Plans, the areas of archaeological concern are located at the Banie (1A, 1B and 2) and Kozielice (1 and 2) subprojects.

As visible from the Banie Commune Development Master Plan (issued in 2014 by the Head of Banie Commune) approx. 8 WTGs can be potentially constructed directly in the protected archaeological zones, which are covered by the 'Zone WIII', i.e. limited archeological conservation protection of archeological stands or in a very close vicinity of those stands.

According to the Kozielice Commune Development Master Plan (issued in 2013 by the Head of Kozielice Commune) approx. 14 WTGs can be potentially constructed directly in the protected archaeological zones, which are covered by the 'Zone WIII', i.e. limited archeological conservation protection of archeological stands or in a very close vicinity of those stands.

Despite of that fact the construction works are conducted under an archaeological supervision.

Conclusion

Based on the undertaken analysis the potential negative impact generated by the Banie (1A, 1B and 2) and Kozielice (1 and 2) subprojects on the cultural heritage monuments and objects can be assessed as low.

In case of the archeological heritage, the construction phase of the subprojects will be conducted within the area of archeological stands. In order to minimize impacts, the archeological supervision is conducted on a regular basis at the construction site, therefore the potential impact is mitigated.

4. ICE AND BLADE THROW RISK

The risk of ice throw must be taken into account during planning of the wind farm investment. This effect may occur when ice generated on the turbine blades under certain meteorological conditions is thrown away of the blade driven by a centrifugal force. The potential risk was not analyzed in the EIA reports. The EIA report for Widuchowa subproject mentions that ice throw can be assessed as a possible risk in a zone of a radius up to 260 m at the maximum wind speed of 23 m/s. The report states also that there is lack of residential areas in the vicinity, i.e. 250 – 500 m, so the risk is relatively low. Ramboll Environ accomplished calculations according to the guidelines provided by the Wind Energy Production in Cold Climate (Wind Energy Production in Cold Climate Tammelin, Cavaliere, Holttinen, Hannele, Morgan, Seifert, and Säntti, 1997), which suggest the following formula for calculating the safe distance: 1.5 * (hub height + rotor diameter). The rough calculations undertaken for all subproject resulted in the following:

- For Banie 1A, Banie 1B and Banie 2 subprojects the maximum ice throw range will be approximately 395 m;
- For Widuchowa and Bielice subprojects the maximum ice throw range will be approximately 353 m;
- For Kozielice 1 and Kozielice 2 subprojects the maximum ice throw range will be approximately 340 m.

The blade or part of blade throw risk occurs in certain circumstances, e.g. if blade structure is affected by ice or production error, or, if an accident caused e.g. by fire or thunder strike occurs while the blades are rotating. Damaged part of the blade or entire blade is then thrown away by a centrifugal force. Theoretically, the throw range can be calculated based on the kinematic of angular throw, which, for given WTGs correspond to a maximum range of throw of some 1500 m. However, in real conditions the thrown blade or its part is still subject to aerodynamics forces and air resistance and actual distances of throw are typically shorter, which was proved both numerically and by observations of real accidents. Following presentation of Mr. Scott Larwood of California Wind Energy Collaborative presentation (2004 Forum Palm Springs), a throw range for near 100 m tall WTGs is approximately equal to WTG overall height for entire blade, and 2.5 times WTG height for part of it. In the lack of the sound scientific background we have calculated that the blade throw range for the selected WTGs will be as follows:

- For Banie 1A, Banie 1B and Banie 2 subprojects the maximum blade throw range will be approximately 383 m;
- For Widuchowa and Bielice subprojects the maximum blade throw range will be approximately 493 m;
- For Kozielice 1 and Kozielice 2 subprojects the maximum ice throw range will be approximately 488 m.

Ramboll Environ has analyzed locations of the WTGs versus potential places of concern, such as human residences and public roads. Although no human residences were found to be in danger of the ice or blade throw, some local roads are within the risk range. The results of the analysis are presented below.

Subproject	WTG	Road	Type of road	Throw risk
Banie 1A	03	Road from Sosnowo to north direction	Dirt road	Blade
	04	Road from Sosnowo to north direction	Dirt road	Ice and blade
	05	Road from Sosnowo to north direction	Dirt road	Ice and blade
	06	Road from Sosnowo to Banie	Dirt road	Blade
	07	Road from Sosnowo to Banie	Dirt road	Ice and blade
	08	Road from Sosnowo to Banie	Dirt road	Blade
	09	Road from Sosnowo to Banie	Dirt road	Ice and blade

	17	Road from Kunowo to Banie	Asphalt road	Ice and blade
	18	Road from Sosnowo to Banie	Asphalt road	Ice and blade
	19	Road from Kunowo to Banie	Asphalt road	Ice and blade
Banie 1B	31	Road from Dłużyna to Piaseczno	Dirt road	Blade
	32	Road from Banie to Piaseczno provincial road No. 121	Asphalt road	Blade
Banie 2	25	Road from Lubanowo to Babinek	Asphalt road	Ice and blade
	26	Road from Lubanowo to Babinek	Asphalt road	Ice and blade
	27	Road from Lubanowo to Pyrzyce	Dirt road	Ice and blade
	28	Road from Lubanowo to Pyrzyce	Dirt road	Ice and blade
	29	Road from Lubanowo to Pyrzyce	Dirt road	Ice and blade
	33	Road from Pyrzyce to Baniewice	Dirt road	Ice and blade
	37	Road from Pyrzyce to Baniewice	Dirt road	Ice and blade
Widuchowa	04	Road from Żelichowo to Kiełbice	Asphalt road	Ice and blade
	06	Road from Żelichowo to Polesiny	Asphalt road	Ice and blade
Kozielice 1	02	Road from Kozielice to provincial road No 122	Dirt road	Blade
	03	Road from Pyrzyce to Rokity (provincial road No. 122)	Asphalt road	Blade
	03	Road from Kozielice to provincial road No 122	Dirt road	Blade
	12	Road from Kozielice to provincial road No 122	Dirt road	Ice and blade
	7	Road from Kozielice to Łozice	Dirt road	Ice and blade
	10	Road from Kozielice to Łozice	Dirt road	Ice and blade
	11	Road from Kozielice to Łozice	Dirt road	Ice and blade
	13	Road from Kozielice to provincial road No 122	Asphalt road	Ice and blade
	14	Road from Kozielice to provincial road No 122	Asphalt road	Ice and blade
	16	Road from Kozielice to provincial road No 122	Asphalt road	Blade
	18	Road from Trzebórz to Kozielice	Asphalt road	Ice and blade
	19	Road from Trzebórz to Kozielice	Asphalt road	Ice and blade
	18	Expressway S3	Asphalt road	Blade
	19	Expressway S3	Asphalt road	Ice and blade
Kozielice 2	21	Road from Mielno Pyrzyckie to Trzebórz	Dirt road	Ice and blade
	22	Road from Mielno Pyrzyckie to Trzebórz	Dirt road	Blade
	23	Road from Mielno Pyrzyckie to Trzebórz	Dirt road	Ice and blade
	25	Road from Mielno Pyrzyckie to Trzebórz	Dirt road	Ice and blade
	26	Road from Mielno Pyrzyckie to Trzebórz	Dirt road	Ice and blade
	28	Road from Mielno Pyrzyckie to Trzebórz	Dirt road	Ice and blade
Bielice	05	Road from Nowe Chrapowo to Czarnowo	Asphalt road	Ice and blade
	06	Road from Nowe Chrapowo to Czarnowo	Asphalt road	Ice and blade
	05	Road south-west of Nowe Chrapowo	Dirt road	Ice and blade
	06	Road south-west of Nowe Chrapowo	Dirt road	Ice and blade
	07	Road south-west of Nowe Chrapowo	Dirt road	Ice and blade
	09	Road south-west of Nowe Chrapowo	Dirt road	Ice and blade

	10	Road south-west of Nowe Chrapowo	Dirt road	Ice and blade
	11	Road south-west of Nowe Chrapowo	Dirt road	Ice and blade

In order to mitigate the risk for humans it is recommended to:

- place warning signs in due distance at all access roads to individual WTGs;
- in agreement with the public roads management authorities, place boards to inform about entering wind farm area and providing contact details to the Company.

5. CUMULATIVE EFFECT OF THE BIELICE WIND FARM

In direct vicinity of the Bielice subproject there is an existing wind farm comprising 2 WTGs, likely GE 2.5 MW. The distance between the wind farms is a few hundred meters, which suggests existence of a cumulative effect.

In case of wind farms, the strongest cumulative effect occurs for noise, shadow flicker, visual effect and impact on birds and bats. For other impacts, such as e.g. electromagnetic fields the cumulative effect is minor, as such impacts are minor one way or the other.

In order to assess a cumulative noise impact an additional to the EIA noise impact assessment has been conducted by Ramboll Environ for Bielice subproject and the neighboring Nowe Chrapowo wind farm. Also the shadow flicker impact was calculated for the entire project, inclusive of the cumulative effect (see section 6). As the Nowe Chrapowo project consists of 2 WTGs only in direct vicinity of the Bielice subproject an impact for birds and bats is not expected to occur.

Below, a discussion of the most important cumulative impact is provided.

5.1 Cumulative Noise Impact

Legal Background of the Noise Protection

The legal principles related to protection against noise are provided by the Act on Environment Protection of April 27, 2001 (JoL No. 62, Item 627 with further amendments). The Act specifies the following indicators that should be used for assessment of the noise impact:

- L_{AeqD} – equivalent noise level A for daytime, understood as a period between 6 a.m. and 10 p.m
- L_{AeqN} – equivalent noise level A for nighttime, understood as a period between 10 p.m and 6 a.m.

In article 113 the Act specifies, that the permissible noise levels in the environment apply to territories designated for:

- residential developments;
- hospitals and social care facilities;
- buildings designated for permanent or periodical stay of children and teenagers,
- health resorts,
- recreation and relaxation;
- residential and service use.

According to the article 114, designation of the specific areas is classified based on the local zoning plan, except:

- if actual local zoning has different character (e.g. school within a residential area), classification of the area is conducted based on its dominant function;
- if specific area is not acoustically protected in general, (e.g. industrial areas) where certain building subject to acoustic protection are locates, the noise protection is conducted by application of technical measures which assure relevant acoustic climate inside such buildings.

In case of a local zoning plan for certain areas, classification is done by local administration based on the actual area use.

Permissible noise levels in the environment

The permissible emission levels in the environment are defined by executive order of the Minister of Environment of June 14, 2007 *on permissible noise levels in the environment* (t.j. Dz. U. z 2014 r. nr 112). The executive order distinguishes permissible noise level in the environment depending on type of noise emission source. Linear sources (such as roads and railway lines), aerial stationary sources (such as industrial facilities and groups of noise emitters), overhead power lines and high acoustic power sources (such as aircrafts) are treated separately.
Due to the character of the development (construction of a group of wind farms which should be classified as stationary aerial sources), the permissible noise levels in the environment for "other objects and groups of noise emission sources" apply. All permissible noise levels are presented in the table below.

Table 1.1.1. Permissible noise levels in the environment for groups of emission sources, excluding noise generated by overhead Power lines and takes off, landings and flights of aircrafts.

Lp.	Land designation	Permissible noise level expressed as equivalent noise level A in dB			
		Roads and railway lines		Other objects or groups of emission sources	
		L_{AeqD} reference time period equal 16 hours	L_{AeqN} reference time period equal 8 hours	L_{AeqD} reference time period equal to 8 the most unfavorable hours	L_{AeqN} reference time period equal to 1 the most unfavorable hour of night
1	Areas A health resorts Hospitals out of the cities	50	45	45	40
2	Single family housing areas Terrains of permanent Or periodical sty of children or teenagers. Social care facilities Hospitals in the cities	61	56	**50**	**40**
3	Multi apartment blocks. **Faming estates** Recreational and relaxation areas. **Mixed housing and service areas**	65	56	**55**	**45**
4	Downtown areas in the cities of more than 100 thousand inhabitants	68	60	55	45

It should be stressed that the executive order of the Minister of Environment distinguishes special protection zones, which include among others buildings for long stay of children and teenagers, such as kindergartens, schools, hostels and hospitals and health care facilities. If such facilities do not operate during nights, the noise protection rules do not apply within that period of the day. In case of the subject Project, no objects or this type are situated in the area of potential impact and none are forecasted based on the issued permits and administrative decisions.
The Project area is covered by the local zoning plans, which indicate certain locations of the WTGs and define zoning conditions for the surrounding areas. According to the local zoning plans the

lands surrounding locations of the WTGs are designated for agricultural use thus are not subject to legal protection against noise. All villages located in the vicinity of the wind farms that constitute the Project have rural character and housing developments there are classified for acoustic protection as farming estates or residential-servicing development. The permissible noise levels for such development are:

- L_{AeqD} – *reference time period equal 8 hours during the daytime – 55dB(A);*
- L_{AeqN} *– reference time period equal 1 hour during the nighttime – 45dB(A).*

Due to the specific working conditions of WTGs which are taken into account within the acoustic analysis, i.e. continuous work under nominal wind conditions, the assessment of the acoustic impact is referred to the permissible noise level during night. This permissible level is lower than that for the daytime, thus requirements to the work of WTG is more restrictive. Hence, if the noise standards are met for night then are also met for the daytime.

Prognosis of the Project Acoustic Impact on the Environment

The planned wind farms were granted environmental decision issued based on the environmental impact assessment procedures. These procedures were based on the environmental impact assessment reports, which included also detailed analysis of the noise impacts. As the environmental decisions were granted, the analyzed noise impacts must have proven the each of the developments did not cause breaches of the noise standards in the environment.

In order to assess a cumulative noise impact a calculations of the noise distribution in the environment have been conducted. The calculations were focused on the location of the nearest to the both wind farms dwellings. It should be stressed that the calculations were conducted for the worst case scenario, i.e. assuming continuous work of all of the WTGs with their full capacity.

For the calculations a noise propagation model compliant with the standard PN-ISO 9613-2:2002 *Akustyka – Tłumienie dźwięku podczas propagacji w przestrzeni otwartej. Ogólna metoda obliczania (Accoustic. Noise deaden while prepagation in open space. A general method of calculation)*. For the calculations the G coefficient was assumed to be equal 0.5. The modelling results are presented in the below table.

Table 1.1.2. Results of the cumulative noise emission by the Bielice and Chrapowo wind farms.

Municipality	Daily hours			Night hours		
	Permissible level	Forecasted cumulative noise level	Breach of the permissible level	Permissible level	Forecasted cumulative noise level	Breach of the permissible level
Nowe Chrapowo	55dB(A)	44,9dB(A)	none	45dB(A)	44,9dB(A)	none
Czarnowo	55dB(A)	34,7dB(A)	none	45dB(A)	34,7dB(A)	none
Rokity	55dB(A)	28,5dB(A)	none	45dB(A)	28,5dB(A)	none
Łozice	55dB(A)	34,6dB(A)	none	45dB(A)	34,6dB(A)	none

The summary of input data as well as the results are presented in the appendixes.

Conclusions of the Noise Impact Analysis

The noise calculations for both the Bielice and Nowe Chrapowo wind farms indicated, that operations of the both wind farms at the same time will not generate an excessive noise impact. A total noise level for cumulative noise impact of both wind farms will be lower than the permissible value given by the Executive Order of the Minister of Environment of June 14, 2007 *on permissible noise levels in the environment* (Dz. U. of 2014, pos. No. 112).

6. SHADOW FLICKER EFFECT

The rotating blades of the turbine may cause the shadow flicker effect. Such impact impacts have not been mentioned in the EIA reports. In order to assess potential for negative impact of this effect Ramboll Environ commissioned a subcontractor who undertaken a detailed assessment.

Polish law does not regulate in any way the issues related to the reduction of shadow flicker effect. Therefore, any recommendations or restrictions associated with it cannot be applied to the investor. The applied guidelines are based on a document Hinweise zur Ermittlung Und Beurteilung der optischen Immissionen von Windenergieanlagen (WEA-Schattenwurf-Hinweise), which is a basis for shadow flicker analysis in Germany. According to that document, the ratio of the shading duration should not exceed 30 hours per calendar year and should be a maximum of 30 minutes per day. Although these values are not regulated by law, they are also used in many other European countries (e.g. Great Britain, France, and the Netherlands).

The calculations were undertaken for all of the subprojects and additionally for Bielice and Nowe Chrapowo wind farms, where a cumulative effect can be expected. The results show that there are no exceedances of shading levels, which are treated as safe for the real conditions (taking into account data from long-term observations derived from meteorological stations). In none of the points designated for measurements, the meteorological probable length of shading exceeds 30 hours per year and 30 minutes per day. While lack of clouds and barriers between the receptor and wind turbine was assumed, the results showed only the theoretical and maximal impact.

Moreover, based on the calculations for the cumulative impact of two neighbouring wind farms, it can be concluded that the shading levels will not be exceeded neither. In fact it is expected that the real influence would be significantly lower than the outputs of the calculations.

7. IMPACT ON THE NATURA 2000 AREAS

The Natura 2000 European network of nature protection areas has been established in order to prevent habitats and species which are considered to be valuable and threatened in the scale of the continent. It is made up of Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) designated respectively under the Habitats and Birds Directives.

The Natura 2000 areas the closest to the Project are:

- SPAs:
  - Dolina Dolnej Odry (PLB320003), situated over 3 km to the west of the westernmost subproject Widuchowa;
  - Jezioro Miedwie i Okolice (PLB320005) situated over 5 km to the north of the northernmost subproject Banie;
  - Jeziora Wełtyńskie (PLB320004) situated over 5-7 km to the northwest of the subproject Banie;
- SACs:
  - Las Baniewicki (PLH320064) situated approximately 300 m to the west of the Banie 2 subproject;
  - Dolina Tywy - (PLH320050) situated approximately 600-700 m to the west of Banie 2 subproject;
  - Dziczy Las (PLH320060) situated approximately 600 m to the east of Banie 1 and Banie 2 subprojects and 500 m to the west of the Kozielice 2 subproject;
  - Pojezierze Myśliborskie (PLH320060) situated approximately 1.3 km to the south of the Kozielice 1 and Kozielice 2 subprojects.

While the Project impact on birds was assessed in a detailed way and based on the results of the monitoring programs, the impact on nature habitats in the vicinity of the Banie and Kozielice subprojects needs further comments. These are based on the recommended by the European Commission methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC "Assessment of plans and projects significantly affecting Natura 2000 sites".

