

Study ENVIRONMENTAL IMPACT REPORT FOR THE "GŁUSZYNKO–GRAPICE" WIND FARM AND ITS TECHNICAL INFRASTRUCTURE (Słupsk District, Pomeranian Province)		
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1. A decision of the Head of Potęgowo Commune on the need to conduct the environmental impact assessment for the project consisting of the construction of the "Głuszynko–Grapice" wind farm, consisting of 22 wind turbines with the maximum power of 3MW each, along with access roads, assembly yards and power infrastructure: a MV/110 kV power station, a MV fibre-optic lines and a 110 kV cable fibre-optic line.
2. An opinion (decision) of the Regional Director for Environmental Protection in Gdańsk on the need to conduct the environmental impact assessment and on the scope of the environmental impact report for the planned project entitled: "Construction of the 'Głuszynko–Grapice' wind farm, consisting of 22 wind turbines with the maximum power of 3MW each, along with access roads, assembly yards and power infrastructure: a MV/110 kV power station, a MV fibre-optic lines and a 110 kV cable fibre-optic line.
3. A local spatial development plan of Głuszynko and Grapice wind park in the Potęgowo Commune approved by Resolution no. XXXIV/242/2009 of the Potęgowo Commune Council of 31 August 2009 (Official Journal of the Pomeranian Province No. 163, item 3181).
4. Antczak J., 2010 "Report on the monitoring of avifauna of the >Grapice< Wind Farm (Potęgowo Commune, Pomeranian Province, Poland). Pre-implementation stage: September 2009 – August 2010".
5. Kościów R., 2010 "Report and assessment of potential impact of the designed location of the >Grapice< Wind Farm on bats".
6. An extract from land register – appendix to "Report..." **in a separate volume.**

Cartographic appendix:

1. The "Głuszynko–Grapice" wind farm. Environmental impact report – area of wind farm (1:10 000).
2. The "Głuszynko–Grapice" wind farm. Environmental impact report – the course of HV 110kV cable lines between "Grapice" and "Bięcino" main power delivery points (1:20 000).

1. SCOPE AND LEGAL BASIS OF THE STUDY

The subject of the study is the environmental impact report for the project consisting in the construction of "Głuszynko–Grapice" wind farm, consisting of 20 wind turbines with the maximum power 3MW each, along with access roads, assembly yards and power infrastructure: MV/110 kV electrical power station, MV fibre-optic lines and cable line 110 kV fibre-optic lines, in Potęgowo and Damnica communes (Fig. 1), hereinafter referred to as ">Głuszynko–Grapice< wind farm".

The report has been drawn up as an appendix to the application for issuing the decision on environmental conditions of the project implementation.

According to the Act of 3 October 2008 on the Disclosure of Information on the Environment and Its Protection, Participation of the Public in Environmental Protection and Environmental Impact Assessments (Journal of Laws of 2008 No. 199, item 1227, as amended) and the Regulation of the Council of Ministers of 9 November 2010 on investment projects that may significantly affect the environment (Journal of Laws No.213, item 1397), the project entitled ">Głuszynko–Grapice< wind farm" in Potęgowo and Damnica communes, including:

- installations generating electric energy using wind energy, with total height not lower than 30 m (§ 3, passage 1, item 6);
 - a substation with the rated voltage not lower than 110 kV (§ 3, passage 1, item 7);
- belongs to the category of objects that may significantly affect the environment. Due to the above, the project must be approved by via a decision on environmental conditions of its execution.

The decision on the need for conducting environmental impact assessment and the scope of the environmental impact report for the construction of the "Głuszynko–Grapice" wind farm, issued by the Head of Potęgowo Commune (**Appendix 1**), after obtaining the opinion of the Regional Director for Environmental Protection in Gdańsk (**Appendix 2**)¹.

According to Article 66 of the Act of 3 October 2008 on the Disclosure of Information on the Environment and Its Protection, Participation of the Public in Environmental Protection and Environmental Impact Assessments (Journal of Laws of 2008 No. 199, item 1227):

1. *Environmental impact report should contain:*

- 1) *description of the planned investment project, in particular:*
 - a) *characteristics of the entire investment project and conditions of the land use at the stage of construction and operation or use,*
 - b) *main characteristics of production processes,*
 - c) *expected types and quantities of contamination, resulting from operation of the planned investment project;*
- 2) *description of nature components of the environment covered by the scope of the expected impact of the planned project, including elements of the environment covered by protection on the basis of the Act of 16 April 2004 on nature conservation;*
- 3) *description of monuments located in the vicinity or within the direct range of impact of the planned investment project, protected on the basis of the provisions concerning protection and care of monuments;*

¹ The District Sanitary Inspector in Słupsk did not issue an opinion within the statutory time limit.

- 4) *description of the expected environmental impacts should the project not be implemented;*
- 5) *description of analysed options, including:*
 - a) *an option proposed by the applicant and a rational alternative option,*
 - b) *an option most favourable for the environment along with justification of its selection;*
- 6) *identification of the expected environmental impact of analysed options, including in the case of occurrence of major industrial failure, as well as possible cross-border environmental impact;*
- 7) *justification of the option suggested by the applicant, with indication of its effect on the environment, in particular on:*
 - a) *people, plants, animals, fungi and natural habitats, water and air,*
 - b) *land surface, taking into consideration ground mass movements, climate and landscape,*
 - c) *material goods,*
 - d) *monuments and cultural landscape, covered by the existing documentation, in particular the register or the record of monuments,*
 - e) *interrelations between elements mentioned in a-d;*
- 8) *description of forecasting methods used by the applicant, as well as description of expected significant environmental impacts of the planned project, including direct, indirect, secondary, cumulative, short-term, medium-term, long-term, permanent and temporary environmental impacts resulting from:*
 - a) *existence of the project,*
 - b) *use of environmental resources,*
 - c) *emissions;*
- 9) *description of planned activities designed to prevent, restrict or environmentally compensate the negative environmental impact, in particular with regard to goals and objects protected under the Natura 2000 programme, and on the integrity of this area;*
- 10) *for roads being projects that may always significantly affect the environment:*
 - a) *determination of assumptions for:*
 - *rescue archaeology of monuments identified in the area of the planned project, uncovered during construction works,*
 - *the programme for protection of the existing monuments and cultural landscape against adverse impact of the planned project,*
 - b) *analysis and assessment of possible hazards and damages to monuments protected pursuant to the provisions concerning protection of monuments and care over monuments, in particular archaeological monuments, located in the vicinity or in immediate range of the impact of the planned project;*
- 11) *if the planned investment project involves the use of installation, comparison of the suggested technology with the technology meeting the requirements referred to in Article 143 of the Act of 27 April 2001 - Environmental Protection Law;*
- 12) *indication of whether the planned project requires establishment of a limited use area as defined by the provisions of the Act of 27 April 2001 - Environmental Protection Law and delimitation of such area, restrictions concerning the intended use of the area, technical requirements concerning building facilities and their operation; it does not apply to investment projects consisting in construction of national roads;*
- 13) *presentation of issues in a graphic form;*

- 14) *presentation of issues in a cartographic form, in the scale corresponding to the subject and level of detail of the issues analysed in the report, for complex presentation of conducted analyses of the environmental impact of the investment project;*
 - 15) *analysis of possible social conflicts related to the planned investment project;*
 - 16) *presentation of proposal of monitoring of the impact of the planned investment project at the stage of construction, operation or use, in particular with regard to goals and objects protected under the Natura 2000 programme, and on the integrity of this area;*
 - 17) *indication of difficulties resulting from technology deficiencies or gaps in contemporary knowledge encountered during preparation of the report;*
 - 18) *non-specialist language summary of information contained in the report, with regard to each element of the report;*
 - 19) *surname of a person or persons who have prepared the report;*
 - 20) *sources of information forming the basis for preparation of the report.*
2. *Information referred to in passage 1 items 4-8 should take account of the expected impact of the analysed options on goals and objects protected under the Natura 2000 programme, and on the integrity of this area.*
 3. *Should one observe a possible cross-border effect, the information referred to in passage 1 item 1-16 should include identification of the impact of the planned investment project outside the territory of the Republic of Poland.*
 4. *Should the planned project require establishment of a limited use area, the report should be accompanied by a copy of a cadastral map certified by a competent authority, showing boundaries of an area where the limited use area should be established. This does not apply to projects consisting in construction of national roads.*
 5. *If the planned project involves the use of an installation for which the integrated permit must be obtained, the environmental impact report should include a comparison of the proposed technique with the best available techniques.*
 6. *The Environmental Impact Report should take into account the impact of the investment project at particular stages of its execution, operation or use, as well as elimination.*

Environmental impact report for the "Głuszynko–Grapice" wind farm covers the issues as specified in Article 66 of the Act of 3 October 2008 on the Disclosure of Information on the Environment and Its Protection, Participation of the Public in Environmental Protection and Environmental Impact Assessments (Journal of Laws of 2008 No. 199, item 1227), taking into consideration the requirements contained in the decision of the Head of Potęgowo Commune (**Appendix 1**).

The "Report.." has been prepared on the basis of:

- design materials provided by the Ordering Party – "EWG Słupsk" Sp. z o.o. in Legnica;
- field study regarding ecophysiography, zoology and landscape conducted in November 2010;
- environment monitoring:
 - "Report on the monitoring of avifauna of the >Grapice< Wind Farm (Potęgowo Commune, Pomeranian Province, Poland). Pre-implementation stage: September 2009 – August 2010" (Antczak 2010);
 - "Report and assessment of the potential impact of the designed location of the >Grapice< Wind Farm on bats" (Kościów 2010);

- archive materials of BPiWP "PROEKO" in Gdańsk;
- published materials concerning methodical aspects of environmental impact assessments;
- published materials concerning the project area and its region;
- common and local environmental protection law.

The list of sources in the form of published materials, archive materials and legal acts on the basis of which the "Report" was prepared is included in chapter 13.

2. DESCRIPTION OF THE PLANNED PROJECT

2.1. The planned project – basic option

The project consists in construction of the "Głuszynko–Grapice" wind farm, consisting of the following basic elements (cart. appendices):

- 1) 20 wind turbines, with total maximum power of 60 MW on reinforced concrete foundations, equipped with assembly platforms with hardened pavement,
- 2) access roads connecting wind turbines with public roads,
- 3) end-user MV/110 kV substation (the "Grapice" main power delivery point),
- 4) cable (to earth) MV power grid connecting wind turbines with the substation;
- 5) cable (to earth) HV/110 kV power line connecting "Grapice" and "Bięcino" main power take-up points;
- 6) cable (to earth) telecommunication network connecting turbines with the automated control centre.

Under the designed project, use turbines meeting the following parameters is planned:

- 1) power of up to 3 MW,
- 2) the tip height (blade erected) of 170m AGL, including a 120-meter tower and a rotor 50-meter long,
- 3) maximum acoustic power at the level not exceeding acceptable noise levels as specified by the environmental protection law, at the border of residential areas or other areas designed for permanent stay of people and at borders of such areas as set forth in local spatial development plans,

In addition, all turbines will fulfill the following requirements:

- marking ensuring avoidance of obstacle collision (5 lanes painted on the external ends of the propeller, the same width, perpendicular to the axis of the propeller, covering 1/3 of the propeller's length – 3 red or orange strips and 2 white),
- structure of the wind turbine painted white or grey (uniform colours of the whole wind park),
- ban on placing advertisements, except for symbols (logo) of the manufacturer or the investor, or the equipment owner.

The "Głuszynko–Grapice" wind farm will be located mostly in the Potęgowo Commune, in geodetic precincts of Głuszynko, Grapice, Nieckowo, Rzechcino, Skórowo Nowe (the larger part of the project, i.e. wind turbines, transformer station, access roads, power connections, and a fragment of 110 kV fibre-optic cable line) and in the Damnica Commune, in precincts of Wiszno, Dąbrówka, Damno, Świącichowo, Damnica and Bięcino (where cable line 110 kV will run), on geodetic plots listed in table 1.

All locations of wind turbines are consistent with arrangements of "Local Spatial Development Plan of Głuszynko and Grapice wind park in the Potęgowo Commune" approved by Resolution no. XXXIV/242/2009 of the Potęgowo Commune Council of 31 August 2009 (Official Journal The Pomeranian Province No. 163, item 3181) (**Appendix 3**).

Table 1 Numbers of geodetic plots on which the "Głuszynko–Grapice" wind farm is located

Geodetic precinct	Numbers of plots	Comments
Potęgowo Commune		
Głuszynko	1/15, 1/17, 1/21, 2/1, 2/2, 2/3, 2/4, 2/5, 2/6, 3/1	locations of 13 wind turbines
	1/15, 1/17, 1/20, 1/21, 2/1, 2/2, 2/4, 2/5, 2/6, 3/1, 9/18, 19, 20, 21, 137, 141	construction of access roads and assembly yards
	1/15, 1/17, 1/20, 1/21, 2/1, 2/2, 2/3, 2/4, 2/5, 2/6, 3/1, 17, 18, 19, 20, 21, 163, 170	construction of medium voltage fibre-optic cable lines
Grapice	3/6, 3/7, 3/9, 4/14	locations of 7 wind turbines
	3/6, 3/7, 3/9, 4/14, 6, 13, 157	construction of access roads and assembly yards
	3/4, 3/6, 3/7, 3/9, 4/14, 4/15, 6	construction of medium voltage fibre-optic cable lines
	3/6	construction of the MV/110kV substation (main power take-up point)
	2/4, 3/6, 157	construction of the 110kV cable line
Rzechcino	83/1, 95	construction of access roads and assembly yards
Nieckowo	35/10, 133, 134	construction of access roads and assembly yards
Skórowo Nowe	35	construction of access roads and assembly yards
Damnica		
Wisžno	3/2, 3/5, 6/12, 16, 38, 46, 48, 55, 58, 84, 87, 97, 114, 125, 136	construction of the 110kV cable line
Dąbrówka	14, 18	construction of the 110kV cable line
Damno	1/19, 8, 30, 31, 143, 227, 128/1, 229, 231, 232	construction of the 110kV cable line
Święcichowo	161/1, 161/2	construction of the 110kV cable line
Damnica	2, 7, 8/4, 207, 238/1, 275, 286, 285, 290/6	construction of the 110kV cable line
Bięcino	36/1, 55, 163, 187, 189, 203, 255	construction of the 110kV cable line

Source: The application for issuing the decision on environmental conditions.

The planned project will be located in areas which were used agriculturally and in undeveloped areas. Currently these areas are dominated by annual crops, and meadows and pastures used agriculturally. The designed buildings of wind turbines, and their power and road infrastructure will not interfere in the current land use, which will be used agriculturally.

The whole project covers the total area of ca. 12.18 ha, of which:

- ca. 10.54 ha is located within the Potęgowo Commune;
- ca. 1.64 ha is located within Damnica.

Each power station requires the total area of ca. 2,100 m², including:

- foundation – ca. 900 m² (total area for 20 power stations will amount to ca. 1.8 ha);
- an assembly yard – ca. 1,200 m² (total area for 20 power stations will amount to ca. 2.4 ha);

Surface area of the location of MV/110kV station will be ca. 4,400 m².

Access roads, 5 m wide, will run from the nearest hardened roads of local importance, communal, district or provincial roads. The internal radius of exits from the aforementioned roads will be 12.0 to 35 m. The total length of access roads will be ca. 6,850 m. The total surface area of the land intended for new access roads and exits will be 4.34 ha.

The remaining project area occupied by 110 kV and MV fibre-optic cable lines is about 1.14 ha within the Potęgowo Commune and roughly 1.64 ha within the Damnica Commune.

110 kV fibre-optic cable line, 18.1 km long, will run through the area of Potęgowo and Damnica communes. The line will run mainly in right-of-ways of communal roads, and agricultural land – bypassing clusters of trees and shrubs. After laying the line the areas will be restored to their primary condition. Humus layers on the construction site will be removed, preserved and used after the completion of the works at areas where turfing is to be performed.

As a target, one plans to maintain the agricultural use of the land within the areas intended for assembly yards, and laying of power cables.

Type of technology

Electric energy produced as a result of using kinetic wind energy in 20 wind turbines with the maximum power of up to 3 MW each, will be transferred via underground medium voltage power cables to the "Grapice" main power take-up point where it will be transferred to the transformer via a MV (30 kV) switching station. The transformer of the station will allow voltage to be changed from the level of wind turbine generators (middle voltage – 30 kV) to 110 kV, which is appropriate for transmitting electric power over long distances.

Then high voltage electric energy will be sent, through 110 kV bay, using high voltage cable line, to the "Bięcino" main power take-up point, from which it will be sent to the electricity system.

Technology of producing electric energy using wind turbines and transmitting this energy to the network is based on the following transformations and phenomena:

- aerodynamic, i.e. transformation of wind energy into the circular motion of the rotor (blades, propellers of the power station),
- electromagnetic, i.e. transformation of mechanical energy (rotary motion of the rotor) into electric energy (power generator),
- electrical, i.e. electrical transformation and adjustment (with regard to voltage, frequency and phase) to the receiving network (e.g. a transformer station being a

Main Power Supply Point) and transmission of energy to the network via the delivering line.

The wind turbine consists of a steel tower constructed in the form of a pipe, and a head - the nacelle equipped with a power generator, a motor positioning the rotor according to the wind direction, a vibration-damping device and electronic protections. The hub with rotor blades is made of plastics used in aviation structures. Each of the blades turns individually, in such a way that optimum working conditions are ensured, taking account of the current wind loads.

Installation of the wind turbine takes place in their foundation areas, using ready-made elements (sections of the carrying pillar, propellers, nacelle) using a crane. Turbines will have monolithic foundations of reinforced concrete.

Power stations will be operated automatically. The control system includes programmed parameters for disconnecting the power station depending on, e.g. the duration of the fixed wind velocity threshold limit overrun, short-circuits and lightnings, transmission line breaks, or other breakdowns.

The designed wind turbines are state-of-the-art, and are characterised by low rotational speed of propellers, and thereby one of the lowest noise generation coefficients.

Underground mV cable lines connecting turbines will be arranged in excavations with the depth of ca. 1.3 m BGL and the width of ca. 0.5 – 0.8 m.

The turbines are to be operated for ca. 25-30 years. Wind turbines are automatic devices. Proper functioning and operational supervision of the wind turbines will be ensured by telecommunications infrastructure (network of ground optotelecommunication lines placed in parallel to power cables). For the needs of data exchange between particular turbines, main power take-up points and dispatch systems of power industry, external data communication network will be constructed (fibre-optic).

The MV/110 kV transformer station planned to be executed as part of the project, will be covered by the restricted zone - a fenced area.

The MV/100 kV station project envisages application of typical technical solutions and high-quality devices commonly used in this type of facilities – according to the needs. Elements of the designed power station will consist of, among others: transformers, oil separators, control room building, vertical and horizontal air terminals. 30 kV and 110 kV cable lines will also be built within the area of the station.

The plot intended for development of the main power take-up point is situated within the area without a storm water drainage system. The drainage system of the transformer location will include:

- inspection chamber made of reinforced concrete rings;
- sedimentation tank made of reinforced concrete rings;
- coalescence separator;
- sample collection chamber;
- drainage to a soakaway.

Internal road system connected to public roads will provide access to wind turbines and to end-user transformer station for technical-maintenance service. The roads will have hardened pavement, in lanes ca. 4.5 -5 m wide.

On the whole, the project envisages the course of access roads along existing routes of local roads, new roads will be marked out only when access from the existing roads is impossible.

The areas of foundation of wind turbines and construction of access roads and assembly yards will be subjected to geo-technical examination.

The planned 110 kV power line will be laid in the excavation 90 cm wide at the minimum depth of 1 m. Cables with external diameter of ca. 10 cm will be laid in three-conductor bundles. Along with power cables, a fibre-optic pipeline will be laid or the needs of 110 kV line, made of RHDPE pipes with the diameter of 4.2 cm. At crossings with elements of underground utilities, and water courses the power cables and pipeline will be additionally placed in protective RHDPE pipes.

For the purposes of laying the designed 110 kV cable line excavations in areas with low density of underground utilities are planned to be executed using mechanical equipment, while in areas with extensive infrastructure, close to trees, excavations will be executed manually. Trees growing near the excavation will be protected by timbering. Should roots be present, they are to be bypassed using culverts or drills without damaging them.

Crossings with hardened roads, area utilities and water courses will be executed by controlled drills. The longest drill is planned under the Łupawa River and meadows in protected habitats in its valley; it will be ca. 500 m long. The soil masses from excavations will be used on the construction site. Any possible excess will be transported. No drainage of excavations is planned. No aggregate is planned to be used.

Expected quantity of used water and other raw materials, materials, fuels and energy

At the construction stage the analysed project will use diverse quantities of raw materials, materials, fuels and energy (see sec. 8.2.). Apart from construction materials, it will apply to the use of water for social-living purposes of construction teams, fuels for construction equipment, as well as transport service.

Concrete used to construct foundations will not be produced on the site, and will be supplied by concrete plants having attestations for production of high-end brand concretes as required by Polish Standards, i.e. C45/55 (in the quantity of ca. 17,980 m³) and concrete bed C16/20 (in the quantity of ca. 2,300 m³). In addition to construct foundations of the wind turbines 20,940 m³ of aggregate (backfill and embankment of the foundation), and 1,470 t of reinforcing steel are to be used. Foundations of the MV/110 kV power station will be made using ca. 300 m³ of B15 concrete.

For construction of roads and communication lines it is planned to use:

- sand (as bed) – ca. 7,500 m³;
- broken stone – ca. 1,000 m³.

Demand for road slabs - ca. 250 m².

In the period of operation the "Głuszynko–Grapice" wind farm along with technical infrastructure will use mainly kinetic energy of wind and small quantities of electric energy for the needs of warning lighting of the wind turbines and power supply of the transformer station.

For own needs – 220V DC acid-free accumulator batteries with Aqua Gen gas recombination will be used. Moreover, own needs will be satisfied from overhead MV line. Heating of rooms – only for a period of inspections, up to +5°C, with electric storage heaters.

The wind farm will not use other raw materials, materials and fuels during its operation.

Type and expected quantities of substances or energies introduced to the environment when applying solutions protecting the environment

Wind turbines are operated automatically and do not require construction of social facilities and water-sewerage infrastructure (no water consumption and sewage discharge).

Only the transformer station will be equipped with the storm water drainage system. Stormwater flowing from roofs will be drained to green areas. Water from precipitation and thaws, gathering in tight gullies under transformers, will flow to separating chambers and then to a soakaway.

In order to separate water from oil and to drain it, stations will be equipped with a monitoring and separation system meeting requirements of Polish regulations concerning environmental protection of water against oil contamination.

Wind farm "Głuszynko–Grapice" will be the source of:

- noise emitted to the environment – emissions of acoustic energy to the environment will be caused by the rotor operation and rotation of propellers; planned wind turbines are sources of high acoustic power that will cause temporary changes in the acoustic climate on the significant area, but within limits acceptable for the vicinity of buildings designed for permanent stay of people (see sec. 6.2.5.);
- infrasounds below values that may affect people's health (see sec. 6.2.6.);
- electromagnetic radiation from the MV/HV transformer station – it will cover the fenced area, at a safe distance from developed areas, which will ensure fulfilment of legal standards in this respect;
- waste generation (see sec. 6.2.4.).

In addition, except for delivery of substances (waste) and emission of energy (noise, infrasounds), the "Głuszynko–Grapice" wind farm will cause:

- elimination of soil cover and vegetation of agrocenoses at the construction stage (see sec. 6.1.1. and 6.1.2.);
- local limitation of stormwater infiltration to the ground – this water will flow along foundations and on pavement of internal roads, and will soak into the ground in their direct vicinity; stormwater from the transformer station will be drained to the ground after initial treatment (see sec. 6.2.1.)
- potential impact on birds and bats (see sec. 6.2.3.);
- impact on physiognomical landscape qualities of the project area and its surrounding (see sec. 6.2.8.).

2.2. Project options

Apart from the basic option of the project described in chapter 2.1., the following options were considered:

- an option of not beginning the project (zero option);

- options differing from the basic option in number and arrangement of planned turbines (Fig. 2) and along the course of 110 kV cable line.

Option of not beginning the project - zero option

This option would be the most environmentally beneficial for the area of location and its surrounding, at the same time it will be unfavourable in terms of global emission of power production pollutants to the atmosphere and counteracting climate changes (instead of the source of so-called green energy, it will be necessary to establish a conventional source elsewhere).

Failure to implement the project would not affect the local environment – it would be intact. At the same time, the positive impact of wind turbines would not be present - their use contributes to reduction of emission of pollutants into the atmosphere, including greenhouse gases, and ensures saving of limited fossil energy raw materials.

Failure to implement the project would not affect the local environment – it would be intact. At the same time, the positive impact of wind turbines would not be present - their use contributes to reduction of emission of pollutants into the atmosphere, including greenhouse gases, and ensures saving of limited fossil energy raw materials.

Production of 1 MWh of power in a conventional power plant fired with hard coal equals emission of ca. 2.142 kg of sulphur dioxide (SO₂), 1.584 kg of nitrogen oxide (NO_x), 0.19 kg of dusts into the atmosphere². It also emits large amounts of carbon dioxide (CO₂) responsible for warming of the climate of Earth – ca. 907.02 kg

Assuming the average efficiency for the industry, the wind turbine with rated power of 3 MW may limit the 24-hour emissions of:

- sulphur dioxide - by ca. 30.84 kg;
- nitrogen oxide - by ca. 22.81 kg;
- dusts - by ca. 2.79 kg;
- carbon dioxide - by ca. 13 tons.

The designed project with total rated power of 60 MW, estimated efficiency of ca. 20%, is the source of ca. 106 000 MWh of energy per year, which means the possibility of annual reduction of emissions³:

- sulphur dioxide - by ca. 227 tons;
- nitrogen oxide - by ca. 168 tons;
- dusts - by ca. 20 tons;
- carbon dioxide - by ca. 9,637 tons.

Abandoning the construction of the planned wind farm would be inconsistent with policy of atmosphere protection and counteracting climate changes on the global scale and Poland's energy policy (see sec. 2.3.), including with the postulate of diversification of source of energy in Poland and increase in the use of renewable energy.

² ENERGA S.A.: Information about the effect of electric energy generation on the environment with regard to the volume of emissions of different fuels used to generate electricity sold by ENERGA – OBRÓT S.A. in 2009 (www.energa.pl)

³ The values estimated on the basis of data published by ENERGA S.A.

Alternative options

Originally, the location of 30 wind turbines was discussed in the area of Głuszyno and Grapice in the Potęgowo Commune (Fig. 2a).

On further stages of the project, for environmental and technical reasons, a decision was made to give up 8 turbines and modify the location of the remaining turbines (Fig. 2b).

Then, according to results of ornithological monitoring, a decision was made to give up two further turbines, limiting their number to 20 in the final option (Fig. 2b).

As part of optional solutions application of wind turbines by different manufacturers with similar parameters was discussed, including:

- turbines by Enercon E101 3.0 with rated power of 3MW;
- turbines by Nordex N90, /2500 LS with rated power of 2.5MW; 104.5 dB
- turbines by Nordex 100 N/2500 LS with rated power of 2.5MW;
- turbines by GE 2,5 xl with rated power of 2.5MW; - 105dB
- turbines by Goldwind PMDD 2.5 with rated power of 2.5MW;
- turbines by Siemens SWT-2,3-101o with rated power of 2.3MW;
- turbines by Vestas V90 2.0 with rated power of 2MW; 104dB
- turbines by Vestas V90 3.0 with rated power of 3MW; 107dB

No final selection of turbines was made yet, on the other hand, for the purposes of environmental impact assessment, this report uses parameters of the Vestas V90 3.0MW turbine with the largest potential environmental impact.

The option selected for implementation (20 wind turbines – Fig. 2b) was prepared on the basis of the following assumptions:

- maintenance of proper distances from turbines to residential buildings – ensuring observance of the standards of noise levels for residential buildings;
- location of turbines according to the results of pre-investment ornithological and chiropterological survey.

Within the scope of execution of the 110 kV cable line connecting the area of the wind turbines with the "Bięcino" station, three options of its course were considered at the previous stages of the project:

- Option I (basic) –ca. 18.1 km long;
- Option II –ca. 16.7 km long, the course more simple than in the basic option, refers to the existing roads to a smaller extent (more frequently runs through areas used agriculturally and crosses existing trees);
- Option III – overhead line.

In addition, as part of option I (basic) the length of a section planned for execution by means of directional drilling was modified. Originally, there were plans to drill on the section of ca. 60 m (only under the riverbed). In final option one decided to drill on the section of 500 m (under the riverbed and under meadows in protected habitats – see sec. 7.1.).

A solution alternative to the basic option with 20 wind turbines would be to further limit the number of turbines. In terms of local environmental protection location of a smaller number of turbines would be more beneficial. In turn, in global terms, more

the location of the highest possible number of sources of clean energy, which include wind turbines, is favorable. Therefore, the implementation option characterised by significant effects in reducing emissions described in this chapter at relatively small environmental damage seems to be optimal.

2.3. Environmental impact assessment for options of the project

As reported in chapter 2.2., options considered for the planned project differed mainly in the number of turbines and their arrangement.

Location of a smaller number of turbines would be more beneficial in terms of protection of the local environment. In terms of environmental impact, implementation of more wind turbines (maximum option - 30 turbines) would result in:

- increasing the area surface subject to transformations (new excavations for foundations, execution of assembly yards and access roads, excavations for MV cables);
- higher noise emission (a higher number of sources);
- increased impact on landscape;
- potentially larger impact on birds and bats.