Brief description of the project or plan

The description of the Project is provided in section 1 above.

Brief description of the Natura 2000 sites

The SACs of concern can be characterized as following:

- Las Baniewicki (PLH320064) – 3 types of habitats belonging to the Annex I of the Habitats Directive No. 92/43/EEC (Annex I: 'Types of natural habitats important from the community point of view for which designation of special protection areas is required') have been identified within that area (codes 3150, 99160 and 91E0);
- Dolina Tywy - (PLH320050) – 16 types of habitats belonging to the Annex I of the Habitats Directive (codes 3140, 3150, 3260, 6120, 6210, 6410, 6430, 7140, 7210, 9110, 9130, 9160, 9170, 9190, 91E0 and 91F0) as well as 2 species listed under Art. 4 of Directive 2009/147/WE (Birds directive) and belonging to the Annex II of the Habitats Directive (Annex II: 'Types of fauna and flora species natural habitats important from the community point of view for which designation of special protection areas is required') have been identified within that area (fish *Cobitis taenia and Rhodeus sericeus amarus*);
- Dziczy Las (PLH320060) - 9 types of habitats belonging to the Annex I of Habitats Directive (codes 3150, 6150, 7140, 9110, 9130, 9160, 91D0, and 91F0) as well as 5 species listed under Art. 4 of Directive 2009/147/WE and belonging to the Annex II of Habitats have been identified within that area (two beetles: *Cerambyx cerdo and Osmoderma eremita*, and 3 birds: *Chlidonias niger, Circus pygarus, Grus grus*);
- Pojezierze Myśliborskie (PLH320060) - 15 types of habitats belonging to the Annex I of the Habitats Directive (codes 3140, 3150, 3160, 6120, 6210, 6410, 6150, 7140, 7210, 7230, 9130, 9130, 9160, 91D0, 91E0 and 91F0) as well as 5 species listed under Art. 4 of Directive 2009/147/WE and belonging to the Annex II of Habitats Directive have been identified within that area (amphibian: *Bombina bombina,* fish: *Cobitis taenia, Cottus gobio,* perennial: *Liparis loeselli* and *shellfish Unio crassus*).

As one can see from the above, the major subject of protection at the nearby Natura 2000 areas are nature habitats, inclusive these of standing waters (31xx codes), running water (32xx codes), grasslands (61xx, 62xx codes), tall-herb humid meadows (64xx codes), Sphagnum acid bogs (71xx codes), Calcareous fens (72xx codes), Forests of Temperate Europe (91xx codes). These habitats appear to be the most sensitive to changes in groundwater conditions (level, quality) and in less extent also air pollution.

Assessment

Wind farms can generate impacts during construction, operation and decommissioning. The most common impacts generated during construction are noise emission, excavation and ground works, secondary dust and products of fuels incinerations emissions. In some extent also soil contamination with fuels, oils or solvents may occur, however, a risk for such contamination is limited if reputable companies are involved. The ground works are related to excavation of soil for foundations and for construction of access roads, assembly yards and underground cabling.

During the wind farm operations the most common impacts include noise emission, impact on birds and bats and impact on humans, such as shadow flicker effect or threat of an ice or blade throw.

The nearest Natura 2000 areas are at least 300 m (in case of the Banie subproject which belongs to Phase III of the Project) or 500 m (in case of the Kozielice 2 subproject belonging to the Phase II of the Project) distant from the nearest WTGs. Construction of WTGs themselves and their associated infrastructure of roads, assembly yards and underground cabling will not affect directly any valuable habitat of the Natura 2000 areas. Such, however, could potentially affect the habitats indirectly, e.g. by disturbance of the groundwater condition in the area and in consequence drying of the sensitive habitats. Significant impact in case of the subject wind farm is not expected to occur as the ground works, even assuming intensive dewatering of the excavations, last too short to generate groundwater depression in a range of a few hundred meters, i.e. reaching the valuable habitats of the Natura 2000 area. This potential indirect effect disappears after completion of the ground works, hence is the short-term one and reversible.

Another indirect impact may be related to contamination of groundwater during the construction works. Given the construction works are executed by reputable companies which adopt strict environmental and health and safety rules, such risk is assessed low.

No other direct or indirect impacts of the construction phase works are expected to occur.

The wind farm construction and operation is not expected to alter any changes of the nearby Natura 2000 areas. In particular no reduction of habitat area will occur, the key species of the area will not be disturbed, no habitat or species fragmentation will take place and the species density will not be reduced. Moreover, the wind farm will not generate any climate change or adverse environmental impacts that might affect the conservation value of the area.

8. SUMMARY OF ENVIRONMENTAL IMPACTS

The table below presents summary of expected environmental impacts of the wind farms during construction, operation and decommissioning.

Environmental impact	Mechanism			Duration			Reversibility	
	Direct	Indirect	Second-ary	Short-term	Medium-term	Long-term	Reversible	Irreversible
CONSTRUCTION PHASE								
Change of the upper soil layer (excavations)	X			X			X	
Topsoil removal	X					X	X	
Impact on flora	X					X	X	
Impact on fauna	X	X		X			x	
Air emission (primary and secondary)	X			X			x	
Noise emission	X			X			x	
Solid waste (mainly excavated soil)	X			X			x	
OPERATIONAL PHASE								
Avoidance of emission from conventional energy sources			X			X	X	
Noise emission	X					X	X	
Solid waste	X					X	X	

Environmental impact	Mechanism			Duration			Reversibility	
	Direct	Indirect	Second-ary	Short-term	Medium-term	Long-term	Reversible	Irreversible
Impact on birds and bats	X	X				X	X	
Landscape impact	X					X	X	
DECOMISISONING PHASE								
Air emission	X			X			X	
Noise emisison	X			X			X	
Solid waste	X			X			X	

APPENDIX 1
ANALYSIS OF NOISE EMISSION

Copy No. 1

Analysis of Noise Emission

Construction of the Bielice wind farm in the area of Zachodniopomorskie Voivodeship

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OPOLE, September 2015

Assotiations and organizations

The analysis of the noise emission of Bielice and Nowe Chrapowo wind farms, located in the commune of Bielice, the Zachodniopomorskie Voivodeship

Made in accordance with Article 66 of the act of 3 October 2008 *on access to information on environment and its protection, public participation in environment protection and assessments of impact on environment* [i.e. Journal of Laws of 2013, item 1235], in particular including data:

Noise

Legal background of the noise protection

The legal principles related to protection against noise are provided by the Act on Environment Protection of April 27, 2001 (JoL No. 62, Item 627 with further amendments). The Act specifies the following indicators that should be used for assessment of the noise impact:

- L_{AeqD} – equivalent noise level A for daytime, understood as a period between 6 a.m. and 10 p.m
- L_{AeqN} – equivalent noise level A for nighttime, understood as a period between 10 p.m and 6 a.m.

In article 113 the Act specifies, that the permissible noise levels in the environment apply to territories designated for:

- residential developments;
- hospitals and social care facilities;
- buildings designated for permanent or periodical stay of children and teenagers,
- health resorts,
- recreation and relaxation;
- residential and service use.

According to the article 114, designation of the specific areas is classified based on the local zoning plan, except:

- if actual local zoning has different character (e.g. school within a residential area), classification of the area is conducted based on its dominant function;
- if specific area is not acoustically protected in general, (e.g. industrial areas) where certain building subject to acoustic protection are locates, the noise protection is conducted by application of technical measures which assure relevant acoustic climate inside such buildings.

In case of a local zoning plan for certain areas, classification is done by local administration based on the actual area use.

Permissible noise levels in the environment

The permissible emission levels in the environment are defined by executive order of the Minister of Environment of June 14, 2007 *on permissible noise levels in the environment* (i.e. Dz. U. z 2014 r. nr 112). The executive order distinguishes permissible noise level in the environment depending on type of noise emission source. Linear sources (such as roads and railway lines), aerial stationary sources (such as industrial facilities and groups of noise emitters), overhead power lines and high acoustic power sources (such as aircrafts) are treated separately.

Due to the character of the development (construction of a group of wind farms which should be classified as stationary aerial sources), the permissible noise levels in the environment for "other objects and groups of noise emission sources" apply. All permissible noise levels are presented in the table 1.1.1.

Table 1.1.1. Permissible noise levels in the environment for groups of emission sources, excluding noise generated by overhead Power lines and takes off, landings and flights of aircrafts.

Lp.	Land designation	Permissible noise level expressed as equivalent noise level A in dB			
		Roads and railway lines		Other objects or groups of emission sources	
		L_{AeqD} reference time period equal 16 hours	L_{AeqN} reference time period equal 8 hours	L_{AeqD} reference time period equal to 8 the most unfavorable hours	L_{AeqN} reference time period equal to 1 the most unfavorable hour of night
1	Areas A health resorts Hospitals out of the cities	50	45	45	40
2	Single family housing areas Terrains of permanent Or periodical sty of children or teenagers. Social care facilities Hospitals in the cities	61	56	**50**	**40**
3	Multi apartment blocks. **Faming estates** Recreational and relaxation areas. **Mixed housing and service areas**	65	56	**55**	**45**
4	Downtown areas in the cities of more than 100 thousand inhabitants	68	60	55	45

It should be stressed that the executive order of the Minister of Environment distinguishes special protection zones, which include among others buildings for long stay of children and teenagers, such as kindergartens, schools, hostels and hospitals and health care facilities. If such facilities do not operate during nights, the noise protection rules do not apply within that period of the day. In case of the subject Project, no objects or this type are situated in the area of potential impact and none are forecasted based on the issued permits and administrative decisions.

The Project area is covered by the local zoning plans, which indicate certain locations of the WTGs and define zoning conditions for the surrounding areas. According to the local zoning plans the lands surrounding locations of the WTGs are designated for agricultural use thus are not subject to legal protection against noise. All villages located in the vicinity of the wind farms that constitute the Project have rural character and housing developments there is classified for acoustic protection as farming estates or residential-servicing development. The permissible noise levels for such development are:

- L_{AeqD} – reference time period equal 8 hours during the daytime – **55dB(A)**
- L_{AeqN} – reference time period equal 1 hour during the nighttime – **45dB(A)**

Due to the specific working conditions of WTGs which are taken into account within the acoustic analysis, i.e. continuous work under nominal wind conditions, the assessment of the acoustic impact is referred to the permissible noise level during night. This permissible level is lower than that for the daytime, thus requirements to the work of WTG are more restrictive. If the wind farms, keeping the noise level standards at night means that these for daytime will be met as well.

Prognosis of the Project acoustic impact on the environment

The planned wind farms hold environmental decision issued after accomplishing the environmental impact assessment procedure. A part of the environmental impact assessment procedure, the environmental assessment report, which includes detailed analysis of the impact of the Project in terms of noise emissions, has been prepared.

Issue of the environmental decision indicates lack of the excessive impacts generated on the acoustic climate.

Noise emission from other wind farms in the area

Essentially, no other wind farms are planed in the area of the wind farms which are a subject of this noise study. The only exceptions are two wind turbines, i.e. Nowe Chrapowo wind farm, which are already operating ("Zespół Elektrowni Wiatrowych Nowe Chrapowo").

The Nowe Chrapowo wind farm is located between the village of Nowe Chrapowo and Łozice, which is approximately 340 m from the planned WTG's No. 9 (EWB9) and No. 11 (EWB11) belonging to the Bielice subproject. The wind farm comprises 2 WTG's of a capacity of 2.5 MW each (probably GE 2.5 MW).

In order to investigate the potential interaction of wind turbines, the Nowe Chrapowo wind farm (as the only wind farm project located in close vicinity) and Bielice subproject were

taken into account for the calculations of the noise distribution in the environment. The calculations were also conducted in the calculations points, which were located in the nearest buildings/residential areas in the neighboring villages.

It should be noted that the calculations were made for the most unfavorable conditions from the acoustic point of view, i.e. assuming that all wind turbines are operating at their full capacity during the whole period of reference.

The calculations were done using a model of noise propagation, in line with ISO 9613-2: 2002 standard: *Acoustics – Attenuation of sound during propagation in the open area. General method of calculation*. The value of G = 0.5 was assumed in the calculations.

The calculation results are shown in the table below.

Table 1.1.2. The results of calculations of the cumulative noise emitted by the wind farms Bielice and Nowe Chrapowo

Location (village)	Daytime			Nighttime		
	Permissible noise level	The predicted level of cumulative noise	Exceedances of the permissible levels	Permissible noise level	The predicted level of cumulative noise	Exceedances of the permissible levels
Nowe Chrapowo	55dB(A)	44,9dB(A)	Lack	45dB(A)	44,9dB(A)	Lack
Czarnowo	55dB(A)	34,7dB(A)	Lack	45dB(A)	34,7dB(A)	Lack
Rokity	55dB(A)	28,5dB(A)	Lack	45dB(A)	28,5dB(A)	Lack
Łozice	55dB(A)	34,6dB(A)	Lack	45dB(A)	34,6dB(A)	Lack

Detailed data input and calculation results along with noise distribution maps are attached to this document.

Conclusions of the noise impact analysis

The calculations conducted for all the wind farms located in the area of Nowe Chrapowo village, i.e. Nowe Chrapowo wind farm (already existing) and Bielice subproject showed that the operations of both wind farms at the same time will not cause a nuisance to the environment in terms of noise emissions. The total noise level, which is the result of cumulative acoustic impacts, generated from both wind farms, will be lower that the permissible noise levels, determined by the Regulation of Minister of Environment of June 14, 2007 on permissible noise levels in the environment (i.e. Dz. U. z 2014 r. nr 112).

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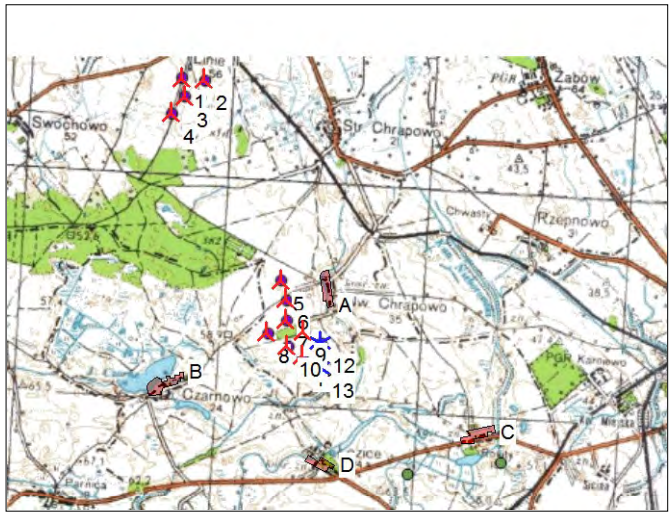
Calculated:
2015-09-27 20:17/3.0.629

DECIBEL - Main Result

Calculation: Noise Emmision of Banie - Kozielice Wind Farm [night]

Noise calculation model:
ISO 9613-2 Poland
Wind speed:
10,0 m/s
Ground attenuation:
General, fixed, Ground factor: 0,5
Meteorological coefficient, C0:
0,0 dB
Type of demand in calculation:
1: WTG noise is compared to demand (DK, DE, SE, NL etc.)
Noise values in calculation:
All noise values are mean values (Lwa) (Normal)
Pure tones:
Pure and Impulse tone penalty are added to WTG source noise
Height above ground level, when no value in NSA object:
4,0 m Allow override of model height with height from NSA object
Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:
0,0 dB(A)



Scale 1:125 000
New WTG
Existing WTG
Noise sensitive area

All coordinates are in
Polish GK 1992/19-ETRS89

WTGs

	Y (east)	X (north)	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Noise data Creator	Name	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones
1	216 286	599 032	31,6	BIE EWB01	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	USER	Level 0 - Mode 0 105,5dB(A) - 07-2013	10,0	105,5	No h
2	216 649	599 007	31,4	BIE EWB02	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	USER	Level 0 - Mode 0 105,5dB(A) - 07-2013	10,0	105,5	No h
3	216 331	598 729	30,0	BIE EWB03	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	USER	Level 0 - Mode 0 105,5dB(A) - 07-2013	10,0	105,5	No h
4	216 112	598 457	37,0	BIE EWB04	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	USER	Level 0 - Mode 0 105,5dB(A) - 07-2013	10,0	105,5	No h
5	217 928	595 676	45,0	BIE EWB05	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	USER	Level 0 - Mode 0 105,5dB(A) - 07-2013	10,0	105,5	No h
6	218 012	595 358	45,0	BIE EWB06	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	USER	Level 0 - Mode 0 105,5dB(A) - 07-2013	10,0	105,5	No h
7	218 008	595 014	48,8	BIE EWB07	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	USER	Level 0 - Mode 0 105,5dB(A) - 07-2013	10,0	105,5	No h
8	217 698	594 810	50,0	BIE EWB08	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	USER	Level 0 - Mode 0 105,5dB(A) - 07-2013	10,0	105,5	No h
9	218 300	594 824	45,0	BIE EWB09	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	USER	Level 0 - Mode 0 105,5dB(A) - 07-2013	10,0	105,5	No h
10	218 033	594 589	47,5	BIE EWB10	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	USER	Level 0 - Mode 0 105,5dB(A) - 07-2013	10,0	105,5	No h
11	218 286	594 428	50,0	BIE EWB11	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	USER	Level 0 - Mode 0 105,5dB(A) - 07-2013	10,0	105,5	No h
12	218 584	594 643	45,0	NC1	Yes	GE WIND ENERGY	GE 2.5-100-2 500	2 500	100,0	150,0	USER	Noise 0	10,0	105,0	No h
13	218 568	594 235	46,8	NC2	Yes	GE WIND ENERGY	GE 2.5-100-2 500	2 500	100,0	150,0	USER	Noise 0	10,0	105,0	No h