The project option selected for implementation consist of a smaller contemplated number of turbines (20).

Furthermore, as part of optional solutions, the layout of turbines was modified. The location of turbines in the option adopted for implementation was maximally adjusted to areas with the least natural value, with maximum possible economic benefits.

Preparation of options of the course of the 110 kV cable line was aimed at minimising its impact on the environment, including the Natura 2000 site - "Dolina Łupawy".

Option I was recognised as the one least harmful for the environment. The course of the line in this option was optimised (in connection with existing roads), due to the impact on biotic environment – vegetation (no need to log trees). Furthermore, implementation by means of directional drill of the 500-meter-long section will eliminate the threat for habitats protected under the Natura 2000 network, within the Łupawa Valley.

Option II to a smaller extent refers to the course of existing roads, i.a. it runs through forests and trees. The implementation of this option would require trees and shrubs to be cut. Furthermore, on the section of the course running through the Łupawa Valley, the route of the course of the cable line in option II crosses (apart from the Łupawa) several smaller watercourses, which creates a greater risk for this area.

The option relating to implementation of the overhead line (option III), as opposed to other options, would require smaller transformation of the upper layer of lithosphere at the investment stage (implementation of excavations for foundations only in places where line poles will be founded). On the other hand, it would result in the need to log trees in strips of land under the line (and maintenance of this state throughout the period of operation of the line). This option is the only one significantly affecting the landscape, in particular on a section crossing the Łupawa valley. Moreover, overhead power lines are a significant source of electromagnetic radiation and noise. This option was abandoned at the primary design stage of the project.

2.4. Solutions protecting the environment for the option selected for implementation – the option most beneficial for the environment

Wind turbines are the source of so-called green energy. Their use, thanks to replacing conventional sources of energy, contributes to a decrease in the emission of CO₂, SO₂, NO_x and dusts to the atmosphere, which results in beneficial environmental effects in both local (decrease in air pollution, better aerosanitary conditions of people's lives) and global scale (limitation of climatic and derivative effects of the greenhouse effect). Use of renewable energy sources complies with principles of sustainable development binding in Poland, as well as international commitments of Poland, especially those resulting from membership in the EU and ratification of the United Nations Framework Convention on Climate Change and the so-called Kyoto Protocol.

During past planning and design works for the "Głuszyńsko–Grapice" wind farm, i.a. the following solutions protecting the environment were applied:

- 1) location of wind turbines and a transformer station:
 - away from residential facilities, which eliminates the possible impact on people related to the excessive level of noise emitted by wind turbines, as well as the influence of electromagnetic field of the transformer station;
 - in the areas used agriculturally with no significant environmental qualities;
 - conducting geotechnical surveys of the area intended for foundation of building facilities;
- 2) use of uniform colours of the wind turbine structures, non-contrasting with the environment, in order to limit the impact on the landscape,
- 3) use of underground cables between particular turbines, which will minimise the impact on the landscape; laying of the line underground will also have no effect on the use of real estate, since cable lines will be laid below the depth to which arable lands are used during agricultural works; it will also minimise the risk of collision with birds, for which overhead power lines constitute a serious risk,
- 4) receipt and utilisation of waste classified as hazardous (e.g. gear oils) by specialised services, in accordance with the conditions resulting from the Act on Waste,
- 5) equipping the transformer station in oil sumps and a system for monitoring and separating oil from stormwater, minimising the risk of transformer oil leakage to the environment;
- 6) foundation of wind turbines on solid cylindrical towers, which contrary to lattice towers (otherwise referred to as truss towers) do not provide nesting places for birds, and thereby do not attract them to the area of wind turbines;
- 7) the underground course of the 110 kV line, setting its route to bypass areas of forests and trees (in connection with existing roads) and execution of passages of the line by means of directional drill – minimising the environmental impact.

2.5. Conditions of land use at the stages of construction and operation of the project

The construction stage of the planned project will consist, in the first place, in construction of access roads to particular turbines (i.e. land levelling, delivery of material and rearrangement of the road profile). This process may partially apply to

existing roads which will be periodically shut down. Once the construction of roads is complete, they will be approved for general use.

Next, the area under the location of the wind turbines and within assembly yards will be levelled and then excavations for foundations of wind turbines will be made. The next stage of works will focus on pouring foundations and installation of turbines after their setting (hardening).

Areas covered by earthworks and installation works will be abandoned from agricultural use for the duration of these works.

After completion of installation works the areas around the wind turbines will be reclaimed and restored for agricultural use. Areas permanently abandoned from agricultural use will only include areas where foundation of the wind turbines and access roads are located.

Areas with MV and HV (110 kV) power cables and optotelecommunication lines will also be restored to their primary use.

Location of residential buildings, farming buildings and protected services in the operation phase of the project will be forbidden within the range of over-standard noise emitted by turbines – it complies with "Local spatial development plan of the Głuszyńsko-Grapice wind farm in Potęgowo.

This plan determines, i.a (**Appendix 3**):

- 22 areas of acceptable location of wind turbines – location of the wind turbines is approved only in the boundaries of areas EW1-22.
- an area of acceptable location of the transformer station – GPZ,
- areas of internal access roads – KDW1-22.

3. STRUCTURE AND ANTHROPISTATION OF THE NATURAL ENVIRONMENT IN THE PROJECT AREA

3.1. Regional location

The location area of the "Głuszynko–Grapice" wind farm, according to physical-geographical regionalisation of Poland by Kondracki (1998), is located in the mesoregion of the Damnicka Upland, being a part of the macroregion of the Koszalińskie Coastland.

The Damnicka Upland is located between the valleys of the Słupia and Łeba rivers, raising 20-30 m above the Sławieńska Plain in the west, i.e. up to 60-80 m above sea level, and in some places even up to 100 m above sea level. Thanks to higher elevation and steep slopes demarcating the valleys, the Damnicka Upland is clearly distinguished from the surrounding regions. In the north, on the borderland the Słowińskie Coast, there are moraine hills of the Gardno phase, accompanied by a sandur in the south. Soils are predominantly podzolic soils (on sands) and brown earth soils (on clays). The region spreads over the area of 830 km². The Łupawa River flows through the central part of the Damnicka Upland.

3.2. The structure of the natural environment in the location of the "Głuszynko–Grapice" wind farm and its direct surroundings

3.2.1. Abiotic environment

Topography

The area of the "Głuszynko–Grapice" wind farm is located within a moraine upland with numerous post-glacial depressions and small hills, among which the most typical are a succession of elongated hills – eskers, curving from Potęgowo through Grapice to Rzechcin (through the central part of the area of the project location). Small ponds or marshes are present in the local hollows.

Height differences within the upland are small, usually lower than 15 m.

In addition, the topography is enriched by numerous valleys – smaller ones, predominantly with gentle slopes, and larger, much deeper with steep slopes (e.g. north-west and west from the project location).

Geological structure

Subsurface geological formations of the project area are Quaternary formations. On the upland the Pleistocene glacial and water-glacial deposits on dump clays take the form of thin patches of ablation sands. Thickness of Quaternary deposits ranges from 40 to 135 m.

In the valleys of watercourses and in land depressions there are Holocene river deposits (mud and sands), lake deposits (gyttja and lake marl) and marsh deposits (peats). Edges of the valleys are usually made up of sand and sand-gravel water-glacial deposits.

They linger on a very diverse surface of sub-Quaternary formations – from Tertiary and Cretaceous periods. Tertiary deposits are formed mostly as sands, dusty sands and loams with the addition or interbedding of coalified organic matter.

In hydrographic terms, the area of the "Głuszynko–Grapice" wind farm is located in the drainage basin of the Łupawa, which flows south-west of the area, at the minimum distance of ca. 3.5 km.

The source of the Łupawa is located in the north-western part of the Kashubian Lake District. It is located 155.8 m above sea level. The length of the Łupawa is 102.5 km, and the average drop is 1.5 ‰. The total area of the basin occupies 924.5 km². In its lower reaches the Łupawa flows through the Słowińskie Coast with a large and shallow seaside lake - Gardno (2,468.1 ha, max. depth of 2.6 m). Then the Łupawa flows into the Baltic Sea in Rowy through a short channel (about 1 km).

In the areas of direct location of the wind turbines, the main power take-up points and their access roads there are no surface waters. Surface waters located nearby are small water ponds and marshes. Two watercourses are flowing west and south-west of the project location (Darżyńska Struga and its tributary flowing from Jeziorki), connecting in the area of Grapice and flowing together into the Łupawa.

The designed course of HV 110 kV connection crosses one of the aforementioned courses (a tributary from the Jeziorko south of the village of Jeziorki), the Łupawa River (north of the village of Bobrowniki) and a melioration ditch (north of the village of Dąbrówka).

The area of the Potęgowo Commune, including the area of the project, is characterised by large resources of underground waters. The north-western part of the location of the "Głuszynko–Grapice" wind farm (including locations of 5 wind turbines, the main power take-up point and a fragment of the 110 kV cable line), is located within the range of the Major Groundwater Reservoir no. 115 "Łupawa" and its buffer zone, and the south-eastern edge of the area (including locations of 2 wind turbines), is located within the boundaries of the buffer zone of the "Łeba" Major Groundwater Reservoir no. 107.

The area of the "Łupawa" Major Groundwater Reservoir no. 115 includes also an eastern section of HV 110 kV connection (the "Grapice" main power take-up point – the "Bięcino" main power take-up point, length of ca. 6 km, and its buffer zone includes a section of ca. 8.1 km).

The "Łupawa" Major Groundwater Reservoir no. 115 is an intermoraine tank, with the total area of 118 km². The main usable level here are the Quaternary intermoraine aquifer sands. Discretionary resources of the Major Groundwater Reservoir amount to 28,631 m³/24h (i.e. 1,193 m³/h), exploitable resources of intakes in the area of the tank – 1,064.1 m³/h.

The "Pradolina Łeby" Major Groundwater Reservoir no. 107 with the total area of 195 km² with discretionary resources amounting to 6,700 m³/h. The ceiling of aquifer formed of sands and gravels is located only 0.5 – 5.0 m BGL, much deeper on the edge of the upland – ca. 80 m BGL.

The soil cover of the area is dominated, on the surface, by leached, acidic and surface brown soils. In land depressions organogenic soils are present.

Climatic conditions

The area of the Potęgowo Commune, according to climate regionalisation of Poland (Wosia, 1999), conducted on the basis of the analysis of the frequency of occurrence of different types of weather, is located in the East Coastal region. This region includes an eastern section of the Słowińskie Coast and a part of the Kashubian Coast. The specific character of climatic relations of this area consists, among others, in recording a

relatively large number of cold weather days, including days with heavy cloudiness and cold weather days with precipitation. On average, there are almost 53 cold weather days, almost 30 cold days with heavy cloudiness, and 32 cold weather days with precipitation a year. Moderately cold days with ground frost without precipitation with moderate or heavy cloudiness are relatively rare.

The warmest months in the area of the Potęgowo Commune are July and August, and the coldest are January and February. Average annual air temperature - $+ 7.6^{\circ}\text{C}$ (Słupsk station) is typical for this part of the province. The frost-free period is relatively long (170-180 days). Vegetation period lasts, on average, 185 – 200 days.

Typical features of the climate include: a short and late winter, as well as a relatively large number of hot days – 25. The average length of winter in the period of 1950-94 in the area of Słupsk (and thus in Potęgowo) amounted to 61 days.

It is a region with quite high annual precipitation - 771 mm in Słupsk, 740 mm in Malczkowie (average for the country - 600 mm). The month with highest precipitation is July.

In annual scale, prevailing winds are those blowing from W, SW and NW. The northern and central part of the commune is classified as one of the areas with the strongest winds in the country. The highest strength - the average monthly speed of more than 10 m/s - the wind reaches mainly in November and January, most often in the north-eastern part of the commune.

3.2.2. Biotic environment

3.2.2.1. Vegetation⁴

According to the "Study of the Conditions and Directions of Spatial Development of the Potęgowo Commune" (2010), the structure of land use of the Potęgowo Commune is dominated by arable lands, occupying more than 2/3 of the commune. The majority of them are agricultural lands. Agricultural cultivations constituting monocultural agrocenoses are accompanied by elements of natural vegetation in the form of segetal communities. The field landscape includes areas where cultivations were abandoned (fallow), overgrown with birch and pine in subsequent phases of natural succession of vegetation.

Permanent green lands occupy a relatively small surface (ca. 10% of the surface area of the commune), mostly within boggy areas and in the vicinity of natural reservoirs and watercourses. Green lands are dominated by eutrophic damp meadows (knotweed-thistle) which are accompanied by various rush communities and moors in the river valleys and aquatic and coastal vegetation communities of reservoirs.

The proportion of woodland areas of the Potęgowo Commune is one of the lowest in the Słupsk District and is 26.8%.

Forest communities are dominated by various forms of acidophilic Pomeranian beech-oak forest. They are neighboured by fragments of acidophilic lowland beechwood. Patches of alder forests developed in the form of enclaves within other deciduous forests, in the lowest-located basins and hollows and in the bottoms of river valleys – in places where water remains on the ground for a long period of time

⁴ "Environmental protection programme for the Potęgowo Commune", 2003.

or for the entire year. In hydrogenic habitats with slow flow and lower level of groundwaters there are ash-alder alluvial forests. Their base is almost exclusively low moor peats.

A dominant species of the stands is pine. Pine forms pure tree stands and mixed stands with birch, spruce, beech and oak. The second place, with much lower share in the tree stand, is occupied by birch. Trees with even lower share (a few per cent) are beech, spruce and oak.

In the areas of the planned location of wind turbines and the transformer station there are only agrocenoses of arable lands with periodic segetal vegetation.

In the vicinity of the project area forests and trees usually occupy small areas, covering local low-lying areas and river valleys. Larger forest complexes are present in further surrounding (at the minimum distance of ca. 3.5 km south-west and over 3.7 km north-east). These are forests associated with valleys of the Łupawa and Łeba rivers, overgrowing their bottoms and banks. According to "Plan of spatial development of the Pomeranian Province" (2009) valleys of these rivers constitute regional ecological corridors.

Furthermore, (apart from the aforementioned forests) vegetation in the surroundings of the location of the "Głuszynko–Grapice" wind farm is represented, first of all, by:

- agrocenoses (arable lands and fallows);
- meadow-grazing communities used agriculturally;
- roadside tree lanes;
- trees and shrubs in the fields with hydrogenic vegetation;
- orchards, gardens, home greenery;
- ruderal vegetation near buildings.

On the route of the 110 kV power cable line there are (cart. app. 2):

- arable lands (with vegetation of agrocenoses and green lands);
- roads, hardened and unhardened road crossings (with accompanying ruderal vegetation);
- tree plantings;
- locally, forest complexes;
- hydrographic objects – watercourses, including the Łupawa river bed with water and water-edge vegetation.

3.2.2.3. Fauna – general characteristics

According to the "Study of the Conditions and Directions of Spatial Development of the Potęgowo Commune" (2010) within the Potęgowo Commune there are many species of fauna representing different groups of vertebrates: fish, amphibians, reptiles, birds and mammals.

In the rivers of the commune we may spot salmonidae – brown and rainbow trout, sea trout, stickleback, European perches, gudgeons and lampreys, roaches and bleaks.

In preserved, waterlogged land hollows, in ponds, in wooded edges of small watercourses and melioration ditches amphibians are present, such as, e.g. frogs:

water frog, lake frog, moor frog, marsh frog; toads: common toad, spadefoot toad, as well as smooth newt and northern crested newt.

The mid-forest sections of the Łupawa, which within the commune is a submontane river, are breeding grounds for common kingfisher, mountain wagtail, common sandpiper and common merganser. Extensive complexes of fields between Głuszynko and Rzechcino in the northern part of the commune play a very important role, due to post-breeding and migration groups of cranes exceeding 1,000 birds.

In larger forest complexes in the eastern part of the commune live populations of deers, wild boars, roe deers, 2 species of marten, badgers, foxes, raccoon dogs. Some European hares live in fields. Hedgehogs are frequent in shrubs and gardens.

3.2.2.4. Ornithological monitoring

An annual monitoring of avifauna of the "Głuszynko–Grapice" wind farm was conducted in the period from September 2009 to August 2010: "Report on the monitoring of avifauna of the >Grapice< Wind Farm (Potęgowo Commune, Pomeranian Province, Poland). Pre-implementation stage: September 2009 – August 2010" (Antczak 2010) (**Appendix 4**), covering the project area in the primary option of 22 wind turbines (Fig. 3). In accordance with the "Report on the monitoring of avifauna of the >Grapice< Wind Farm (Potęgowo Commune, Pomeranian Province, Poland). Pre-implementation stage: September 2009 – August 2010" (Antczak 2010):

At least 96 bird species related to the investment area were found during the research conducted in the period from September 2009 to August 2010 in the areas planned for construction of the "Grapice" wind farm and in its closest vicinity. (tab. 2)

Breeding avifauna consisted of 53 species. Additionally, another 14 species were found in immediate proximity. Of this number 11 species were included in Annex 1 to the Birds Directive; breeding species included white stork, western marsh harrier, corncrake, crane, woodlark and red-backed shrike. In addition, at a distance from the area (4-5 km) red kite, white-tailed eagle and lesser spotted eagle had their nests.

Within the distance of ca. 3 km there were at least two nests of red kite, and at the distance of ca. 5 km from the boundaries of the wind farm two breeding nests of white-tailed eagle were located and one of lesser spotted eagle (both species were associated with proglacial stream valleys of the Łupawa and the Łeba). The aforementioned species visited the area of the wind farm irregularly (1-3 times a year), and consequently the high risk of collision with working turbines was excluded.

In the period of spring migrations 679 birds belonging to 17 species were recorded, performing directional flights (to the east and north-east).

Average intensity of directional flights in the spring was very low - on average 22.6 birds/hour (4-56 birds/hour).

Table 2 The species composition, the status on the area and distinguished forms of conservation of birds observed during the annual monitoring.

Legend:

Status on the area:	L – breeding within the limits of the area;
	LX - breeding in the vicinity;
	P - passing or visiting;
Conservation status:	OGAT – strict protection of species;
	OŁOW – hunting protection of species (certain months);

OCZ - partial protection of species;
 Threat category according to the Polish Red Data Book of Animals:
 EXP – extinct in Poland
 VU – vulnerable
 NT – near threatened
 LC – least concern

** - breeding sites at the distance of more than 2 km from the boundaries of the wind farm

Item	Species	Status on the area	Conservation status	App. I of the Birds Directive	Polish Red Data Book of Animals
1	mute swan	P	OGAT		
2	bean goose	P	OŁOW		
3	greater white-fronted goose	P	OŁOW		
4	greylag goose	P	OŁOW		
5	common teal	P	OŁOW		
6	mallard duck	L	OŁOW		
7	partridge	L	OŁOW		
8	quail	L	OGAT		
9	cormorant	P	OCZ		
10	grey heron	P	OCZ		
11	white stork	LX	OGAT	+	
12	red kite **	LX	OGAT	+	NT
13	white-tailed eagle **	LX	OGAT	+	LC
14	western marsh harrier	L	OGAT	+	
15	hen harrier	P	OGAT	+	VU
16	northern goshawk	P	OGAT		
17	Eurasian sparrowhawk	LX	OGAT		
18	common buzzard	LX	OGAT		
19	rough-legged buzzard	P	OGAT		
20	lesser spotted eagle **	LX	OGAT	+	LC
21	corncrake	L	OGAT	+	
22	crane	L	OGAT	+	
23	European golden plover	P	OGAT	+	EXP
24	northern lapwing	L	OGAT		
25	common snipe	P	OGAT		
26	green sandpiper	P	OGAT		
27	black-headed gull	P	OGAT		
28	common gull	P	OGAT		
29	European herring	P	OCZ		

	gull				
30	stock dove	LX	OGAT		
31	common wood pigeon	L	OŁOW		
32	collared dove	LX	OGAT		
33	cuckoo	L	OGAT		
34	common swift	LX	OGAT		
35	Eurasian wryneck	L	OGAT		
36	green woodpecker	L	OGAT		
37	large woodpecker	L	OGAT		
38	lesser spotted woodpecker	L	OGAT		
39	woodlark	L	OGAT	+	
40	Eurasian skylark	L	OGAT		
41	barn swallow	LX	OGAT		
42	common house martin	LX	OGAT		
43	tree pipit	P	OGAT		
44	meadow pipit	L	OGAT		
45	yellow wagtail	L	OGAT		
46	white wagtail	L	OGAT		
47	Eurasian wren	L	OGAT		
48	common robin	L	OGAT		
49	thrush nightingale	L	OGAT		
50	black redstart	LX	OGAT		
51	whinchat	L	OGAT		
52	northern wheatear	P	OGAT		
53	common blackbird	L	OGAT		
54	fieldfare	L	OGAT		
55	song thrush	L	OGAT		
56	redwing	P	OGAT		
57	mistle thrush	P	OGAT		
58	marsh warbler	L	OGAT		
59	icterine warbler	L	OGAT		
60	lesser whitethroat	L	OGAT		
61	common whitethroat	L	OGAT		
62	garden warbler	L	OGAT		
63	Eurasian blackcap	L	OGAT		
64	wood warbler	L	OGAT		
65	common chiffchaff	L	OGAT		
66	willow warbler	L	OGAT		

67	goldcrest	P	OGAT		
68	long-tailed tit	P	OGAT		
69	willow tit	L	OGAT		
70	great tit	L	OGAT		
71	Eurasian blue tit	L	OGAT		
72	Eurasian nuthatch	L	OGAT		
73	short-toed treecreeper	L	OGAT		
74	red-backed shrike	L	OGAT	+	
75	great grey shrike	L	OGAT		
76	Eurasian jay	L	OGAT		
77	magpie	L	OCZ		
78	jackdaw	LX	OGAT		
79	rook	P	OCZ		
80	hooded crow	P	OCZ		
81	raven	L	OCZ		
82	starling	L	OGAT		
83	house sparrow	LX	OGAT		
84	Eurasian tree sparrow	LX	OGAT		
85	common chaffinch	L	OGAT		
86	brambling	P	OGAT		
87	common greenfinch	L	OGAT		
88	goldfinch	L	OGAT		
89	Eurasian siskin	P	OGAT		
90	linnet	L	OGAT		
91	twite	P	OGAT		
92	common rosefinch	L	OGAT		
93	bullfinch	P	OGAT		
94	Eurasian reed warbler	L	OGAT		
95	reed bunting	L	OGAT		
96	corn bunting	L	OGAT		

Source: Antczak (2010).

In the period of post-breeding dispersion and autumn migrations 1,924 birds were recorded, belonging to 24 species performing directional flights (to the south-west and west).

Average intensity of directional flights in the summer and in the autumn, depending on adopted assumptions, was 24 – 27.5 birds/hour (1.2 – 86.6 birds/hour during particular censuses).

Within the radius of 5 - 7 km from the wind farm at least 5 significant feeding grounds or resting areas of whooper swans, bean geese, white-fronted geese, cranes, European golden plovers were located.

In the sector no. 2 a staging area of European golden plovers was found with up to 1,800 birds and a staging area of cranes with up to 450 birds.

Full text of the ornithological monitoring by Antczak (2010) is included in Appendix 4, being an integral part of this "Report".

3.2.2.5. Chiropterological monitoring

An annual pre-implementation monitoring of bats was conducted in the period from 1 September 2009 to 1 September 2010: "Report and assessment of potential impact of the designed location of the >Grapice< Wind Farm on bats" (Kościów 2010) (**Appendix 5**) was conducted, covering the location of the planned project (Fig. 4).

According to the aforementioned study:

The monitoring was conducted in the area of the designed location of the investment project, which included field works conducted as an annual pre-implementation monitoring in the form of scientific research. Field works consisted of 29 night-time controls of the area of the designed location of the project, conducted on 2 Chiropterological Transects (TCH – 18 functional sections) with the total length of 3.6 km, and from 12 permanent Nacelle Monitoring Points (PND) and 9 Additional Monitoring Points (DD).

Only 3 species of bats were detected within the area (tab. 3).

The most numerous species was common pipistrelle *P. pipistrellus*. (...). The second most common species was serotine bat *Eptesicus serotinus*. (...)

Table 3 The quantitative structure of bats (values estimated on the basis of the frequency of ultrasound detections) in the area the "Grapice" Wind Farm in the period from 1 September 2009 to 1 September 2010.

Item	Name of species			population of particular species	
				from	to
1.	common pipistrelle	<i>Pipistrellus pipistrellus</i>	(Schreber, 1774)	3	9-11
2.	serotine bat	<i>Eptesicus serotinus</i>	(Schreber, 1774)	2-3	4-5
3.	Natterer's bat	<i>Myotis nattereri</i>	(Kuhl, 1817)	0	4-5
Total:				9	21

Source: (Kościów 2010).

(...) *in the case of species found within the designed location of the project it can be stated that:*

Natterer's bat *Myotis nattereri* - *is a protected species, sometimes quite numerous locally, especially in the hibernation period when it is the most frequent and the most numerous hibernating bat, gladly inhabiting boxes for birds and bats in*

the spring-summer period. It is common in the entire country, its population in Europe greatly reduces southwards and northwards. According to IUCN category, it is a lower risk (LR), least concern, not a threatened species in Europe, and not a threatened species in Poland.

Common pipistrelle *P. pipistrellus* - *is a species subject to legal protection in Poland, it is quite numerous locally, and common in the entire country. Population in Europe is safe, therefore, it is not classified by IUCN.*

Serotine bat *Eptesicus serotinus* - *is a protected species, at times quite numerous locally, common in the entire country, and according to IUCN category, it is a lower risk species (LR), namely not threatened in Europe.*

The conservation status of particular bat species presented above indicates that against the background of the conditions of our country and Europe in the area of the investment project we are dealing with species numerous and common for the analysed area. Populations of the above listed species are not threatened with extinction at the continental level. (...)

*Bats were not found within the boundaries of the wind farm, that is directly in the area of arable fields. Very low numbers were observed only near the limits of the monitored area - extremely few detections reported only near the village of Nieckowo, in the neighborhood of the sector S6X, where common pipistrelle was observed *P. pipistrellus*. (...)*

No reproductive colonies were found within the designed location of the wind turbines in the course of the monitoring. Moreover, no colonies or daily hiding places of bats were found within the distance of 1 km from the boundaries of the wind farm.

The full text of the "Report and assessment of the potential impact of the designed location of the >Grapice< Wind Farm on bats" (Kościów 2010) is included in Appendix 5, being an integral part of this "Report..."

3.2.6. Natural processes and natural linkages between the project area and the environment

Geodynamic, hydrological and ecological processes are of key importance to the location of the "Głuszynko–Grapice" wind farm and in its environment.

As far as geodynamic processes are concerned, surface mass movements are possible, as well as surface and linear water erosion within the slopes of local depressions and valley formations, mainly in the southern part of the project area. A similar threat is present within the area of slopes of the valleys of watercourses present on the route of the HV/110 kV connection, including the Łupawa valley. These slopes are mostly covered with vegetation of agrocenoses or grass vegetation, and consequently the morphodynamic threat increases only slightly in the non-vegetation season.

In the location of the wind turbines there are no hydrographic objects which could pose a flood risk. Such threat is present in the Łupawa valley, located on the route of the HV/110 kV connection (cart. app. 2).

For the Łupawa river, areas of direct flood hazard were demarcated in the study "Demarcation of the boundaries of direct flood hazard for the purpose of reasonable restoration of areas. Łupawa" (2003/2004). The designated scope of flood risk

caused by the Łupawa affects only the valley's bottom, in a narrow strip along the river bed (at the minimum distance of over 3.6 km from the planned location of the wind turbines). On the route of the 110 kV cable line the flood risk affects the section of ca. 140 m.

Natural linkages consist here, above all, in surface and underground water run-off. Water is the main carrier of matter, and hence migration of chemical elements in the environment. It causes an unidirectional process of geochemical coupling on autonomous surfaces (top parts), transit surfaces (slopes) and subordinated surfaces (hollows, valley bottoms). Autonomous surfaces lose the matter, which flows, as well as accumulates and disappears (denudation), to a different extent, in transit surfaces, whereas on subordinated surfaces the matter is mostly accumulated. Due to the topography, in the area of the study one observes surface run-off from top parts of the upland to local land hollows, and towards the west - to valleys of local watercourses, and further to the Łupawa river.

Natural linkages also consist in atmospheric circulation. The essence of atmospheric relations consists in transition of air properties in physical terms (temperature, humidity) and chemical terms (air composition, wind as a carrier of chemical elements) depending on the flow over specific areas. In view of the prevalence of western winds in the project area west-east linkages are observed most often. West (and north-west) from the location of the wind turbines there are arable lands and small, fragmented forest complexes, which, in general, increases quality of air-masses approaching the area.

As for environmental processes in the project area, succession of vegetation is locally observed. In areas not used agriculturally, especially on the borders of forest patches and tree plantings, as well as in areas of hydrogenic habitats, secondary succession of forest and waterside vegetation is observed. The encroachment of natural vegetation began spontaneously when factors limiting the possibility of its development ceased to operate. In other areas succession of vegetation is counteracted mainly by agrotechnical treatments.

Ecological linkages (migrations of plants and animals) are stimulated, first of all, by the ecological network of the area. It consists of a network of naturally active areas, ecological patches and corridors penetrating a given area, ensuring natural functional linkages on a horizontal plane. The presence of the ecological network is a necessary condition for maintaining the relative ecological balance of the natural environment, enriches its material-functional structure and diversifies the landscape in terms of physiognomy.