h) Generic octave distribution used

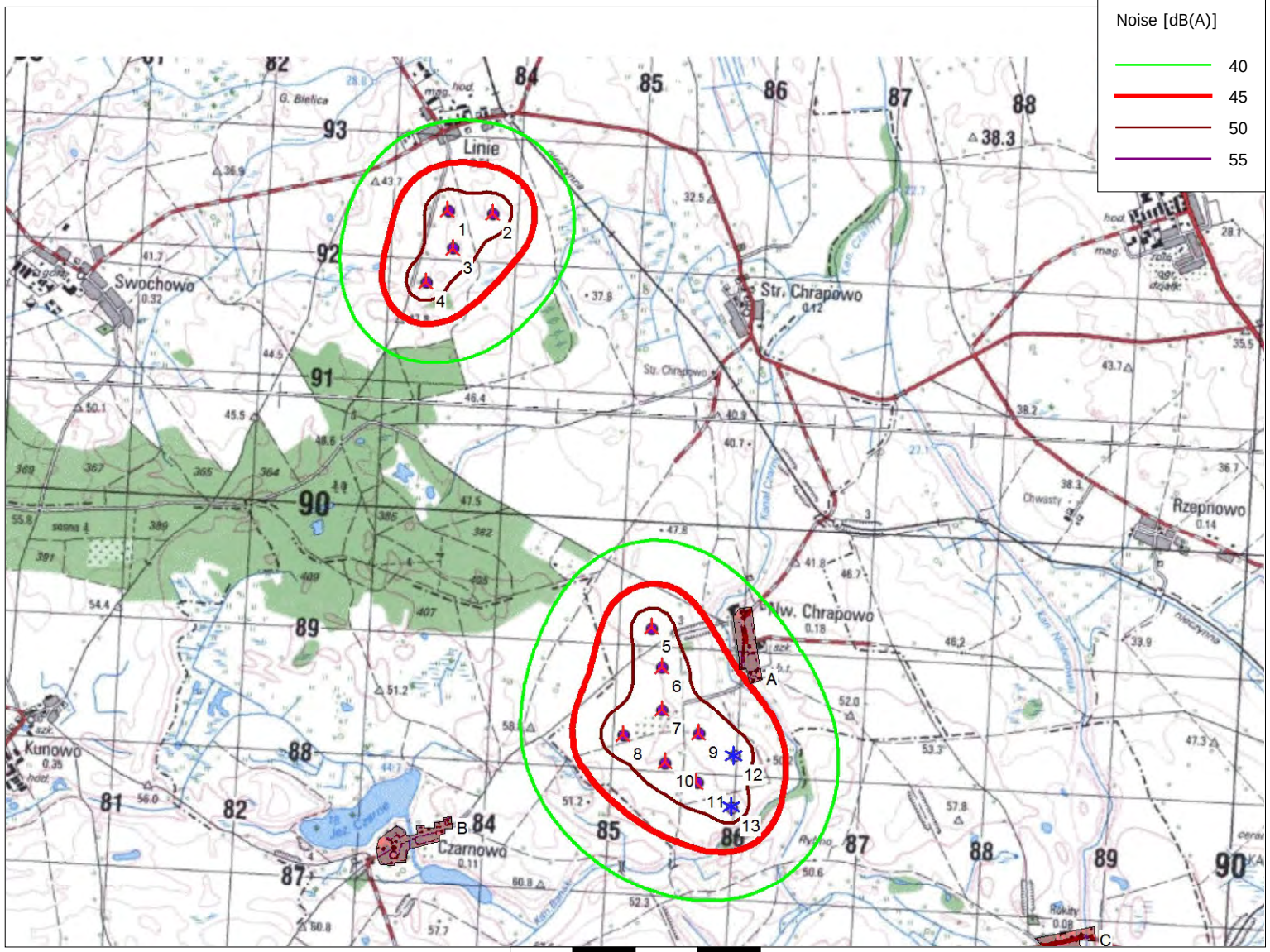
Calculation Results

Sound Level

Noise sensitive area					Demands	Sound Level		Demands fulfilled ?
No.	Name	Y (east)	X (north)	Z [m]	Imission height [m]	Noise [dB(A)]	From WTGs [dB(A)]	Distance to noise demand [m]	Noise
A	Nowe Chrapowo	218 715	595 222	45,0	4,0	45,0	44,9	9	Yes
B	Czarnowo	216 318	594 149	49,5	4,0	45,0	34,7	1 123	Yes
C	Rokity	220 924	593 060	47,1	4,0	45,0	28,5	2 269	Yes
D	Łozice	218 396	592 781	50,8	4,0	45,0	34,6	1 085	Yes

Distances (m)

WTG	A	B	C	D
1	3969	4880	7521	6593
2	3745	4867	7279	6462
3	3701	4577	7258	6292
4	3641	4310	7199	6114
5	659	2218	3967	2930
6	618	2080	3706	2604
7	703	1898	3508	2265
8	1073	1530	3667	2144
9	574	2093	3159	2043
10	930	1770	3268	1842
11	902	1987	2969	1649
12	593	2318	2823	1870
13	997	2249	2631	1463



0 500 1000 1500 2000 m

Map: rejon Chrapowo , Print scale 1:50 000, Map center Polish GK 1992/19-ETRS89 East: 217 550 North: 596 633

New WTG | Existing WTG | Noise sensitive area

Noise calculation model: ISO 9613-2 Poland. Wind speed: 10,0 m/s

Height above sea level from active line object

Project:

WF Banie Kozielice

DECIBEL - Map 10,0 m/s

Calculation:

Noise Emmision of Banie - Kozielice Wind Farm [night]

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Calculated:

2015-09-27 20:17/3.0.629

Project:
WF Banie Kozielice

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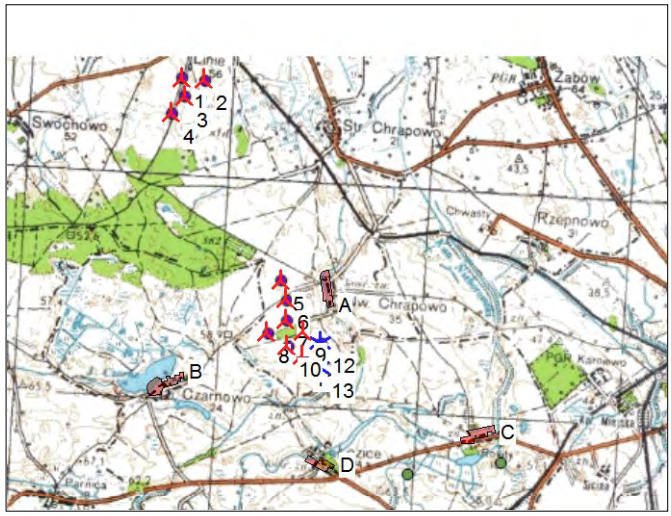
Calculated:
2015-09-27 20:09/3.0.629

DECIBEL - Main Result

Calculation: Noise Emmision of Banie - Kozielice Wind Farm [day]

Noise calculation model:
ISO 9613-2 Poland
Wind speed:
10,0 m/s
Ground attenuation:
General, fixed, Ground factor: 0,5
Meteorological coefficient, C0:
0,0 dB
Type of demand in calculation:
1: WTG noise is compared to demand (DK, DE, SE, NL etc.)
Noise values in calculation:
All noise values are mean values (Lwa) (Normal)
Pure tones:
Pure and Impulse tone penalty are added to WTG source noise
Height above ground level, when no value in NSA object:
4,0 m Allow override of model height with height from NSA object
Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:
0,0 dB(A)



Scale 1:125 000
New WTG
Existing WTG
Noise sensitive area

All coordinates are in
Polish GK 1992/19-ETRS89

WTGs

	Y (east)	X (north)	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Noise data Creator	Name	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones	
1	216 286	599 032	31,6	BIE EWB01	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	USER	Level 0 - Mode 0 105,5dB(A) - 07-2013	10,0	105,5	No	h
2	216 649	599 007	31,4	BIE EWB02	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	USER	Level 0 - Mode 0 105,5dB(A) - 07-2013	10,0	105,5	No	h
3	216 331	598 729	30,0	BIE EWB03	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	USER	Level 0 - Mode 0 105,5dB(A) - 07-2013	10,0	105,5	No	h
4	216 112	598 457	37,0	BIE EWB04	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	USER	Level 0 - Mode 0 105,5dB(A) - 07-2013	10,0	105,5	No	h
5	217 928	595 676	45,0	BIE EWB05	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	USER	Level 0 - Mode 0 105,5dB(A) - 07-2013	10,0	105,5	No	h
6	218 012	595 358	45,0	BIE EWB06	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	USER	Level 0 - Mode 0 105,5dB(A) - 07-2013	10,0	105,5	No	h
7	218 008	595 014	48,8	BIE EWB07	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	USER	Level 0 - Mode 0 105,5dB(A) - 07-2013	10,0	105,5	No	h
8	217 698	594 810	50,0	BIE EWB08	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	USER	Level 0 - Mode 0 105,5dB(A) - 07-2013	10,0	105,5	No	h
9	218 300	594 824	45,0	BIE EWB09	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	USER	Level 0 - Mode 0 105,5dB(A) - 07-2013	10,0	105,5	No	h
10	218 033	594 589	47,5	BIE EWB10	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	USER	Level 0 - Mode 0 105,5dB(A) - 07-2013	10,0	105,5	No	h
11	218 286	594 428	50,0	BIE EWB11	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	USER	Level 0 - Mode 0 105,5dB(A) - 07-2013	10,0	105,5	No	h
12	218 584	594 643	45,0	NC1	Yes	GE WIND ENERGY	GE 2.5-100-2 500	2 500	100,0	150,0	USER	Noise 0	10,0	105,0	No	h
13	218 568	594 235	46,8	NC2	Yes	GE WIND ENERGY	GE 2.5-100-2 500	2 500	100,0	150,0	USER	Noise 0	10,0	105,0	No	h

h) Generic octave distribution used

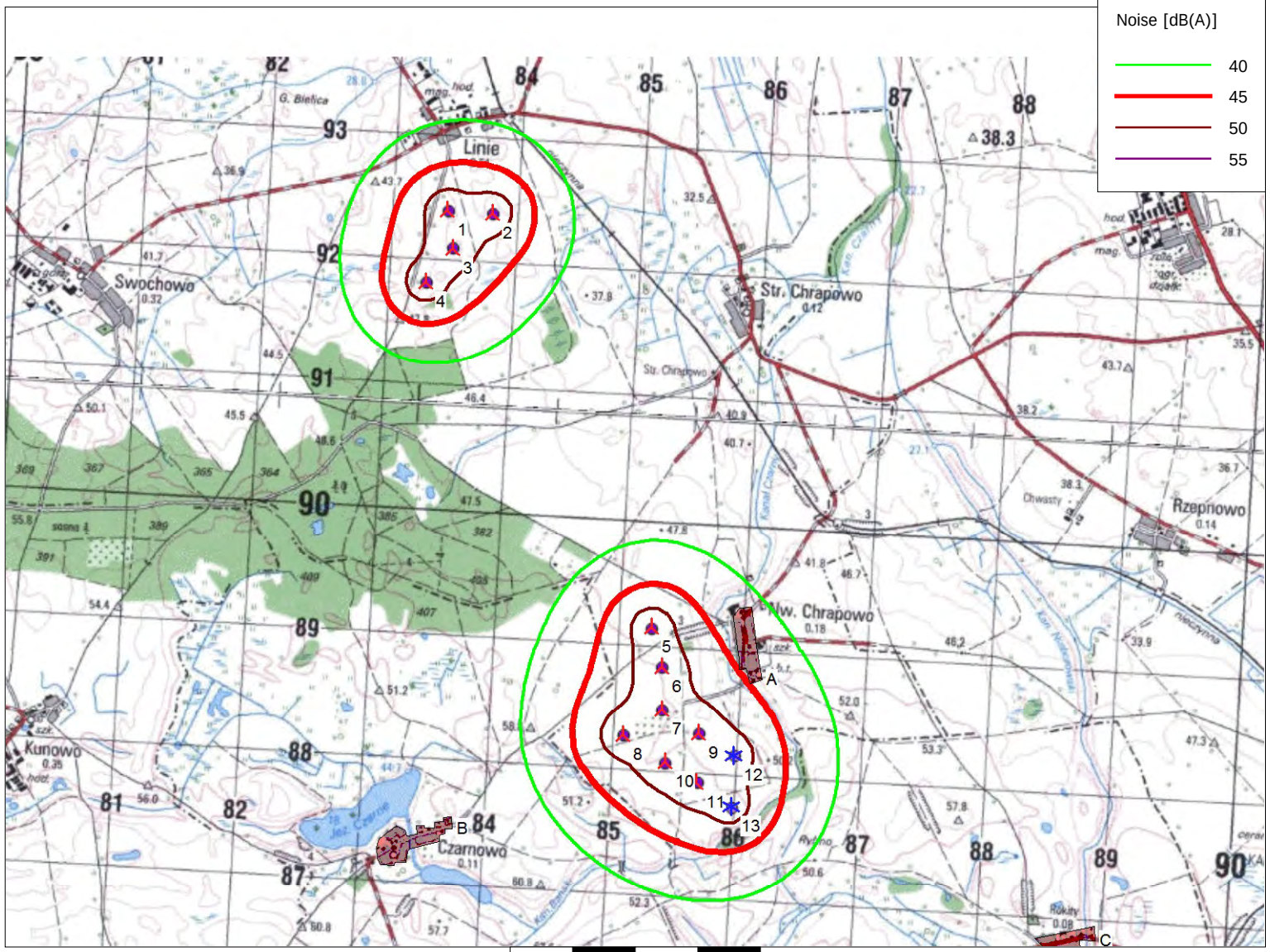
Calculation Results

Sound Level

Noise sensitive area No.	Name	Y (east)	X (north)	Z [m]	Imission height [m]	Demands Noise [dB(A)]	Sound Level From WTGs [dB(A)]	Demands fulfilled ? Noise
A	Nowe Chrapowo	218 715	595 222	45,0	4,0	55,0	44,9	Yes
B	Czarnowo	216 318	594 149	49,5	4,0	55,0	34,7	Yes
C	Rokity	220 924	593 060	47,1	4,0	55,0	28,5	Yes
D	Łozice	218 396	592 781	50,8	4,0	55,0	34,6	Yes

Distances (m)

WTG	A	B	C	D
1	3969	4880	7521	6593
2	3745	4867	7279	6462
3	3701	4577	7258	6292
4	3641	4310	7199	6114
5	659	2218	3967	2930
6	618	2080	3706	2604
7	703	1898	3508	2265
8	1073	1530	3667	2144
9	574	2093	3159	2043
10	930	1770	3268	1842
11	902	1987	2969	1649
12	593	2318	2823	1870
13	997	2249	2631	1463



0 500 1000 1500 2000 m

Map: rejon Chrapowo , Print scale 1:50 000, Map center Polish GK 1992/19-ETRS89 East: 217 550 North: 596 633

New WTG | Existing WTG | Noise sensitive area

Noise calculation model: ISO 9613-2 Poland. Wind speed: 10,0 m/s

Height above sea level from active line object

Project:

WF Banie Kozielice

DECIBEL -

Map 10,0 m/s

Calculation:

Noise Emmision of Banie - Kozielice Wind Farm [day]

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Calculated:

2015-09-27 20:09/3.0.629

APPENDIX 2
ANALYSIS OF VISUAL IMPACTS

Copy No. 1

Analysis of the shadow flicker effect

Construction of a wind farms Banie and Kozielice Zachodniopomorskie Voivodeship

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OPOLE, September 2015

Assotiations and organizations

The analysis of the impact of light phenomena of the undertaking relying on the construction of the wind farm in the region of Banie and Kozielice, the communes of Banie and Kozielice, the Zachodniopomorskie Voivodeship

Made in accordance with Article 66 of the act of 3 October 2008 *on access to information on environment and its protection, public participation in environment protection and assessments of impact on environment* [i.e. Journal of Laws of 2013, item 1235], in particular including data:

Shadow flicker

Legal background of the shadow flicker

National legislation and EU legislation do not contain any standards or guidelines, concerning the analysis of the impact of wind farms as far as the shadow flicker effect is concerned. There is no legal basis governing both acceptable values and methodology as a basis for this type of analyses. In this case it seems justifiable to use the experience of other European countries where the issue of shadow flicker has been recognized and found its reflection either in specific methodology of forecasting this effect or in the guidelines on acceptable values. For the purpose of this documentation the German experience has been used. It is the country which has many years of experience in the field of wind energy, including practical experience connected with operation of many wind farms. Furthermore, Germany's geographical position makes the general meteorological conditions similar to those occurring in Poland.
In accordance with the document called “Hinweise zur Ermittlung Und Beurteilung der optischen Immissionen von Windenergieanlagen (WEA-Schattenwurf-Hinweise)”, which is the basis for analyzing the shadow flicker in Germany, the indicator of the duration of shading should not exceed 30 hours per calendar year. The indicator of the duration of shading during the day should be maximum 30 minutes. The same values are used in many other European countries, although they are not regulated by law (e.g. Great Britain, France, and Holland).