The main element of the ecological network in the vicinity of the project area is the regional ecological corridor of the Łupawa valley to the south-west and the ecological corridor of the Łeba valley to the north-east. These corridors cover river valleys along with adjacent forest complexes. They are crucial for migrating fish species and connection between the coastal and the lakeland strip ("Spatial development plan of the Pomeranian Province", 2009).

On the moraine upland the ecological network of the studies area has a form of the mosaics of small ecological patches in the form of forest complexes and hydrogenic land hollows. Ecological linkages between local ecological patches on the upland area fostered by the agricultural use of the soil.

3.3. Diagnosis of the environment anthropisation

Main signs of anthropisation of the natural environment of the project area and its surroundings:

- domination of agricultural land use, effects of which include, e.g. synanthropisation of vegetation, degradation of the ecological structure of the area and the specific character of the landscape - cultural agricultural landscape;
- rural settlement with compact farm development with home gardens and buildings related to agricultural economy (former State Farms) in villages: Głuszynko, Grapice, Jeziorki, Rzechcino – sources of emission of pollutants into the atmosphere, as well as domestic and industrial sewage and waste;
- investments in Potęgowo (at the minimum distance of ca. 1.3 km to the south east), including single-family and multi-family dwellings, and municipal and production facilities – sources of emission of pollutants into the atmosphere, as well as domestic and industrial sewage and waste;
- the network of hardened and dirt roads (car traffic as a source of emission of pollutants to the atmosphere, and noise), mostly district roads: no. 39309 Pobłocie-Potęgowo, no. 39157 Wiszno-Grapice-no. 39309 and no. 39314 Nieckowo-Potęgowo, and district roads located on the route of the HV/110 kV connection - no. 39153 Głównicyce-Mianowic, no. 39151 Będzichowo-Damno, no. 39150 Będzichowo-Damno and no. 39149 Bięcino-Warblewo;
- low-voltage power line networks.

At a further distance the concentration of anthropogenic environmental transformations is observed in Lębork (ca. 15 km east of the project area).

Aerosanitary conditions

Potential sources of atmospheric pollutions in the vicinity of the project area include:

- domestic furnaces, heat sources and technological emission from commercial facilities within the studied area and in its surroundings;
- emission of traffic pollutants from roads of local importance;
- diffuse dust emission from the areas without vegetation (e.g. dirt roads).

According to the "Study of the Conditions and Directions of Spatial Development of the Potęgowo Commune" (2010) the main emitters of atmosphere pollutions within the commune include:

- a boiler room for the housing society in Potęgowo;
- a boiler room for the school in Potęgowo;
- a joinery in Potęgowo;
- a boiler room of the Agricultural Plant in Grapice.

In addition, medium and low emissions from burning of low-power coal in households and local boiler rooms are a source of significant atmospheric air pollution, very burdensome, especially in the heating season. This energy carrier, unfavourably affecting air quality, is used for heating of apartments by most households in the commune.

There are no air quality measurement stations in the project area. The area of the Słupsk District was included to the Lębork-Słupsk zone, which in 2009 was rated "A"

(the level of substances does not exceed the acceptable levels) both for health protection and plant conservation.

Noise

In the area of the "Głuszynko–Grapice" wind farm, there are no industrial plants, or other objects emitting noise to the environment. Local acoustic nuisance may be large agricultural farms (equipment base, livestock facilities, etc.) in villages surrounding the project area (Głuszynko, Grapice, Jeziorki, Rzechcino) and certain commercial and public facilities in Potęgowo.

The source of noise emissions within the project area and in its surroundings is car traffic on district roads: no. 39309 Pobłocie-Potęgowo, no. 39157 Wiszno-Grapice-no. 39309 and no. 39314 Nieckowo-Potęgowo, and district roads located on the route of the HV/110 kV connection - no. 39153 Główny Mianowic, no. 39151 Będzichowo-Damno, no. 39150 Będzichowo-Damno and no. 39149 Bięcino-Warblewo.

In the project area objects and areas with functions protected owing to acoustic nuisance are buildings in the villages on its outskirts. It features mainly farm buildings and services-related development and production and commercial facilities (see sec. 6.2.5. and app. 1).

Electromagnetic radiation

Within the project location there are no objects constituting a significant source of non-ionising electromagnetic radiation. No high voltage lines run through the area, there are no power stations (GPZ) with the voltage of 110 kV or above, no base transceiver stations. This area is crossed only by medium-voltage overhead power lines. The closest base transceiver stations can be found near Skórowo Nowe, ca. 1.4 km south-east of the project area.

State of water pollution and transformation of water's circulation

Surface waters

Monitoring of surface waters pollution in the project area covered waters of the Łupawa River and its tributaries, including the Darżyńska Struga.

Water from the Darżyńska Struga was examined in 2009 by Provincial Inspectorate for Environmental Protection in Gdańsk in the Głuszyno control point, ca. 1.2 km upstream the mouth of the Łupawa.

The condition of water from Darżyńska Struga was considered good in chemical terms, moderate - in biological and ecological terms, and "less than good" in physical-chemical terms (due to general concentration of organic carbon). Generally, the condition of the homogenous water body of the Darżyńska Struga was considered bad.

Groundwaters

According to "Study of the Conditions and Directions of Spatial Development of the Potęgowo Commune" (2010) underground waters in the Potęgowo Commune (including within Major Groundwater Reservoir no. 115 "Łupawa" and within Major Groundwater Reservoir No.107 "Łeba" and in its designed buffer zones) are of good quality.

Lithosphere transformation

Basic lithosphere transformations in the project area include:

- transformation of physical and chemical properties of soils in areas used agriculturally related, first of all, to agrotechnical treatments;
- transformations related to the transport infrastructure, including embankments, excavations, and levelling;
- areas of geomechanical transformations, related to adaptation of land for investment, in particular excavations and embankments related to foundation of buildings, location of technical infrastructure, etc.

Synanthropisation of vegetation

In view of the dominance of arable lands in the land use structure, vegetation of the area is synanthropic in almost 100%. They are mainly agrocenoses of arable lands. Deforestation and agricultural use of lands significantly transformed habitats, which become fallows. Soils were changed, especially top parts of their profiles whose natural layout, including humus layers, was destroyed by formation of the plow layer. Changes concerning aeration different than in forest soils, water retention or a different composition of soil organisms were contemporarily increased by the use of mineral fertilisers, and especially by contamination with pesticides.

Synanthropisation of meadows and pastures is related to melioration treatments and overgrazing, as well as introduction of "quality grass".

Synanthropisation of vegetation is most evident in the case of damaged soil surface near infrastructure, where ruderal vegetation is present.

4. FORMS OF NATURE CONSERVATION IN THE PROJECT AREA

4.1. Location of the project

The area of the "Głuszynko–Grapice" wind farm is located beyond the nature conservation designation types defined in the Act on Nature conservation (consolidated text: Journal of Laws of 2009, No. 151, item 1220, as amended), except for **the planned 110 kV HV power line**, which, over a distance of ca. 1,070 m will run through and over two distances (ca. 110 m and ca. 360 m) will run along the border of the Natura 2000 SCI "Dolina Łupawy" (Fig. 5, app. 2).

No species of plants and fungi under species protection in Poland were found within the project location (in planned locations of wind turbines, transformer station and routes of access roads and medium-voltage lines). Surfaces indicated for direct locations of wind turbines and its supporting infrastructure (including the main power take-up point), are overgrown with segetal vegetation, accompanying field cultivations.

The total of 96 bird species were found during ornithological monitoring in the area of the planned investment project, of which 83 species are covered by strict protection, 7 with partial protection, and another 7 by hunting protection (tab. 2). In addition, from among 11 of these species are species from Annex I to the Birds Directive (tab. 2).

As regards chiroptera, three bat species observed in the course of the monitoring (Natterer's bat, common pipistrelle and serotine bat) are subject to strict protection (Regulation of the Minister of Environment of 28 September 2004 on protected wild animals – Journal of Laws of 2004, No. 220, item 2237). None of these species is recorded in the Polish Red Book of Animals, nor in Annex II to Council Directive 92/43/EEC.

" **Dolina Łupawy** " **PLH220036** covers valleys of the Łupawa and Bukowina from the lake of Jasień. The boundaries of the area cover:

- natural, deep beds of the Łupawa and Bukowina rivers;
- springs and small streams (tributaries);
- extensive areas of submontane alder-ash alluvial forests *Carici remotae-Fraxinetum* on the slopes of the valley, as well as oak-hornbeam forests *Stellario-Carpinetum* in many ravines, and beech forests *Luzulo-Fagetum* and *Asperulo-Fagetum*;
- waterlogged meadows, poor fens and raised bogs, as well as dystrophic lakes in no run-off areas.

Protected habitats of the area include 14 types of habitats from Annex I to Council Directive 92/43/EEC (see sec. 7.1.).

The above habitats are at the same time important habitats of extremely rich fauna.

Furthermore, the following animal species listed in Annex II to Council Directive 92/43/EEC are protected within the area of the Natura 2000 SCI "**Dolina Łupawy** " PLH220036:

mammals:

- European beaver (*Castor fiber*);
- European otter (*Lutra Lutra*);
- amphibians:
- great crested newt (*Triturus cristatus*)
- fish and lampreys:
- brook lamprey (*Lampetra planeri*);
- river lamprey (*Lampetra fluviatilis*),
- Atlantic salmon (*Salmo salar*);
- spined loach (*Cobitis taenia*);
- European bullhead (*Cottus Gobio*).

No plants listed in Annex II to Council Directive 92/43/EEC were found within the area of the Natura 2000 SCI "Dolina Łupawy" PLH220036.

An additional natural value of the area are:

- montane and submontane nature of the river;
- one of the largest clusters of springs in Pomerania;
- large complexes of submontane alluvial forests;
- numerous rare and endangered plant species from the Polish Red Book
- very numerous population of freshwater alga *Hildenbrandtia rivularis*, which indicates clean water;
- valuable Salmonidae species;
- habitats of birds of prey and birds of mud and meadow areas;
- picturesque landscape with vast forests.

4.2. Region of the project area

The regional surroundings of the location of the "Głuszynko–Grapice" wind farm (at a distance up to ca. 20 km) covers the following forms of nature conservation defined in the Act on Nature conservation of 16 April 2004 (Journal of Laws No. 92 of 30 April 2004, item 880 with later amendments) (Fig. 5):

- **the Słowiński National Park and its buffer zone** – at the minimum distance of ca. 15.7 km north of the nearest planned location of wind turbines and ca. 14.4 km from the planned 110 kV cable line and accordingly ca. 12.8 and ca. 8.2 km north – the boundary of the buffer zone of the Park;
- **nature reserves:**
 - **"Grodzisko Runowo"** (ca. 7.3 km south-east of the nearest planned location of the wind turbines and ca. 11.8 km from the planned 110 kV cable line);
 - **"Czarne Bagno"** (ca. 7.8 km north-east of the nearest planned location of the wind turbines and ca. 10.3 km from the planned 110 kV cable line);
 - **"Łebskie Bagno"** (ca. 10.6 km north-east of the nearest planned location of the wind turbines and ca. 12.7 km from the planned 110 kV cable line);
 - **"Torfowisko Pobłockie"** (ca. 11 km north of the nearest planned location of wind turbines and ca. 11.1 km from the planned 110 kV cable line);
 - **"Bagna Izbickie "** (ca. 13.3 km north of the nearest planned location of wind turbines and ca. 12.3 km from the planned 110 kV cable line);

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- **"Jałowce"** (ca. 14.3 km north of the nearest planned location of wind turbines and ca. 10.3 km from the planned 110 kV cable line);
 - **"Karwickie Źródłiska"** (ca. 15.5 km south-east of the nearest planned location of the wind turbines and ca. 20.3 km from the planned 110 kV cable line);
 - **"Las Górkowski"** (ca. 17.3 km north-east of the nearest planned location of the wind turbines and ca. 17.6 km from the planned 110 kV cable line);
 - **"Nowe Wicko"** (ca. 19 km north-east of the nearest planned location of the turbines and ca. 19.6 km from the planned 110 kV cable line);
 - **the "Dolina Słupi" Landscape Park and its buffer zone** – at the minimum distance of over 20 km south-west of the nearest planned location of wind turbines and ca. 14.4 km from the planned 110 kV cable line and accordingly ca. 11.7 and 6.4 km to the south – the boundary of the buffer zone of the Park);
 - **Protected Landscape Area "Fragment of the Łeba Urstromtal and moraine hills south of Lębork"** (ca. 5 km south-east of the nearest planned location of wind turbines and ca. 9.8 km from the planned 110 kV cable line);
 - **Area of Protected Landscape "Coastal strip east of Ustka"** (more than 25 km north-west of the nearest planned location of wind turbines and ca. 14.4 km from the planned 110 kV cable line);
 - **Natura 2000 sites :**
 - special protection areas for birds:
 - **"Ostoja Słowińska" PLB220003** – at the minimum distance of ca. 15.7 km north of the nearest planned location of wind turbines and ca. 14.4 km from the planned 110 kV cable line (non-governmental organizations proposed to extend the area to the buffer zone of the Słowiński National Park);
 - **"Dolina Słupi" PLB220002** – at the minimum distance of over 20 km south of the nearest planned location of the wind turbines and ca. 14.4 km from the planned 110 kV cable line;
 - **"Przybrzeżne wody Bałtyku" PLB990002** – at the minimum distance of more than 25 km north-west of the nearest planned location of wind turbines and ca. 19 km from the planned 110 kV cable line;
 - sites of Community importance:
 - **"Dolina Łupawy" PLH220036** – at the minimum distance of ca. 3,5 km south and west of the nearest planned location of wind turbines;
 - **"Łebskie Bagna" PLH220040** – at the minimum distance of ca. 7.8 km north-east of the nearest planned location of wind turbines and ca. 10.3 km from the planned 110 kV cable line;
 - **"Torfowisko Pobłockie" PLH220042** – at the minimum distance of ca. 11 km north of the nearest planned location of wind turbines and ca. 11.1 km from the planned 110 kV cable line;
 - **"Bagna Izbickie" PLH220001** – at the minimum distance of ca. 13.8 km north-east of the nearest planned location of wind turbines and ca. 12.5 km from the planned 110 kV cable line;
 - **"Karwickie Źródłiska" PLH220071** – at the minimum distance of ca. 14.6 km south-east of the nearest planned location of wind turbines and ca. 19.4 km from the planned 110 kV cable line.

- **"Ostoja Słowińska" PLH220023** – at the minimum distance of ca. 15.7 km north of the nearest planned location of wind turbines and ca. 12.8 km from the planned 110 kV cable line;
 - **"Górkowski Las" PLH220045** – at the minimum distance of ca. 17.3 km south-east of the nearest planned location of wind turbines and ca. 17.6 km from the planned 110 kV cable line;
 - **"Klify Poddębские" PLH220100** – at the minimum distance of over 29 km north-west of the nearest planned location of wind turbines and ca. 18.1 km from the planned 110 kV cable line;
- "Shadow List 2010" sites:
- **"Dolina Słupi"** – at the minimum distance of ca. 14.1 km south of the nearest planned location of the wind turbines and ca. 10 km from the planned 110 kV cable line;
 - **nature monuments** – closest to the planned wind turbines in forest complexes within the Protected Landscape Area "Fragment of the Łeba Urstromtal and moraine hills south of Lębork" and in the area of Poganice – more than 5 km from the nearest planned location of the wind turbines; closest to the planned 110 kV cable line – in Karżniczka, at the minimum distance of ca. 2.6 km to the south;
 - **ecological lands** – closest, at the minimum distance of ca. 1.8 km north of the nearest planned location of wind turbines and the 110 kV cable line, within a forest complex;
 - **documentation site of inanimate nature "Oz Grapice "** – at the minimum distance of ca. 1.3 km south-west of the nearest planned location of wind turbines and ca. 2.3 km from the planned 110 kV cable line;

The Słowiński National Park

According to the Act of 16 April 2004 on Nature conservation (Journal of Laws of 2004, No. 92, item 880 with later amendments) the National Park covers an area characterised by particular natural, scientific, social, cultural and educational values, with the total area not smaller than 1,000 ha, where all the nature and landscape qualities are protected.

The Słowiński National Park (SPN) was established on 1 January 1967, under the Regulation of the Council of Ministers of 23 September 1996 (Journal of Laws No.42, item 254). Currently applicable Regulation of the Council of Ministers of 2 March 2004 on the Słowiński National Park (Journal of Laws No. 43, item 390) determines its area, boundaries, as well as principles of management and the limits of the buffer zone.

The area of SNP is 32,744.03 ha, including 21,572.89 ha in the Pomeranian Province and 11,171.14 ha of coastal waters of the Baltic Sea. The onshore area of the Park covers the Łebsko Spit and the area of coastal lakes: Gardno, Dołgie Małe, Dołgie Wielkie, Łebsko, as well as forest and open areas; it is located south of a strip of the Baltic Sea's coast with approximate length of 35 km, from 184.75 to 217.30 kilometer of the seashore, i.e. from Rowy to the Łeba.

The Park was entered by the International Union for Conservation of Nature (category II) to the international list of national parks. Its dunes and marshy areas creates its natural landscape unique for Europe and the area of the Baltic Sea. In

1977 the Park, as the first in Poland, was recognised by UNESCO as a Biosphere Reserve.

In 1995 the Park was entered on the list of objects of the Ramsar Convention - "The Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat" - ratified by Poland on 22 March 1978 (Journal of Laws of 29.03.1978).

The SPN has a buffer zone designated for protection against external threats. The planned "Głuszynko–Grapice" wind farm is located outside the SNP buffer zone (at the distance of ca. 12.8 km (turbines), and ca. 8.2 km (110 kV cable line) from its boundaries).

Nature reserves

"Grodzisko Runowo" – a natural-archaeological reserve, established by a decision of the Minister of Forestry and Wood Industry of 21.09.1981. Due to its dual nature, the reserve protects natural forest biocenoses and early-medieval settlement comprised of fortified settlements, settlements and a tumulus cemetery from the 9th-12th century.

"Czarne Bagno" - a peat-bog reserve with the surface area of 102.86 ha, established by the Regulation of the Pomeranian Governor of 3 April 2006. It covers the fragment of high peat deposits along with a dystrophic lake with rare least water-lilies *Nuphar pumilii*. The purpose of protection in the reserve is to maintain fragments of a vast high peat bog typical for the Baltic region with its raised bogs, moors, marshes, and water and forest ecosystems.

"Łebskie Bagno" – a peat-bog reserve with the surface area of 111.32 ha, established by the Regulation of the Pomeranian Governor of 3 April 2006. Located in the Łeba Urstromtal within the Janowice forest district, it protects populations of 5 flowering plant species, and 4 moss species from the Polish Red Book. Protection is also extended to peat bog phytocenoses, phytocenoses of swampy forest and marshy birch forest. An important thing is to protect degenerated habitats of raised peat bog capable of regeneration. The Łeba Bog is a Baltic-type raised peat bog, with the ecological balance affected by improper use. Regenerating peat-forming phytocenoses, that is regeneration of peat bogs, is observed.

"Torfowisko Pobłockie" – was established by the Regulation of the Minister of Forestry and Agriculture of 12.10.1982. (Monitor Polski No. 25 of 18. 10. 1982, item 234, par. 11). The area of the reserve is 112.3 ha, the purpose of protection is to preserve a Atlantic-type raised peat bog with a locality of myrica gale and marshy forests and thickets.

In 2005 the conservation plan for the reserve was prepared (established by the Regulation No. 92/06 of the Pomeranian Governor of 11.12.2006), that envisaged construction of gates inhibiting outflow of water from the dome and local revealing mossy moors and populations of myrica.

"Bagna Izbickie" – an area covering peat bogs and forests, established by the Regulation of the Minister of Forestry and Agriculture of 12.10.1982 (Monitor Polski No. 25 of 18. 10. 1982, item 234, par. 10). The object covers the area of 281.18 ha, the purpose of protection is to preserve Atlantic-type peat moors – a characteristic element of the agricultural landscape of vegetation of coastal regions of the Southern Baltic.

"Jałowiec" – a forest reserve, partial protection, the surface area of 1.29 ha, established in 1984. It includes concentration of numerous common junipers

(*Juniperus communis*) of varied forms in the pine forest stand among moraine hills. The purpose of protection is to preserve numerous tree types of common juniper concentrated on a small area and to track processes of its development in the existing habitats and vegetation complexes. In the reserve there are tree forms of different shapes, reaching the height of 4-8 m.

"Karwickie Źródlika" – a forest reserve with the surface area of 3.22 ha, established by the Regulation of the Pomeranian Governor of 9 July 2007. It encompasses the fragment of peat bogs with numerous watercourses, covered with alders. The purpose of nature conservation in the reserve is to preserve springs along with the surrounding forest and characteristic, rare and protected plant species.

"Las Górkowski" – a forest and peat bog reserve, within the area of the Łeba Urstromtal (established in 1984, the surface area of 99.36 ha). Numerous protected species of plants (e.g. marsh Labrador tea, lily-of-the-valley, common polypody, black currant, glossy buckthorn, wavy hairgrass, bilberry, guelder rose) are also present.

"Nowe Wicko" – a flora reserve, within the area of the Łeba Urstromtal (established in 1984, the surface area of 24.49 ha). The reserve protects an eutrophic lake with local rush communities and marshy birch forest. There are also protected plants such as crested wood fern, sweetgale, black currant, glossy buckthorn.

The "Dolina Słupi" Landscape Park established in 1981 by Resolution No. X/42/81 of the Provincial National Council in Słupsk of 8 December 1981 on establishing the "Dolina Słupi" Landscape Park and areas of protected landscape (Official Journal of WRN in Słupsk No. 9, item 23; Official Journal of the Słupskie Province of 1991 No. 13, item 66). The buffer zone was demarcated around the Park, to protect the Park against harmful impact of external factors.

The park covers the river basin of the middle section of the Słupia river and its tributaries: Bytowa, Jutrzenka and Skotawa. It is characterised by a diversified post-glacial landscape with its typical geomorphological forms (up to 160 m ASL) and numerous lakes. Some lakes are oligotrophic Lobelia lakes. The largest lakes are: Jasień, Skotowskie and Głębokie. 40-100 year-old forests are mainly pine coniferous forests and mixed and deciduous forests (beech and oak). In the stream valleys there are alder and ash alluvial forests.

For protection against external hazards a buffer zone was established around the Park. The location of the "Głuszynko–Grapice" wind farm is planned outside the buffer zone of the Park (at the distance of ca. 11.7 km (turbines), ca. 6.4 km (110 kV cable line) from its boundaries).

Protected Landscape Area "Fragment of the Łeba Urstromtal and moraine hills south of Lębork", was established by Resolution No. X/42/81 of the Provincial National Council in Słupsk of 8 December 1981 on establishing the "Dolina Słupi" Landscape Park and protected landscape area (Official Journal of WRN in Słupsk No. 9, item 23). The protected landscape area within the boundaries of Lębork covers a forest complex, a part of the Okalica valley in the southern part of the city, and its eastern edge. The total surface of the Protected Landscape Area "Fragment of the Łeba Urstromtal and moraine hills south of Lębork" is 16,731 ha.

Protected Landscape Area "Seashore east of Ustka", with the surface area of 3,336 ha, is located entirely in Ustka. It covers the coast from Rowy to the eastern border of Ustka. Valuable features of this area include the sea with a beach, dunes and a cliff (in the Poddąbie-Orzechowo-Ustka section). Dunes are covered with seaside vegetation - pioneer communities with sand sedge and European beachgrass and complexes of coastal crowberry coniferous forests with crowberry, and beech forests. Forests cover 45% of the entire area.

Natura 2000 sites⁵

Special protection area for birds "Ostoja Słowińska" PLB220003 covers a region with the total area of 19,326.7 ha, located in the Pomeranian Province, in communes: Łeba (357 ha), Wicko (2,350.5 ha), Główny (2,121.4 ha), Smołdzino (14,276.9 ha) and Ustka (222 ha).

The area is a bird refuge of European importance. The presence of at least 25 bird species from Annex I to the Birds Directive was confirmed in the area (Sidło, Błaszowska, Chylarecki - ed. 2004). Populations of 10 species (6 of them are non-Annex I species) fit into Important Bird Area criteria introduced by Bird Life International. These are: whooper swan, bean goose, greater white-fronted goose, Eurasian wigeon, mallard, common pochard, snew, common merganser, crane and dunlin. In addition, 15 of the species found there are in the Polish Red Book of Animals. The refuge is one of important nesting places of dunlin. This species breeds irregularly, which is associated with overgrowing meadows on which it nested before in large numbers. During seasonal migrations lakes are an important resting and feeding place for geese, swans and ducks, with flocks of several thousand birds. Peat bogs south of the Żarnowska protection area are the place where cranes gathers in the most numerous groups in the migration period (more than 5000 birds).

Special protection area for birds "Dolina Słupi" PLB220002 covers a region with the total area of 37,471.8 ha, located in the Pomeranian Province.

The area covers the estuary of the middle section of the Słupia River and its tributaries: Bytowa, Jutrzenka and Skotawa. It is characterised by a diversified post-glacial landscape with its typical forms: ribbon and kettle lakes, outwash plains and end moraine hills. Some of the numerous lakes are oligotrophic Lobelia lakes. The largest lakes are: Jasień, Skotowskie and Głębokie. 40-100 year-old forests are mainly pine coniferous forests and mixed and deciduous forests (beech and oak). In the stream valleys there are alder and ash alluvial forests. The landscape of the refuge is diverse, with numerous ravines and hills, the highest of which are 160 m high.

The site is inhabited by at least 22 bird species from Annex I to the Birds Directive, and 6 species from the Polish Red Data Book (PCK). During the breeding period, the site is inhabited by at least 1% of the national population (C3 and C6) of the following bird species: red kite (PCK), goatsucker, osprey (PCK), common sandpiper, goldeneye, common merganser; the following birds are present in a relatively high density (C7) and in considerable quantities: white stork, black stork, crane, green sandpiper, woodlark, red-backed shrike. Many valuable, well-preserved types of natural habitats from Annex I to the Habitat Directive, forming a mosaic.

⁵ Characteristics of areas according to standard data forms (<http://natura2000.gdos.gov.pl/natura2000/>).

Various types of fens and alluvial forests are of particular value. The area of presence of 6 species of animals from Annex II, including otter. The greatest threats for the area include pollution of water with municipal and agricultural waste, uncontrolled tourist load, including settlement pressure.

Special protection area for birds "Przybrzeżne wody Bałtyku" PLB990002 covers a region with the total area of 211,741.2 ha, including 0.7 ha within the Łeba Commune and 0.4 ha within the Ustka Commune. The site is a bird refuge of European importance, covering coastal waters of the Baltic Sea with the depth from 0 to 20 m on the section of 200 km, from the base of Hel Peninsula to the Pomeranian Bay.

Two bird species from Annex I to the Birds Directive winter in the area: black-throated loon and red-throated loon. In the winter period, there are more than 1% of the migrating population long-tailed duck and at least 1% of the population of black guillemot and velvet duck. Benthic fauna is dominated by crustaceans. Large sea mammals - gray seals, ringed seals and porpoises are rarely observed (www.mos.gov.pl).

The site of Community importance "Dolina Łupawy" PLH220036 – discussed in chapter 4.1.

The site of Community importance "Łebskie Bagno" PLH220040 consists of two Baltic peat bogs (Czarne Bagno and Łebskie Bagno) located in the Łeba Valley, in a complex of meliorated fen mires. Every fen is partially, but to a different extent, degraded as a consequence of long-term drainage, exploitation of peat, fire and forestation.

Top parts of the fens are partially open: in Łebskie Bagno there are fragments of living bog in stagnation and very well regenerating marshy communities in well-hydrated post-mining headings. In Czarne Bagno there are no intact raised bogs. Slopes of domes of both bogs are dominated by marshy wildwoods with spontaneous or planted forest stand.

An important site due to its raised bogs and marshy forests. An interesting stratigraphy and ecology of the bog. In total, 5 natural habitats from Annex I to Council Directive 92/43/EEC was declared.

The site of Community importance "Torfowisko Pobłockie" PLH220042 is a Baltic raised bog, mostly forested, but with a woodless dome covered with raised bogs and mossy moors. The woodless dome is surrounded by marshy coniferous forests. In the eastern part, there is a complex of peat workings, almost completely overgrown dystrophic lakes, willow thickets and primary forms of alder forests. Relatively well preserved raised bog with a woodless dome. A typical, concentric layout of natural habitats is preserved. 7 types of natural habitats from Annex I to Council Directive 92/43/EEC. The value of peat-bog natural habitats in the object is additionally raised by the abundance of rare plant species typical for peat bogs (deergrass, cross-leaved heath, sweetgale).

The site of Community importance "Bagna Izbickie" PLH220001 encompasses the fragment of the bottom of the Łeba Urstromal, filled with peat

formations, criss-crossed with land improvement ditches and canals. Peat was extracted there on a considerable surface in the past. Currently it is home to an extensive complex of Atlantic moors with marshy heaths, sweetgale bushes and marshy forests. In numerous peat-pits transitional-peat bog communities are developing. The area is surrounded by meadow communities partly covered by birch woods.

The area includes an extensive complex of Atlantic moors, marshy forests and birchwoods and well-developed transitional-peat bog communities (in peat-pits). There are 3 types of habitats from Annex I to Council Directive 92/43/EEC here, occupying in total more than 80% of the area. The presence of 2 species from Annex II of Council 92/43/EEC was confirmed, though their populations are not numerous. A fragment of the area is covered with sweetgale bushes. Species of Atlantic plants form rich populations.

The site of Community importance "Karwickie Źródłiska" PLH220071 includes areas of springs with sources of, among others, Unieszynka. Partially forested area, with the presence of natural habitats and numerous sources of streams flowing in several furrows. The most precious object is a headwater area with its surroundings, formed as a result of backward erosion, with intensive outflow of underground waters from under steep slopes. The spring fen dome is occupied by former peat bogs, currently crossed by streams and covered with a patch alder-ash alluvial forest. Slopes are covered by phytocoenoses of forest complexes: Acidophilic beech forest, fertile beech forest and Subatlantic deciduous forest. In the valleys of courses the area patches of alluvial forests; a part of forest areas is covered by a large patch of acidic oak forests. The area is rich in species of plants and have some rare and protected animals; it is characterised by very attractive landscapes.

Well preserved area of springs, occupied by an alluvial forest and surrounded by a beech forest, with a rich set of rare and protected plant species. The presence of many other sources of minor watercourses and peat hollows.

The site of Community importance "Ostoja Słowińska" PLH220023 protects the landscape and the diversity of morphological forms observed in the Gardno-Łebska Spit, including unique seaside barchan dunes (up to 40 m above sea level, wandering at the annual rate of 3-10 m), two largest brackish seaside lakes: Łebsko (7,140 ha, max. depth 6.3 m) and Gardno (2,468 ha, max. depth 2.6 m) along with adjacent meadows, peat bogs and marshy forests. In total, the area includes: the main complex of the Słowiński National Park (along with sea waters incorporated into the park in 2004), the Rowokół complex and the river bed of the Łupawa connecting Rowokół with the main complex. In intra-dune hollows called deflation hollows we observe primary succession of vegetation, from initial psammophytic communities to coastal crowberry coniferous forest.

The area is covered by well-preserved habitats typical of seaside areas formed on large surfaces, including 26 types of natural habitats from Annex I to Council Directive 92/43/EEC. The area includes localities of many rare and endangered species, including 23 from Annex II to Council Directive 92/43/EEC (including 8 fish species, as well as one of the more numerous populations of common toadflax (also a species from Annex II to this Directive) and many species of vascular plants covered by legal protection. Interesting species of invertebrates are also found in this

area, e.g. leeches *Hirudinae*: *Haementria costata*, *Haemopsis sanguisuga*, *Piscicola geometra*, and arachnids *Arachnidae*: *Arctosa* sp, *Dolomedes fimbriatus*. The unique landscape of moving dunes is the object of protection here. A marine part of the area is an important habitat for Baltic population of porpoise. This is important bird refuge of European importance E 09 (Słowiński National Park). The site is added to the list of the Ramsar Convention sites; it is also located within the Słowiński Biosphere Reserve. There are at least 28 birds species from Annex I to Birds Directives, and 11 species from the Polish Red Data Book (PCK). During the breeding period, the site is inhabited by at least 1% of national population of the following bird species: white-tailed eagle, golden eagle, osprey, eagle owl, dunlin (*schinzii*), common ringed plover; there are also relatively high concentrations of western marsh harrier, black cormorant. In the period of migrations the area hosts at least 1% of the migrating populations of the following bird species: snew, crane, bean goose and common merganser; there are also relatively high concentrations of greater white-fronted goose and Eurasian wigeon.

The site of Community importance "Górkowski Last" PLH220046 includes strongly deformed complex of coniferous forest and marshy birch forest, covering former Baltic peat bogs in the Łeba valley.

It was established to protect the following types of habitats:

- marshy coniferous and deciduous forests (*Vaccinio uliginosi-Betuletum pubescentis*, *Vaccinio uliginosi-Pinetum*, *Pino*);
- willow, poplar, alder and ash riverine forests (*Salicetum albo-fragilis*, *Populetum albae*, *Alnenion*)

The site of Community importance "Klify Poddębskie" PLH220100 includes cliff and dune coast of the Baltic Sea between Orzechowo and Rowy and a fragment of a forest complex and parabolic sand dunes. The cliff coast differs in height, from 5 to 35m above sea level. There are sections of both dead and living cliffs. The cliff is built sequentially of till, spit sands and early Holocene peats and fossil soils covered with Eolian sands in the western part. The discussed section of the coast is one of the most active cliffs on the southern coast of the Baltic Sea. According to the archive data, the coast east of Ustka retreated in the period 1862-1938 by 150 cm (at the annual rate of ca. 2 m/year). In the years 1960-1978 the lower base of the cliff went back 32 m. The dune coast is quite low, in some places with formed primary stages of white and grey dunes. On the cliff, there are parabolic dunes, moving until recently. The refuge includes quite strongly diversified range of habitats, apart from oligotrophic habitats we may also find there relatively fertile habitats of beech, mixed deciduous and alluvial forests.

As far as the Polish coast is concerned, the refuge includes an unique structure of the seashore with neighbouring cliff and dune sections. Special attention should be paid to Eolian formations (parabolic dunes moving until recently) on the cliff. Marine accumulation sands also cover the western part of the cliff (the section from Orzechowo to Poddąbie). In terms of natural habitats a dominant role is played by communities of acid beech forests (located on leeward slopes of parabolic dunes) and quite well preserved coastal crowberry coniferous forests. Small areas are covered by yellow dunes and fragments of their primary forms, as well as gray dunes. Dune deflation hollows created in deflation areas are covered with

communities of marshy coniferous and birch forests. Fragments of mixed deciduous and alluvial forests are also to be found there. The refuge hosts a number of species of plants protected due to their rarity or endangered status.

The area of "Dolina Słupi" proposed by non-governmental organizations "Shadow List 2010" would cover the area of the Słupia valley from Sulęczyno to the mouth of the river, along with its tributaries. The area of this region was formed in the period of the north Atlantic continental glacier melting, which contributed to diversification of landscape forms and elevational diversity. A substantial part of the area is covered by forests (ca. 10% of the area are forest habitats).

Forest communities most often observed there are fresh and mixed pine forests, marshy coniferous forests are much less frequent. Deciduous forests are represented by several types of communities, of which the largest area is covered by lowland beech forests: acidic and fertile; river valleys are accompanied by oak-hornbeam forests with *Stellaria*, willow and poplar alluvial forests and willow bushes. Other very interesting vegetation formation are peat bogs, including particularly valuable fragments of close to raised bogs. An important element of the landscape are lakes of different size, shape and origin. The most valuable objects are oligotrophic *Lobelia* lakes with their relict flora. Thanks to the presence of lakes, numerous streams and rivers the area provides friendly environment for many species of fish, including valuable migratory fish: salmon and sea trout. Marshy areas provide excellent conditions for development for 10 species of amphibians and 4 species of reptiles. Ornithofauna is also rich.

The Słupia Valley is characterised by great biodiversity. The area includes 21 types of natural habitats, occupying nearly 50% of the area and a number of species from Annex II to the Habitat Directive: 5 species of invertebrates, 6 species of fish, 3 species of amphibians and reptiles, 3 species of mammals.

The area has not yet been reported to the European Commission (as of February 2011).

Nature monuments

Natural monuments in the Potęgowo Commune include 22 objects (15 established at the provincial level and 7 by the Communal Council in Potęgowo by resolutions no. 17/103/2007 of 27.12. 2007 and No. XIX/128/2008 of 29.02.2008). Natural monuments closest to the wind farms are located at the distance of more than 5 km, within the forest areas of the Protected Landscape Area "Fragment of the Łeba Urstromtal and moraine hills south of Lębork" and in the area of Poganice. The monument located nearest to the planned 110 kV cable line is the one in Karzniczka (The Damnica Commune), at a distance of ca. 2.6 km to the south.

Ecological sites

So far 43 ecological sites were established in the Potęgowo Commune (5 established at the provincial level and over 38 by the Commune Council). Ecological sites closest to the project area are located at the minimum distance of ca. 1.8 km to the north, within a forest complex.

Documentation site of inanimate nature "Oz Grapice"

A site of the total area of 6.55 ha was established by Regulation No. 11/2001 of the Pomeranian Governor of 7 November 2001, the object of protection is a well-preserved longitudinal hill of glacial origin – an esker.

5. DESCRIPTION OF MONUMENTS PROTECTED ON THE BASIS OF REGULATIONS ON PROTECTION AND CARE OF MONUMENTS AND OTHER OBJECTS OF CULTURAL HERITAGE IN THE PROJECT AREA

In the location of the "Głuszynko–Grapice" wind farm there are objects entered in the register of monuments on the basis of regulations on protection and care of monuments.

The closest objects entered in the register of monuments of the Provincial Conservator of Monuments in Gdańsk are located in Głuszyno, at a distance of more than 2.2 km from the area of the wind turbines. These are palace-park and manor-park complexes. Monuments are also found in Damnica, Bobrowniki, Damno and Bięcino located near the route of the 110 kV HV cable. The nearest of these objects is The Juda Tadeusz Parish Church in Damno, located ca. 300 m west from the route of the cable.

Additionally, in towns located near the project location, in villages: Głuszynko (ca. 750 m to the south-west), Grapice (ca. 700 m to the south and west), Rzechcino (over 1.9 km to the north-east), Nicekowo (over 2 km to the north-east) and Skórowo (ca. 3 km to the east) there are historic, though palace-park and manor-park complexes not entered in the register of monuments.

None of the planned wind turbines of the "Głuszynko–Grapice" wind farm, its access roads and the main power take-up point, is located within the buffer zone of archeological sites. The minimum distance between the planned location of the wind turbines with related technical infrastructure and buffer zones of archeological sites exceeds 160 m.

6. IMPACT ASSESSMENT FOR THE PROJECT OPTION SELECTED FOR IMPLEMENTATION

6.1. Construction stage

6.1.1. Abiotic environment

Top layer of the lithosphere

The impact of the planned wind farm with its accompanying infrastructure on the abiotic environment will be observed mainly at the investment stage, lasting usually a few months. It will include construction of access roads and excavations for the foundations of wind turbine towers and cable excavations. The excavations for foundations will result in elimination of the soil cover and transformations in surface geological structures as a result of earthworks, as well as formation of waste in the form of soil from excavations for foundations and construction of roads (see sec. 6.1.3.).

It is planned that foundation will have the depth of ca. 3 m BGL, which, considering the planned parameters of foundations (base 30 x 30 m), will result in the need for disposal of ca. 2,700 m³ of soil (sands and clays) for each wind turbine, that is ca. 54,000 m³ of soil for the entire complex of 20 wind turbines. In addition, considerable amounts of soil and ground will be formed as a result of the construction of transport areas (pavement excavations). Soil from excavations may be used road levelling and land development after the end of construction, or used in a different way.

Construction excavations will be also made when power and telecommunication cables are being laid. Spoil from cable excavations will be used to fill them back. After the completion of works, these areas will be restored to their agricultural function.

In the foundation areas of the wind turbines and on assembly yards surrounding them (with the total area of up to 2,100 m² each), in the area of the transformer station (ca. 0.44 ha), cable excavations (ca. 2.78 ha) and in the areas of new access roads (the length of ca. 6.85 km) the soil cover will be removed (mainly III and IV class soils) and the area will be permanently developed (foundations of turbines and their assembly yards, the transformer station area and communication areas). It will apply to lands with the total area of ca. 9.4 ha. In the course of the works the top layer of soil should be laid in a separated place, while soil from excavations for foundations should be used for construction of road embankments and land management after the end of the construction. In the case of surplus soil it should be transported to proper places to be possibly used.

In connection with the use of heavy equipment, storage of construction materials and construction elements during the construction of the wind turbines, physical transformations of the soil cover may occur in the vicinity of the direct location of the farm. These include:

- changes in the lithological structure of the bedrock (subsoil);
- destruction of the soil profile;
- changes in the physical structure of soil due to the weight of building equipment and stored material.

Laying of the 110 kV HV cable and optotelecommunication cable will require:

- excavation of ca. 0.9 m width and of ca. 1 m depth;
- temporary storage of excavated material;
- levelling and cleaning of the excavation bottom from stones and other objects
- sand bed (or bed of sifted soil) ca. 10 cm thick;
- laying of power cables and fibre-optic pipeline in the excavation;
- filling of the excavation with placement of warning tapes above it (at the depth of 0.5 m);
- compaction of soil in the excavation (in layers).

During earthworks related to performance of the aforementioned works the following transformations of the environment will take place:

- elimination of the soil cover (removal of the soil cover and depositing the superlayer for later use, after completion of earthworks);
- transformations in surface geological structures (extraction of ca. 17,000 m³ of ground layer from the excavation and its temporary deposition on the surface until completion of cable laying; on sections on which cable lines pass under district roads with hardened pavement (asphalt) directional drill or ramming method will be used;
- on section on which the 110 kV cable power line crosses the Łupawa along with trees covering its banks and meadows found in protected habitats in its valley, along the distance of ca. 500 m (within the boundaries of the Natura 2000 site "Łupawa Valley" PLH220036) directional drill will be used;
- air pollution and noise emission (operation of building equipment, transportation of materials) - operation of building equipment (excavations), transportation of bedding layer and cable network elements; impact of emission of pollutants produced during construction of cable lines will be virtually limited to the area of direct surrounding of works area and it will not threaten the environment in any way; owing to the fact that construction-installation works will be conducted in daytime, and taking into consideration the distance of construction sites from the nearest residential buildings, it can be assumed that the equivalent level of noise beyond the area of conducted works, caused by operation of machines, as well as increased traffic of cars and self-propelling devices will not be onerous for the inhabitants (the noise level periodically occurring during construction works is not regulated by the Polish law);
- generation of waste, mostly soil and ground (surplus from excavations - see sec. 6.1.3.).

After the completion of works, cable excavations will be filled up and revegetated.

To minimise the abovementioned transformations, the soil from excavations will be stored in layers on the site and used in the same order during backfilling (compaction in layers).

The passage of the cable line under the bed of the Łupawa on the length of ca. 90 m (within the area of the Natura 2000 site "Łupawa Valley" PLH220036) will be made by means of a directional drill. This method is an excavationless method, minimising the environmental impact of the investment.

Surface and underground waters

There are no surface waters in the location of the wind turbines and the designed transformer station. Construction of the wind farm and its accompanying infrastructure will not have any impact on hydrographic features.

Foundation of the wind turbines and the transformer station will be preceded by geotechnical examination of the ground. Due to shallow foundations of the planned turbines (ca. 3 m BGL), breaching of the first groundwater level is not expected. In the case of local presence of shallow underground waters, foundations will be made using a "wet" method, i.e. without draining excavations.

Construction of the transformer station may result in local periodical limitation of stormwater infiltration. Beyond that, no impact on underground waters at the construction stage is expected. To minimise hazards associated with leakage of petrol derivatives, temporary equipment bases must be secured (impermeable pavement) and any possible equipment repairs beyond these areas should be banned.

Application of the directional drill method at crossings of the planned 110 kV HV cable lines with watercourses, will minimise the impact of the planned investment on hydrographic features. This will ensure that the banks of watercourses and their hydrological regimes are not damaged and that the quantity of load and pollutions in water in these courses is not increased.

To sum up: Implementation of the planned project will not cause a significant impact on surface and underground waters. In particular, it will not threaten water resources of the Major Groundwater Reservoirs No. 115 "Łupawa" and No. 107 "Łeba" and other courses on its route, including the Łupawa within the limits of the Natura 2000 site "Dolina Łupawy" PLH220036.

Atmospheric air and acoustic climate

Impact of the condition of air pollution will result mostly from operations of building equipment (excavations, construction of sections of roads and maneuvering yards) and transportation of building materials and excavated soil, as well as from construction elements of the wind turbines.

Vehicle traffic, excavations, as well as storage of excavated soil and, possibly, loose building materials will result in periodic emission of dust to the atmosphere. It will be diffuse and limited in scope, mainly to the construction site. In view of good ventilation conditions, it will not significantly affect erosanitary conditions in the project area.

Calculations of the volume of emissions of traffic pollutants

A small source of air pollution related to the stage of construction and operation of the project will be, among others, flue gas from vehicles. More than ten thousand substances were distinguished in emissions from combustion engines. Assessments take account of only significant chemical substances, typical of traffic. These are:

- on the local scale - nitrogen oxides, hydrocarbons, carbon monoxide
- on the macro-scale - carbon dioxide (greenhouse gas)

Assessments ignore sulphur dioxide and lead (due to elimination of the sulphur and lead content from fuels). Therefore, the most important pollutants considered in the analysis will be **nitrogen oxides, carbon monoxide and hydrocarbons**, as well as the volume of suspended dust emission - due to traffic dominated by heavy vehicles.

Vehicle traffic – construction phase

The investment impact on air pollution at the construction stage was calculated using the truck traffic intensity data listed below:

- maximum traffic intensity – ca. 100 vehicles/12 hours (daytime); maximum of 10 vehicles/h was assumed;
- minimum traffic intensity – ca. 10 vehicles/12 hours (daytime); ca. 1 vehicle/h;
- average traffic intensity – ca. 30 vehicles/12 hours (daytime);

The construction phase will last ca. 9 months – traffic in the analysed area assumed for the entire construction stage (ca. 200 days) is ca. 6,000 trucks.

Vehicle traffic – operation phase

The minimum vehicle traffic in the operation phase will be:

- 2 passenger cars/8 hours
- 1 truck/month

Intensity of vehicle traffic at the operation stage is minute (negligible)

Methodology of calculations

Road traffic is a specific source of atmosphere pollution which is difficult to analyse, since it is not possible to directly measure emission, and emitters are mobile and are located very close to the ground surface. The volume of emission from the analysed area was estimated using COPERT 4 - a computer program used to calculate emission of pollutants from road traffic. Basic factors determining the volume of emission from traffic include:

- type of vehicles - the size and type of the engine, the type of standard concerning toxicity valid at the time a vehicle was admitted to traffic,
- vehicle traffic parameters - traffic intensity, structure by type, speed for particular vehicle classes,
- type of emission - from a heated engine or an engine heating from a given ambient temperature;

Emission from the analysed area was calculated using maximum values of traffic intensity quoted on the previous page.

Specific baseline emissions were calculated with the use of COPERT 4. Calculation were made for several types of trucks. Emissions calculated using COPERT 4 were introduced to a program for modelling traffic pollution spreading, which made it possible to determine maximum and average annual concentrations of pollutions.

Owing to the fact that traffic includes very diverse automotive vehicles, it is necessary for calculations to consider the structure with regard to the type and the year of production (age) of the vehicle. These factors are taken into account by averaging specific emissions with weighing factors resulting from participation of a given group of vehicles in the entire traffic population. Proportions of vehicles coming from different production periods (meeting particular standards) adopted for calculations per year are presented below:

Conventional	0%
Euro 1 - 91/441/EEC	0%
PC Euro 2 - 94/12/EEC	0%

PC Euro 3 - 98/69/EC Stage2000	0%
PC Euro 4 - 98/69/EC Stage2005	50%
PC Euro 5 (post2005)	50%
PC Euro 6	0%

The stream of vehicles moving on the analysed area was divided into several groups of vehicles specified in tables 4 – 7. The tables present average specific emission factors for various types of trucks calculated using COPERT 4 (and own EMISJA spreadsheet). Average specific emission factors were calculated for the most important traffic pollutants – nitrogen oxides, carbon monoxide, hydrocarbons and suspended dust. The speed of 10-30 km/h was assumed in the calculations.

Table 4. Specific emission factors – nitrogen oxides (NO_x)

heavy vehicles	<7.5t	7.5-12t	12-14t	14-20t	20-26t	28-32t	>32t
Conventional	5.21	8.92	10.26	13.32	16.03	17.74	18.57
HD Euro I - 91/542/EEC Stage I	5.68	9.68	10.90	14.54	17.63	20.24	21.04
HD Euro II - 91/542/EEC Stage II	5.42	8.77	9.98	13.99	16.18	18.70	19.09
HD Euro III - 2000 Standards	2.83	4.73	5.32	7.16	8.58	10.19	9.95
HD Euro IV - 2005 Standards	1.61	2.69	3.03	4.08	4.89	5.81	5.67
HD Euro V - 2008 Standards	0.31	0.52	0.59	0.79	0.94	1.12	1.09
HD Euro VI	0.31	0.52	0.59	0.79	0.94	1.12	1.09
Share	0.00%	0.00%	0.00%	33.33%	33.33%	33.33%	0.00%
average specific emission factor 2.94 g/km							

Table 5 Specific emission factors – hydrocarbons (C_x H_y)

heavy vehicles	<7.5t	7.5-12t	12-14t	14-20t	20-26t	28-32t	>32t
Conventional	3.66	3.24	3.57	5.22	2.96	2.93	3.25
HD Euro I - 91/542/EEC Stage I	0.66	1.23	1.36	1.96	2.44	2.40	2.72
HD Euro II - 91/542/EEC Stage II	0.43	0.79	0.87	1.26	1.56	1.54	1.73
HD Euro III - 2000 Standards	0.40	0.75	0.83	1.22	1.50	1.44	1.65
HD Euro IV - 2005 Standards	0.02	0.04	0.05	0.07	0.08	0.08	0.09
HD Euro V - 2008 Standards	0.02	0.04	0.05	0.07	0.08	0.08	0.09
HD Euro VI	0.02	0.04	0.05	0.07	0.08	0.08	0.09
Share	0.00%	0.00%	0.00%	33.33%	33.33%	33.33%	0.00%
average specific emission factor 0.08 g/km							

Table 6 Specific emission factors – carbon monoxide (CO)

heavy vehicles	<7.5t	7.5-12t	12-14t	14-20t	20-26t	28-32t	>32t
Conventional	4.70	6.56	7.12	10.16	7.29	7.83	8.18
HD Euro I - 91/542/EEC Stage I	1.71	2.94	3.19	4.47	5.63	5.77	6.41
HD Euro II - 91/542/EEC Stage II	1.30	2.21	2.41	3.26	4.09	4.57	4.80
HD Euro III - 2000 Standards	1.62	3.02	3.34	4.72	5.90	6.07	6.81
HD Euro IV - 2005 Standards	0.13	0.24	0.25	0.36	0.43	0.44	0.47
HD Euro V - 2008 Standards	0.13	0.24	0.25	0.36	0.43	0.44	0.47
HD Euro VI	0.13	0.24	0.25	0.36	0.43	0.44	0.47

Share	0.00%	0.00%	0.00%	33.33%	33.33%	33.33%	0.00%
average specific emission factor 0.41 g/km							

Table 7 Specific emission factors – suspended dust (PM10)

heavy vehicles	<7.5t	7.5-12t	12-14t	14-20t	20-26t	28-32t	>32t
Conventional	0.97	1.12	1.18	1.67	1.51	1.56	1.70
HD Euro I - 91/542/EEC Stage I	0.42	0.71	0.76	1.10	1.39	1.37	1.54
HD Euro II - 91/542/EEC Stage II	0.18	0.27	0.29	0.35	0.46	0.48	0.53
HD Euro III - 2000 Standards	0.21	0.35	0.38	0.52	0.65	0.60	0.69
HD Euro IV - 2005 Standards	0.11	0.14	0.14	0.17	0.20	0.21	0.21
HD Euro V - 2008 Standards	0.11	0.14	0.14	0.17	0.20	0.21	0.21
HD Euro VI	0.07	0.08	0.08	0.08	0.09	0.09	0.09
Share	0.00%	0.00%	0.00%	33.33%	33.33%	33.33%	0.00%
average specific emission factor 0.19 g/km							

Calculations were made for the construction phase. Maximum emission volumes (temporary) were calculated for the maximum traffic intensity - 10 vehicle/h, and the average annual emission volume for the average traffic intensity - 3 vehicle/h. It was assumed that the distance which 1 vehicle must travel within the investment area is ca. 3 km. Calculated emission volumes are presented in table 8.

Table 8 Emission volumes from the investment area at the construction phase

	Maximum emission [kg/h]	Average emission [kg/h]	Total emission from the entire period of the construction phase [Mg/9 months]
Nitrogen oxides NOx	0.09	0.02	0.05
Hydrocarbons CxHy	0.002	0.0004	0.001
Carbon monoxide CO	0.012	0.003	0.007
Suspended dust PM10	0.006	0.001	0.003

Volume of emissions calculated above are insignificant and will not affect the aerosanitary quality in the project area.

Impact of traffic pollutants produced by the construction site on air pollution.

Calculations of maximum one-hour concentrations were conducted for maximum one-hour emissions.

The highest of maximum concentrations

Emission volumes calculated above relate to the entire construction site. In order to present distribution of maximum concentrations (1-hour) calculations were conducted for the selected linear section of the emission source (except for 5 and 6 of the vertical structure of the atmosphere, as these states occur only in night-time, and the maximum traffic intensity occur during the day). Calculations of maximum concentrations were made for maximum emission, by grouping all sources of emission in the area of a single linear source, which overstate results of calculations of pollution concentrations (since in reality these sources will be dispersed on a larger area).

Table 9 The highest maximum concentration calculated:

Type of contamination	Distance from source of emission [m]	S_{mm} ($\mu\text{g}/\text{m}^3$)	D_1 ($\mu\text{g}/\text{m}^3$)
NO _x	roadway axis	7	200
	edge of the road	5	
	10 m from edge of the road	2	
CO	10 m from edge of the road	0.04	30000
C _x H _y	10 m from edge of the road	0.3	2,000*
PM10	10 m from edge of the road	0.07	280

* average reference value $D_1 = 2000 \mu\text{g}/\text{m}^3$ (aliphatic hydrocarbons $D_1 = 3,000 \mu\text{g}/\text{m}^3$; aromatic hydrocarbons $D_1 = 1,000 \mu\text{g}/\text{m}^3$)

It seems based on the calculations that:

- the maximum concentration of nitrogen oxides on the road axis (in the location of the source of emission) is below 10% of the acceptable level
- the maximum concentration of nitrogen oxides at the distance of 10 m from edge of the road decreases to trace amounts (1% of the acceptable level)

The maximum concentration of other pollutants (CO, C_x H_y, PM10) may be omitted (significantly below 1% of the reference value).

It can be also concluded based on the calculations that the size of average annual concentrations from the analysed area for all traffic pollutants will be negligible.

To sum up, concentrations of all traffic pollutants produced in the construction phase from the area of the designed wind farm will be negligible.

Other atmospheric pollutions

During welding works CO, NO₂ and suspended dust will be emitted. In addition, C-type gasoline, falling dust, xylene and toluene may be emitted during finishing works. Impact of emission of pollutants produced in the course of installation and finishing works will be virtually limited to the area of their direct vicinity and will not pose a threat for the environment.

Transportation of excavated materials with trucks, delivery of concrete to pour foundations, as well as transportation of construction elements will periodically worsen aerosanitary conditions (flue gas and dust) in the vicinity of their routes, which, consequently, should be determined with bypassing settlement areas to the possibly greatest extent.

Road transport and operation of heavy equipment in the project location will involve noise emission (see sec. 6.1.5.).

Owing to the fact that construction-installation-assembly works will be conducted in the daytime and due to the distance between construction sites from the nearest residential building it can be assumed that the equivalent level of noise beyond the area of conducted works, caused by operation of construction equipment and accompanying technical devices, as well as by higher traffic of cars and self-propelling devices will not be onerous for the inhabitants (the noise level occurring periodically during construction works is not regulated in the Polish law).

Vibrations

Operation of heavy building equipment (excavators, bulldozers, batching plants) may cause vibrations which will be located within the area of conducted works and will cease upon their completion. They can be harmful for construction of buildings and be onerous for persons staying in buildings. Their presence is, however, short-term and relates to the area of up to a few dozen meters from the area of operation of devices. In the case of the planned project such vibrations will be present only in the period of construction of wind turbine tower foundations.

Owing to the distance between residential buildings and construction sites (more than 500 m) the vibration threat for the closest buildings and persons staying in them is not expected.

6.1.2. Biotic environment

Vegetation

Impact of the wind turbines along with accompanying infrastructure on vegetation will occur only at the construction stage. Vegetation in the areas of the direct location of the wind turbines and on assembly yards surrounding them (ca. 2,100 m² each) and in the location of the substation and in areas of new access roads, represented mainly by agrocenoses, will be eliminated.

Elimination of vegetation will take place also on routes of MV cable connections (between the turbines and the transformer station) and on the route of the 110 kV HV cable line.

The designed MV cable connections will run through arable lands (with vegetation represented mainly by agrocenoses) and along the existing and designed roads (with accompanying ruderal vegetation). Similarly, the route of the 110 kV HV cable lines will run on mainly on right-of-ways of communal roads and on agricultural lands. The route of cable lines bypasses clusters of trees and shrubs, however, cutting-out of single trees or shrubs at the implementation stage may be necessary. In such cases, the provisions of the Act on Environmental Protection apply (consolidated text: Journal of Laws of 2009, No. 151, item 1220, as amended - see sec. 7.3.). The route of the designed 110 kV HV cable line (within the limits of the Natura 2000 site) passes under the riverbed and through meadows only on the section running through the Łupawa valley (including habitats protected under Natura 2000 – 6510 lowland and mountain hay meadows extensively used). On this section the cable route will be made by directional drill of ca. 500 m, bypassing protected habitats of meadows and vegetation growing on the banks of the river (see sec. 7.1.).

Trees growing near excavations along the entire course of 110 kV HV cable line are to be protected by boarding. In the case of roots earthworks will be carried out manually to bypass them.