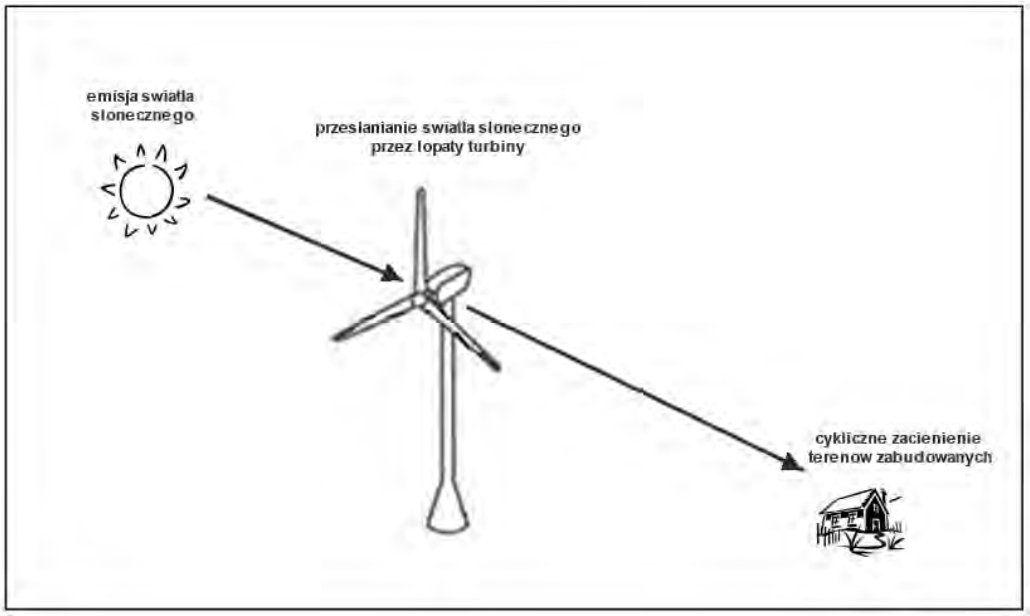
Prognosis of the Project shadow flicker impact on the environment

The shadow flicker effect relies on a cyclical shading of the sunlight by the moving turbine blades. The sun rays falling on the turbine are shaded, which causes that a dynamic shadow appears. The intensity of the effect, and in the process its perception by people, depends on several factors:

- the height of and diameter of the rotor
- distances of the observer from the wind farm - the further the residential areas are from the investment, the smaller is the effect of shadow flicker. It is assumed that the shadow flicker is not perceptible from a distance equal to 10 times the diameter of the rotor (in average from 400 - 800 meters),
- the season of the year,
- cloudiness - the greater the extent of cloudiness, the smaller the intensity of shadow flicker
- presence of trees between the wind turbine and the *observer* - trees and buildings existing between the WTG and the observation point significantly reduce the shadow flicker effect
- window exposition in buildings, which are in the shadow flicker zone

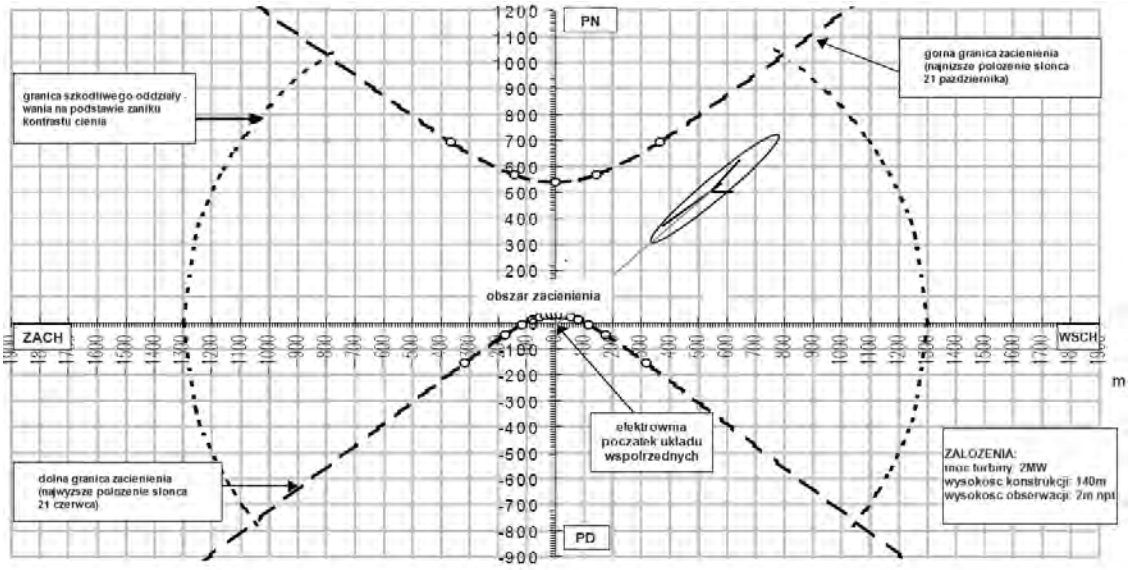
- light in the room - if a given room has an additional artificial lighting or light comes through a window, which is not in the zone of shadow flicker, the intensity of this effect may be significantly limited.

. The shadow flicker effect has been presented in **Drawing 1.1.1.**



Drawing. 1.1.1. The shadow flicker effect

The area that is subject to the impact of the shading effect is variable during the year. This is due to the different height of the sun above the horizon during the whole year. **The maximum range of the impact is therefore during the fall and spring**. Potential shading area of a big wind power plant (> 2 MW) is shown in **DRAWING 1.1.2**.



Rys. 1.1.2. Potential shading area of a big wind power plant

The remaining the shadow flicker effect directly affects the ability to concentrate and ability to perform works. Under the most unfavorable conditions, this phenomenon can lead to irritability

Shadow flicker effect from WTG's

In order to determine the scope and intensity of the impact of the designed wind power plant Banie – Kozielice in relation to the shadow flicker effect, the German guidelines have been used, which are defined in the document “Hinweise zur Ermittlung Und Beurteilung der optischen Immissionen von Windenergieanlagen (WEA-Schattenwurf-Hinweise)”.

The methodology of works connected with building a calculation model comprised the following assumptions:

- minimum height of the sun above the horizon: 3 º,
- the shadow flicker effect will occur when the rotor will shade at least 20% of the falling light,
- calculations of the impact of the shadow flicker effect were made at a height of 1.5 m above ground level,
- calculations of the impact of the shadow flicker effect were made for each day of the year separately, assume that each year has 365 days,
- calculation step was defined every 1 minute.

One of the most essential elements of the calculation model is to define meteorological data concerning insolation. In the subject case there have been adopted average values from many years to central Poland confirmed by the analysis of maps of insolation for the whole territory of Poland made available by the Institute of Meteorology and Water Management (the material made available on www.imgw.pl). The tabulated statistical probability of insolation has been presented in the table below.

Table 1.1.1. Average daily insolation throughout the year

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Hourly insolation during the day [h/day]	1,33	2,19	3,53	5,54	7,87	7,57	7,41	7,34	4,73	3,34	1,48	1,08

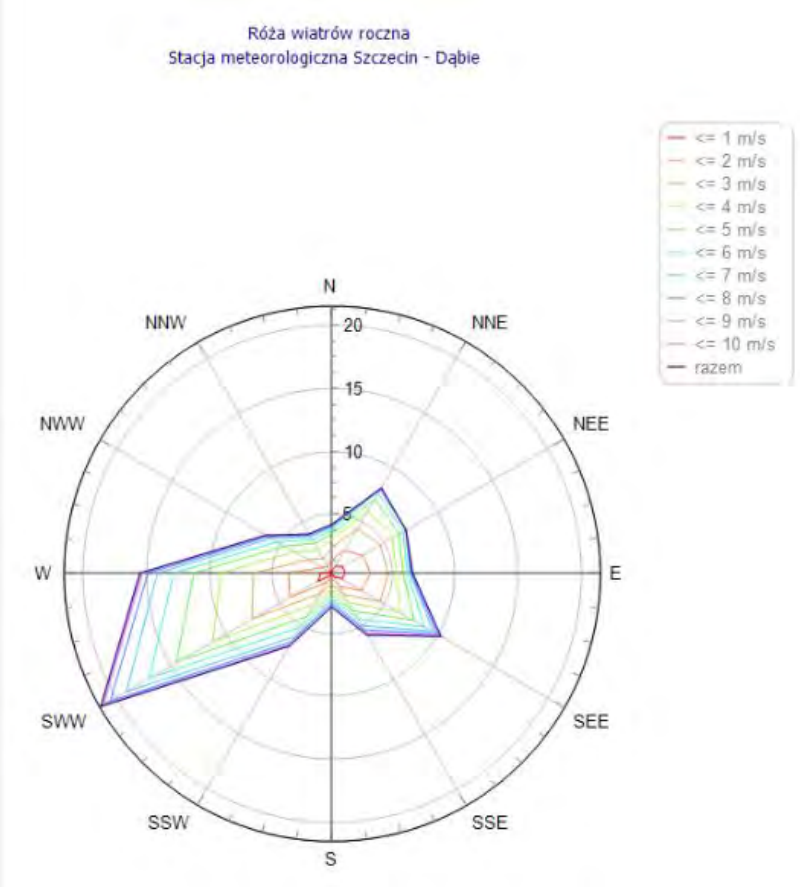
The second element of the calculation model is to define the frequency of the occurrence of particular winds. This value directly affects both, the work time of the wind turbines and the location of the rotor blades against the falling sun’s rays. In that subject case the meteorological data coming from the research for the city of Szczecin conducted for many years have been used. The distance between the designed wind power plant and the city of Szczecin is about 40 km, which in case of meteorological phenomena (especially those coming from many years standing statistical research) is a small distance allowing successfully to apply the data. The tabulated meteorological data have been presented in the table below.

Table 1.1.2. The frequency of specific wind directions [h/a]

	NNE	NEE	E	SEE	SSE	S	SSW	SWW	W	NWW	NNW	N
1 m/s	79	69	65	100	58	29	68	207	150	61	38	40
2 m/s	117	102	97	148	85	44	100	307	222	91	56	60

3 m/s	128	112	106	162	93	48	110	337	244	100	61	65
4 m/s	117	102	97	148	85	44	100	307	222	91	56	60
5 m/s	95	83	79	120	69	35	81	250	181	74	45	49
6 m/s	69	61	57	87	51	26	59	182	132	54	33	35
7 m/s	53	47	44	67	39	20	45	140	101	41	25	27
8 m/s	33	29	28	42	24	12	28	87	63	26	16	17
9 m/s	15	13	13	19	11	6	13	40	29	12	7	8
10 m/s	6	5	5	7	4	2	5	15	11	4	3	3
>10 m/s	4	4	4	5	3	2	4	11	8	3	2	2
Razem*	**520**	**457**	**432**	**658**	**380**	**194**	**446**	**1369**	**991**	**406**	**248**	**266**

* total time for wind with speed over 2 m/s has been included (above the start speed of wind turbines)



Rys. 1.1.1. The wind rose for the meteorological station Szczecin Dąbie.

Because of the fact that the starting wind speed for wind turbines with a capacity of 2 MW is 2.5m/s, duration of winds with lower speed was treated as a period of atmospheric silence occurrence.

The Banie-Kozielice project is intended to be implemented in three stages. However, calculations for the shadow flicker effect were performed for the target project size, ie. assuming realization of all components of wind farms.

The calculations, in accordance with the guidelines of the document Hinweise zur Ermittlung Und Beurteilung der optischen Immissionen von Windenergieanlagen (WEA-Schattenwurf-Hinweise) have been conducted each time at the height of 1,5m above ground level.
The calculations of shading have been conducted in 30 calculation points localized by resident buildings, existing in an area of the potential impact of the designed wind power plant Banie - Kozielice.. In both cases there have been analyzed theoretical values (the worst-case scenario) and statistical values based on many years standing meteorological observation (the real scenario). The results of the calculations have been presented in tables below.

Table 1.1.3. Shading time for the period of one day

	Calculation point localization	Theoretical astronomic length of the time of shading	Impact in real conditions (meteorological probable length of the time of shading)		
			Acceptable level of shading	Meteorological probable length of the time of shading	Exceeding the acceptable level
1	Swochowo	0:09 h/day	0:30 h/day	0:01 h/day	---
2	Stare Chrapowo	0:11 h/day	0:30 h/day	0:01 h/day	---
3	Nowe Chrapowo	0:45 h/day	0:30 h/day	0:05 h/day	---
4	Czarnowo	0:22 h/day	0:30 h/day	0:02 h/day	---
5	Łozice	0:17 h/day	0:30 h/day	0:02 h/day	---
6	Rokity	0:42 h/day	0:30 h/day	0:04 h/day	---
7	Linie	1:11 h/day	0:30 h/day	0:07 h/day	---
8	Sicina	0:15 h/day	0:30 h/day	0:02 h/day	---
9	Nowielin	0:10 h/day	0:30 h/day	0:01 h/day	---
10	Krzemlin	0:00 h/day	0:30 h/day	0:00 h/day	---
11	Przydarłów	0:12 h/day	0:30 h/day	0:01 h/day	---
12	Siemczyn	0:21 h/day	0:30 h/day	0:02 h/day	---
13	Kozielice (cz. zachodznia)	0:52 h/day	0:30 h/day	0:05 h/day	---
14	Kozielice (cz. wschodnia)	0:52 h/day	0:30 h/day	0:05 h/day	---
15	Mielno Pyrzyckie	0:24 h/day	0:30 h/day	0:02 h/day	---
16	Zadeklino	0:07 h/day	0:30 h/day	0:01 h/day	---
17	Trzebórz	0:45 h/day	0:30 h/day	0:05 h/day	---
18	Tetyń	0:00 h/day	0:30 h/day	0:00 h/day	---
19	Babinek	0:05 h/day	0:30 h/day	0:01 h/day	---
20	Lubanowo (cz. zachodnia)	0:26 h/day	0:30 h/day	0:03 h/day	---
21	Lubanowo (cz. wschodnia)	1:04 h/day	0:30 h/day	0:06 h/day	---
22	Sosnowo	0:38 h/day	0:30 h/day	0:04 h/day	---
23	Tywica	0:41 h/day	0:30 h/day	0:04 h/day	---
24	Kunowo	0:11 h/day	0:30 h/day	0:01 h/day	---
25	Banie	0:00 h/day	0:30 h/day	0:00 h/day	---
26	Dłużyna	0:00 h/day	0:30 h/day	0:00 h/day	---
27	Piaskowo	0:24 h/day	0:30 h/day	0:03 h/day	---
28	Piaseczno	0:00 h/day	0:30 h/day	0:00 h/day	---
29	Baniewice	1:06 h/day	0:30 h/day	0:07 h/day	---
30	Swobnica	0:34 h/day	0:30 h/day	0:04 h/day	---

Table 1.1.4. Shading time for whole year.

	Calculation point localization	Theoretical astronomic length of shading time	Impact in real conditions (meteorological probable length of shading time)		
			Acceptable shading level	Meteorological probable length of shading time	Exceeding the acceptable level

				duration	
1	Swochowo	1:00 h/year	30:00 h/year	0:14 h/year	---
2	Stare Chrapowo	4:54 h/year	30:00 h/year	1:01 h/year	---
3	Nowe Chrapowo	85:17 h/year	30:00 h/year	12:48 h/year	---
4	Czarnowo	21:41 h/year	30:00 h/year	5:32 h/year	---
5	Łozice	14:29 h/year	30:00 h/year	1:14 h/year	---
6	Rokity	33:29 h/year	30:00 h/year	2:59 h/year	---
7	Linie	85:16 h/year	30:00 h/year	5:22 h/year	---
8	Sicina	5:01 h/year	30:00 h/year	0:51 h/year	---
9	Nowielin	3:07 h/year	30:00 h/year	0:35 h/year	---
10	Krzemlin	0:00 h/year	30:00 h/year	0:00 h/year	---
11	Przydarłów	3:22 h/year	30:00 h/year	0:53 h/year	---
12	Siemczyn	21:07 h/year	30:00 h/year	2:09 h/year	---
13	Kozielice (cz. zachodznia)	85:57 h/year	30:00 h/year	14:26 h/year	---
14	Kozielice (cz. wschodnia)	77:57 h/year	30:00 h/year	12:38 h/year	---
15	Mielno Pyrzyckie	30:01 h/year	30:00 h/year	2:45 h/year	---
16	Zadeklino	0:43 h/year	30:00 h/year	0:05 h/year	---
17	Trzebórz	98:19 h/year	30:00 h/year	16:28 h/year	---
18	Tetyń	0:00 h/year	30:00 h/year	0:00 h/year	---
19	Babinek	0:26 h/year	30:00 h/year	0:03 h/year	---
20	Lubanowo (cz. zachodnia)	21:37 h/year	30:00 h/year	4:19 h/year	---
21	Lubanowo (cz. wschodnia)	85:38 h/year	30:00 h/year	16:51 h/year	---
22	Sosnowo	62:28 h/year	30:00 h/year	4:46 h/year	---
23	Tywica	56:46 h/year	30:00 h/year	6:13 h/year	---
24	Kunowo	2:57 h/year	30:00 h/year	0:35 h/year	---
25	Banie	0:00 h/year	30:00 h/year	0:00 h/year	---
26	Dłużyna	0:00 h/year	30:00 h/year	0:00 h/year	---
27	Piaskowo	23:04 h/year	30:00 h/year	5:50 h/year	---
28	Piaseczno	0:00 h/year	30:00 h/year	0:00 h/year	---
29	Baniewice	79:57 h/year	30:00 h/year	5:59 h/year	---
30	Swobnica	30:28 h/year	30:00 h/year	5:52 h/year	---

The results of the calculations: being the direct printout from the calculation program: have been enclosed to this document in a form of a printout and in an electronic form (a CD).

Shadow flicker from other wind farms in the area

Currently there are no other wind projects in the area of the designed wind farm, except from those which are the subject of this document. The only exception are two wind turbines which are part of Nowe Chrapowo project ("Zespół Elektrowni Wiatrowych Nowe Chrapowo"), described in the preceding parts of the document.

To define a cumulative impact of shading effects the calculations have been made taking into account Nowe Chrapowo i Bielice projects (as only wind project which is situated in potential area of cumulative impacts). Calculations have been also made in calculation points located at the external buildings, nearest to the village.

The results of the calculations have been presented in tables below.

Table 1.1.5. Shading time for the period of one day – cumulative impact

	Calculation point localization	Theoretical astronomic length of shading time	Impact in real conditions (meteorological probable length of shading time)		
			Acceptable shading level	Meteorological probable length of shading time duration	Exceeding the acceptable level
1	Nowe Chrapowo	0:45 h/day	0:30 h/day	0:05 h/day	---
2	Czarnowo	0:22 h/day	0:30 h/day	0:02 h/day	---

Table 1.1.6. Shading time for the whole year – cumulative impact

	Calculation point localization	Theoretical astronomic length of shading time	Impact in real conditions (meteorological probable length of shading time)		
			Acceptable shading level	Meteorological probable length of shading time duration	Exceeding the acceptable level
1	Nowe Chrapowo	85:17 h/year	30:00 h/year	12:48 h/year	---
2	Czarnowo	24:37 h/year	30:00 h/year	6:11 h/year	---

Detailed data and calculation results with calculation results with noise distribution maps have been enclosed to this document.

Conclusions of the shadow flicker impact analysis

It results from the conducted calculations that shading levels which are treated as safe will not be exceeded for the real conditions, ie. taking into account data from many years standing observations from meteorological stations. In none of the calculation points meteorological probable length of shading time will not exceed 30 hours within the year and 30 minutes within the day.