Physical transformation of vegetation may happen during construction of the wind turbines, due to the use of heavy equipment and storage of construction elements, along with elimination of plant cover near the direct location of the wind turbines (temporary installation sites), as well as on routes of cable excavations. It will relate only to vegetation of arable lands.

After completion of investment works areas temporarily occupied for the purpose of construction (e.g. cable excavations and storage areas) will be revegetated (to the

primary condition including restoration of agricultural function). The planned location of the turbines are located within arable lands, covered by field cultivations. Tree and shrub vegetation in areas of designed construction works will not be threatened.

Fauna

Fauna will probably temporarily migrate to the neighbouring areas during construction of the wind turbines, as a result of nuisances related to operation of building equipment (noise, flue gas, vibrations, physical threat) and access roads to construction sites, except for synanthropic species, having high capacity for adaptation to varying environmental conditions (primarily some species of rodents and birds).

Field observations show that construction works scare fauna within a few hundred meters from construction sites. It is a typical temporary impact.

In the direct location of the wind turbines and in areas of new access roads, soil fauna will be eliminated, as a result of elimination of the soil cover.

6.1.3. Waste

Construction waste will be generated during construction of the planned project (roads, power network, telecommunication network, foundations of the turbines, assembly of the turbines), classified to group 17 according to the Regulation of the Minister of Environment of 27 September 2001 on the catalogue of waste - Journal of Laws No. 112, item 1206 (tab. 10). Quantities of waste were estimated by analogy to constructed wind farms.

Table 10 Types of waste at the wind turbine construction

Waste group code	Type of waste	Volume (for the entire complex of 20 wind turbines)
15	PACKAGING WASTE; SORBENTS, WIPING CLOTHS, FILTRATION MATERIALS AND PROTECTIVE CLOTHING NOT INCLUDED IN OTHER GROUPS	
15 01	Packaging waste (together with selectively collected municipal packaging waste)	
15 01 01	Paper and cardboard packaging	22 m ³
15 01 02	Plastic packaging	66 m ³
15 01 03	Wood packaging	10 m ³
15 01 04	Metal packaging	0.02 t
15 01 05	Multi-material packaging	0.9 m ³
15 01 06	Mixed packaging waste	3 m ³
15 02	Sorbents, filtration materials, fabrics for wiping and protective clothing	
15 02 03	Sorbents, filtration materials, fabrics for wiping (e.g. rags, cloths) and protective clothing other than listed in 15 02 02	0.5 m ³

17	WASTES FROM CONSTRUCTION, RENOVATION AND DISMANTLING OF BUILDING FACILITIES AND ROAD INFRASTRUCTURE (INCLUDING SOIL AND GROUND FROM CONTAMINATED AREAS)	
17 01	Waste construction and road infrastructure materials and elements (e.g. concrete, bricks, tiles, ceramics)	
17 01 01	Concrete waste and concrete debris from demolitions and refurbishments	28 m ³
17 01 03	Waste of other ceramic materials and equipment elements	2 m ³
17 01 07	Mixed waste from concrete, brick debris, waste ceramic materials and equipment elements, other than listed in 17 01 06	5 m ³
17 01 82	Other unlisted waste	4 m ³
17 02	Wood, glass and plastics	
17 02 01	Wood	3.8 m ³
17 02 03	Plastics	3.2 m ³
17 03	Bituminous mixtures, coal tar and tarred products	
17 03 80	Tar board waste	3.2 m ³
17 04	Metals (including their alloys)	
17 04 05	Iron and steel	3.8 tons
17 04 11	Cables other than listed in 17 04 10	500 rm
17 05	Soil and ground (including soil and ground from contaminated areas and spoil from deepening)	
17 05 04	Soil and ground, including stones, other than listed in 17 05 03	70,000 m ³
17 06	Insulation materials and asbestos-containing construction materials	
17 06 04	Insulation materials other than listed in 17 06 01 and 17 06 03	3.8 m ³

Source: prepared by the author, waste classification according to the Regulation of the Minister of Environment of 27 September 2001 on the catalogue of waste.

A considerable part of the aforementioned waste (except for soil and ground) will be temporarily accumulated in special containers/bins, which will minimise the risk of pollutants penetrating into the ground-water environment. For the majority of waste from group 17 listed in table 10, except for 17 01 81, 17 02 03, 17 04 11 and 17 06 04, their holder (the Investor), according to the Regulation of the Minister of Environment of 21 April 2006 on the list of types of waste which the waste holder may transfer to natural persons or organisational units, other than entrepreneurs, and acceptable methods of its recycling (Journal of Laws No.75, item 527, as amended. Journal of Laws of 2008 No. 235, item 1614), may transfer to natural persons or organisational units, other than entrepreneurs to use them for their own needs (according to the principles specified in the aforementioned regulation).

Waste that is not be transferred to natural persons or organisational units other than entrepreneurs to be used them for their own needs, must be taken away at the Investor's expense to the legally established waste dump. The removal must be performed by a business entity holding a relevant decision of the Governor of the Słupsk District or other.

Principles of handling waste are regulated by the Act on Waste (consolidated text: Journal of Laws of 2007 No. 39, item 251 with later amendments) and its executive acts.

6.1.4. Material and cultural assets

Material assets

Material goods within the planned project location are represented by a network of paved and dirt roads (communal roads), MV and LV power lines, and in the surroundings by village buildings, diversified in terms of architecture and technical condition.

During construction of the "Głuszynko–Grapice" wind farms it will be necessary to reconstruct and modernise a part of communal roads and other local dirt roads, as well as to construct new service roads.

Most of the roads surrounding the project location are not paved and are not in good technical condition. Most of them will be repaired and modernised in order to provide free access for vehicles servicing the wind turbines during their construction and operation. Modernisation will consist primarily in providing new pavement for roads, similarly to the one planned for service roads. The modernised roads will remain public. The roads will be modernised when the General Contractor of the project deems it necessary due to technical and safety reasons.

Maintenance roads on private lands will be access roads to the planned wind turbines with the minimum width of 5 m (width of pavement). For the needs of construction works, apart from maintenance roads, temporary access roads may be constructed.

Maintenance roads and assembly yards will remain in place after completion of construction of the turbines, whereas areas occupied by temporary storage yards, manoeuvre areas, passing bays will be revegetated by laying of a soil layer previously removed (restoration of agricultural function).

Apart from the road network, construction of the wind turbines will not affect other material assets. In particular, construction of the "Głuszynko–Grapice" wind farm will not exert adverse impact on management of villages.

Cultural assets

The planned complex will not have physical impact on cultural assets at the construction stage.

In the location of the planned project there are no objects entered in the register of monuments. The closest objects entered in the register of monuments on the basis of provisions concerning protection of and care of monuments are located more than 2 km from the planned location of the wind farm (in Głuszyno and Czerwieniec) and at the minimum distance of ca. 300 m from the planned route of the 110 kV HV line (in Damno). Construction of the "Głuszynko – Grapice" wind farm, along with its infrastructure, will not create hazard for these objects.

In addition, the planned wind turbines, the main power take-up points, their access roads and cable connections (including the 110 kV HV line) will be constructed beyond the buffer zones of archeological sites, at a safe distance (more than 700 m) from other cultural assets (palace-park or manor-park complexes).

6.1.5. People's health

The planned project's impact on people's health will occur at the construction stage as a result of transportation of:

- material from excavations for foundations of the wind turbines;
- construction materials to construction sites;
- people to construction sites and back.

Inconveniences related to effects of car transport, i.e. contamination of the atmosphere (flue gas and dust from roads), noise, ground vibrations, accident hazard will be limited spatially (vicinity of roads) and temporarily (the expected construction period is 6 – 9 months).

Periodical environmental inconveniences related to the investment process are not subject to standardisation in regulations on environmental protection.

6.2. Operation stage

6.2.1. Abiotic environment

Top layer of the lithosphere

There will be no impact on the surface layers of the lithosphere at the operation stage of the planned wind farm.

Water conditions

At the stage of operation the impact of the planned wind farm on water conditions will consist in local limitation of stormwater infiltration. It will flow over the surface of foundations and soak into the ground in the immediate vicinity of the wind turbines. Stormwater from the communication areas will be discharged over the surface into the ground. Owing to the nature and the intensity of vehicle traffic on these roads (only agricultural vehicles commuting to fields and service staff of the wind turbines), no threat for groundwater will be present.

The planned transformer station will be equipped with a stormwater drainage system. Stormwater flowing from the roof will be drained to the neighbouring green areas. The water from precipitation and thaws collected in tight wells under transformers will flow away to a separation well and then to a soakaway. In order to separate water from oil and drain it, the station will be equipped with the system for monitoring and separation meeting requirements of Polish regulations concerning environmental protection of water against oil contaminants.

No rest and refreshment facilities are planned within the area of the transformer station. Consequently, it will not be a source of sanitary sewage.

To sum up, the functioning of the "Głuszynko–Grapice" wind farm along with technical infrastructure, using the aforementioned technologies, will not result in hazards for surface waters and groundwaters, including water resources of the Major Groundwater Reservoirs No. 115 "Łupawa" and No. 107 "Pradolina Łeby".

Atmospheric air pollution

At the operation stage of the planned project there will be no atmospheric air pollution with gases, dusts or odours.

Overall, wind turbines are eco-friendly devices which limit emissions of power engineering pollutants to the atmosphere.

Operation of access roads will be related to emission of traffic pollutants. Owing to the nature and the low intensity of vehicle traffic on these roads (only agricultural vehicles commuting to fields and service staff of the wind turbines), participation of these contaminants in the general balance of pollutants in the location of the wind turbines will be insignificant.

Climate

Impact of the wind turbines on the local climatic conditions will consist primarily in the weakening of the wind force. The kinetic energy of wind will be transformed into mechanical energy of power generating devices and ultimately into electric energy (the essence of functioning of wind turbines). These changes will affect primarily the propeller rotation area (70-170 m AGL).

Small anemometric changes will also take place in the surroundings of the wind turbine tower, including near the ground.

Structures of the wind turbines will also result in a small decrease in the intensity of direct sun radiation reaching the ground (shading). These will be changes irrelevant for living organisms.

6.2.2. Impact on vegetation

At the operation stage, the wind farm along with accompanying infrastructure will not affect vegetation.

6.2.3. Impact on fauna

6.2.3.1. Introduction

Impact on animals, especially on flying animals, is a potential, most important environmental effect of operation of the wind turbines. Impact on birds and bats (impact on invertebrates not identified) may be demonstrated by:

- death rate as a result of collision with structures of the wind turbines;
- changes in distribution of animals as a result of loss of habitats or feeding grounds in the location of the wind turbines and in its surroundings;
- changes in flight routes (wind turbines as an ecological barrier).

6.2.3.2. Birds

In general, the number of collisions of birds with turbines depends on numbers of birds using a given area. The largest death rate among birds was recorded in the case of wind turbines located in areas (Gromadzki 2002)⁶:

- treated by birds as feeding grounds;
- crossed by regular routes of migration flights;
- crossed by routes used by birds to regularly commute to feeding grounds or roost sites.

The impact of the species composition of birds on their death rate, which results from interspecific differences in the height of flights and daily distribution migration activity, has also been documented.

A significant effect on an increase in the hazard of collision of birds with structures of the wind turbines relates to:

- parameters of the wind turbines: height, diameter of rotors, rotor speed, nighttime illumination;
- size of the wind farm and layout of turbines;
- meteorological conditions (first of all, visibility);
- time of the day: dawn, day, twilight and night (different activity of birds and visibility);
- season: spring flights, breeding period, autumn flights, overwintering.

The deterrent effect of wind turbines on birds (including that related to their acoustic effects) was observed at the distance of up to ca. 800 m, on average 200-500 m (Gromadzki 2002). Areas of the wind farm and their surroundings are rarely used by birds as feeding, resting and nesting places, flights of birds are also irregular. The deterrent effect of the wind turbines on birds is, at the same time, a factor reducing their death rate.

The first results of post-implementation ornithological monitoring of wind turbines in Poland are known. For instance, according to the published data concerning results post-implementation monitoring of wind turbines located near Puck (in Pomerania), namely in the area of considerable spring and autumn migrations, including migrations of species regarded as colliding (Falconiformes), potentially colliding (Anseriformes, Gruidae, Charadriiformes); the death rate for the migration period route and the breeding season (in the years 2007–2008 the death rate was examined for 4 months in one year, in 2009 for 8 months) is 0.1–0.15 victim/turbine/month, and the estimated death rate in one year, assuming high use of air space by birds for this location, is 13–34 victims/year (1.2–1.8 victim/turbine/year) (Zieliński et al, 2007, 2008 and 2009).

⁶ Gromadzki M., 2002, Uwarunkowania faunistyczne – ornitologiczne, in: Gromadzki M., Przewoźniak M., Ekspertyza nt. ekologiczno-krajobrazowych uwarunkowań lokalizacji elektrowni wiatrowych w północnej (Pobrzeże Bałtyku) i w centralnej części woj. pomorskiego, BPIWP „Proeko”, Gdańsk.

Conclusions from ornithological monitoring of the location of the "Głuszynko–Grapice" wind farm (Antczak 2010 – Appendix 4)

*In the area of the wind farm the intensity of transit flights was very small in relation to other regions of the Pobreże. Autumn flights were slightly better marked than the spring flights. The most intensive flights were observed in the case of the most common species – lark, common starling, chaffinch and fieldfare. **Flights of larger non-Passeriformes birds** (geese, swans, cranes), **was practically unnoticeable**. As for Charadriiformes only lapwing, European golden plover and seagulls performed transit flights – however, it was poorly marked in this group as well. Narrow migration corridors were not observed. It should be assumed that flights were performed in the so-called broad front. (...)*

*This leads to the conclusion that **construction of the farm will not result in a high, above-average mortality among transiting birds, nor will it distort the route of migration.***

Within the limits of the farm there was a locally important resting and feeding site of cranes. (...) Cranes mainly use the northern fragment of the farm (sector 2) and their number in the autumn peak amounted to up to 450 birds. In the spring (in March) the number of cranes was lower and amounted to up to 120 birds. (...) These birds avoid farms, efficiently circumventing them or flying above them, consequently there are no data on cases of collisions with working turbines. In the sector 2, fields used by cranes was the regular feeding and resting site for flocks of European golden plovers in the autumn period (up to 1,800 birds).

*On the other hand, a rapidly developing sector of wind power industry and more and more larger areas of agricultural landscape covered by wind parks result in limitation of available resting and feeding places for migrating birds, which will increase in the future. Therefore, one should already now consider the need to protect places regularly used by selected species of birds in migration periods. For this purpose, it is necessary to suggest **exemption of a part of fields located north of Karwieńskie Błota** (sector 2) from investment plans.*

What was achieved by abandoning the location of two wind turbines originally planned in this area (see sec. 2.2. and Fig. 2b).

Potential effect on breeding birds is more diversified – certainly, some territories of lark, whinchat, corn bunting and other species nesting on fields will be lost, however, it should be emphasised that these are species common for the agricultural landscape. In turn, a group of species related to trees, shrubs, alleys and tree lanes should not react negatively to the wind turbines, assuming that these elements will be preserved during the investment process.

Special attention should be paid to the area of Karwieńskie Błota and water reservoirs neighbouring it to the east. *This is a nesting place of the richest group of birds in the area of the planned farm, a resting place of passerines during their migration, and a nesting site for several less popular species (from App. 1 BD), e.g. Western marsh harrier, crane, corncrake, woodlark and red-backed shrike (...) - the area will be located beyond the location of the wind farm in the adopted option.*

***In the case of raptors** the situation is more complex, e.g. due to the fact that this group is considered especially exposed to collisions with working turbines.*

*The most numerous and most often observed **common buzzard** may be exposed to collisions or loss of some hunting areas, **the investment will not,***

however, affect the favorable situation of its population due to its large numbers and commonness.

The second most regularly observed species was **western marsh harrier** nesting near a reservoir near Karwieńskie Błota within the limits of the farm. This area was excluded from investment plans, i.a. due to the presence of this species. **Preservation of breeding habitats of western marsh harrier should be a sufficient protective operation** since these birds hunt low over the ground, and fly higher mostly in the spring during their mating season, near nesting places. **The threat of collisions with working turbines can be considered insignificant for this species.**

Three less common species of raptors – **red kite, sea eagle and lesser spotted eagle** - nested in the Łupawa and Łeba urstromtals, visited the area of the farm only occasionally (1-3 observations during the year). Therefore, **the collision threat for these species should be considered insignificant**

Other raptor species (**hen harrier, northern goshawk, Eurasian sparrowhawk and rough-legged buzzard**) were observed during migration shifts and **their numbers during particular censuses were limited to single birds**

Other valuable species (e.g. from Annex 1 to the Birds Directive) nesting within the limits of the investment area – **corncrake, red-backed shrike and woodlark did not form large clusters and their high numbers in the respective habitats in Pomerania justifies their omission when considering hazards connected with construction of the farm in Grapice.**

White storks nesting around the farm (7 nests), used the farm in a diverse yet not intensive manner – most of them fed on small meadows or at melioration ditches near farms, and these areas for non-environmental reasons (noise) will be located ca. 500 m away from the nearest wind turbine, thus **feeding grounds of storks will not be affected**

Most of **cranes** nesting within the limits of the farm **will be protected as a result of minimisation activities** (mainly protection of Karwieńskie Bagna and an adjacent water reservoir), and **loss of 1 or 2 positions will be insignificant for preservation of the favourable condition of the population of this species**

In the winter period, the area did not constitute valuable wintering site for any species having the endangered status in Poland or Europe.

To sum up, it can be stated that, considering recommendations to minimise the risk of adverse impacts, especially activities moving the turbines far from Karwieńskie Błota and the adjacent water reservoir, as well as not developing feeding grounds of cranes and European gold plovers in the sector 2, **the planned investment will not constitute above-average hazards for the local groups of breeding birds, as well as for migrating or wintering birds.**

Full text of ornithological monitoring prepared by Antczak (2010) is included in Appendix 4, which constitutes an integral part of this "Report...".

6.2.3.3. Bats

The most important feeding places of bats in the agricultural landscape are usually water reservoirs (Downs and Racey 2006), while the basic flight routes

between highways and feeding places are linear elements of the landscape, especially tree lines (Verboom and Huitema 1997). Important feeding places for bats may also be patches of deciduous old growth forests and their borders (Walsh and Harris 1996, Russ and Montgomery 2002). On the other hand, on the open areas the activity of *Pipistrellus* bats drops to zero already at the distance of 70 meters away from the river or the water reservoir; it reaches minimum values also ca. 40 meters from the tree line (Downs and Racey 2006).

Most of bats avoid treeless, extensive arable fields (Lesiński et al, 2000). According to these data, the turbines located at a distance greater than 100-200 meters away from linear tree plantings and water reservoirs should constitute only a minor threat to bats.

Conclusions from chiropterological monitoring of the location of the "Głuszynko–Grapice" wind farm (Kościów 2010 – Appendix 5)

Only 3 species of bats, common for the entire country, were found in the examined area. (...) The value of indicators obtained on the basis of collected data indicates the lack of presence of bats in the planned location of the wind turbines and extremely low biodiversity of bats in the synurbisation areas located beyond the investment area, at the distance of ca. 1 km from its boundaries.

Total number of observed bats, estimated on the basis of the frequency of observations/detections of bats, varied between 9 to 21. In total, for 11 positions only 134 bats were recorded in the course of the monitoring. All these bats were observed outside the location of the designed wind farm.

The frequency of observations of particular species of bats allowed to designate 1-2 areas of relatively regular presence of bats (...). All these areas of relatively permanent presence of bats were located outside the location of the designed wind turbines. Based on this, it is stated that the observed populations of bats are not affected by wind turbines of the designed farm. Thereby, their location does not constitute a threat for objects used by bats as stated in the report, such as feeding grounds, watering places and hibernaculum.

On the basis of the results presented above it is assessed that the designed wind farm is located at a distance sufficient for effective buffering of a potential impact on bats. Moreover, the designed location of the wind farm does not constitute an ecological barrier for bats, therefore, the risk of barotrauma for bats or direct collisions with turbines located far beyond the area in which bats are present, is minute.

The planned location of the wind farm does not pose a risk of losing habitats by bats – bats occupied only synurbisation areas. Main feeding and watering places would be located beyond the investment area, at a distance of at least 1 km from the boundaries of the wind farm (...). In addition, the most important areas of relatively permanent presence of bats were located outside the boundaries of the wind farm.

The designed location of the wind farm does not constitute an ecological barrier for flight routes of bats to feeding and watering places - no flight routes of bats on the basis of conducted observations.

To sum up: it is assessed that the location of the project will not contribute to a significant increase in mortality of bats, as the detected bat species were chiefly associated with developed areas.

The full text of "Report and assessment of the potential impact of the designed location of the >Grapice< Wind Farm on bats" (Kościów 2010) is included in Appendix 5, which constitutes an integral part of this "Report...".

6.2.3.4. Other animals

Species of large mammals present in the region of the project area (see sec. 3.2.2.3.) are, first of all, associated with the forest and fringe environment. Their presence in the agricultural areas is short-term. The impact of the wind turbines (operating in the agriculturally used area) on these animals will not be significantly different than that of other infrastructure and economic objects.

The wind turbines do not constitute barriers for movement of land animals.

The impact of sound waves (in the full range of spectrum, including ultra- and infrasounds), vibrations and motion of propellers on land and water vertebrates and invertebrates is likely, but was not examined (Goc, Meissner, 2007). Possible death rate among birds may cause changes in distribution of scavengers for which the area of the wind turbines may become a potential feeding ground.

From experiences of wind farms operating in Western Europe it seems that wind turbines do not cause changes in "land" fauna of a given area.

In literature concerning the impact of wind turbines on animals there is no information on their impact on land animals – such impact was only observed for flying animals, primarily birds, which can collide with turbines.

The issue of the impact of infrasounds on animals is also irrelevant. Infrasound noise levels measured near wind turbines are very small, undetectable for humans, and do not result in any confirmed adverse effects on the human body. As a result, one can assume that they are harmless for animals.

Polish law does not regulate the issue of the noise and infrasound impact on animals. Binding Regulation of the Minister of Environment of 14 June 2007 on acceptable noise levels in the environment (Journal of Laws of 2007, No. 120, item 826) includes standards of acceptable noise only for humans.

6.2.4. Waste

During operation of the "Głuszyńko–Grapice" wind farm and accompanying infrastructure no solid waste will be generated, except for waste related to overhauls of technical devices.

As regards different types of turbines, in accordance with manufacturer data, it can be assumed that gear oil will be changed from once a year to once every ten (or more) years (it is an individual matter even for particular wind turbines within the farm - whether the oil should be changed is usually determined on the basis of analyses in the half-year cycle for gear oil and in the annual cycle for hydraulic oil). Quantity of oil in one turbine, depending on the type, is at the level of 60 - 90 l.

Hazardous waste may be generated in case of need to change oils and filters in subassemblies of turbines (tab. 11).

Table 11 Possible types and volumes of hazardous waste for the "Głuszyńko-Grapice" wind farm

Item	Waste type	Code	Quantity of waste during the year ^{1/}	Waste management
1	hydraulic mineral oils not containing halogenoorganic compounds	13 01 10*	ca. 2.6 [m ³] ^{2/}	transferring to the waste recipient
2	mineral engine, gear and lubricating oils which do not contain halogenoorganic compounds	13 02 05*	ca. 16 [m ³]	transferring to the waste recipient
3	other engine, gear and lubricating oils	13 02 08*	ca. 4 [m ³] ^{3/}	transferring to the waste recipient
4	packaging containing traces of hazardous substances or contaminated with such substances	15 01 10*	ca. 3.6 [m ³]	used for temporary storage of waste and/or transferred to the waste recipient
5	sorbents, filtration materials, wiping cloths and protective clothing contaminated with hazardous substances	15 02 02*	ca. 150 [kg]	transferring to the waste recipient
6	used devices containing hazardous elements, other than listed in 16 02 09 to 16 02 12	16 02 13*	ca. 100 [kg]	transferring to the waste recipient

Source: prepared by the author, classification of waste according to the Regulation of the Minister of Environment dated 27 September 2001 on the catalogue of waste

^{1/} Estimated on the basis of information from operating wind farms.

^{2/} Used hydraulic oils constitute waste after completion (on average, every 5 years) of the major inspection of the hydraulic oil installation – small leaks discovered between inspections are removed with the use of wiping cloths.

^{3/} Used gear oils may constitute waste only in the case of unexpected loss of their properties (change of this oil is not planned in normal operation) - small leaks discovered between inspections are removed with the use of wiping cloths.

Waste management

Used oils (item 1, in table 11), in the case of need to drain them from the installation, are collected in tight containers (item 4 table 11) in a closed wind turbine tower, in a manner preventing their spilling, on a hardened, impermeable surface, according to Regulation of the Minister of Economy and Labour of 4 August 2004 on exact procedure for handling of waste oils (Journal of Laws No.192, item 1968).

According to the aforementioned Regulation:

"Waste oils are collected and stored selectively according to the requirements resulting from the method of their industrial use or neutralisation. (...)

Waste oils are collected in tight containers, made of non-flammable materials, resistant to waste oils, discharging static charges, equipped with tight closing, secured against breaking. (...)

The containers for waste collection may be used by the producer of waste and their next holder, place of recycling or neutralisation."

Filtration materials and wiping cloths (item 5 in table 11) are collected in special containers at the levels of operation of wind generators and transferred to the waste recipient after filling up.

Receipt and disposal of used oils and oiled cloths requires entering into a contract with an authorised company.

Used fluorescent lamps (item 6 in table 11) are collected in metal manufacturer's packaging in designated places in the intermediate storage in a manner protecting it against breaking. Receipt and neutralisation of used light sources requires entering into a contract with an authorised company.

Principles of handling waste are regulated by the Act on Waste (consolidated text: Journal of Laws of 2007 No. 39, item 251 with later amendments) and its executive acts.

6.2.5. Acoustic conditions impact

Analysis framework

- Regulation of the Minister of Environment of 14 June 2007 on acceptable noise levels in the environment (Journal of Laws No. 120 item 826 + appendix),
- Polish Standard PN-ISO 9613-2 Acoustics. Sound suppression during propagation in the open space. General calculation method,
- LEQ Professional 6.0 for Windows, consistent with the above standard,
- The programme-spatial concept of the project - the expected location of the "Głuszynko–Grapice" wind farm,
- Technical data of Vestas V90 3.0 MW wind turbine.

Purpose of the analysis

The purpose of this analysis is prognostic identification of values and range of noise emitted to the environment from the area of the "Głuszynko–Grapice" wind farm, making it possible to assess the impact of effects of this investment on acoustic environment.

Profile of noise sources

A programme of the investment project recorded in the design of the Wieliszewo wind farm envisages construction of 20 turbines. The complex will include turbines with maximum power of 3 MW.

The source of noise emitted from the wind turbines to the environment is operation of the rotor and motion of propellers causing emission of acoustic energy to the environment. These are source with high acoustic power causing changes in the acoustic climate on huge tracts of land. A factor increasing the range of effect is location of mobile parts of turbines at a considerable height, reaching from a few dozen to 100-200 meters.

The data available from the manufacturer of turbines – Vestas – formed the basis for calculations and determination of the range of effect of the designed wind farm . Calculated, rated acoustic power declared by the manufacturer is 107 dB. No

measurement data are available. The height of turbines $h = 105$ m was adopted in the analysis.

Contemporary wind turbines are equipped with devices allowing their parameters to be adjusted, depending on the level of noise desired in a given area. According to the information of the manufacturer, in the case of the analyzed turbines the acoustic power will be changed in steps and will assume the values of 107, 105.9 and 105.4 dB.

Table 12 Parameters of locations of point noise sources – data for calculations

No.	X [m]	Y [m]	Z [m]	Pma	Symbol
1	4,657.0	1,487.0	105.0	107.0	1
2	5,109.0	1,460.0	105.0	107.0	2
3	5,767.0	2,091.0	105.0	107.0	3
4	5,804.0	2,537.0	105.0	107.0	4
5	5,452.0	1,771.0	105.0	107.0	5
6	5,325.0	2,203.0	105.0	107.0	6
7	4,964.0	1,936.0	105.0	107.0	7
8	5,459.0	2,834.0	105.0	107.0	8
10	4,475.0	1,946.0	105.0	107.0	9
11	4,269.0	2,338.0	105.0	107.0	10
12	4,696.0	2,461.0	105.0	107.0	11
13	4,214.0	2,774.0	105.0	107.0	12
15	3,800.0	2,962.0	105.0	107.0	13
16	2,926.0	3,521.0	105.0	107.0	14
17	1,904.0	3,534.0	105.0	107.0	15
18	1,621.0	3,884.0	105.0	107.0	16
19	2,017.0	4,072.0	105.0	107.0	17
20	2,392.0	4,325.0	105.0	107.0	18
21	1,559.0	4,329.0	105.0	107.0	19
22	1,969.0	4,505.0	105.0	107.0	20

The acoustic data presented above were used in LEQ Professional 6.0 to determine the range of propagation of noise emitted from the analysed wind farm to the environment. The calculations were made for level A acoustic power without taking into account distribution of the level of acoustic power of the source in octave bands. Air temperature 10°C, relative humidity 70%. Ground attenuation was calculated assuming the ground ratio $G = 1$.

Determination of the evaluation criterion of the noise impact on the environment

The criterion of the acceptable level of noise in the environment for protected functions is defined on the basis of the Regulation of the Minister of Environment with

14 June 2007 on acceptable noise levels in the environment (Journal of Laws No. 120, item 826 + appendix).

It seems from the presented concept that the designed wind farm is located in arable lands or agricultural wastelands and none of the plots, on which the designed turbines are to be built, borders directly with protected areas.