Calculations for theoretical conditions (the so-called astronomic length of shading time) which assumes that clouds will not appear on the sky for the whole year and wind turbines will work constantly (without stoppage) with maximum speed, shows that designed wind farm may be a nuisance as far as shadow flicker is concerned. It should be emphasized that this is the possible, theoretical worst-case scenario, whose occurrence in reality is highly unlikely. Polish law does not regulate in any way the issues related to the reduction of the shadow flicker effect. Hence it is impossible to impose on the investor any recommendations or restrictions related to it.

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Calculated:
2015-09-28 07:16/3.0.629

SHADOW - Main Result

Calculation: Shadow Flicker Effect of Banie - Kozielice Wind Farm

Assumptions for shadow calculations

Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

Minimum sun height over horizon for influence	3 °
Day step for calculation	1 days
Time step for calculation	1 minutes

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,33	2,19	3,53	5,54	7,87	7,57	7,41	7,34	4,73	3,34	1,48	1,08

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
266	520	457	432	658	380	194	446	1 369	991	406	248	6 367

Idle start wind speed: Cut in wind speed from power curve

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: CONTOURLINE_ONLINEDATA_0.wpo
Obstacles used in calculation
Eye height: 1,5 m
Grid resolution: 10,0 m
Topographic shadow included in calculation

All coordinates are in
Polish GK 1992/19-ETRS89

Scale 1:400 000

New WTG Shadow receptor

WTGs

	Y (east)	X (north)	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
1	218 483	590 926	66,1	KEW01	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
2	218 719	590 469	67,3	KEW02	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
3	218 919	590 104	70,0	KEW03	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
4	218 876	590 896	64,7	KEW04	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
5	219 065	590 560	65,0	KEW05	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
6	219 301	590 298	66,8	KEW06	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
7	219 079	591 343	61,3	KEW07	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
8	219 047	590 787	60,8	KEW08	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
9	219 427	591 260	60,0	KEW09	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
10	219 452	591 699	56,3	KEW10	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
11	220 087	591 745	55,0	KEW11	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
12	221 008	591 524	60,0	KEW12	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
13	221 791	590 961	60,0	KWE13	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
14	221 613	590 615	60,0	KEW14	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
15	222 133	590 582	60,0	KEW15	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
16	221 591	590 152	71,7	KEW16	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
17	221 350	589 469	72,8	KEW17	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
18	221 076	589 250	70,0	KEW18	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
19	223 182	588 716	76,6	KEW19	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
20	220 008	592 471	45,0	KEWK02	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
21	221 566	592 672	45,2	KEWK03	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
22	218 162	588 389	69,9	KEW20	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
23	217 376	588 339	78,8	KEW21	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
24	217 043	588 040	76,7	KEW23	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
25	216 870	587 449	80,0	KEW27	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
26	216 286	599 032	31,6	BIE EWB01	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
27	216 649	599 007	31,4	BIE EWB02	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
28	216 331	598 729	30,0	BIE EWB03	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
29	216 112	598 457	37,0	BIE EWB04	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
30	217 928	595 676	45,0	BIE EWB05	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
31	218 012	595 358	45,0	BIE EWB06	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
32	218 008	595 014	48,8	BIE EWB07	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0

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Calculated:
2015-09-28 07:16/3.0.629

SHADOW - Main Result

Calculation: Shadow Flicker Effect of Banie - Kozielice Wind Farm

...continued from previous page

	Y (east)	X (north)	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
33	217 698	594 810	50,0	BIE EWB08	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
34	218 300	594 824	45,0	BIE EWB09	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
35	218 033	594 589	47,5	BIE EWB10	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
36	218 286	594 428	50,0	BIE EWB11	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
37	217 686	588 166	75,6	KOZ2 KEW22	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
38	218 023	588 019	69,6	KOZ2 KEW24	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
39	217 583	587 773	74,5	KOZ2 KEW25	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
40	217 202	587 612	76,6	KOZ2 KEW26	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
41	217 490	587 400	75,0	KOZ2 KEW28	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
42	217 254	587 135	75,0	KOZ2 KEW29	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
43	216 887	587 021	80,0	KOZ2 KEW30	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
44	217 065	586 682	77,9	KOZ2 KEW31	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
45	216 678	586 500	80,0	KOZ2 KEW32	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
46	216 369	586 336	77,6	KOZ2 KEW33	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
47	216 871	586 210	76,9	KOZ2 KEW34	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
48	216 174	586 038	76,0	KOZ2 KEW35	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
49	216 666	585 925	78,1	KOZ2 KEW36	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
50	216 997	585 775	75,0	KOZ2 KEW37	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
51	216 580	585 580	78,7	KOZ2 KEW38	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
52	215 951	585 583	80,0	KOZ2 KEW39	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
53	216 278	585 399	78,8	KOZ2 KEW40	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
54	216 541	585 111	75,0	KOZ2 KEW41	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
55	208 643	596 057	60,0	BAN 1A BEW01	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
56	210 365	592 448	60,0	BAN 1A BEW02	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
57	210 709	592 489	60,0	BAN 1A BEW03	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
58	210 200	592 123	60,0	BAN 1A BEW04	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
59	210 515	592 163	60,0	BAN 1A BEW05	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
60	211 824	587 855	85,1	BAN 1A BEW06	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
61	211 759	587 559	90,0	BAN 1A BEW07	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
62	205 796	594 886	62,9	BAN 1A BEW08	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
63	205 306	594 830	60,0	BAN 1A BEW09	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
64	205 987	594 630	61,2	BAN 1A BEW16	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
65	205 590	594 512	55,1	BAN 1A BEW17	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
66	208 843	595 834	60,0	BAN 1A BEW18	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
67	205 156	594 452	57,4	BAN 1A BEW19	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
68	204 783	594 239	57,7	BAN 1A BEW31	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
69	205 194	594 140	60,7	BAN 1A BEW32	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
70	206 270	592 245	60,3	BAN 2 BEW20	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
71	206 061	591 837	66,7	BAN 2 BEW21	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
72	205 974	591 424	75,0	BAN 2 BEW22	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
73	206 267	591 589	71,4	BAN 2 BEW23	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
74	205 766	587 397	68,1	BAN 2 BEW24	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
75	206 174	587 570	66,9	BAN 2 BEW25	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
76	206 414	587 174	66,0	BAN 2 BEW26	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
77	209 078	596 169	60,0	BAN 2 BEW27	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
78	206 037	587 101	74,5	BAN 2 BEW28	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
79	205 552	587 084	75,1	BAN 2 BEW29	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
80	206 088	585 509	85,0	BAN 2 BEW30	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
81	206 421	585 336	75,7	BAN 2 BEW33	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
82	206 167	585 113	83,3	BAN 2 BEW34	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
83	205 900	584 845	80,6	BAN 2 BEW35	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
84	206 233	584 697	73,5	BAN 2 BEW36	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
85	205 684	585 673	85,0	BAN 2 BEW37	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
86	205 815	585 188	85,0	BAN 2 BEW40	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
87	205 510	585 398	85,0	BAN 2 BEW41	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
88	209 222	595 869	59,9	BAN 2 BEW42	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
89	209 522	595 901	60,8	BAN 2 BEW45	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
90	210 326	594 879	57,9	BAN 2 BEW46	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
91	209 939	594 912	59,7	BAN 2 BEW39	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
92	209 576	594 702	54,1	BAN 2 BEW43	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
93	210 031	594 556	52,4	BAN 2 BEW44	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	95,0	2 500	0,0
94	200 184	587 606	54,2	WID WEW02	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
95	200 007	587 221	55,0	WID WEW04	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
96	199 955	586 313	53,6	WID WEW06	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0

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Calculated:
2015-09-28 07:16/3.0.629

SHADOW - Main Result

Calculation: Shadow Flicker Effect of Banie - Kozielice Wind Farm

Shadow receptor-Input

No.	Name	Y (east)	X (north)	Z [m]	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
A	Swochowo	213 818	598 150	35,2	1,0	1,0	1,0	0,0	90,0	"Green house mode"
B	Stare Chrapowo	218 505	598 182	30,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
C	Nowe Chrapowo	218 571	595 574	45,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
D	Czarnowo	216 353	594 115	53,4	1,0	1,0	1,0	0,0	90,0	"Green house mode"
E	£ozice	218 401	592 787	48,4	1,0	1,0	1,0	0,0	90,0	"Green house mode"
F	Rokity	220 985	593 207	45,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
G	Linie	216 286	599 578	30,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
H	Sicina	223 080	592 564	47,9	1,0	1,0	1,0	0,0	90,0	"Green house mode"
I	Nowielin	224 062	590 198	65,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
J	Krzemlin	224 043	587 250	70,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
K	Przydar³ów	221 431	587 861	84,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
L	Siemczyn	219 200	589 473	76,8	1,0	1,0	1,0	0,0	90,0	"Green house mode"
M	Kozielice (cz. zachodnia)	219 877	590 618	60,6	1,0	1,0	1,0	0,0	90,0	"Green house mode"
N	Kozielice [cz. wschodnia]	221 059	590 236	60,4	1,0	1,0	1,0	0,0	90,0	"Green house mode"
O	Mielno Pyrzyckie	217 561	589 244	71,8	1,0	1,0	1,0	0,0	90,0	"Green house mode"
P	Zadeklino	216 236	591 820	68,7	1,0	1,0	1,0	0,0	90,0	"Green house mode"
Q	Trzebórz	217 909	587 138	70,6	1,0	1,0	1,0	0,0	90,0	"Green house mode"
R	Tetyñ	216 860	584 553	70,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
S	Babinek	202 538	594 865	50,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
T	Lubanowo (cz. zachodznia)	205 598	593 749	67,5	1,0	1,0	1,0	0,0	90,0	"Green house mode"
U	Lubanowo (cz. wschodnia)	206 522	594 322	55,8	1,0	1,0	1,0	0,0	90,0	"Green house mode"
V	Sosnowo	209 153	595 323	55,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
W	Tywica	206 980	592 423	60,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
X	Kunowo	212 080	594 322	49,9	1,0	1,0	1,0	0,0	90,0	"Green house mode"
Y	Banie	209 925	591 498	55,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
Z	D³u¿yna	212 478	589 249	85,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
AA	Piaskowo	210 797	587 412	90,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
AB	Piaseczno	211 798	586 244	90,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
AC	Baniewice	205 638	587 901	73,1	1,0	1,0	1,0	0,0	90,0	"Green house mode"
AD	Swobnica	206 770	584 312	56,1	1,0	1,0	1,0	0,0	90,0	"Green house mode"

Calculation Results

Shadow receptor

		Shadow, worst case			Shadow, expected values
No.	Name	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
A	Swochowo	1:00	10	0:09	0:14
B	Stare Chrapowo	4:54	49	0:11	1:01
C	Nowe Chrapowo	85:17	181	0:45	12:48
D	Czarnowo	21:41	115	0:22	5:32
E	£ozice	14:29	87	0:17	1:14
F	Rokity	33:29	103	0:42	2:59
G	Linie	85:16	96	1:11	5:22
H	Sicina	5:01	32	0:15	0:51
I	Nowielin	3:07	35	0:10	0:35
J	Krzemlin	0:00	0	0:00	0:00
K	Przydar³ów	3:22	25	0:12	0:53
L	Siemczyn	21:07	111	0:21	2:09
M	Kozielice (cz. zachodnia)	85:57	229	0:52	14:26
N	Kozielice [cz. wschodnia]	77:57	183	0:52	12:38
O	Mielno Pyrzyckie	30:01	110	0:24	2:45
P	Zadeklino	0:43	9	0:07	0:05
Q	Trzebórz	98:19	285	0:45	16:28
R	Tetyñ	0:00	0	0:00	0:00
S	Babinek	0:26	8	0:05	0:03
T	Lubanowo (cz. zachodznia)	21:37	73	0:26	4:19
U	Lubanowo (cz. wschodnia)	85:38	191	1:04	16:51
V	Sosnowo	62:28	138	0:38	4:46
W	Tywica	56:46	130	0:41	6:13
X	Kunowo	2:57	32	0:11	0:35
Y	Banie	0:00	0	0:00	0:00
Z	D³u¿yna	0:00	0	0:00	0:00

To be continued on next page...

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Calculated:
2015-09-28 07:16/3.0.629

SHADOW - Main Result

Calculation: Shadow Flicker Effect of Banie - Kozielice Wind Farm

...continued from previous page

No.	Name	Shadow, worst case			Shadow, expected values
		Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
AA	Piaskowo	23:04	83	0:24	5:50
AB	Piaseczno	0:00	0	0:00	0:00
AC	Baniewice	79:57	143	1:06	5:59
AD	Swobnica	30:28	73	0:34	5:52

Total amount of flickering on the shadow receptors caused by each WTG

No.	Name	Worst case [h/year]	Expected [h/year]
1	KEW01	5:33	1:07
2	KEW02	7:25	1:18
3	KEW03	15:31	2:50
4	KEW04	11:14	2:26
5	KEW05	14:54	2:44
6	KEW06	30:37	5:23
7	KEW07	1:33	0:23
8	KEW08	15:59	3:27
9	KEW09	5:45	0:54
10	KEW10	13:41	0:56
11	KEW11	2:15	0:15
12	KEW12	1:20	0:10
13	KWE13	2:44	0:35
14	KEW14	3:05	0:36
15	KEW15	13:38	3:20
16	KEW16	34:51	6:54
17	KEW17	26:25	1:44
18	KEW18	8:29	0:41
19	KEW19	3:22	0:53
20	KEWK02	12:15	1:17
21	KEWK03	21:27	2:16
22	KEW20	34:48	2:13
23	KEW21	1:47	0:10
24	KEW23	0:00	0:00
25	KEW27	9:30	2:00
26	BIE EWB01	45:47	2:57
27	BIE EWB02	42:30	3:02
28	BIE EWB03	1:05	0:13
29	BIE EWB04	1:48	0:23
30	BIE EWB05	24:05	5:21
31	BIE EWB06	23:57	4:05
32	BIE EWB07	28:55	3:37
33	BIE EWB08	24:41	4:19
34	BIE EWB09	6:32	0:48
35	BIE EWB10	3:12	0:49
36	BIE EWB11	1:57	0:28
37	KOZ2 KEW22	3:52	0:19
38	KOZ2 KEW24	0:00	0:00
39	KOZ2 KEW25	0:18	0:01
40	KOZ2 KEW26	16:56	3:12
41	KOZ2 KEW28	5:46	1:05
42	KOZ2 KEW29	21:09	4:20
43	KOZ2 KEW30	8:21	1:29
44	KOZ2 KEW31	10:59	1:36
45	KOZ2 KEW32	5:32	0:46
46	KOZ2 KEW33	3:30	0:26
47	KOZ2 KEW34	9:54	0:51
48	KOZ2 KEW35	2:18	0:13
49	KOZ2 KEW36	10:32	0:50
50	KOZ2 KEW37	0:00	0:00
51	KOZ2 KEW38	0:00	0:00
52	KOZ2 KEW39	1:26	0:07
53	KOZ2 KEW40	0:08	0:00
54	KOZ2 KEW41	0:00	0:00

To be continued on next page...

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SHADOW - Main Result

Calculation: Shadow Flicker Effect of Banie - Kozielice Wind Farm

...continued from previous page

No.	Name	Worst case [h/year]	Expected [h/year]
55	BAN 1A BEW01	0:00	0:00
56	BAN 1A BEW02	0:00	0:00
57	BAN 1A BEW03	0:00	0:00
58	BAN 1A BEW04	0:00	0:00
59	BAN 1A BEW05	0:00	0:00
60	BAN 1A BEW06	12:22	3:15
61	BAN 1A BEW07	10:42	2:34
62	BAN 1A BEW08	13:27	2:33
63	BAN 1A BEW09	5:46	1:13
64	BAN 1A BEW16	46:40	9:08
65	BAN 1A BEW17	10:26	2:10
66	BAN 1A BEW18	0:00	0:00
67	BAN 1A BEW19	3:38	0:40
68	BAN 1A BEW31	23:38	4:40
69	BAN 1A BEW32	4:06	0:42
70	BAN 2 BEW20	16:37	2:49
71	BAN 2 BEW21	9:55	1:03
72	BAN 2 BEW22	13:53	1:05
73	BAN 2 BEW23	16:21	1:16
74	BAN 2 BEW24	36:02	2:02
75	BAN 2 BEW25	24:25	2:51
76	BAN 2 BEW26	10:52	0:43
77	BAN 2 BEW27	0:00	0:00
78	BAN 2 BEW28	8:38	0:28
79	BAN 2 BEW29	0:00	0:00
80	BAN 2 BEW30	0:00	0:00
81	BAN 2 BEW33	0:00	0:00
82	BAN 2 BEW34	0:00	0:00
83	BAN 2 BEW35	25:42	4:59
84	BAN 2 BEW36	12:45	2:23
85	BAN 2 BEW37	0:00	0:00
86	BAN 2 BEW40	0:00	0:00
87	BAN 2 BEW41	0:28	0:05
88	BAN 2 BEW42	0:00	0:00
89	BAN 2 BEW45	0:00	0:00
90	BAN 2 BEW46	6:43	1:01
91	BAN 2 BEW39	12:45	1:37
92	BAN 2 BEW43	37:05	2:08
93	BAN 2 BEW44	9:00	0:42
94	WID WEW02	0:00	0:00
95	WID WEW04	0:00	0:00
96	WID WEW06	0:00	0:00

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Calculated:
2015-09-28 10:12/3.0.629

SHADOW - Main Result

Calculation: Shadow Flicker Effect of Banie - Kozielice Wind Farm

Assumptions for shadow calculations

Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

Minimum sun height over horizon for influence	3 °
Day step for calculation	1 days
Time step for calculation	1 minutes

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,33	2,19	3,53	5,54	7,87	7,57	7,41	7,34	4,73	3,34	1,48	1,08

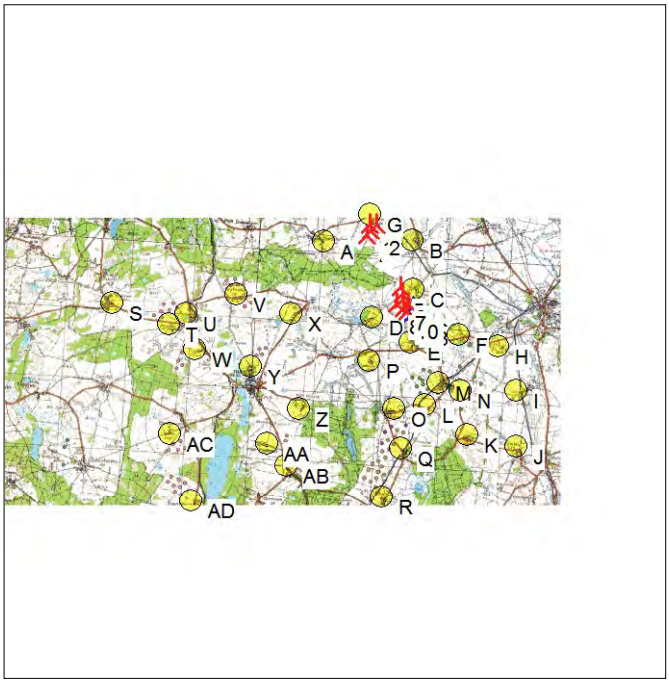
Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
266	520	457	432	658	380	194	446	1 369	991	406	248	6 367

Idle start wind speed: Cut in wind speed from power curve

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: CONTOURLINE_ONLINEDATA_0.wpo
Obstacles used in calculation
Eye height: 1,5 m
Grid resolution: 10,0 m
Topographic shadow included in calculation

All coordinates are in
Polish GK 1992/19-ETRS89



Scale 1:400 000
New WTG
Existing WTG
Shadow receptor

WTGs

	Y (east)	X (north)	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
1	216 286	599 032	31,6	BIE EWB01	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
2	216 649	599 007	31,4	BIE EWB02	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
3	216 331	598 729	30,0	BIE EWB03	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
4	216 112	598 457	37,0	BIE EWB04	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
5	217 928	595 676	45,0	BIE EWB05	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
6	218 012	595 358	45,0	BIE EWB06	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
7	218 008	595 014	48,8	BIE EWB07	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
8	217 698	594 810	50,0	BIE EWB08	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
9	218 300	594 824	45,0	BIE EWB09	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
10	218 033	594 589	47,5	BIE EWB10	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
11	218 286	594 428	50,0	BIE EWB11	Yes	VESTAS	V100-2.0-2 000	2 000	100,0	125,0	2 500	0,0
12	218 584	594 643	45,0	NC1	Yes	GE WIND ENERGY	GE 2.5-100-2 500	2 500	100,0	150,0	2 500	5,0
13	218 568	594 235	46,8	NC2	Yes	GE WIND ENERGY	GE 2.5-100-2 500	2 500	100,0	150,0	2 500	5,0

Shadow receptor-Input

No.	Name	Y (east)	X (north)	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
				[m]	[m]	[m]	[m]	[°]	[°]	
A	Swochowo	213 818	598 150	35,2	1,0	1,0	1,0	0,0	90,0	"Green house mode"
B	Stare Chrapowo	218 505	598 182	30,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
C	Nowe Chrapowo	218 571	595 574	45,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
D	Czarnowo	216 353	594 115	53,4	1,0	1,0	1,0	0,0	90,0	"Green house mode"
E	Łozice	218 401	592 787	48,4	1,0	1,0	1,0	0,0	90,0	"Green house mode"
F	Rokity	220 985	593 207	45,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
G	Linie	216 286	599 578	30,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
H	Sicina	223 080	592 564	47,9	1,0	1,0	1,0	0,0	90,0	"Green house mode"
I	Nowielin	224 062	590 198	65,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
J	Krzemlin	224 043	587 250	70,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
K	Przydar³ów	221 431	587 861	84,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
L	Siemczyn	219 200	589 473	76,8	1,0	1,0	1,0	0,0	90,0	"Green house mode"
M	Kozielice (cz. zachodnia)	219 877	590 618	60,6	1,0	1,0	1,0	0,0	90,0	"Green house mode"

To be continued on next page...

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Calculated:
2015-09-28 10:12/3.0.629

SHADOW - Main Result

Calculation: Shadow Flicker Effect of Banie - Kozielice Wind Farm

...continued from previous page

No.	Name	Y (east)	X (north)	Z [m]	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
N	Kozielice [cz. wschodnia]	221 059	590 236	60,4	1,0	1,0	1,0	0,0	90,0	"Green house mode"
O	Mielno Pyrzyckie	217 561	589 244	71,8	1,0	1,0	1,0	0,0	90,0	"Green house mode"
P	Zadeklino	216 236	591 820	68,7	1,0	1,0	1,0	0,0	90,0	"Green house mode"
Q	Trzebórz	217 909	587 138	70,6	1,0	1,0	1,0	0,0	90,0	"Green house mode"
R	Tetyñ	216 860	584 553	70,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
S	Babinek	202 538	594 865	50,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
T	Lubanowo (cz. zachodznia)	205 598	593 749	67,5	1,0	1,0	1,0	0,0	90,0	"Green house mode"
U	Lubanowo (cz. wschodnia)	206 522	594 322	55,8	1,0	1,0	1,0	0,0	90,0	"Green house mode"
V	Sosnowo	209 153	595 323	55,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
W	Tywica	206 980	592 423	60,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
X	Kunowo	212 080	594 322	49,9	1,0	1,0	1,0	0,0	90,0	"Green house mode"
Y	Banie	209 925	591 498	55,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
Z	D³u¿yna	212 478	589 249	85,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
AA	Piaskowo	210 797	587 412	90,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
AB	Piaseczno	211 798	586 244	90,0	1,0	1,0	1,0	0,0	90,0	"Green house mode"
AC	Baniewice	205 638	587 901	73,1	1,0	1,0	1,0	0,0	90,0	"Green house mode"
AD	Swobnica	206 770	584 312	56,1	1,0	1,0	1,0	0,0	90,0	"Green house mode"

Calculation Results

Shadow receptor

		Shadow, worst case			Shadow, expected values
No.	Name	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
A	Swochowo	1:00	10	0:09	0:14
B	Stare Chrapowo	4:54	49	0:11	1:01
C	Nowe Chrapowo	85:17	181	0:45	12:48
D	Czarnowo	24:37	136	0:22	6:11
E	£ozice	0:00	0	0:00	0:00
F	Rokity	0:00	0	0:00	0:00
G	Linie	85:16	96	1:11	5:22
H	Sicina	0:00	0	0:00	0:00
I	Nowielin	0:00	0	0:00	0:00
J	Krzemlin	0:00	0	0:00	0:00
K	Przydar³ów	0:00	0	0:00	0:00
L	Siemczyn	0:00	0	0:00	0:00
M	Kozielice (cz. zachodnia)	0:00	0	0:00	0:00
N	Kozielice [cz. wschodnia]	0:00	0	0:00	0:00
O	Mielno Pyrzyckie	0:00	0	0:00	0:00
P	Zadeklino	0:00	0	0:00	0:00
Q	Trzebórz	0:00	0	0:00	0:00
R	Tetyñ	0:00	0	0:00	0:00
S	Babinek	0:00	0	0:00	0:00
T	Lubanowo (cz. zachodznia)	0:00	0	0:00	0:00
U	Lubanowo (cz. wschodnia)	0:00	0	0:00	0:00
V	Sosnowo	0:00	0	0:00	0:00
W	Tywica	0:00	0	0:00	0:00
X	Kunowo	0:00	0	0:00	0:00
Y	Banie	0:00	0	0:00	0:00
Z	D³u¿yna	0:00	0	0:00	0:00
AA	Piaskowo	0:00	0	0:00	0:00
AB	Piaseczno	0:00	0	0:00	0:00
AC	Baniewice	0:00	0	0:00	0:00
AD	Swobnica	0:00	0	0:00	0:00

Total amount of flickering on the shadow receptors caused by each WTG

No.	Name	Worst case [h/year]	Expected [h/year]
1	BIE EWB01	45:47	2:57
2	BIE EWB02	42:30	3:02
3	BIE EWB03	1:05	0:13
4	BIE EWB04	1:48	0:23

To be continued on next page...

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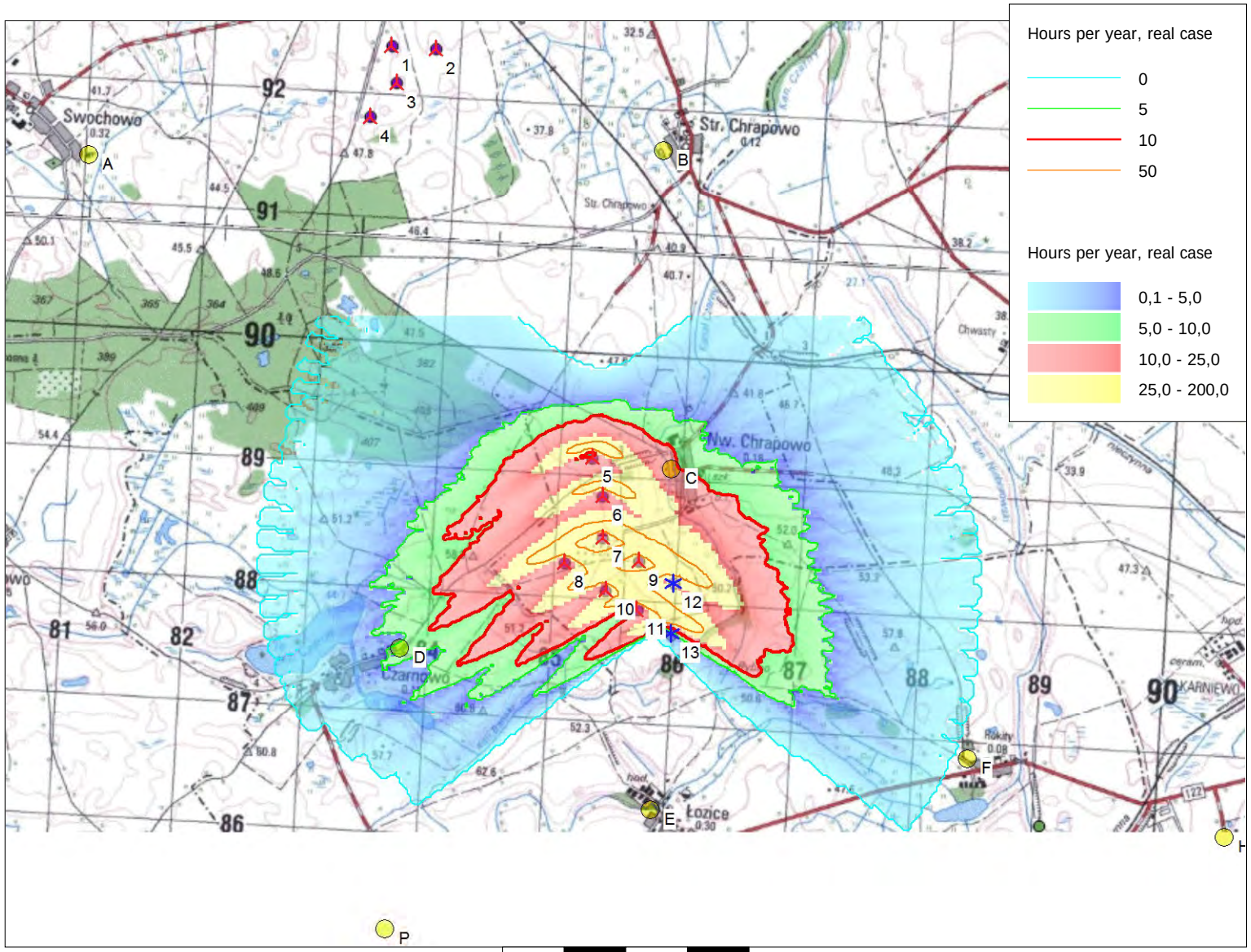
SHADOW - Main Result

Calculation: Shadow Flicker Effect of Banie - Kozielice Wind Farm

...continued from previous page

No.	Name	Worst case [h/year]	Expected [h/year]
5	BIE EWB05	24:05	5:21
6	BIE EWB06	23:57	4:05
7	BIE EWB07	28:55	3:37
8	BIE EWB08	24:41	4:19
9	BIE EWB09	6:32	0:48
10	BIE EWB10	3:12	0:49
11	BIE EWB11	1:57	0:28
12	NC1	1:33	0:22
13	NC2	1:36	0:19



Map: rejon Chrapowo , Print scale 1:50 000, Map center Polish GK 1992/19-ETRS89 East: 217 953 North: 595 202

New WTG Existing WTG Shadow receptor

Flicker map level: Height Contours: CONTOURLINE_ONLINEDATA_0.wpo (1)

Project:
WF Banie Kozielice

SHADOW - Map

Calculation:
Shadow Flicker Effect of Banie - Kozielice Wind Farm

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Calculated:
2015-09-28 10:12/3.0.629

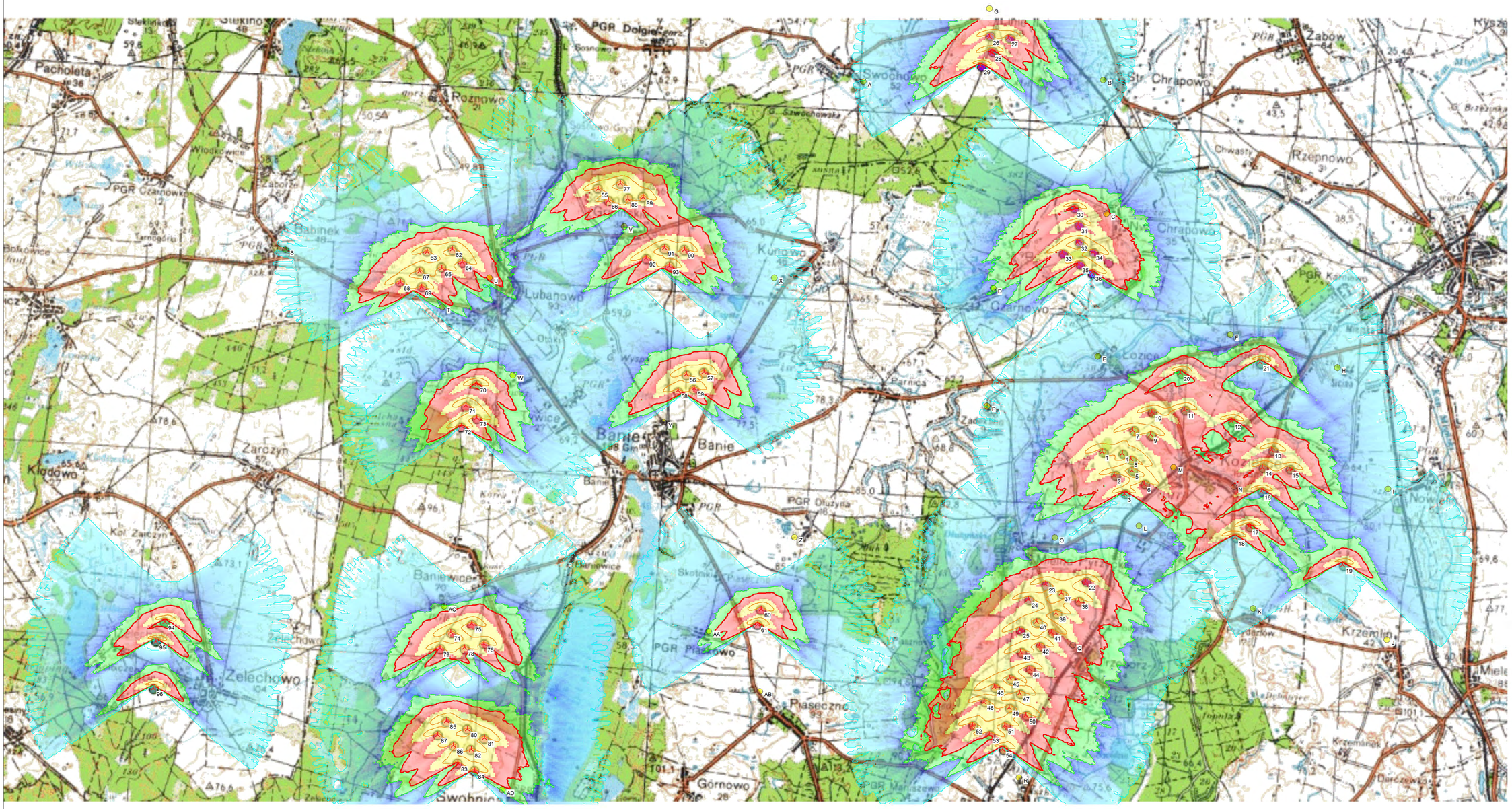
Hours per year, real case

0
5
10
50

Hours per year, real case

0,1 - 5,0
5,0 - 10,0
10,0 - 25,0
25,0 - 200,0

Project:
WF Banie Kozielice



0 500 1000 1500 2000 m

Map: topografia 100k [main topo] , Print scale 1:40 000, Map center Polish GK 1992/19-ETRS89 East: 211 330 North: 591 604

Flicker map level: Height Contours: CONTOURLINE_ONLINEDATA_0.wpo (1)