As a result, at the present time, in accordance with binding legal acts, i.e. the above quoted regulation, there is no legal basis for identification of the acceptable level of noise in the environment in places where the plots where the turbines will be constructed contact the surrounding areas.

Owing to the expected ranges of impact of the wind farm one should check the noise level which it can generate in the environment on the border of the existing and designed residential and farming development. This level must not exceed the values specified in items 2a and 3b of Table no. 1 of Appendix to the above Regulation.

At the same time, it should be remembered that start-up of the analysed wind farm will change in a permanent manner the acoustic climate in that area. This fact will considerably contribute to a possibility to change city-planning functions and will result in restrictions related to the use of areas neighbouring the planned investment project.

Analysing the present and possible future ways of land management, one should take into account the possibility of the emergence of new single-family residential buildings, residential-service buildings or areas of farmstead buildings in the vicinity of the planned wind farm.

In the first of these cases the acceptable level of noise in the environment on the border of single-family residential buildings will be:

from other objects and operations being the source of noise

$L_{AeqD} = 50 \text{ dB between 6.00 and 22.00 (daytime),}$

$L_{AeqN} = 40 \text{ dB in between 22.00 and 6.00 (nighttime).}$

In the second and third case the level of noise near the limits of the areas of residential-service buildings or areas of farmstead buildings:

from other objects and operations being the source of noise

$L_{AeqD} = 55 \text{ dB between 6.00 and 22.00 (daytime),}$

$L_{AeqN} = 45 \text{ dB between 22.00 and 6.00 (nighttime).}$

From the above statement it appears that the range of impact of the analysed wind farm on the environment should be assessed according to the isoline $L_{Aeq}=50$ or $L_{Aeq} = 55 \text{ dB}$ in the daytime and according to the isoline $L_{Aeq} = 40 \text{ dB}$ or $L_{Aeq}=45 \text{ dB}$ in the nighttime, depending on existing and possibly designed provisions of local management plans concerning protected buildings.

Analysis results

The calculations were conducted for the basic option mentioned before, i.e. for rated noise power of 107 dB. The maximum scope has been analysed – all the wind turbines designed in that area work at the maximum noise power of $L_{AW} = 107 \text{ dB}$.

The acceptable level of noise in the nighttime within the analysed area is defined by the value $L_{Aeq}=45 \text{ dB}$, which cannot be exceeded on the borders of areas of existing and designed farming development.

The results of calculations in the observation point grid are outlined in the form of a site plan with sources of noise (20 points corresponding to individual turbines of the farm), observation points (14 points placed on the borders of areas with farming buildings and single residential dwellings in this area). The range of the noise impact is presented using equal-loudness contours.

The obtained results were presented in a graphic form. Figure no. 6 presents the image of acoustic field resulting from operation of 20 designed wind turbines, assuming the noise power of $L_{AW} = 107$ dB. In the case of this option (maximum range of noise) in the areas of residential buildings the expected noise levels are $L_{Aeq} = 39 - 45$ dB.

Table 13 Results of calculations in observation points (on the borders of areas of residential buildings)

X [m]	Y [m]	Leq [dB(A)]
2,532.0	2,908.0	42.4
2,274.0	2,876.0	42.1
716.0	3,446.0	39.2
1,466.0	4,974.0	43.1
3,884.0	1,696.0	44.5
4,112.0	1,408.0	45.0
4,658.0	936.0	44.4
5,002.0	902.0	44.4
5,634.0	1,092.0	44.0
5,664.0	684.0	40.6
6,350.0	958.0	39.1
6,292.0	1,894.0	44.2
6,392.0	2,350.0	43.8
6,302.0	2,948.0	42.8

LEQ Professional v. 6 PN-ISO 9613-2 Forecasting of industrial noise – certificate of Environmental Protection Inspection (BH/158/95 of 17.10.1995) Author: Włodzimierz Pełka SOFT-P Piotrków Tryb., Phone/fax (44) 646 27 28, mobile phone 0601 30 67 86

These results indicate that in the case of the noise power of $L_{AW} = 107$ dB operation of the entire wind farm (20 turbines) would be possible without limitation during the daytime and the nighttime.

The analysis made it possible to determine the area where the noise level in the nighttime exceeds the value $L_{Aeq}=45$ dB. The limits of this area are, at the same time, the boundaries of the area in which development should be prohibited (a ban on location of new residential buildings in farming development). At the same time,

location of new single-family residential buildings should be prohibited in the area where the noise level in the nighttime exceeds the value of $L_{Aeq} = 40$ dB.

The detailed picture of the equal-loudness contours was presented in the cartographic appendix, and the specification of minimum distances between farming buildings and wind turbines is contained in table 14.

Table. 14 Minimum distances between the planned "Głuszynko–Grapice" wind turbines and farm buildings

no. of the wind turbine	distance [m]	direction	comments
EW1	538	west	dense development of Głuszynko (farm buildings)
EW2	574	south	dispersed farm buildings of Głuszynko
EW3	561	south-east	dispersed farm buildings of Nowe Skórowo
EW4	614	east	dispersed farm buildings of Nowe Skórowo
EW5	704	south	dispersed farm buildings of Głuszynko
EW6	1013	east	dispersed farm buildings of Nowe Skórowo
EW7	988	west	dense development of Głuszynko (farm buildings)
EW8	847	north-east	dispersed farm buildings of Nieckowo
EW10	638	south-west	dense development of Głuszynko (farm buildings)
EW11	745	south-west	dense development of Głuszynko (farm buildings)
EW12	1114	south-west	dense development of Głuszynko (farm buildings)
EW13	1127	south	dense development of Głuszynko (farm buildings)
EW15	146	west	dense development of Grapice (farm buildings)
EW16	735	south	dense development of Grapice (farm buildings)
EW17	758	south-east	dense development of Grapice (farm buildings)
EW18	1004	south-west	dispersed farm buildings of Grapiczki
EW19	1064	north-west	dense development of Jeziorki (farm buildings)
EW20	1108	north-west	dense development of Jeziorki (farm buildings)
EW21	657	north	dense development of Jeziorki (farm buildings)
EW22	678	north-west	dense development of Jeziorki (farm buildings)

Conclusions

The analysis showed that, from the point of view of shaping the acoustic climate, the analysed investment project can be implemented according to the plan. The designed complex may operate without limitation during the daytime and the nighttime at full noise power of each turbine, i.e. at $L_{AW} = 107$ dB.

The analysis presented in the report was made on the basis of calculated noise level values. This analysis should be repeated after obtaining measurement data of the designed turbine from the manufacturer.

As regards the course of the proceedings concerning the analysed investment project one should not forget that the above results and conclusions are based on a forecast resulting from the computer analysis of the project. The forecast stated above should be verified based on the actual condition of the investment, which will be confirmed after its implementation, based on the measurements completed as part of the post-implementation analysis.

6.2.6. Infrasound emission

According to the Polish standard PN-86/N-01338 infrasounds are sounds or noise whose frequency spectrum ranges from 2 Hz to 16 Hz. According to ISO 7196 infrasounds are sounds or noise whose spectrum frequency ranges from 1 Hz to 20 Hz.

As regards infrasound emissions of artificial origin, there is a concept of infrasound noise and low-frequency noise which covers the scope of frequencies from Hz to 250 Hz.

Infrasounds included in infrasound noise, are received by the organism mostly by the hearing organs. Their audibility depends on the level of sound pressure. However, great individual variability was observed with regard to auditory perception of infrasounds, especially for the lowest frequencies. Hearing thresholds for infrasounds are higher the lower is their frequency; and for example: for frequency of 2 Hz - 120-140 dB, for frequencies of 6 ÷ 8 Hz - ca. 100 dB and for frequencies of 12 ÷ 16 Hz - ca. 90 dB.

Apart from a specific auditory road infrasounds are received by vibration receptors. Thresholds of this perception are 20 ÷ 30 dB higher than hearing thresholds. When sound pressure exceeds the value of 140 dB, infrasounds may cause permanent, harmful changes in the organism. The phenomenon of resonance of structures and internal organs of the body is possible, subjectively felt already at 100 dB as an unpleasant feeling of internal vibration. Apart from ear-squeeze, this is one of the most typical symptoms confirmed by persons exposed to infrasounds. However, a dominant effect of the infrasound impact on the body is their oppressive effect, occurring already at small exceedances of the hearing threshold. This effect is characterised by subjectively defined states of excessive fatigue, discomfort, drowsiness, balance disorders, psychomotor impairment and disturbances of physiological functions. Objective confirmation of these conditions are changes in central nervous system, typical of reduction in wakefulness (according to the information published on the website of the Central Institute for Labour Protection - www.ciop.pl).

In the case of wind turbines infrasounds are generated in the event that the blade of the turbine is improperly designed or the rotation speed is improperly selected. In the initial period of development of wind turbines they were truly oppressive for the environment. However, tightening of legal regulations and fast development in this field led to obtaining the structure that emit almost no infrasounds.

Based on numerous tests (Ingielewicz, Zagubień 2004, Leventhall 2005, 2005, Chouard 2006) it can be stated that:

- infrasound noise levels measured in the immediate vicinity of wind turbines are very small;

- The G-weighted noise level (infrasounds) generated by the turbine, measured at the distance of 500 m is virtually at the level of background noise and is non-perceptible for humans. For instance, according to measurement results (Ingielewicz, Zagubień 2004) for FW Jankowice Wielkie (in areas Olszanka and Skarbimierz communes, Opolskie Province) the G-weighted noise level (infrasounds) generated by the turbine along with background noise ranged between 56.4 dB for 2 Hz and 78.4 dB for 16Hz, while the G-weighted noise level of background noise after shutting off all turbines was 55.8 for 2 Hz to 76.1 dB for 16 Hz;
- No negative effects on the human body were confirmed for infrasounds with the G-weighted noise level L_G smaller than 90 dB;
- infrasounds with the level of sound pressure lower than the above listed hearing thresholds do not result in an auditory event and are not perceptible for humans.

To sum up, wind turbines emit infrasounds on a very low level, definitely below the value that may affect people's health.

6.2.7. Emission of electromagnetic radiation

Legal standards regulating the impact of electromagnetic radiation on the environment

List of physical values recommended for use when assessing the impact of electrical fields on people is included in Council Recommendation of 12 July 1999. It specifies, e.g. restrictions on people's exposure to varying electrical magnetic and electromagnetic fields. These restrictions resulted from numerous tests concerning the impact of the fields on living organisms. The basic values for which the basic restrictions were described are:

- magnetic induction - B;
- current density - J;
- specific absorption rate - SAR;
- power density - S.

All the values depend on the frequency of generated fields.

In order to make practical assessment of risk of exceeding the basic limitations possible, the so-called "reference levels" were applied, resulting directly from the basic limitations. The reference levels were obtained based on analytical research methods, as well as numerous sensory tests.

The reference levels are:

- electrical field strength - E;
- magnetic field strength - H;
- magnetic induction - B;
- power density - S;
- limb current - IL.

Council Recommendation provides the following reference values for the frequency of fields equal to 50 Hz:

- electric field strength – **5kV/m**;
- magnetic field strength – **80A/m**;

- magnetic induction – **100 μ T**.

Should no reference limits be exceeded, basic limitations are also not exceeded. On the other hand, should the values of strength of electric or magnetic field, or magnetic induction measured in the environment, be higher than the respective reference limits, it does not necessarily mean that the basic limitations are exceeded. In such a situation, in accordance with Recommendation, it should be ascertained for each case that basic restrictions are not exceeded.

In Poland the issue of acceptable levels of electromagnetic fields in the environment and methods of controlling these levels is regulated by Regulation of the Minister of the Environment of 30 October 2003 on acceptable levels of electromagnetic fields in the environment, as well as methods of controlling these levels (Journal of Laws No.192, item 1883). Regulation provides threshold values:

- acceptable value of 50 Hz electrical field for areas available for population – 10kV/m;
- acceptable value of electric field for areas planned for residential development – 1kV/m;
- acceptable value of 50 Hz magnetic field in the environment – 60A/m.

These values are specified for the height of 2 m above the level of the ground or other surfaces where people can be present.

Threshold values specified in the Regulation of the Minister of the Environment are presented in the tables (tab. 15 i 16).

Table 15 Acceptable levels of electromagnetic non-ionising radiation characterised by threshold values of physical values for places available for people.

Item	Radiation frequencies scope	Electric component	Magnetic component	Power density
1	0 Hz	10 [kV/m]	2,500 [A/m]	-
2	from 0 Hz to 0.5 Hz	-	2,500 [A/m]	-
3	from 0.5 Hz to 50 Hz	10 [kV/m]	60 [A/m]	
4	from 0.05 kHz to 1 kHz	-	3/f [A/m]	-
5	from 0.001 MHz to 3 MHz	20 [V/m]	3 [A/m]	-
6	from 3 MHz to 300 MHz	7 [V/m]	-	-
7	from 300 MHz to 3 GHz	7 [V/m]	-	0.1 [W/m ²]

Table 16 Acceptable levels of electromagnetic non-ionising radiation characterised by threshold values of physical values for areas planned for residential development.

Item	Radiation frequencies scope	Electric component	Magnetic component	Power density
1	50 Hz	1 [kV/m]	60 [A/m]	-

Based on the said regulation a specific analysis is made with regard to the presence, or lack of presence of areas where values of electrical and magnetic field

strength exceed the stated standards, in the surroundings of the facility being the source of electromagnetic radiation. In the case of no presence of this type of phenomena, there is no basis to confirm the adverse impact of fields generated by the facility on people's health and the natural environment.

Electromagnetic radiation sources of the planned project

The planned project includes the following potential sources of electromagnetic radiation:

- MV/HV transformer station,
- wind turbines;
- MV cable lines connecting the complex with the planned MV/HV transformer station;
- 110 kV HV cable line connecting the "Grapice" main power take-up point with the "Bięcino" main power take-up point.

The MV/HV transformer station will be a part of technical infrastructure of the planned "Głuszynko–Grapice" wind farm. MV cable connections will be used to connect the wind farm with the designed switching station in the transformer station.

According to the Regulation of the Council of Ministers of 9 November 2004 on determination of the types of investment projects that may significantly affect the environment and the detailed conditions related to qualifying the projects to drawing up the environmental impact report (Journal of Laws of 2004, No. 257, item 2573 with later amendments).

Cable connections, both MV (connecting the complex with the transformer station) and HV (the 110 kV line connecting the "Grapice" main power take-up point with the "Bięcino" main power take-up point) and the wind turbines (generators) do not constitute significant sources of electromagnetic radiation. As per the technology of making this type of power devices, appropriate screens preventing radiating of electromagnetic energy to the surroundings – the environment – are used.

In connection with the above, the only possible significant source of electromagnetic radiation within the area of the "Głuszynko–Grapice" wind farm may be the MV/HV transformer station (the "Grapice" main power take-up point).

Distribution of electrical field

Tables 15 and 16 show that for areas planned for residential development, the acceptable level of the electric component of electromagnetic field, with the industrial frequency (50 Hz – frequency of power grids) must not exceed the value of **1 kV/m**. On the other hand, for places available for people, the acceptable level of the electric component of electromagnetic field with the frequency of 50 Hz must not exceed the value of **10 kV/m**.

According to the Regulation of the Minister of the Environment of 30 October 2003, 10 kV/m is the threshold value of electrical field for places available for people. On the other hand, in areas planned for development, the value of this field may not exceed 1 kV/m. The specified values must not be observed lower than 2m over the ground or other surface where people can be present.

Regulation of the Minister Labour and Social Policy of 29 November 2002 on the highest permitted concentrations and intensity of factors harmful for health in the

work environment (Journal of Laws No.217, item 1833) defines four buffer zones which for electric field E with the frequency of 50 Hz are as follows:

- *dangerous zone, in which* $E > 20 \text{ kV/m};$
- *hazard zone, in which* $10 \text{ kV/m} < E < 20 \text{ kV/m};$
- *intermediate zone, in which* $5 \text{ kV/m} < E < 10 \text{ kV/m};$
- *safe zone, in which* $E < 5 \text{ kV/m}.$

In the safe zone the presence of employees is allowed without any time limits.

In the intermediate zone employees working at sources can be present throughout the entire working shift.

In the hazard zone the time of presence of employees working at sources of fields during the working shift depends on the intensity of electric field in this zone.

In the dangerous zone the presence of employees is forbidden.

No limitations apply in an area where the electrical field strength is lower than 1 kV/m and such area is deemed completely safe for people.

The area where technical equipment of the transformer station (emission sources) is located will be fenced with netting with the height of 2 m, in a manner effectively preventing unauthorised access. Only persons who completed a specialised professional training or persons accompanying them will be able to enter the described area.

The essence of making assessment of the environmental impact of the investment project for the construction of the MV/HV transformer station, is determination of theoretical distribution of the power density of electromagnetic radiation in areas where people may potentially be present. As regards Article 135 of the Act of 27 April 2001 - Environmental Protection Law, determination of distribution of electromagnetic field in areas not available for people is unjustified, which is confirmed by item 34 of Regulation of the Minister of Environment of 30 October 2003 on acceptable levels of electromagnetic fields in the environment, as well as the method of controlling these levels, regulating their measurement beyond the fenced area of the station.

Owing to the fact that the area of the transformer station will be closed, any possible occurrence of electromagnetic fields – their zones - will remain in places not available for people.

The purpose of analysing issues related to electromagnetic radiation is to estimate the size of possible contaminations of this type, and to determine, based on this, the need to establishing limited use areas. As it results from respective regulations in the field of environmental protection (Article 135 of the Environmental Protection Law), limited use areas are not established in fenced areas where installations are located. Therefore, indication – estimation of zones of electromagnetic fields which remain within inaccessible area - is pointless from the point of view of standards resulting from particular regulations of the Environmental Protection Law.

On the basis of general land management concept of the transformer station and experience within the scope of issues related to forecasting distribution of electromagnetic fields, it is stated that the location of elements being parts of the concerned facility excludes the possibility of exceeding values of electrical and

magnetic components in places accessible for people, i.e. beyond the fencing of the station. At the same time, based on experience in building facilities of this type, it is stated that the electrical field strength beyond fencing of the station will not exceed 1kV.

The MV/HV transformer station will not constitute a threat for the environment and people and will meet the requirements included in the Regulation of the Minister of Environment of 30 October 2003 on acceptable levels of electromagnetic fields in the environment, as well as the method of controlling these levels.

Moreover, based on past experiences, i.e. measurements of electromagnetic fields performed empirically in similar existing facilities (areas of the 110 kV switching station), it is stated that the electrical field strength within the planned station, following its expansion, will not exceed the threshold value for the intermediate zone (10 kV/m) in places accessible to personnel.

Distribution of the magnetic field

From tables 15 and 16 it seems that for areas planned for residential development and for places available for people, the acceptable level of the magnetic component of the electromagnetic field with the frequency of 50 Hz must not exceed **60 A/m**.

As in the case of the electrical field, also the magnetic field is regulated by Regulation of the Minister of the Environment of 30 October 2003 on acceptable levels of electromagnetic fields in the environment, as well as methods of control of meeting these levels. This regulation states that the threshold value of the magnetic field for areas available for people is 60 A/m. These values are measured 2 m above the ground or other surface where people can be present.

As regards the area of the planned transformer station, constituting the work environment as well, Regulation of the Minister of Labour and Social Policy of 29 November 2002 on the highest permitted concentrations and intensity of factors harmful for human health in the work environment is applicable. This regulation distinguishes four impact zones of the magnetic field and specifies threshold values for each of them.

The Regulation of the Minister of Labour and Social Policy, of 29 November 2002 regarding the work environment defines four buffer zones which for the magnetic field H with the frequency of 50 Hz are as follows:

- dangerous zone, in which $H > 2,000 \text{ A/}$;
- hazard zone, in which $200 \text{ A/m} < H < 2,000 \text{ A/}$;
- intermediate zone, in which $66.6 \text{ A/m} < H < 200 \text{ A/}$;
- safe zone, in which $H < 66.6 \text{ A/m}$.

Based on experience in building facilities of this type and later actual measurements of electromagnetic fields, it is stated that the intensity of the magnetic field at maximum load in the area of the station, following its expansion, will not exceed 60 A/m (threshold value for the safe zone). In this case it should also be stated that the intensity of the magnetic field beyond the fenced area of the station, will not exceed the acceptable value for areas available for people. As it has been already mentioned, this area will be completely unavailable for outsiders, therefore, the impact of magnetic components of electromagnetic fields generated in its area

will affect neither people nor land animals. This phenomenon may possibly affect flying birds, however, they stay in a given area only for a limited period of time. Therefore, the phenomenon should be considered as negligible.

6.2.8. Landscape

The specific character of the landscape of the wind turbines

The visual characteristics of the wind turbines consists in the fact that (Przewoźniak 2007):

- these are tall facilities, with the tip height of even up to 200 m when the blade is erected;
- in groups, due to distances of 300-450 m between particular turbines, they form a landscape obstacle at different levels;
- towers are set in teams according to two basic diagrams:
 - regularly – linearly or in a system of apexes of a triangle, which bears marks of the spatial order but strongly geometrises the landscape;
 - irregularly, as necessary for the topography and other conditions, which introduces physiognomical disorder but is closer to the "irregular" nature⁷;
- propellers are moving during most of the year, which draws attention, is eye-catching and may cause the stroboscopic effect and the shadow flicker effect (see sec. 6.2.10);
- moving rotors may cause periodically light reflections in the sunny weather due to the specific positioning of the Sun and propellers;
- structures of the turbines periodically cast a permanent and movable shadow, depending on the position of the Sun;
- turbines are not visible at night (except for night obstruction markings - a red lamp on the top of the tower).

Apart from parameters of the wind turbines and complexes thereof the basic impact for their presence in the landscape depends on:

- characteristics of the area, especially:
 - topography (plain, hilly, mountainous, valley);
 - land use (primarily the presence of forests, but also tree stands, tree lanes and tree lines, as well as building structures);
 - the presence of water reservoirs forming extensive exhibition surfaces;
- concentrations of people as observers of the wind turbines, especially:
 - settlement units (cities, villages, recreational complexes);
 - transport routes (roads and railway lines);
 - tourist routes (land and water).

The field reconnaissance in the areas where wind turbines already exist demonstrated, i.a. that (Przewoźniak 2007):

⁷ Przewoźniak M., 2007, Ochrona przyrody w planowaniu przestrzennym, czyli o tym, że przyroda jest krzywa a jej ochrona w planowaniu przestrzennym nie jest prosta, Urbanista 1 (49).

- from a close distance a wind turbine is a foreign element in the landscape owing to its obvious technical nature and the lack of possibility to mask as a result of its height;
- as the distance between the observer and turbines increases, their landscape dissonance decreases, which results mainly from the fact that the load-carrying structure of the turbine is narrow – a significant decrease of the visibility of the turbines in the hilly moraine landscape with diverse topography at the distance of ca. 6 km;
- a very significant feature affecting the possibility to see wind turbines in the landscape is their concentration – the greater the number of turbines the grater landscape dissonance;
- a significant feature of wind turbines, affecting the way they are viewed on the background of the landscape are colours of the structure – the majority of observed turbines were white or light-grey – white is more contrasting under all weather conditions, and in the case of brilliant paint it produces additional light effects;
- adverse perception of turbines results also from advertisements placed on them, which are designed to be visible;
- wind turbines considered as air obstacles have tips of propeller painted in red ⁸ - it provides better visibility and, at the same time, contrasts with the landscape;
- the visibility of turbines is, however, mostly affected by topography in a broad area surrounding them and its tree coverage, especially forests;
- a very important determinant of the visibility of turbines, variable in time, are weather conditions and, first of all, cloudiness, including colour of clouds and direction of illumination of the wind turbines in relation to the observer;
- landscape exposure of turbines and their visibility is also strongly affected by locating in places visible from roads, especially when they are located close to one another - they dominate in the landscape and remain visible for a long time for observers travelling by car or train;
- locations exhibited the most in the landscape are those close to settlement units when turbines are dominant objects in relation to development in the area due to their size.

Aesthetic assessment of wind turbines are subjective, dependent on individual feelings and preferences and thus extremely diverse – from negative, due to the nature of large technical structures, to positive, praising its sophisticated, simple and modern shape. In fact, it is irrelevant whether they are ugly or nice, but whether they result in significant transformation of the landscape. Significant, namely:

- in which territorial scale: local, subregional or interregional;
- which landscape is transformed – natural, cultural (settlement, industrial-infrastructural, etc.) and whether it is subject to protection;

⁸ Wind turbines considered as air obstacles, according to the Regulation of the Minister of Transportation and Construction of 14 January 2006 changing the regulation on the method of reporting and marking of air obstacles (Journal of Laws, No.9, item 53), (...) *should have tips of the blades painted in stripes of the same width, perpendicular to a longer part of the blade, covering 1/3 of the blade's length (3 red or orange and 2 white stripes). Extreme stripes cannot be white.*

- how large is the number of people that will be permanently and periodically (communication areas) present in the changed landscape.

Wind turbines, owing to the height of the structure, are technical elements visible from long distances. On land areas visibility ranges for high structures are limited owing to diversified landscape obstacles and landscape background (e.g. hills, forests, buildings) near facilities. Wind farms always affect the landscape on a local scale (location and its surroundings within several kilometers), and might have an impact on subregional and interregional scale, within more than ten or even a few dozen kilometers, depending on the specific nature of the area and weather conditions. The above impacts relate to the period of operation of wind farms, i.e. ca. 25-30 years.

Disturbances in natural qualities of natural or cultural landscape may decrease tourist and leisure attractiveness of the region of wind farm, though opinions on this matter are diverse (some believe that wind turbines are an element of the tourist attractiveness).

General landscape determinants of the assessment of the "Głuszynko–Grapice" wind farm

- the expected height of particular wind turbines (the tip height - up to 170 m above ground level, including a tower - up to 120 m);
- the structure of facilities in the form of solid load-carrying towers;
- light, uniform colours of the entire structure of the turbine (red tips of propellers - obstruction markings);
- the morphological diversity of the region of the wind farm – from the bottom of the Łupawa valley (neighbouring from the north) to the top parts of the moraine upland;
- presence of forest complexes restricting views;
- presence of village buildings of Głuszynko, Grapice, Jeziorki, Rzechcino and Potęgowo;
- the course of district roads Pobłocie-Potęgowo, Wiszno-Grapice-dr.39309 and Nieckowo-Potęgowo;
- no areas covered by the landscape protection in close proximity to the location of the wind turbines – the closest protected landscape area at a distance of more than 5 km south-east from the nearest planned wind turbine.

Detailed analysis of landscape conditions

The planned wind turbines, as large technical facilities, will significantly change the past, typical agricultural landscape and will result in its anthropisation in the project area and in its surroundings. Field mapping and the analysis of topographic maps in scales 1:10,000 and 1:50,000 (Fig. 7, app and Pictures 1 -12) indicated that the wind farm will be visible, first of all:

- 1) from agricultural cultivation areas – from the direct surroundings of the location of the wind turbines,
- 2) from rural settlement units located in the surroundings of the project area, in particular from villages located in the vicinity, i.e.: Głuszynko, Grapice, Jeziorki, Rzechcino and Potęgowo, and to a smaller extent from villages in further

surroundings of the area, including: Szczypkowice, Słowęcino, Górzyno, Nieckowo, Skórowo, Darzewo, Żychlin, Darżyno, Grąbkowo, Głuszyno, Dąbrówka, Bobrowniki and Łojewo;

- 3) from roads running through the project area and in its vicinity, both district and local;
- 4) to a small extent from forms of nature conservation, mainly from the Natura 2000 SCI "Dolina Łupawy PLH220036" and from ecological sites.

Re. 1)

The planned wind turbines, as large technical facilities in the number of up to 20 pieces, will significantly change the current, typical agricultural landscape and will result in its anthropisation in the project area and in its surroundings. In the project area where the distance to the planned turbines will be the smallest (a few hundred meters) and thus their landscape exposure will be the biggest, there are no buildings and people are present here only periodically during field works. Consequently, the impact of the planned wind turbines on observers will be limited.

Re. 2)

The impact of the turbines on the landscape visible from settlement units will relate to villages in its vicinity, in particular:

- Głuszynko (visible to the north, north-east and east from the distance of ca. 0.5 - 2 km and to the north-west, from the distance of 2 - 3.5 km);
- Grapice (visible to the north and north-west, from the distance of ca. 0.7 - 1.7 km and to the east and south-east, from the distance of ca. 0.7 - 3 km);
- Jeziorki (visible to the south and south-east, from the distance of ca. 0.7 - 5 km);
- Rzechcino (visible to the south-west, south and south-east, from the distance of ca. 1.8 - 3.6 km);
- Potęgowo (visible to the north and north-west from the distance of 1.1 - 5.5 km).