New WTG

Shadow receptor

SHADOW - Map

Calculation:
Shadow Flicker Effect of Banie - Kozielice Wind Farm

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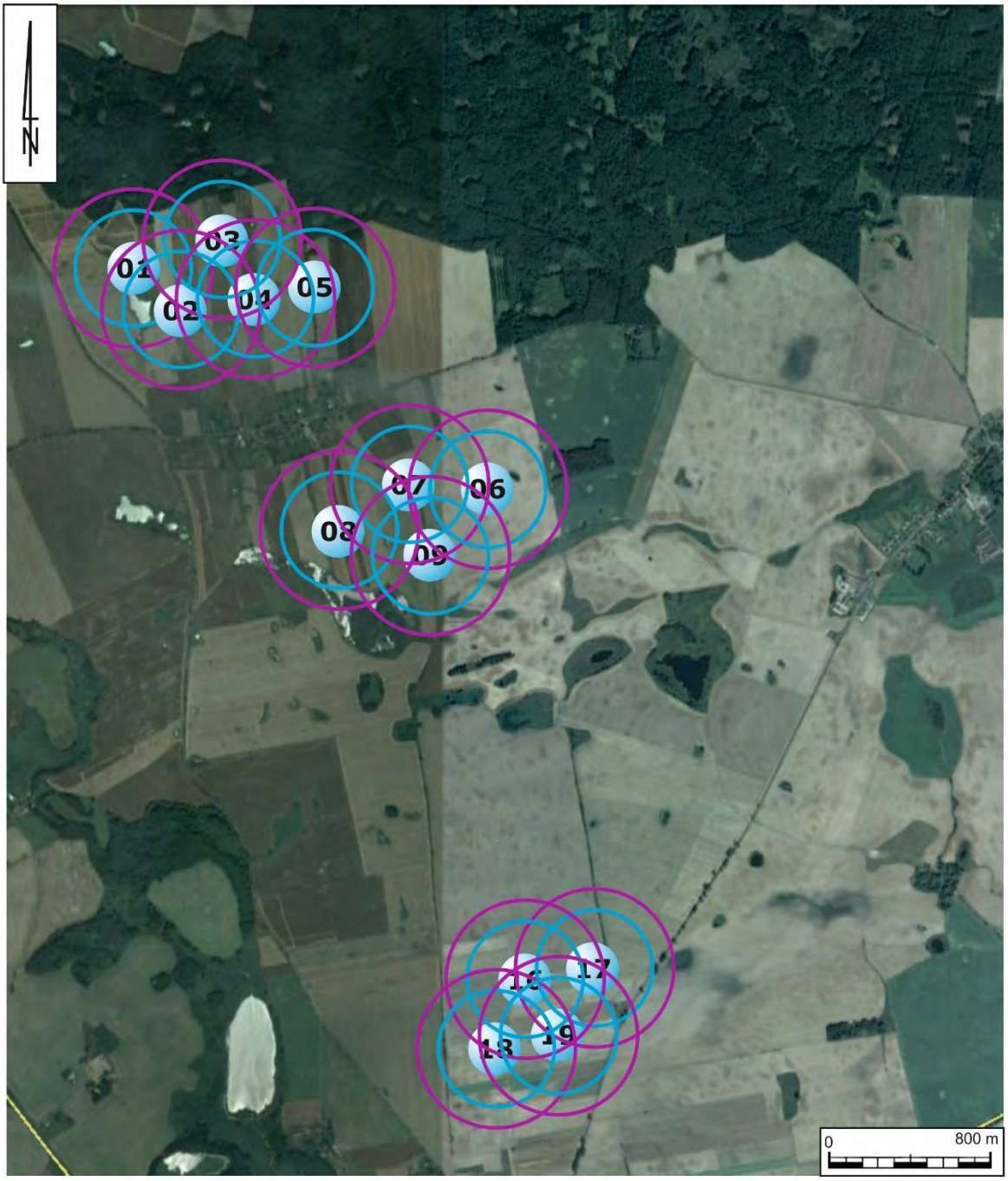
Calculated:
2015-09-28 07:16/3.0.629

APPENDIX 3
ICE AND BLADE THROW RISK MAPS



Ice throw range

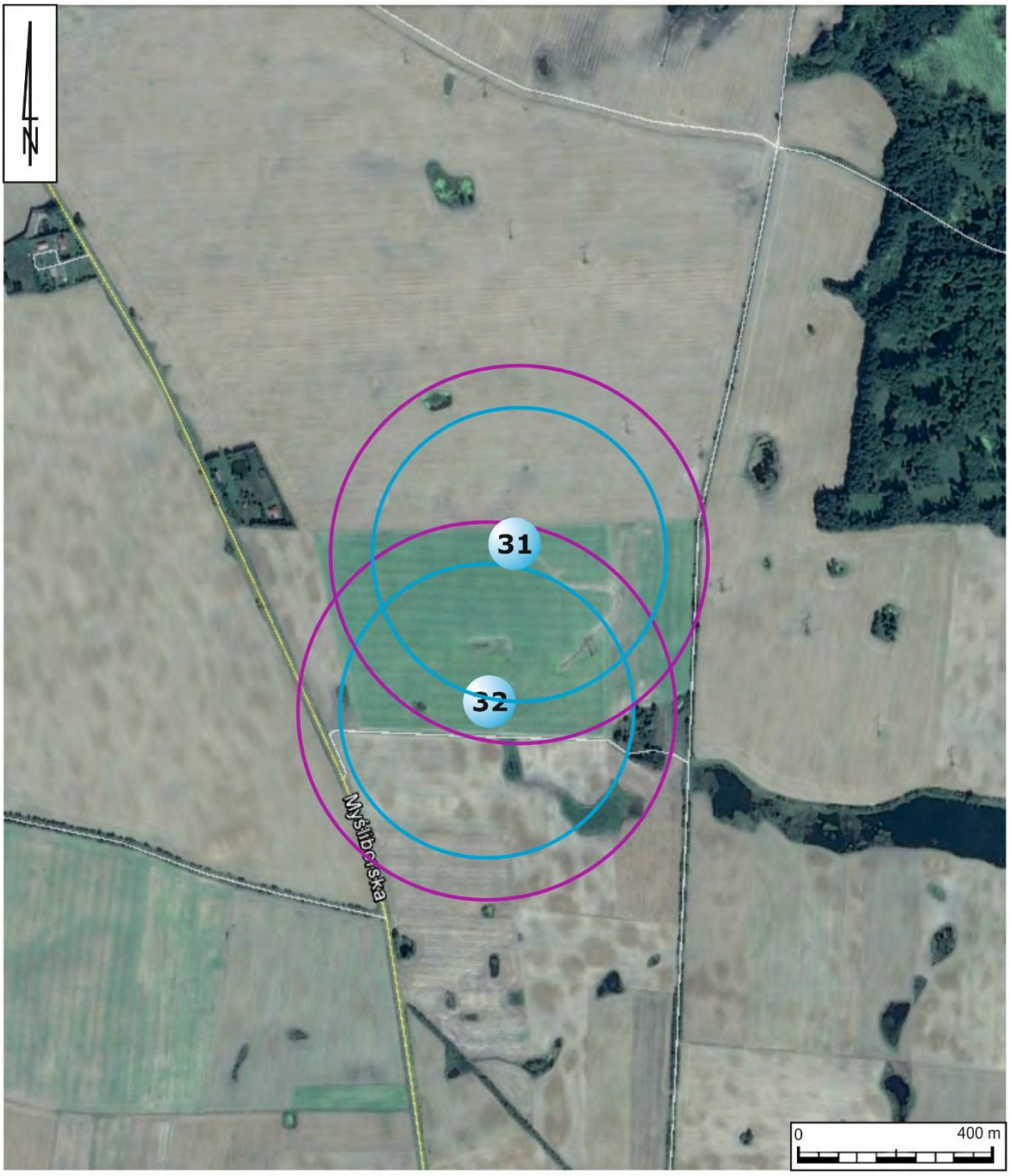
Blade throw range

RAMBOLL ENVIRON

Banie 1A Subproject
Banie Commune
Poland

Ice and blade throw range

Scale: refer to scalebar	Date: January 2016
Project No.: PL1260	TI: AR
Source: Geoportal; www.geportal.gov.pl	



Ice throw range

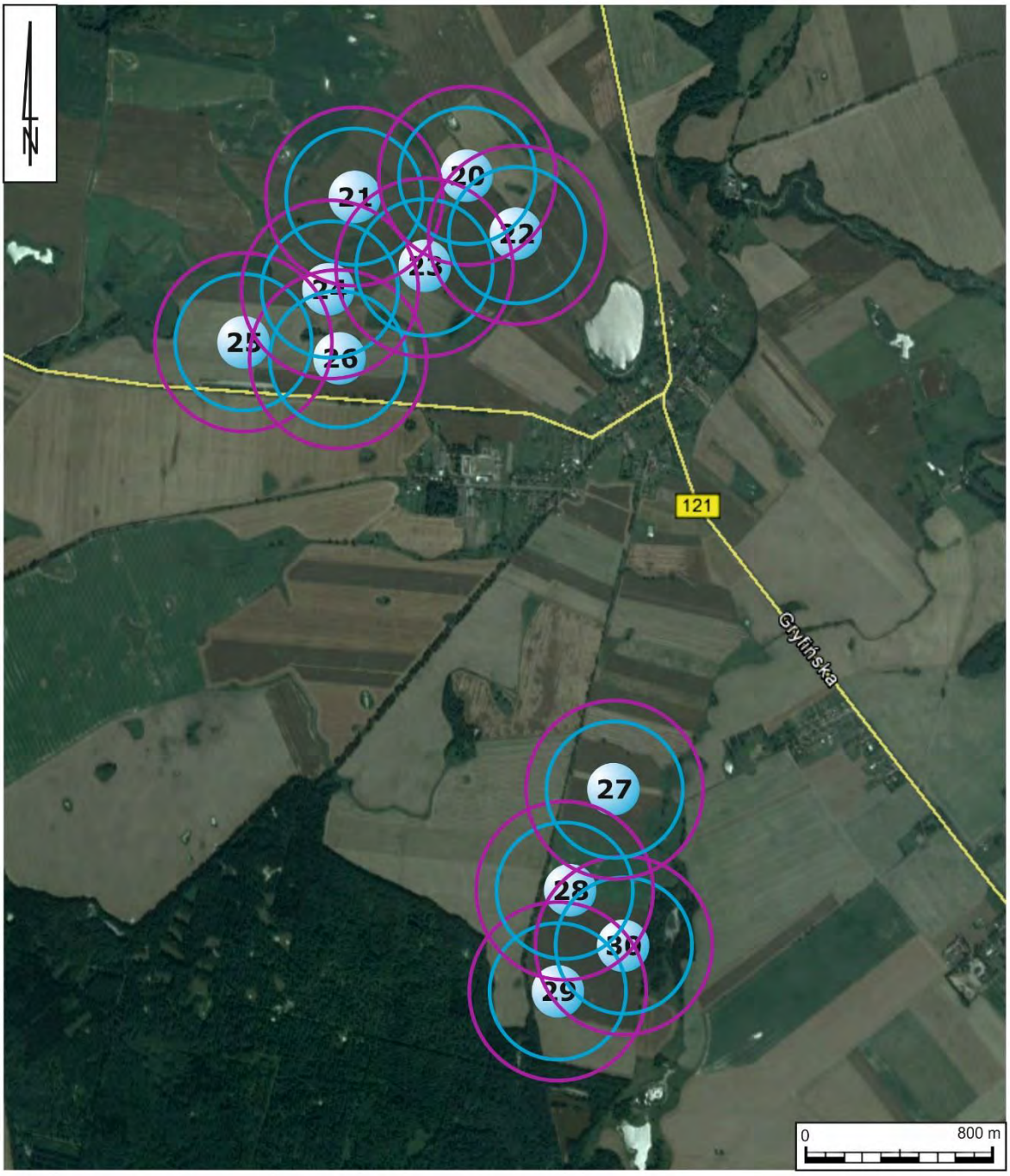
Blade throw range

RAMBØLL
ENVIRON

Banie 1B Subproject
Banie Commune
Poland

Ice and blade throw range

Scale: refer to scalebar	Date: January 2016
Project No.: PL1260	TI: AR
Source: Geoportal; www.geportal.gov.pl	



Ice throw range

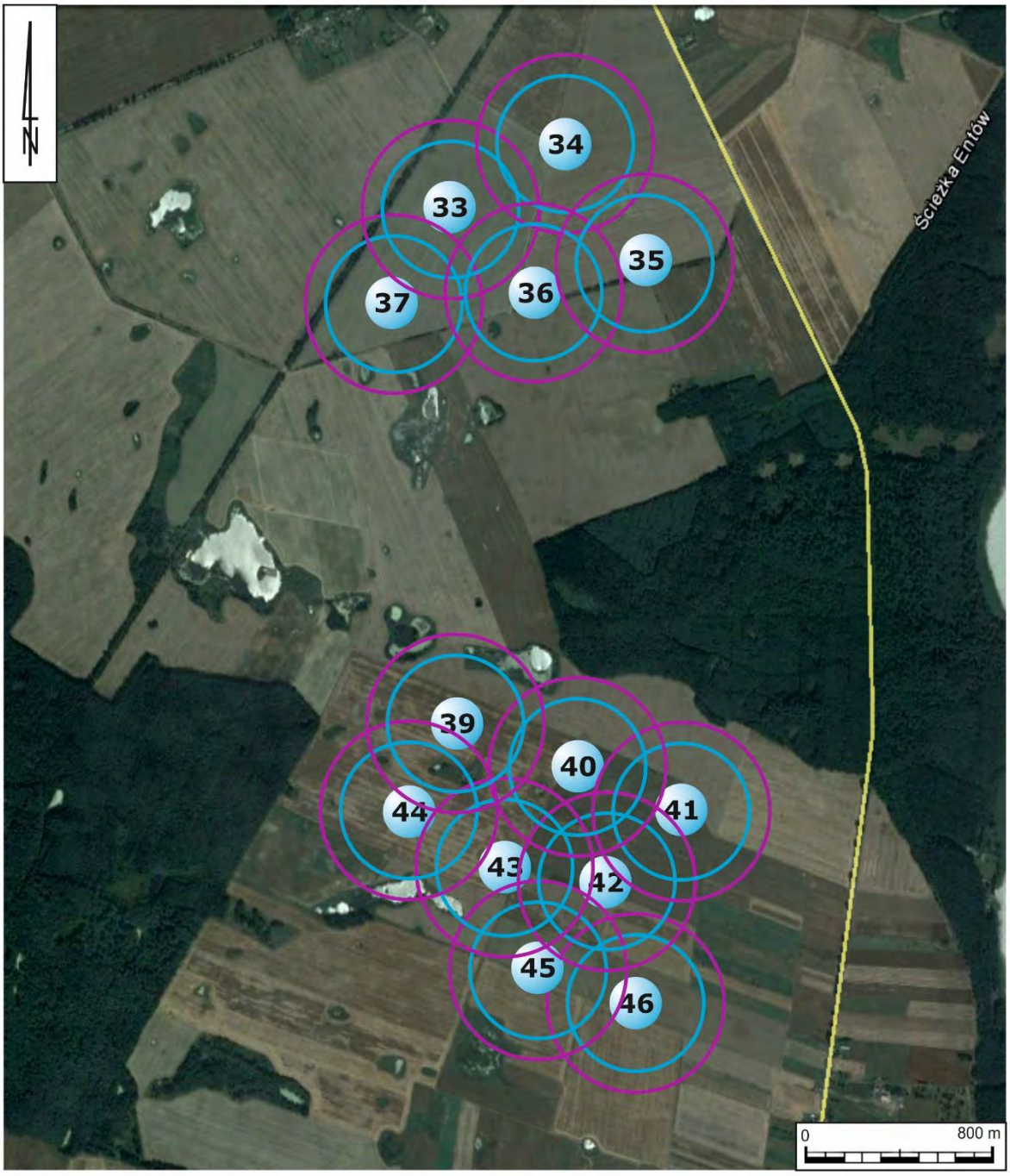
Blade throw range

RAMBOLL
ENVIRON

Banie 2 Subproject (North)
Banie Commune
Poland

Ice and blade throw range

Scale: refer to scalebar	Date: January 2016
Project No.: PL1260	TI: AR
Source: Geoportal; www.geportal.gov.pl	



Ice throw range

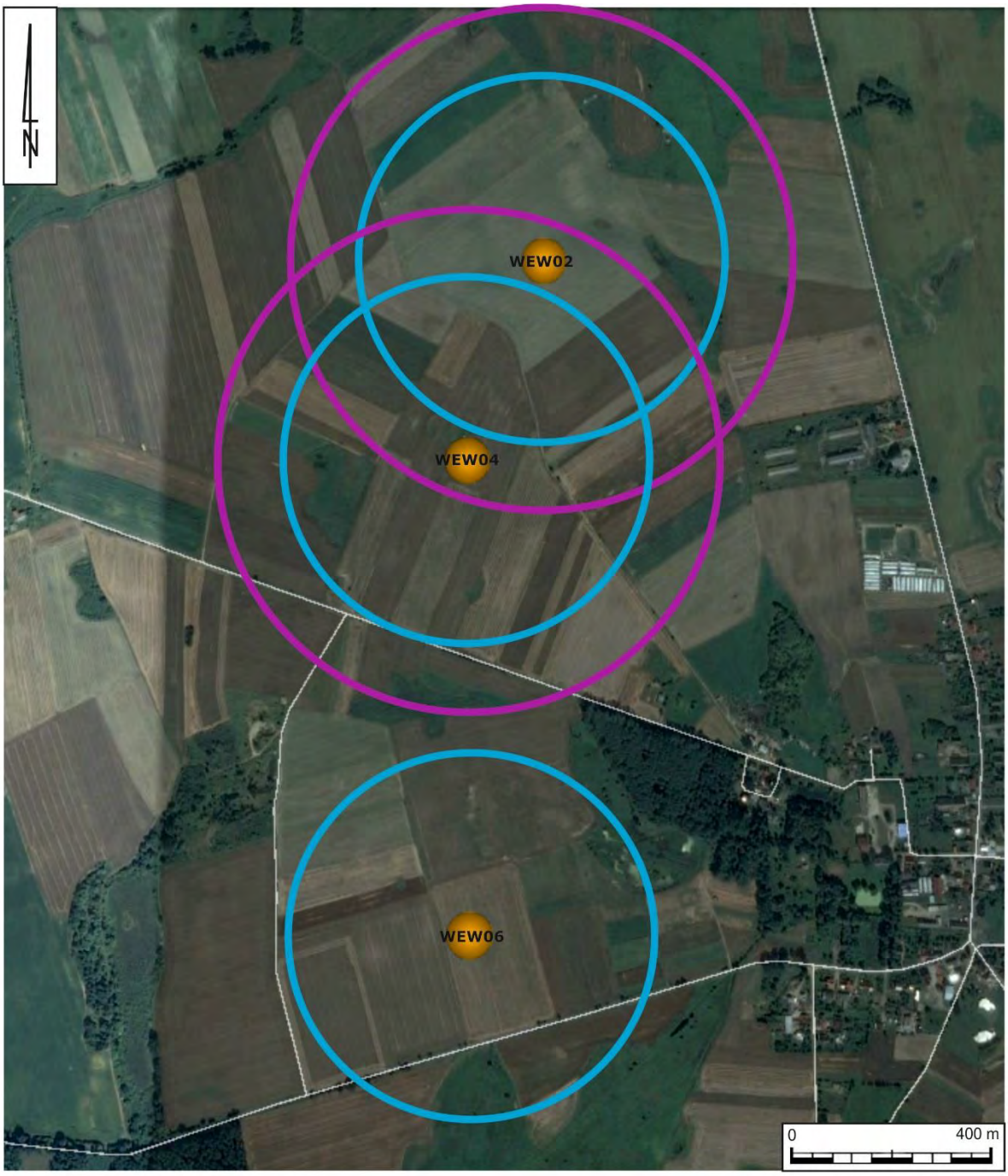
Blade throw range

RAMBOLL
ENVIRON

Banie 2 Subproject (South)
Banie Commune
Poland

Ice and blade throw range

Scale: refer to scalebar	Date: January 2016
Project No.: PL1260	TI: AR
Source: Geoportal; www.geportal.gov.pl	