To a smaller extent, the turbines will be visible from villages in the vicinity of the area (partial covering), including villages:

- Szczypkowice (visible to the south, from the distance of 5.4 - 9 km);
- Słowęcino and Górzyno (visible to the south and south-west, from the distance of 5 - 6.5 km);
- Nieckowo (visible to the south-west and west, from the distance of 2 - 5.6 km);
- Skórowo (visible to the west, from the distance of 2.7 - 7 km);
- Darzewo (visible to the west and north-west, from the distance of ca. 5.3 - 10 km);
- Żychlin (visible to the north-west, from the distance of 5 - 9 km);
- Darżyno and Grąbkowo (visible to the north and north-west, from the distance of 3.3 - 7 km);
- Głuszyno (visible to the north, from the distance of 2.2 - 3.1 km, and to the north-east and east, from the distance of 2.4 - 4 km);
- Dąbrówka (visible to the east and south-east, from the distance of 2.1 - 6.7 km);
- Bobrowniki (visible to the east and south-east, from the distance of 5 - 9.5 km);

- Świtawy and Łojewo (visible to the south-east, from the distance of ca. 3.4 km - 8 km);

In addition, the turbines will be viewed against the background of village development of Grapice and Głuszyńko from arable lands, dirt roads and district roads running through the project area – they will result in devaluation of the cultural landscape of rural areas.

Re. 3)

The impact of the turbines on the landscape visible from transport routes will relate, first of all, to:

- district roads: Pobłocie-Potęgowo (7 wind turbines seen to the west, from the minimum distance of ca. 750 m and in the west the minimum distance of ca. 180 m), Wieszno-Grapice-dr.39309 (7 wind turbines seen to the north, from the minimum distance of ca. 350 m and a view of other turbines in the east, along the axis of the roadway, from the minimum distance of more than 500 m) and Nieckowo-Potęgowo (visible to the west from the minimum distance of ca. 350 m);
- from the national road no. 6 south of the project area – (visible from the distance of more than 2.6 km (visibility significantly limited by village buildings, tree stands and hills);
- from the Gdynia-Słupsk railway line running at the minimum distance of ca. 1.1 km south of the project area (visibility limited due to buildings of the village and the location of a substantial part of the railway line in excavations);
- from other local roads running through the project area and in its close vicinity from the distance of a few hundred meters to several kilometers.

In many cases, the presence of trees and bushes and roadside tree lines will limit the view on the wind turbines;

Re. 4)

In the close proximity of the location of the wind turbines there are no forms of nature conservation with the landscape protection function. The nearest protected landscape area (Protected Landscape Area "Fragment of the Łeba Urstromtal and moraine hills south of Lębork") is located at the distance of more than 5 km south-east from the nearest planned location of the wind farm and mainly includes forest complexes - the "Grapice-Głuszyńko" complex will be hardly visible from the edges of this area. The nearest landscape park ("Dolina Słupi") is located at the distance of over 20 km from the planned location of the wind farm - turbines will not be visible from its area.

Insofar as forms of nature conservation are concerned the wind turbines will be visible from fragments of the SCI "Dolina Łupawy" PLH220036 and ecological sites surrounding the project area.

The "Grapice-Głuszyńko" wind turbines will also be visible from the SCI "Dolina Łupawy", from its non-forest edges to the south-west, from the distance of more than 3.5 km - the landscape is not the object of protection on the Natura 2000 sites.

The wind turbines will be hardly visible from ecological sites due to the fact that they are located mostly in the forest areas.

The turbines will not be visible from the area of Słowiński National Park - the Park is located at the minimum distance of ca. 15.7 km with local land elevation, forest

complexes and buildings of several villages between the Park and the location of the wind turbines.

Conclusion

It can be concluded from the analysis of the landscape that the planned complex of 20 wind turbines will be a new, one-of-a-kind element of anthropisation of the landscape in the Potęgowo Commune:

- its landscape exposure will be observed:
 - from villages located in the surroundings of the location, mainly from villages located in its vicinity, i.e.: Głuszyńko, Grapice, Jeziorki, Rzechcino and Potęgowo (from the distance ranging from a few hundred meters to ca. 5 km);
 - from transport routes in the project area, including district roads (from the minimum distance of a few hundred meters), from the national road no. 6 (visibility from the distance of more than 2.6 km, limited by buildings of several villages) and the Gdynia-Słupsk railway line (from the minimum distance of 1.1 km) and local paved and dirt roads, running through the project area and in its vicinity;
 - from forms of nature conservation in the vicinity, only (to a small extent) from the SCI "Dolina Łupawy" PLH220036 - the landscape is not the object of protection in the Natura 2000 sites. Due to the distance and the presence of forest areas the turbines will be hardly visible or will not be visible from other areas covered with forms of nature conservation (including areas of protected landscape and ecological sites, as well as the national park and the landscape park) at a further distance;
- in many of the cases presented above the visibility of the wind turbines will be limited and even eliminated by the presence of roadside tree lines, minor forest patches, trees and bushes, as well as building structures;
- the location of the wind turbines planned for the operation period of 25-30 years (temporary impact on the landscape) within the areas used agriculturally, will contribute to protecting the landscape against the introduction of a permanent, devaluating settlement development;
- elimination of the wind turbines will result in restoring the landscape to its original condition (provided that, the area will continue to be used agriculturally).

6.2.9. Material and cultural assets

At the stage of operation of the planned wind farm no impact on culture goods will be observed (see sec. 6.1.5.).

The wind turbines will be a new element in the cultural landscape of the project area and its surroundings. Their impact on the cultural landscape (agricultural-settlement landscape) will be significant, as a result of the presence of large, peculiar technical structures (see sec. 6.2.8.).

The impact on material assets will affect the scope of land use within the range of over-standard impact of the wind turbines on the acoustic climate. The areas of the wind turbines and their over-standard noise impact (see sec. 6.2.5.) area and will remain in agricultural use. Owners of the lands will not be allowed to apply for changing the land use to construction purposes, associated with permanent stay of

people (homesteads, single-family buildings, etc.). Operation of the wind turbines will not affect agricultural activity, and consequently arable lands will not lose their value.

The value of plots on which the wind turbines will be located will increase due to income from lease of the lands (direct economic benefits).

The local government of the Potęgowo Commune will obtain indirect economic benefits from the increase in property tax.

6.2.10. People's health

The planned wind farm and its accompanying infrastructure can potentially affect people's health by:

- **noise emission** from turbines - "Report..." defines operating conditions of the wind turbines, fulfilment of which will ensure that the impact on the acoustic climate will comply with valid standards (see sec. 6.2.5.) and will not be the source of deterioration of living conditions of people;
- **emission of infrasounds** - wind turbines emit infrasounds on a very low level, much below the value that may affect people's health. (see sec. 6.2.6.);
- **emission of electromagnetic radiation** - current generators of the wind turbines emit radiation of very small intensity, which is not harmful to people, vanishing at the distance of 30-40 m from the source (located 120 m AGL), cable (underground) power lines (medium and high voltage) also do not constitute sources of electromagnetic radiation with over-standard values, and owing to the fact that the area of the main power take-up point will be fenced, over-standard values of electromagnetic fields will be limited to places not available for people (see sec. 6.2.7.);
- **in the extraordinary event (construction disaster)** of the structure of the wind turbine collapsing - a situation of extraordinary hazard is theoretically ruled out, as the structure of the wind turbine meets all standards in terms of strength and loads; any possible collapse of the wind turbines will not affect people's dwellings which will be located at the minimum distance of 540 m;
- **stroboscopic effect** - optical effect of periodical light reflections, related to reflecting sun rays from rotating propellers - minute impact owing to a substantial distance from village buildings (more than 540 m), in addition, the effect is practically eliminated in contemporary turbines by application of matt coatings and anti-reflecting paints (Michałowska-Knap 2006);
- **shadow flicker effect** - optical effect related to casting of a shadow on surrounding areas by rotating blades of the wind turbine (often confused with the stroboscopic effect); this effect is observed briefly during the daytime, in the morning and in the afternoon, when the sun is low on the sky and shining from behind the turbine, and shadows cast by blades of the rotor are very elongated. It is particularly noticeable in the winter period, when the angle of sun rays incidence is relatively small. According to the conducted tests, flashing with the frequency of above 2.5 Hz may cause discomfort in people (for the majority of people the body's reaction is observed at much higher frequencies - 16 -25 Hz). The maximum flickering frequency caused by modern wind turbines does not exceed 1 Hz, therefore it is much below the threshold value of 2.5. Hz and should not be considered harmful (<http://www.oddzialywanie-wiatrakow.pl/oddzia%C5%82ywaniawiatrak%C3%B3w,menu,0,74.html>).

- **changed landscape perception effect** - very diverse impact due to individual, subjective feelings of people (see sec. 6.2.8.).

Operation of the "Głuszyńko–Grapice" wind farm will not adversely affect people's health. On the other hand, it may, just like any other wind farm, affect the neighbouring inhabitants, mostly on the emotional-mental level. This may result from the lack of acceptance for changes in the living environment (above all, the change of the landscape) and subjective concerns that environmental protection standards regarding noise, infrasounds and electromagnetic radiation are not met.

6.3. Elimination stage

Assumed period of operation of modern wind turbines is ca. 25 – 30 years. It is currently unknown whether after the expiry of this time the "Głuszyńko–Grapice" wind farm will be eliminated, or replaced with new structures. In the case of the elimination of the wind turbines, attention should be paid to the following issues:

- threat to the atmospheric air condition resulting from operations of building equipment and means of transport - diffuse emission of air pollutants (suspended and falling dust) and noise; elimination will cause similar problems as construction; no significant adverse impact on the air condition and acoustic climate during elimination is expected;
- elimination of the wind turbines will result in the immediate return of the landscape to the initial condition (provided that physiognomy of the surroundings will not be significantly changed in the meantime), noise and vibration emission will also cease, and so will any possible impact on birds;
- structures of the wind farm will need to be scrapped (maximum 20 turbines x ca. 350 t = 7,000 t), as well as power cables;
- elimination of foundations of the wind turbines will consist in breaking them down and transporting debris to a waste dump or transferring it to physical persons for further use (according to the present Act on Waste – it is unknown what regulations will apply in 25-30 years); the volume of concrete debris will be ca. 54,000 m³;
- other waste, including used synthetic engine oils, gear and lubricating oils 13 02 06 (hazardous waste), used oiled cleaning agents and clothes 15 02 02 (hazardous waste), and non-segregated mixed municipal waste 20 03 01 will be stored in designated and secured places (hazardous waste will be stored in tight, locked containers) until receipt (by specialised companies) or transfer to the nearest places where it may be subjected to recycling or neutralised;
- the land surface and soil will be free of the buildings of the wind farm and their concrete foundations and access roads, pits after foundations will require revegetation (filling with clayey sand and distribution of soil substratum), then the area will be restored for plant production.

The obligation to revegetate the area remaining in place of the eliminated wind farm will fall on the owner of the farm.

In the case of replacement of the planned turbines with new ones a problem related to scrapping of the structure of the wind turbines will occur. It is impossible to determine now whether their foundations will be fit for use.

Table 17 Types of waste at the stage of elimination of the wind turbines

Waste group code	Type of waste	Quantity (for the complex of 20 wind turbines)
17	WASTE FROM CONSTRUCTION, RENOVATION AND DISMANTLING OF BUILDING FACILITIES AND ROAD INFRASTRUCTURE (INCLUDING SOIL AND GROUND FROM CONTAMINATED AREAS)	
17 01	Waste construction and road infrastructure materials and elements (e.g. concrete, bricks, tiles, ceramics)	
17 01 01	Concrete waste and concrete debris from demolitions and refurbishments	ca. 54,000m ³
17 01 03	Waste of other ceramic materials and equipment elements	ca. 16 m ³
17 01 07	Mixed waste from concrete, brick debris, waste ceramic materials and equipment elements, other than listed in 17 01 06	ca. 15 m ³
17 01 81	Waste from repairs and reconstruction of roads	ca. 2,000 m ³
17 01 82	Other unlisted waste	ca. 15 m ³
17 02	Wood, glass and plastics	
17 02 03	Plastics (rotor blades)	ca. 255 t
17 04	Metals (including their alloys)	
17 04 05	Iron and steel (nacelle, hub, turbine tower - ca. 350 t)	ca. 7,000 t
17 04 11	Cables other than listed in 17 04 10	ca. 22,000 m
17 06	Insulation materials and asbestos-containing construction materials	
17 06 04	Insulation materials other than listed in 17 06 01 and 17 06 03	ca. 17 m ³

Source: prepared by the author, waste classification according to the Regulation of the Minister of the Environment of 27 September 2001 on the catalogue of waste.

7. ASSESSMENT OF THE PROJECT'S IMPACT ON LEGAL FORMS OF NATURE AND LANDSCAPE PROTECTION

7.1. Territorial and object-oriented forms of nature conservation

The area of the "Gluszyńko–Grapice" wind turbines is located beyond local forms of nature conservation. Only the route of the 110 kV cable line runs through the Natura 2000 SCI "Dolina Łupawy" PLH220036 on section of 1,070 m, and will be constructed along the border of this area on two other sections (ca. 110 m and ca. 360 m).

Within the boundaries of the SCI "**Dolina Łupawy**" **PLH220036** there are the following types of habitats listed in Annex I to the Habitat Directive (92/43/EEC) meeting the criteria for establishment of a Natura 2000 site:

- (code 3140) hard oligo-mesotrophic waters with benthic vegetation of *Chara spp.*;
- (code 3150) old river beds and natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation;
- (code 3260) water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation ;
- (code 3270) rivers with muddy banks;
- (code 6410) *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinia caerulea*);
- (code 6430) hydrophilous tall herb fringe communities of plains (*Convolvuletalia sepium*) and of the montane to alpine levels (*Adenostylion alliariae*);
- (code 6510) lowland hay meadows (*Arrhenatherion pratensis*);
- (code 7140) transition mires and quaking bogs;
- (code 7150) depressions on peat substrates of the *Rhynchosporion*;
- (code 7220) petrifying springs with tufa formation (*Cratoneurion commutati*);
- (code 7230) alkaline fens;
- (code 9110) *Luzulo-Fagenion* beech forests;
- (code 9130) *Dentario glandulosae-Fagenion*, *Galio odorati-Fagenion* beech forests;
- (code 9160) Sub-Atlantic and medio-European oak or oak-hornbeam forests of the *Carpinion betuli* (*Stellario-Carpinetum*);
- (code 9190) old acidophilous oak woods with *Quercus robur* on sandy plains (*Betulo-Quercetum*)
 - (code 91D0) bog woodland (*Vaccinio uliginosi-Betuletum pubescentis*, *Vaccinio uliginosi-Pinetum*, *Pino mugo-Sphagnetum*, *Sphagno girgensohnii-Piceetum* and birch-pine wetland boreal forest);
- (code 91E0) alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*);
- (code 91F0) riparian mixed forests of *Quercus robur*, *Ulmus laevis* and *Ulmus minor*, *Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers (*Ulmion minoris*).

In addition, from among areas meeting the criteria for establishment of a Natura 2000 site, 2 species of mammals listed in Annex II to Council Directive 92/43/EEC were observed there - *Castor fiber* (beaver) *Lutra lutra* (otter), 1 species from the group of amphibians and reptiles listed in Annex II to Council Directive 92/43/EEC - *Triturus cristatus* (great crested newt) and 5 fish species from Annex II to Council Directive Council 92/43/EEC - *Lampetra planeri* (brook lamprey), *Lampetra fluviatilis* (river lamprey), *Salmo salar* (salmon), *Cobitis taenia* (spined loach) *Cottus Gobio* (European bullhead).

A standard data form for the area does not include the list of plant species from Annex II to Council Directive 92/43/EEC meeting the criteria for establishment of a Natura 2000 site.

The Łupawa valley may be threatened by (www.natura2000.gdos.gov.pl):

- hydro-engineering works;
- cease of the use (e.g. pasturing or mowing) of meadows and soligenic peat bogs;
- intensification of forest management, tree cutting, especially on steep slopes of the valley, ravines and springs;
- locating investment projects causing water contamination within the boundaries of the area and in its vicinity.

The route of the designed 110 kV HV cable line, in the Natura 2000 site "Dolina Łupawy" PLH220036, on the eastern side of the river; it initially runs in the right-of-way of the district road, on the length of ca. 120 m along the border of the "Dolina Łupawy" site (Fig. 8 and 9 and app. 2). This section is mostly covered by dirt with ruderal and herb vegetation associated with neighbouring meadows. Then, on the section of ca. 440 m the line runs through agriculturally used meadows (with herbal vegetation dominated by grasses). According to the inventory of the Forest Management and Geodesy Bureau, conducted for the "Dolina Łupawy" (Fig. 9), these meadows constitute a habitat protected under the Natura 2000 programme – 6510 lowland and mountain fresh meadows used extensively. In the vicinity of meadows there is a small patch of forest in habitats 91E0 willow, poplar, alder and ash alluvial forests and 9160 Subatlantic oak-hornbeam forest (habitats protected under the Natura 2000 programme). This section of the cable line and its passage under the Łupawa river is to be made by a directional drill of ca. 500 m (at the depth of 2 - 9 m under the protected habitat and below 2 m under the river bottom). The river bank is covered with tree stands in willow, poplar, alder and ash alluvial forests, i.e. habitats protected under the Natura 2000 network (91E0).

The drill will make it possible not to damage the bed and river banks of the Łupawa river, including local vegetation and meadows in protected habitats. The drill ends on a meadow on the western side of the river. From this place the line will run on the section of ca. 160 m through agriculturally used meadows with trees and shrubs (the route of the line on this section will bypass trees and shrubs, including protected habitats). The last section of the designed line located in the Natura 2000 site, runs through the right-of-way of a local road. On the section of ca. 220 m this is a mid-forest road. In most part it is a dirt road with ruderal vegetation. A forest complex crossed by the road includes forests in protected habitats – 91E0 willow, poplar, alder and ash alluvial forests. Then, on the section of 360 m the cable will run along the road, along the border of the Natura 2000 site.

The excavation for the purpose of permanent placement of the 110 kV HV cable line will involve periodic elimination of vegetation which on the section running through the Natura 2000 site include mainly herbaceous vegetation of green lands and ruderal vegetation accompanying dirt roads. No risk of destruction of habitats will occur in connection with the directional drill on the section where there are protected habitats (including under the riverbed). This will also allow for eliminating transformations of river edges.

As regards the planned "Głuszyńsko-Grapice" wind turbine complex, due to the nature of the impact at the operation stage and the distinctness of the environment, there will be no impact on habitats, as well as species of plants and animals in the SCI "Dolina Łupawy" PLH220036 – the area of the wind turbines is not attractive for animal species protected under the refuge (these are animals related to the water and forest environment). As regards avifauna associated with "Dolina Łupawy" PLH220036, ornithological monitoring contains the following provisions:

Analysis of the presence and the location of positions of endangered birds indicates small linkages with the Dolina Łupawy refuge, limited to the probability of irregular visits of red kites and white-tailed eagles from this area. Very low intensity of observations of both species leads to the conclusion that there is no significant impact of the planned investment on the avifauna of the Dolina Łupawy refuge.

In the region of the project area there are (Fig. . 5):

- **Słowiński National Park** – at the minimum distance of ca. 15.7 km north of the nearest planned location of the wind turbines (ca. 12.8 km north should the buffer zone be taken into account);
- **nature reserves of which the nearest is "Grodzisko Runowo" and "Czarne Bagno" (at the minimum distance of, respectively, 7.3 and ca. 7.8 km to the north-east), and the rest is located at a distance of more than 10 km;**
- **The "Dolina Słupi" Landscape Park** - at the minimum distance of over 20 km south-west of the nearest planned location of the wind turbines (ca. 11.7 km to the south should the buffer zone be taken into account);
- **Protected Landscape Area "Fragment of the Łeba Urstromtal and moraine hills south of Lębork"** – at the minimum distance of ca. 5 km south-east of the nearest planned location of the wind turbines;
- **Natura 2000 sites, including:**
 - **special protection area "Ostoja Słowińska" PLB220003** – at the minimum distance of ca. 15.7 km north of the nearest planned location of the wind turbines;
 - **site of Community importance "Łebskie Bagno" PLH220040** – at the minimum distance of ca. 7.8 km north-east of the nearest planned location of the wind turbines;
 - **site of Community importance "Torfowisko Pobłockie" PLH220042** – at the minimum distance of ca. 11 km north of the nearest planned location of the wind turbines.
 - **site of Community importance "Bagna Izbickie" PLH220001** – at the minimum distance of ca. 13.8 km north-east of the nearest planned location of the wind turbines;

- **site of Community importance "Karwickie Źródłiska " PLH220071** – at the minimum distance of ca. 14.6 km south-east of the nearest planned location of the wind turbines
 - **site of Community importance "Ostoja Słowińska" PLH220023** – at the minimum distance of ca. 15.7 km north of the nearest planned location of the wind turbines;
 - **site of Community importance "Górkowski Las" PLH220045** – at the minimum distance of ca. 17.3 km south-east of the nearest planned location of the wind turbines
 - site of Community importance proposed by NGOs in **"Shadow List 2010" - "Dolina Słupi"** – at the minimum distance of ca. 14.1 km south of the nearest planned location of the wind turbines
- **nature monuments** - the closest are located in forest complexes in the protected landscape area "Fragment of the Łeba Urstromtal and moraine hills south of Lębork" and near Poganice – both more than 5 km from the nearest planned location of the wind turbines;
 - **ecological sites** - the closest are located at the minimum distance of ca. 1.8 km north of the nearest planned location of the wind turbines, within the forest complex;
 - **documentation site of inanimate nature "Oz Grapice"** – at the minimum distance of ca. 1.3 km south-west of the nearest planned location of the wind turbines;

The Słowiński National Park

Owing to a considerable distance (ca. 15.7 km to the north) from the location of the project the planned wind turbines will not affect the natural qualities of the Słowiński Landscape Park and will not be visible from the area of the Park, nor on its background. The project is located beyond the limits of the buffer zone of the SNP (at the distance of more than 12.8 km).

Nature reserves

Implementation of the planned investment project will not adversely affect nature reserves "Grodzisko Runowo" and "Czarne Bagno", due to the distance (more than 7 km) and the object of protection (natural-archaeological reserve and peat bog reserve) and due to the nature of the impact wind turbines have on the environment (mostly limited to the impact on the acoustic climate, the landscape and, potentially, on flying animals). The impact of the planned wind turbines on other nature reserves located in the surroundings will be minute or non-existent, due to their large distance from the project area (more than 10 km).

Landscape parks

Implementation of the project does not create a risk of devaluation of protected qualities of the "Dolina Słupi" Landscape Park (located at the minimum distance of over 20 km south-west of the investment area). Due to the distance and the presence of field obstructions (trees, rural development, land elevations) the wind turbines will not be visible from the area of the Park.

Areas of protected landscape

The location of the wind turbines will not create a risk for protected qualities of areas of protected landscape and their functions as ecological corridors.

The planned wind turbines will be located at the minimum distance of ca. 5 km from the border of the protected landscape area "Fragment of the Łeba Urstromtal and moraine hills south of Lębork" and will be visible in from its borders only to a small extent.

Due to the distance and the presence of field obstructions, the turbines will not be visible from the remaining areas of protected landscape present in the surroundings.

Natura 2000 areas

The nearest special protection area of birds, "Ostoja Słowińska" PLB220003, is located ca. 15.7 km from the project area (the nearest planned turbine).

The nearest site of Community importance (apart from "Dolina Łupawy" PLH220036, through which the planned 110 kV HV cable line will run), is "Łebskie Bagna" PLH220040, located ca. 7.8 km from the nearest planned location of the wind turbines.

Other Natura 2000 sites are located more than 11 km from the project area.

In the Act of 16 April 2004 on the Nature conservation (Journal of Laws of 2004, No. 92, item 880 with later amendments) the Legislator stipulated with regard to the Natura 2000 sites, e.g. that:

(...)

Article 33. 1. Subject to Article 34, it is forbidden to undertake any actions that may, separately or in connection with other activities, exert a significant negative effect on the goals of protection of the Natura 2000 site, in particular:

- 1) deteriorate the condition of natural habitats or habitats of plant and animal species, whose conservation was the purpose of establishing the Natura 2000 site, or*
- 2) negatively affect species, whose conservation was the purpose of establishing the Natura 2000 site,*
- 3) deteriorate the integrity of the Natura 2000 site or its linkages to other areas.*
- 2. The provision of passage 1 shall apply respectively to proposed sites of Community importance located on the list referred to in Article 27 passage 3 item 1, until the time of approval by the European Commission as sites of Community importance and designating them as special areas of conservation.*
- 3. Drafts of policies, strategies, plans and programmes and amendments thereto, as well as planned projects, which can significantly affect the Natura 2000 site, and which are not directly related to protection of the Natura 2000 site or the areas referred to in passage 2, or which do not result from such protection, require conduct of proceedings with regard to assessment of the impact pursuant to the Act of 3 October 2008 on the Disclosure of Information on the Environment and Its Protection, Participation of the Public in Environmental Protection and Environmental Impact Assessments.*

(...)

Article 34. 1. If it is supported by necessary requirements of superior public interest, including requirements of social or economic nature, and in respect of the lack of alternative solutions, the locally competent regional director of environmental protection, and for marine areas the director of the competent sea office, may give his/her permission to implement the plan or actions that may significantly affect conservation objectives of Nature 2000 site or areas which can be found on the list referred to in Article 27 passage 3 item 1, ensuring natural

compensation necessary for providing consistency and proper functioning of the Natura 2000 network.

2. In the case when significant adverse effects applies to priority habitats and species, the permit referred to in passage 1 can be granted solely for the purpose of:

- 1) protection of health and life of people;*
- 2) ensuring common safety;*
- 3) obtaining favourable consequences of primary importance to the natural environment;*
- 4) resulting from the necessary requirements of superior public interest, after obtaining the opinion of the European Commission)*

(...)

Article 35a. In the case of activities planned to be performed under planned projects, the permit referred to in Article 34, passage 1, shall be replaced by the decision on environmental conditions or the agreement with the regional director for environmental protection, as defined by the Act of 3 October 2008 on the Disclosure of Information on the Environment and Its Protection, Participation of the Public in Environmental Protection and Environmental Impact Assessments. (...).

Article 36. 1. Subject to passage 2, activities to related maintenance of flood protection devices and objects in the Natura 2000 sites are not subject to limitation, neither are economic, agricultural, forestry, hunting and fishing activities, nor amateur fishing, unless it significantly affects the goals of protection of the Natura 2000 site. (...)

In addition, Regulation of the Ministry of Environment on Natura 2000 special protection areas of birds of 21.07.2004 (Journal of Laws No.229, item 2313, as amended Journal of Laws of 2007 No. 179, item 1275 and Journal of Laws of 2008 No. 198, item 1226) includes provisions that:

(...)

§ 4 The purpose of determining the areas referred to in § 2, is to protect the population of wild birds and maintenance of their habitats in an unimpaired condition.

§ 5 The object of protection are species of birds listed in appendix 2 to the Regulation.

(...)

Supplementary legal regulations with regard to Natura 2000 sites are introduced by Regulation of the Minister of the Environment of 13 April 2010 on natural habitats and species being the object of interest of the Community, as well as criteria of selection of areas qualified to be recognised or designated as Natura 2000 sites (Journal of Laws of 2010, No. 77, item 510).

Pursuant to the Act on the Nature conservation, the person overseeing the Natura 2000 site shall prepare the draft plan of protection tasks for a period of 10 years (the draft is to be adopted by the regional director of environmental protection by way of a regulation) and the draft protection plan (the draft is to be adopted by the minister competent for the environment by way of a regulation). Such drafts have not been prepared so far for Natura 2000 sites in the surroundings of the project area.

Regulation of the Ministry of Environment on Natura 2000 special protection areas of birds of 21.07.2004, as amended, includes provisions that:

§ 4. Purposes of designating the areas referred to in § 2, are: conservation of population of wild bird species, maintenance and development of their natural habitats in accordance with environmental requirements, restoration of destroyed biotopes and creation of biotopes.

§ 5. *The object of protection are species of birds listed in Appendix no. 2 to the Regulation and their natural habitats.*";

In the special protection area of birds "**Ostoja Słowińska**" **PLB220003** the presence of at least 28 bird species from Annex I to the Birds Directive (79/409/EEC) was observed. From among them, in accordance with the criteria qualifying bird species and their habitats for protection in the form of the Natura 2000 sites, the following bird species are under protection (species with A, B or C grade according to the standard data form):

- *Botaurus stellaris* (Eurasian bittern);
- *Mergus albellus* (snew);
- *Milvus milvus* (red kite);
- *Haliaeetus albicilla* (white-tailed eagle);
- *Circus aeruginosus* (western marsh harrier);
- *Circus pygargus* (Montagu's harrier);
- *Aquila chrysaetos* (golden eagle);
- *Grus grus* (crane);
- *Sterna hirundo* (common tern);
- *Sterna albifrons* (little tern);
- *Bubo bubo* (eagle owl);
- *Calidris alpina schinzii* (dunlin).

The primary threats for natural values of the area include:

- limitation, and in many places cessation of pasturing on meadows and pastures, which results in disappearance of large, open areas around two largest seaside lakes of the Park; which results in reduction in the number of nesting sites of birds typical of water-mud areas (Charadriidae) and disappearance of plant communities related to human management;
- very high tourist pressure in the most visited places of the Park, within beaches and primary dunes – it destroys psammophile communities and breeding places of local birds;
- large fluctuations of groundwater level and unregulated sewage management – they cause unfavourable changes within the structure of lake and peat ecosystems (reduction in the water level, eutrophication).

Construction and operation of wind farms in the surroundings of the area was not listed as a potential threat for the refuge.

Of the species listed above, the annual ornithological monitoring (Antczak 2010) conducted in the project area confirmed the presence of western marsh harrier and crane (species breeding on the surface) and red kite and white-tailed eagle (species breeding nearby – at the distance of more than 2 km from the surface). In addition, with regard to the area of "Ostoja Słowińska" PLB220003, the ornithological monitoring (Antczak 2010) states that:

A visit of a flock of cranes with roost sites in Krakulice (18 km to the north) was observed in the course of the monitoring. Their number was relatively small (up to 480 birds), and birds used the northern part of sector 2, where the area free of wind

turbines is planned, among others, in order to provide feeding grounds for cranes. No threats were reported for others species related to this refuge. (...)