Ice throw range

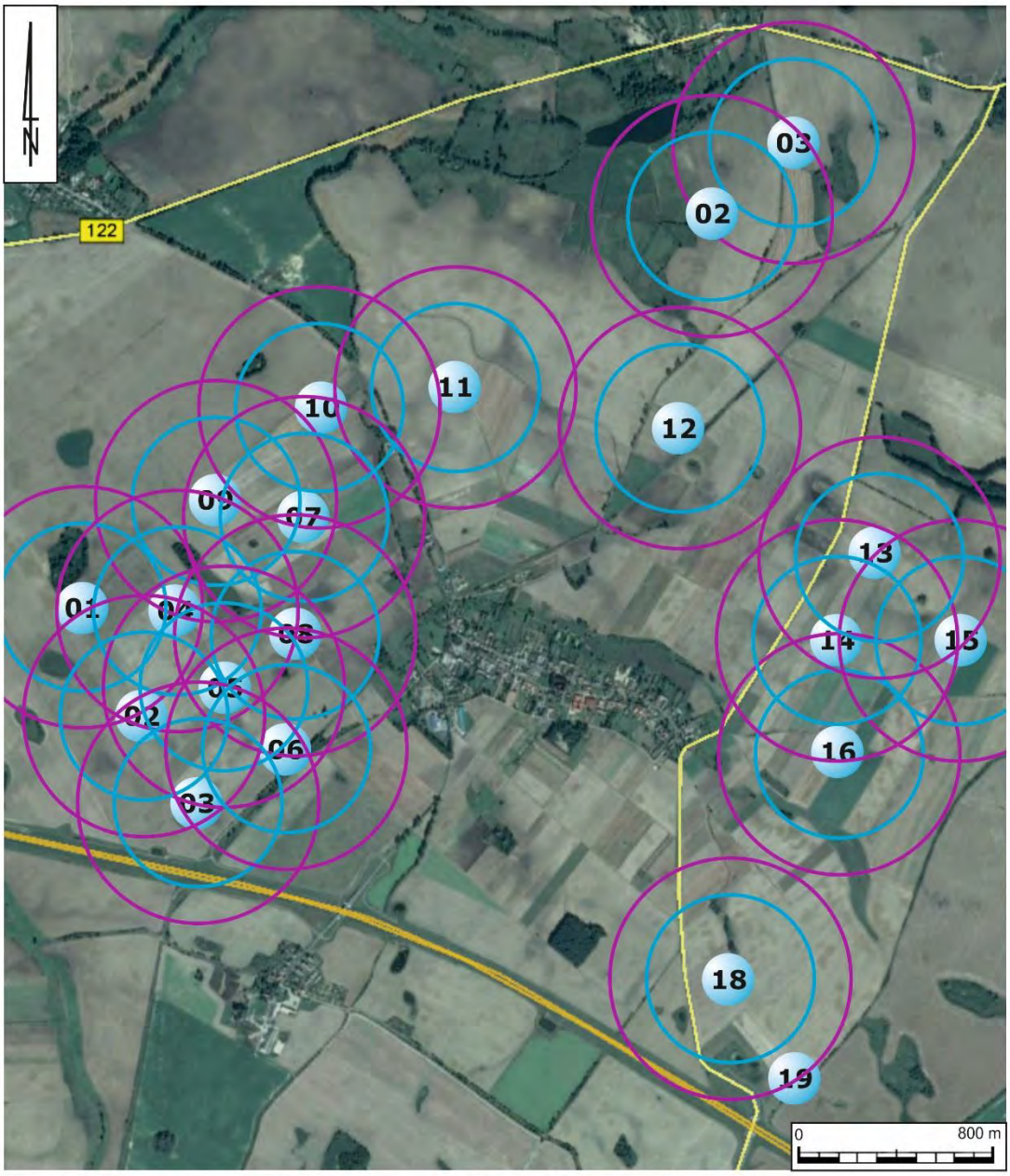
Blade throw range

RAMBOLL ENVIRON

Widuchowa subproject
Widuchowa Commune
Poland

Ice and blade throw range

Scale: refer to scalebar	Date: January 2016
Project No.: PL1260	TI: AR
Source: Geoportal; www.geportal.gov.pl	



Ice throw range

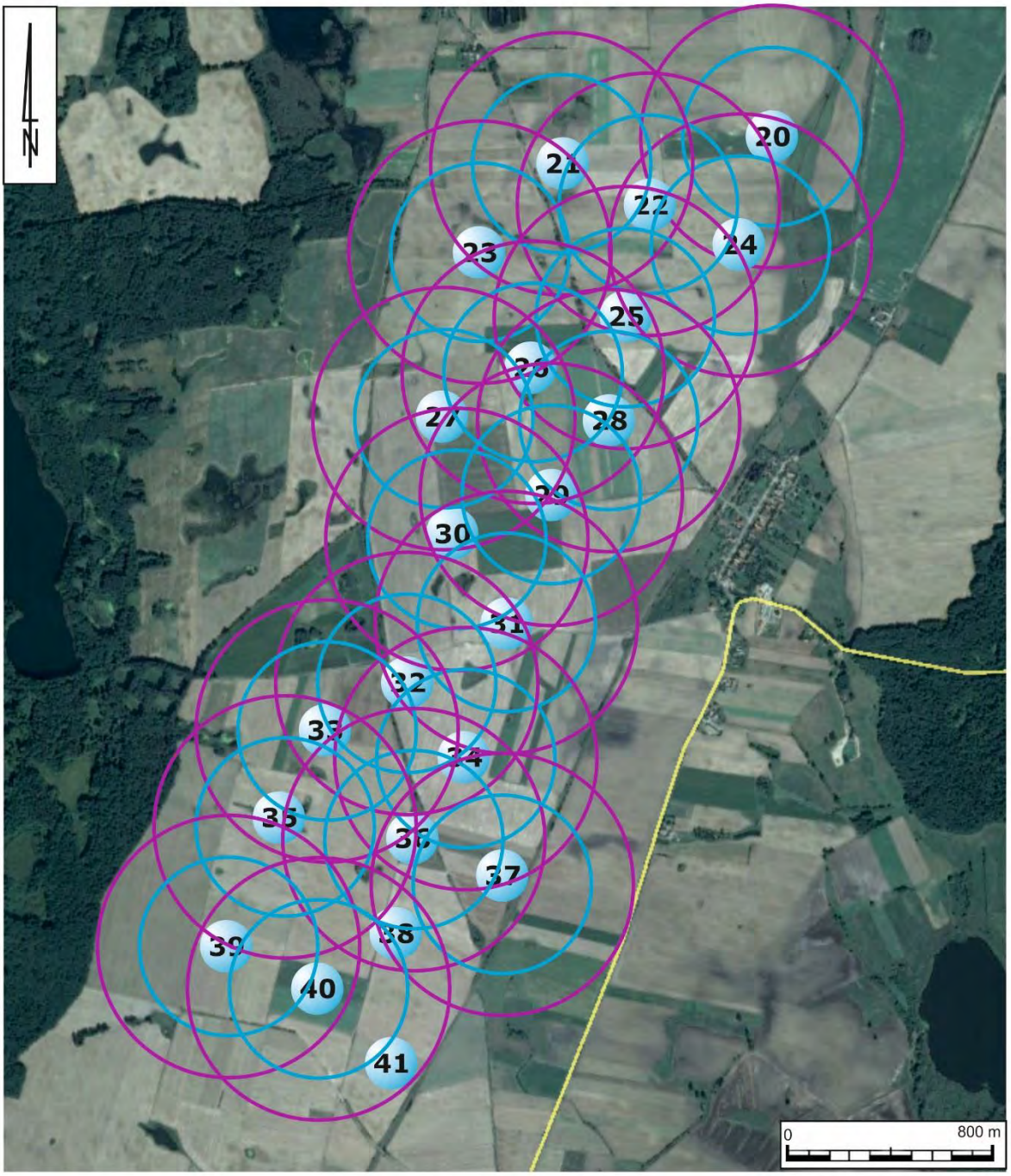
Blade throw range

RAMBOLL
ENVIRON

Kozielice 1 subproject
Kozielice Commune
Poland

Ice and blade throw range

Scale: refer to scalebar	Date: January 2016
Project No.: PL1260	TI: AR
Source: Geoportal; www.geportal.gov.pl	



Ice throw range

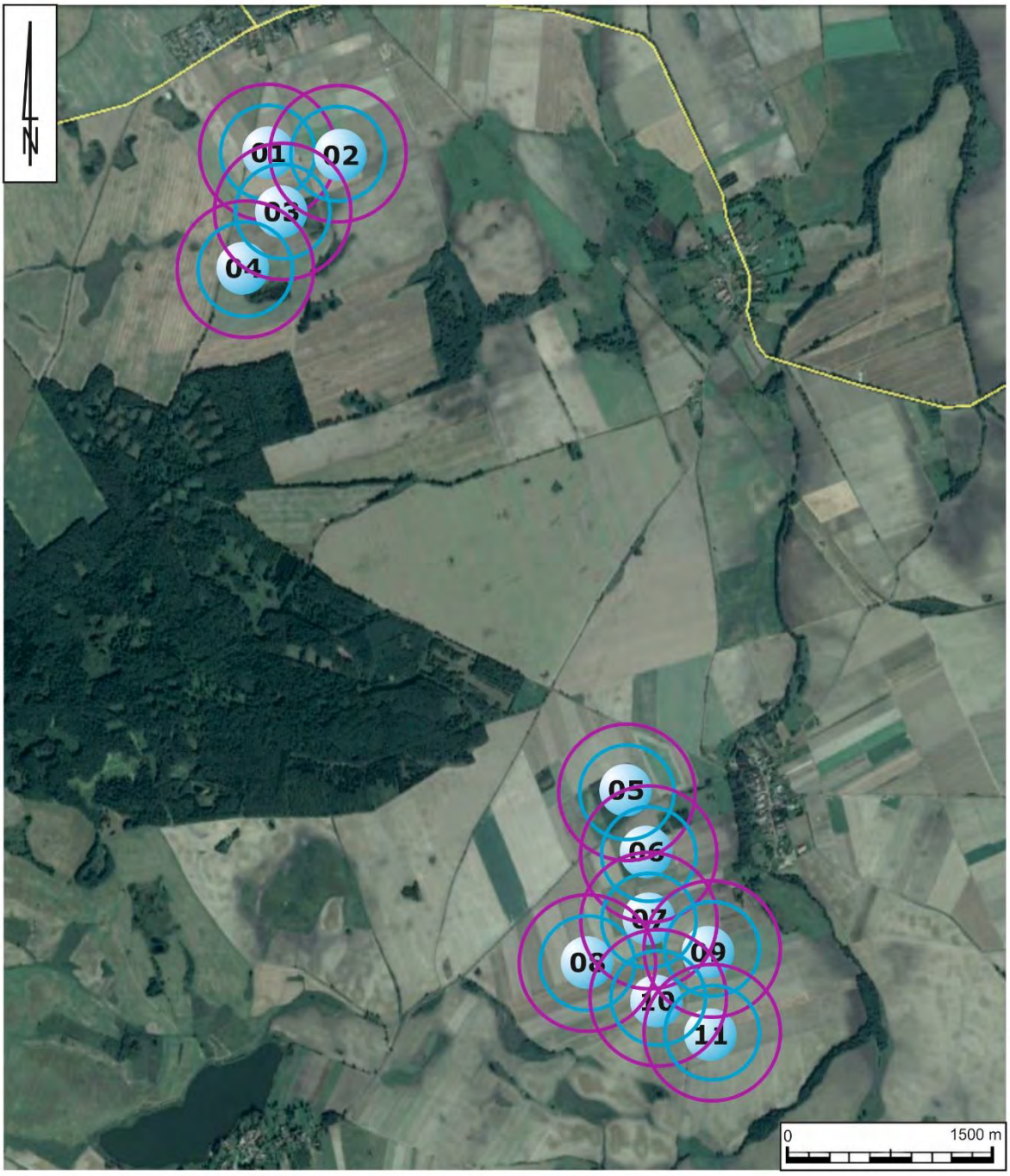
Blade throw range

RAMBOLL
ENVIRON

Kozielice 2 subproject
Kozielice Commune
Poland

Ice and blade throw range

Scale: refer to scalebar	Date: January 2016
Project No.: PL1260	TI: AR
Source: Geoportal; www.geportal.gov.pl	



Ice throw range

Blade throw range

RAMBØLL
ENVIRON

Bielice Subproject
Bielice Commune
Poland

Ice and blade throw range

Scale: refer to scalebar	Date: January 2016
Project No.: PL1260	TI: AR
Source: Geoportal; www.geportal.gov.pl	

APPENDIX 4
NATURA 2000 – SCREENING MATRIX

Natura 2000 - SCREENING MATRIX	
Brief description of the Project	The Wiatromill Sp. z o.o. company (further referred as the Company or Wiatromill) is developing a Banie wind farm project (the Project) located in northwestern Poland. The Project, consists of 50 MW, i.e. 21 wind turbine generators (WTGs) belonging to the Kozielice 1 and 4 WTGs belonging to Kozielice 2. Generally, the Company is developing a wind farm complex, which consists of three separate phases, i.e. Phase I housing 25 WTGs of a total capacity of 50 MW, Phase II housing 29 WTGs of a total capacity of 58 MW and Phase III housing 42 WTGs of a total capacity of 84 MW. Phase I, which consists of Kozielice 1 and a part of Kozielice 2 of a total capacity of 50 MW, will be financed among others by the EBRD. The other phases will be developed independently.
Brief description of the Natura 2000 site	The Special Protection Areas of the Natura 2000 network the closest to the Project are: • Las Baniewicki (PLH320064) situated approximately 300 m to the west of the Banie 2 subproject; • Dolina Tywy - (PLH320050) situated approximately 600-700 m to the west of Banie 2 subproject; • Dziczy Las (PLH320060) situated approximately 600 m to the east of Banie 1 and Banie 2 subprojects and 500 m to the west of the Kozielice 2 subproject; • Pojezierze Myśliborskie (PLH320060) situated approximately 1.3 km to the south of the Kozielice 1 and Kozielice 2 subprojects.
Description of the individual elements of the project (either alone or in combination with other plans or projects) likely to give rise to impacts on the Natura 2000 site	The projects will consist of the following individual elements: • Wind turbines generators (WTGs) and relevant technical infrastructure; • Internal roads and assembly/service yards; • Internal infrastructure of underground power transmission lines and steering cables; • Main electrical substations (MES) medium voltage/high voltage (MV/HV).

Description of any likely direct, indirect or secondary impact of the project (either alone or in combination with other plans or projects) on the Natura 2000 site.	
Size and scale	Not applicable.
Land-take	Any Natura 2000 areas will be taken.
Distance from the Natura 2000 site or key features of the site	The nearest Natura 2000 sites are located: • Approx. 300 m to the west of the Banie 2 subproject ('Las Baniewicki'), 3 types of habitats belonging to the Annex I of the Habitats Directive No. 92/43/EEC (Annex I: 'Types of natural habitats important from the community point of view for which designation of special protection areas is required') have been identified within that area (codes 3150, 99160 and 91E0); • Approx. 600 m to the east of Banie 1 and Banie 2 subprojects and 500 m to the west of the Kozielice 2 subproject ('Dziczy Las'), 9 types of habitats belonging to the Annex I of Habitats Directive (codes 3150, 6150, 7140, 9110, 9130, 9160, 91D0, and 91F0) as well as 5 species listed under Art. 4 of Directive 2009/147/WE and belonging to the Annex II of Habitats have been identified within that area (two beetles: *Cerambyx cerdo and Osmoderma eremita*, and 3 birds: *Chlidonias niger, Circus pygarus, Grus grus*) and • Approx. 600-700 m to the west of Banie 2 subproject ('Dolina Tywy'), 16 types of habitats belonging to the Annex I of the Habitats Directive (codes 3140, 3150, 3260, 6120, 6210, 6410, 6430, 7140, 7210, 9110, 9130, 9160, 9170, 9190, 91E0 and 91F0) as well as 2 species listed under Art. 4 of Directive 2009/147/WE (Birds directive) and belonging to the Annex II of the Habitats Directive (Annex II: 'Types of fauna and flora species natural habitats important from the community point of view for which designation of special protection areas is required') have been identified within that area (fish *Cobitis taenia and Rhodeus sericeus amarus*)
Resources requirements (water abstraction etc.)	No water abstraction will take place.
Emissions (disposal to land, water or air)	No emissions will be generated.

Excavation requirements	The foundation works will require removal of approximately 1200 m^3 of excavated soil per WTG. The excavation works will be a short term procedure.
Transportation requirements	Transportation will take place only during the construction phase of the project implementation. It can be assumed that for a single WTG construction approximately 400 drives of trucks will be needed (the number of trucks' transits is doubled as each truck must return after delivery of its load).
Duration of construction, operation, decommissioning	Construction phase – approx. a few months Operational phase – approx. 25 years Decommissioning phase – approx. a few months.
Describe any likely changes to the site arising as a result of:	
Reduction of habitat area	Will not take place.
Disturbance to key species	Based on the birds monitoring program, the project will not generate an extensive impact on birds.
Habitat or species fragmentation	Will not occur.
Reduction in species density	Will not occur.
Changes in key indicators of conservation value (water quality etc.)	Will not occur.
Climate change	Will not occur.
Describe any likely impacts on the Natura 2000 site as a whole in terms of:	
Interference with the key relationships that define the structure of the site	Will not occur.
Interference with the key relationships that define the function of the site	Will not occur.
Provide indicators of significance as a result of the identification of effects set out above in terms of:	
Loss	Insignificant.

Fragmentation	Insignificant.
Disruption	Insignificant.
Disturbance	Insignificant.
Change to key elements of the site (e.g. water quality etc.)	Insignificant.