In addition, in accordance with the monitoring (Antczak 2010): (...) *within the radius of 10 km there are no areas valuable for breeding birds* (Sidło et al. 2001, Antczak and Mohr 2006, Wilk et al. 2010).

The full text of the ornithological monitoring by Antczak (2010) is included in **Appendix 4**.

In the special protection area of birds "Dolina Słupi" PLB220002 the presence of at least 22 birds species from Annex I to the Birds Directive (79/409/EEC) was reported. From among them, in accordance with the criteria qualifying bird species and their habitats for protection in the form of the Natura 2000 sites, the following bird species are under protection (species with A, B or C grade according to the standard data form):

- *Botaurus stellaris* (Eurasian bittern);
- *Ciconia nigra* (black stork);
- *Ciconia ciconia* (white stork);
- *Pernis apivorus* (honey buzzard);
- *Milvus milvus* (red kite);
- *Haliaeetus albicilla* (white-tailed eagle);
- *Circus aeruginosus* (western marsh harrier);
- *Aquila pomarina* (lesser spotted eagle);
- *Crex crex* (corncrake);
- *Grus grus* (crane);
- *Sterna hirundo* (common tern);
- *Bubo bubo* (eagle owl);
- *Aegolius funereus* (boreal owl);
- *Caprimulgus europaeus* (goatsucker);
- *Alcedo atthis* (common kingfisher);
- *Dryocopus martius* (black woodpecker);
- *Dendrocopos medius* (middle spotted woodpecker);
- *Lullula arborea* (woodlark);
- *Anthus campestris* (tawny pipit);
- *Sylvia nisoria* (barred warbler);
- *Ficedula parva* (red-breasted flycatcher);
- *Lanius collurio* (red-backed shrike).

The primary threats in the area include pollution of water with urban and agricultural waste water, uncontrolled tourist-recreational pressure, including settlement pressure.

Construction and operation of wind farms in the surroundings of the area was not listed as a potential threat for the refuge.

Of the species listed above, the annual ornithological monitoring (Antczak 2010) conducted in the project area confirmed the presence of western marsh harrier, corncrake, crane and woodlark (species breeding on the surface), white stork (a

species breeding nearby) and red kite, white-tailed eagle and lesser spotted eagle (species breeding at the distance of more than 2 km from the surface).

According to the conclusions of the ornithological monitoring (Antczak 2010): (...) *no significant threats were reported for avifauna nesting in valuable protected areas within the radius up to 15 km from the planned investment.* All the more so such threat does not apply to the refuge located further away.

The special protection area of birds **"Przybrzeżne Wody Bałtyku" PLB990002** is a wintering side for considerable quantities of 2 bird species from Annex I to Birds Directive (79/409/EEC); they are protected in accordance with the criteria qualifying bird species and their habitats for protection in the form of the Natura 2000 sites (species with A, B or C grade according to the standard data form):

- *Gavia stellata* (red-throated loon);
- *Gavia arctica* (black-throated loon).

The main threat for the area are plans that assume location of wind turbines here. The birds may also be threatened by certain forms of fishery - pond nets and hook ropes.

Construction of wind turbines, as a threat, applies only to locating wind turbines on the sea within the boundaries of the special protection area of birds "Przybrzeżne Wody Bałtyku" PLB990002.

None of the abovementioned bird species was observed in the project area in the course of the annual ornithological monitoring (Antczak 2010). In addition, the impact of the planned investment on areas located further than 15 km from of the project area (Antczak 2010) can be excluded:

Within the boundaries of the SCI **"Łebskie Bagna" PLH220040** there are the following types of habitats listed in Annex I to the Habitat Directive (92/43/EEC) meeting the criteria for within the established Natura 2000 area:

- (code 3160) natural dystrophic lakes and ponds;
- (code 7110) active raised bogs;
- (code 7120) degraded raised bogs still capable of natural and stimulated regeneration;(code 7140) transition mires and quaking bogs (in the majority with *Scheuchzerio-Caricetea*);(code 91D0) bog woodland (*Vaccinio uliginosi-Betuletum pubescentis*, *Vaccinio uliginosi-Pinetum*, *Pino mugo-Sphagnetum*, *Sphagno girgensohnii-Piceetum* and birch and pine wetland boreal forests).

Hazards include continuation of drainage works on both peat bogs and in their direct vicinity, as well as fires, plantings and secondary succession of trees

The site of Community importance **"Torfowisko Pobłockie" PLH220042** covers the following types of habitats listed in Annex I to the Habitat Directive (92/43/EEC) meeting the criteria for establishing the Nature 2000 site:

- (code 3160) natural dystrophic lakes and ponds;
- (code 4010) Northern Atlantic wet heaths with *Erica tetralix*;
- (code 7110) active raised bogs;

- (code 7120) degraded raised bogs still capable of natural and stimulated regeneration;
- (code 7140) transition mires and quaking bogs (in the majority with *Scheuchzeria-Caricetea*);
- (code 91D0) bog woodland (*Vaccinio uliginosi-Betuletum pubescentis*, *Vaccinio uliginosi-Pinetum*, *Pino mugo-Sphagnetum*, *Sphagno girgensohnii-Piceetum* and birch and pine wetland boreal forests).

The potential threat for the area is: drainage with ditches, increased transpiration as a result of partial afforestation.

The site of Community importance "**Bagna Izbickie**" **PLH220001** covers the following types of habitats listed in Annex I to the Habitat Directive (92/43/EEC) meeting the criteria for establishing the Nature 2000 site:

- (code 4010) Northern Atlantic wet heaths with *Erica tetralix*;
- (code 7120) degraded raised bogs still capable of natural and stimulated regeneration;
- (code 91D0) bog woodland (*Vaccinio uliginosi-Betuletum pubescentis*, *Vaccinio uliginosi-Pinetum*, *Pino mugo-Sphagnetum*, *Sphagno girgensohnii-Piceetum* and birch and pine wetland boreal forests).

In addition, from among species meeting the criteria for establishing the Nature 2000 site, the presence of 1 species of mammals listed in Annex II to Council Directive 92/43/EEC - *Lutra lutra* (otter) and 1 species of invertebrates from Annex II to Council Directive 92/43/EEC - *Lycaena dispar* (large copper) was confirmed.

A serious threat for the area are created by fires, exploitation of peat, drainage meliorations and changes in the land use pattern. Open habitats are threatened by natural succession.

The site of Community importance "**Karwickie Źródlika**" **PLH220071** covers the following types of habitats listed in Annex I to the Habitat Directive (92/43/EEC) meeting the criteria for establishing the Nature 2000 site:

- (code 7140) transition mires and quaking bogs (in the majority with *Scheuchzeria-Caricetea*);
- (code 7220) petrifying springs with tufa formation (*Cratoneurion*);
- (code 9110) *Luzulo-Fagetum* beech forests;
- (code 9160) Sub-Atlantic and medio-European oak or oak-hornbeam forests of the *Carpinion betuli*;
- (code 9190) old acidophilous oak woods with *Quercus robur* on sandy plains;
- (code 91E0) alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salcion albae*).

The area is threatened by any possible changes in water conditions of springs, over-drying and fragmentarisation of the spring fen dome, as a result of erosion caused by the accelerated outflow of water, potential change in land use pattern or water conditions in the adjacent areas.

The site of Community importance **"Ostoja Słowińska" PLH220023** covers the following types of habitats listed in Annex I to the Habitat Directive (92/43/EEC) meeting the criteria for establishing the Nature 2000 site:

- (code 1150) coastal lagoons;
- (code 1210) annual vegetation of drift lines;
- (code 1330) Atlantic salt meadows (*Glauco-Puccinietalia maritimae*);
- (code 2110) embryonic shifting dunes;
- (code 2120) yellow seaside dunes (*Elymo-Ammophiletum*);
- (code 2130) fixed coastal dunes with herbaceous vegetation ("grey dunes");
- (code 2140) declaclified fixed dunes with *Empetrum nigrum*;
- (code 2170) dunes with *Salix repens* ssp. *argentea* (*Salicion arenariae*);
- (code 2180) Wooded dunes of the Atlantic, Continental and Boreal region;
- (code 2190) humid dune slacks;
- (code 3110) oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*);
- (code 3160) natural dystrophic lakes and ponds;
- (code 4010) Northern Atlantic wet heaths with *Erica tetralix*;
- (code 7110) active raised bogs;
- (code 7120) degraded raised bogs still capable of natural regeneration;
- (code 7140) transition mires and quaking bogs;
- (code 9110) *Luzulo-Fagetum* beech forests;
- (code 9190) old acidophilous oak woods with *Quercus robur* on sandy plains;
- (code 91D0) bog woodland (*Vaccinio uliginosi-Betuletum pubescentis*, *Vaccinio uliginosi-Pinetum*, *Pino mugo-Sphagnetum*, *Sphagno girgensohnii-Piceetum* and birch and pine wetland boreal forests).

In addition, from among species meeting the criteria for establishing the Nature 2000 site, the presence of 4 species of mammals listed in Annex II to Council Directive 92/43/EEC - *Castor fiber* (beaver) *Phocoena phocoena* (porpoise), *Lutra lutra* (otter) and *Halichoerus grypus* (grey seal), 1 species from the group of amphibians and reptiles listed in Annex II to Council Directive 92/43/EEC - *Triturus cristatus* (great crested newt), 8 fish species from Annex II to Council Directive 92/43/EEC - *Petromyzon marinus* (sea lamprey) and *Lampetra planeri* (brook lamprey), *Lampetra fluviatilis* (river lamprey) and *Alosa fallax* (twait shad), *Rhodeus sericeus amarus* (amur bitterling), *Misgurnus fossilis* (European weatherfish), *Cobitis taenia* (spined loach), *Pelecus cultratus* (sichel) and 2 species of invertebrates from Annex II to Council Directive 92/43/EEC - *Ophiogomphus cecilia* (green snaketail) and *Leucorrhinia pectoralis* (large white-faced darter) was confirmed.

Threats for the above area include:

- limitation, and in many places cessation of pasturing on meadows and pastures, resulting in disappearance of large, open areas around two largest seaside lakes of the Park. As a result, the number of nesting sites for birds typical of water-mud areas (*Charadriidae*) decreases and plant communities related to human management disappear;

- Very high tourist pressure in the most visited places of the Park within beaches and primary dunes destroys psammophile communities and breeding places of local birds;
- high fluctuations of groundwater level and unregulated sewage management cause unfavorable changes within the structure of lake and peat ecosystems (reduction in water level, eutrophication).

The site of Community importance **"Poddębские Cliffs)" PLH220100** covers the following types of habitats listed in Annex I to the Habitat Directive (92/43/EEC) meeting the criteria for establishing the Nature 2000 site:

- (code 1230) vegetated sea cliffs of the Atlantic and Baltic Coasts;
- (code 2110) embryonic shifting dunes;
- (code 2120) shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes");
- (code 2130) fixed coastal dunes with herbaceous vegetation ("grey dunes");
- (code 2180) wooded dunes of the Atlantic, Continental and Boreal region;
- (code 6510) lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*);
- (code 9110) *Luzulo-Fagetum* beech forests;
- (code 9130) *Asperulo-Fagetum* beech forests;
- (code 9160) Sub-Atlantic and medio-European oak or oak-hornbeam forests of the Carpinion betuli;
- (code 9190) old acidophilous oak woods with *Quercu robur* on sandy plains;
- (code 91D0) bog woodland (*Vaccinio uliginosi-Betuletum pubescentis*, *Vaccinio uliginosi-Pinetum*, *Pino mugo-Sphagnetum*, *Sphagno girgensohnii-Piceetum* and birch and pine wetland boreal forests);
- (code 91E0) alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salcion albae*).

The main antropogenic hazards for the refuge are hotel, pedestrian and bicycle tourism, as well as works related to sea and coast protection. The refuge is also slightly affected by forestry, especially afforestation of dunes, as well as by dehumidification of hydrogenic habitats in the past. From natural hazards one should mention action of the sea, which shaped the present natural environment, but is, at the same time, a destabilising factor. The result of abrasion is, among others, quite significant pace of destruction of a cliff near Poddębie.

Construction of the "Głuszynko–Grapice" wind turbines, including construction and operation of 20 wind turbines and power infrastructure will not cause deterioration of the condition of natural habitats and habitats of plant and animal species, nor will it adversely affect species for which Natura 2000 sites were designated. As it has been stated, it results from the following premises:

- a) the closest special protection area of birds "Ostoja Słowińska" PLB220003 is at the minimum distance of ca. 15.7 km north of the planned location of the wind farm – according to the recommendations of the annual ornithological monitoring

(Antczak 2010), a fragment of the surface, for which *visits of flocks of cranes with roost sites in Krakulice* were reported (located in the area of "Słowińska Refuge " PLB220003) were not taken into account when planning the location of the wind farm, *among others, in order to provide feeding grounds for cranes. For other species related to this refuge no threats were found.*

- b) in the SCI "Dolina Łupawy" PLH220036 it is planned to construct the 110 kV HV cable line – the impact of the planned investment will be limited only to the investment stage and will be related to short-term elimination of vegetation on the route of the cable, construction of the 500-meter section by means of a directional drill will eliminate threats to protected habitats located there; and will avoid transformations of the river ecosystem;
- c) construction and operation of wind turbines at the minimum distance of ca. 3.5 km from the boundaries of the SCI "Dolina Łupawy" and more than 7.8 km from other SCIs will not affect protected habitats within their borders, nor species of plants and animals living there;
- d) construction and operation of the "Głuszyńsko–Grapice" wind turbines along with technical infrastructure will not cause disintegration of any of the Natura 2000 sites (turbines will be located beyond the Natura 2000 sites, and the impact of the cable line planned within the area of "Dolina Łupawy" PLH220036 will be limited only to the investment stage and will be constructed in a manner minimising transformations of the environment – including a directional drill under the bed of the river and meadows in protected habitats;
- e) construction and operation of the "Głuszyńsko–Grapice" wind farm will not affect the consistency network of the Natura 2000 network – the ornithological monitoring (Antczak 2010 – **Appendix 4**) did not confirm significant migration routes of birds between the Natura 2000 sites (*in the area of the farm the intensity of the stream of birds was very small (...). migrating birds flying through a narrow corridor were not observed. It should be assumed that flights were performed on the so-called broad front. (...) construction of the wind farm will not cause high, above-average level of mortality of migrating birds that have a transit camp here, nor will their migration route be disturbed.*)

To sum up, the planned wind farm will not result in significant impact on the Natura 2000 sites.

Nature monuments

implementation of the planned investment project will not have any impact on nature monuments in the surroundings. The closest nature monuments can be found at the distance of ca. 5 km from the planned location of the wind farm.

Ecological sites

A number of ecological sites was established in the surroundings of the project area, covering mainly mid-forest marshes. Construction and operation of the "Głuszyńsko–Grapice" wind farm will not have any impact on natural qualities of ecological sites, of which the closest one is located at the minimum distance of ca. 1.8 km north of the planned location of wind turbines.

Documentation site of inanimate nature

Owing to the object of protection, the wind turbines will not affect the natural qualities of documentation sites of inanimate nature "Journal Grapice" located in the minimum distance of ca. 1.3 km south-west of the nearest planned location of the wind turbines.

7.2. Plant and animal species conservation

Construction and operation of the "Głuszyńko–Grapice" wind farm will not result in hazards for protected species of plants and fungi – all locations of the turbines and transformer station are planned in agriculturally used area covered mainly by agrocenoses.

Owing to the land use pattern, on the route of the 110 kV HV cable line (roads and agricultural green lands) the presence of protected plant and animal species is highly improbable.

Owing to season (winter – non-vegetation period), it is impossible to carry out a detailed inventory of vegetation. To eliminate the risk of destruction of possible positions of protected plants and fungi, it is recommended to conduct works related to laying of the 110 kV HV cable line under supervision of a qualified botanist, who will define the method of operation in the case of observing positions of protected species of plants and fungi (see sec. 9).

The wind turbines could affect protected species of birds and bats with regard single individuals, which do not threaten the entire population – which results from the ornithological monitoring (Antczak 2010 – **Appendix 4**) and chiropterological monitoring (Kościów 2010 – **Appendix 5**).

7.3. Protection of green areas and trees

Conditions of protection of trees and shrubs are provided for by the Act on Nature conservation (consolidated text: Journal of Laws of 2009, No. 151, item 1220, as amended):

Article 83.

1. *Trees and shrubs may be removed from the property, subject to passage 2 and 2a, after obtaining permits issued by the commune head, mayor or the city president, at the request of the holder of the real estate. If the holder is not the owner of the property - the application shall be accompanied by the owner's permission.*
2. *The permit for removal of trees or shrubs from the property entered in the register of monuments is issued by the provincial monument conservator.*
- 2a. *The permit to remove trees within the right-of-way of a public road, except for foreign species of poplar, is issued after agreement with the regional director for environmental protection.*
- 2b. *Should the regional director of environmental protection fail to take a view within 30 days from the date of receipt of the draft permit referred to in passage 2a, the permit is considered agreed.*
- 2c. *The authority competent for issuing the permits referred to in passage 1, before issuing them, check the tree plantings for the presence of protected species"*

(...)

5. *Issue of permits to remove trees or shrubs in areas subject to protection of landscape within the boundaries of (...) the nature reserve requires obtaining a consent (...) of the regional director of nature conservation.*
6. *The provisions of passages 1 and 2 do not apply to trees or shrubs:*
 - 1) *in forests;*
 - 2) *fruit trees and shrubs, excluding those growing on the property entered in the register of monuments and in the national park or the nature reserve - on areas not covered by landscape protection;*
 - 3) *on tree and shrub plantations;*
 - 4) *whose age is below 10 years;*
 - 5) *removed in connection with operation of botanical or zoological gardens;*
 - 6) *(repealed);*
 - 7) *removed on the basis of the decision of the competent authority from areas located between the river bank's and the flood embankment or natural high plain in which the route of flood bank was built, from flood dykes and areas at the distance smaller than 3 m from the foot of the embankment;*
 - 8) *which obstruct the visibility of signalling devices and trains, as well as hinder the operation of railway devices or cause the creation of snowdrifts on the trackage, removed on the basis of the decision of the competent authority;*
 - 9) *constituting air obstacles, removed on the basis of the decision of the competent authority;*
 - 10) *removed on the basis of the decision of the competent authority, with regard to maintenance of specific land drainage systems.*

No tree and shrub vegetation is present in the planned location of the wind turbines and transformer station.

If it is necessary to remove individual trees and shrubs located on the route of the 110 kV HV cable line, the above provision apply. legal regulations.

8. DIAGNOSIS OF POTENTIAL SIGNIFICANT IMPACTS OF THE PLANNED INVESTMENT PROJECT ON THE ENVIRONMENT, INCLUDING CROSS-BORDER IMPACTS, AND THE DESCRIPTION OF APPLIED FORECASTING METHODS

8.1. Impacts resulting from the existence of the investment project

1. At the construction stage (the project does not exist yet), the following impacts will occur:

- a) transformations of the upper layer of lithosphere (excavations),
- b) removal of the soil cover,
- c) removal of vegetation (mainly agrocenoses),
- d) the impact on fauna (mainly the soil fauna and scaring of other animals),
- e) emission of pollutions to the atmosphere (cars and construction equipment),
- f) noise emission (cars and construction equipment),
- g) generation of waste (mainly soil from excavations).

The above the impacts will not be significant, as defined by the regulations on environmental protection.

2. At the stage of operation of the wind turbines, in connection with their existence, the following impacts will occur:

- a) limitation of emission of pollutants to the atmosphere from conventional sources of energy,
- b) noise emission from turbines,
- c) emission of infrasounds from turbines,
- d) emission of electromagnetic radiation by the transformer station,
- e) generation of hazardous waste,
- f) potential impact on avifauna,
- g) potential impact on chiropterofauna,
- h) anthropisation of the landscape,
- i) effect on living conditions of people – a cumulative impact.

Potentially significant impacts are those listed in a, b and h. When it comes to noise emission (item b), it was demonstrated that the acceptable levels will not be exceeded (chapter 6.2.5.).

3. At the elimination stage (the end of existence of the project), the following impacts will occur:

- a) emission of pollutions to the atmosphere (cars and demolition equipment),
- b) noise emission (cars and demolition equipment),
- c) generation of demolition waste.

Potentially significant impacts include generation of demolition waste.

The classification of impacts of the planned project on the environment, including potentially significant impacts, in accordance with Article 66 of the Act of 3 October 2008 on the Disclosure of Information on the Environment and Its Protection,

Participation of the Public in Environmental Protection and Environmental Impact Assessments (Journal of Laws of 2008 No. 199, item 1227 with later amendments) is included in chapter 8.8.

8.2. Impacts resulting from the use of natural resources

The planned project will not use any natural resources, except for renewable, kinetic wind energy (long-term impact, constant in windy weather).

At the construction stage the analyzed project will require use of raw materials, materials and fuels, including:

- reinforcing steel – ca. 1,617 t;
- C45/55 concrete – ca. 19,779 m³;
- C16/20 concrete – ca. 2,530 m³;
- foundation backfilling – ca. 23,034 m³;
- fuels for building equipment and transport services (ca. 400 t).

8.3. Impacts related to elimination or limitation in access to utility resources of the natural environment

For the location of the "Głuszynko–Grapice" wind farm the issue of legal protection of utility resources of the natural environment applies to protection of soils.

Protection of soils

According to the Act of 03.02.95 on Protection of Agricultural and Forest Land (i.e. Journal of Laws of 2004 No.121, item 1266 with later amendments) arable lands of higher valuation classes and organogenic lands are subject to legal protection. According to the Act:

"Use for non-agricultural and non-forest purposes of:

- 1) *arable lands constituting I-III class arable lands, if their contiguous area designed for such purpose exceeds 0.5 ha – requires the consent of the Minister of Agriculture and Food Economy [now the Minister of Agriculture and Rural Development] ;*
- 2) *forest lands being the property of the State Treasury – requires the consent of the Minister of Environmental Protection of Natural Resources and Forestry [now the Minister of the Environment] or a person authorised thereby;*
- 3) *(deleted)*
- 4) *(deleted)*
- 5) *other forest lands*

requires to the consent of the province marshal expressed after obtaining the opinion of the agricultural chamber"

The designed investment foresees the need to set aside arable lands constituting III and IV class arable lands (this applies to the direct location of the wind turbines and their assembly yards, area of the power station and access roads). Use of III class arable land with the contiguous area of more than 0.5 ha for non-agricultural purposes will require the consent of the Minister of Agriculture and Rural Development. There will be no need to change the intended use of forest lands for non-forest purposes.

8.4. Impacts related to potential contamination of the environment

In the scope of environmental contamination the planned project will cause emission of noise (long-term impact, constant in windy weather), infrasounds and electromagnetic radiation (the transformer station) and will be a source of waste.

There is no risk of exceeding acceptable noise limits in the areas of current farmstead, multi-family and single-family housing development, or in residential-service areas. The planned wind farm may operate without limitations at full acoustic power both in the daytime and nighttime. This forecast should be verified based on the actual condition confirmed on the basis of measurements made as part of the post-implementation acoustic monitoring (see sec. 13).

Emission of infrasounds by modern wind turbines is insignificant and does not pose a risk to people's health.

Emission of over-standard electromagnetic radiation by the transformer station will be limited to the fenced area of the station.

Waste will be produced both at the construction stage, as well as at the stage of operation and elimination of the turbines. At the construction stage waste will include soil and ground and, to a smaller extent, building materials, at the operation stage hazardous waste may be generated (requiring a special way of handling), at the elimination stage waste will include mainly building materials. Principles of handling waste are regulated by the Act on Waste (Journal of Laws of 2001, No. 62, item 628, as) and executive acts thereto.

8.5. Limited use areas

The planned "Głuszyńko–Grapice" wind farm does not belong to investment projects for which an area of limited use is established⁹.

The adopted technical, technological and organisational solutions ensure elimination of the adverse environmental impact, including the impact on living conditions of people. Areas within the range of the acoustic impact of the wind farm will continue to be used agriculturally.

8.6. Cross-border environmental impact

The wind farm, owing to the scale of the project and the location at a considerable distance from the borders of Poland (ca. 25 km to the seashore + 12 nautical miles) will not result in any cross-border impact on the environment.

8.7. Risk of occurrence of serious breakdowns

The "Głuszyńko–Grapice" wind farm, owing to the lack of processing production or storage of hazardous substances, is not classified to lower or upper tier establishments.

⁹ According to the Environmental Protection Law the area of limited use is established for "sewage treatment plants, municipal waste dumps, composting plants, transport routes, airports, power lines and power stations and radiocommunication, radionavigation and radiolocation equipment".

At the investment stage, the risk of emergency occurrence can relate only to possible interruptions in operation of mechanical equipment used during construction and installation works (e.g. leakage of petrol derivatives) and can create a risk to the ground and water environment. Prevention of such occurrence will be possible by:

- permanent control of equipment used at the stage of construction and installation of the wind turbines for possible leaks and breakdowns;
- possible repairs of mechanical equipment in designated places;
- implementation of the project by qualified and trained builders.

The investment operation stage may possibly involve the occurrence of theoretical emergency situations, consisting in collapse or damage of the structure of the turbine tower. It is, however, very unlikely. Permanent monitoring of operating parameters of particular turbines and possible damages reduces the possibility of such a situation. However, in the case of occurrence of this type of breakdown no risk for humans will be involved, owing to a substantial distance from residential buildings (more than 550 m).

8.8. Classification of environmental impacts

The classification environmental impacts of the planned project, including potentially significant environmental impacts according to Article 66 of the Act of 3 October 2008 on the Disclosure of Information on the Environment and Its Protection, Participation of the Public in Environmental Protection and Environmental Impact Assessments (Journal of Laws of 2008 no. 199, item 1227 with later amendments) are presented in table 18.

Table 18 Classification of environmental impacts of the planned project, including **potentially significant environmental impacts**

Environmental impacts	Impact type			Impact time			Impact mechanism		
	Direct	intermediate	secondary	short-term	medium-term	long-term (25 years)	temporary	temporary	permanent
CONSTRUCTION STAGE									
Transformations of the upper layer of lithosphere (excavations)	X					X	X		
Elimination of soil cover	X					X	X		
Elimination of vegetation	X					X	X		
Impact on fauna	X	X		X				X	
Emission of pollutants into the atmosphere (cars and construction equipment)	X			X				X	
Noise emission (cars and construction equipment)	X			X				X	
Generation of waste (mainly soil from excavations)	X			X				X	
OPERATION STAGE									
Limitation of emission of pollutants to the atmosphere from conventional sources of energy			X			X			X
Noise emission from turbines (acceptable levels will not be exceeded)	X					X		X	
Emission of infrasounds from turbines	X					X		X	

Emission of electromagnetic radiation from the main power take-up point	X					X		X	
Generation of hazardous waste	X					X		X	
Impact on avifauna	X	X				X		X	
Impact on chiropteroфаuna	X	X				X		X	
Anthropisation of the landscape (assessment based on personal impressions)	X					X			X
Impact on environmental conditions of the wellbeing of people (the effect of cumulative impact)	X	X				X			X
ELIMINATION STAGE									
Emission of pollutants into the atmosphere (cars and demolition equipment)	X			X				X	
Noise emission (cars and demolition equipment)	X			X				X	
Generation of demolition waste	X			X				X	

Source: prepared by the author.

8.9. Cumulative impact assessment

8.9.1. The effect of accumulation of environmental impacts of the "Głuszynko–Grapice" wind farm

The planned wind power complex will contribute to a higher share of green energy sources in the total electricity balance. Environmental considerations related to wind turbines consists in using a renewable energy source, without emitting dusts and gases to the environment. However, the wind farm has the environmental impact, especially with regard to physical condition (sozological issues), functioning of the nature (ecological issues) and physiognomy of the landscape (aesthetic issues).

Sozological issues in the case of the wind turbines relate, above all, to noise emission (energy impact). Assuming that parameters presented in this report will be achieved, the "Głuszynko–Grapice" wind farm will not have the over-standard impact in this respect, and will not be harmful for people. At the operation stage, the turbines will not result in material impact on the environment (emission of solid liquid and gaseous waste) and will help to avoid emission of additional gas and dust pollutants to the atmosphere from conventional power industry. Wind turbines replace conventional power engineering, based on combustion of coal, oil or gas, or limit its development. Therefore, they extemporaneously or ultimately result in limiting emissions of combustion products into the atmosphere, first of all, CO₂, SO₂, NO_x and dusts. This improves the quality of atmospheric air and should limit the greenhouse effect. The "Głuszynko–Grapice" wind turbines will contribute to this effect. The cumulative impact of the wind farm on the environment with regard to sozology can be considered positive.

Construction and operation of the "Głuszynko–Grapice" wind farm will result in direct and indirect impact on ecosystems, including:

- 1) elimination of natural habitats at the construction stage (assembly yards, foundations of the turbines, access and service roads) – this will affect only agroecosystems of small ecological value;
- 2) elimination of vegetation at the construction stage – this will affect only agrocenoses and ruderal vegetation of small ecological value;
- 3) Transformations of habitats at the operation stage (noise impact) – minor importance owing to a limited spatial range of the impact, nature of habitats (arable lands) and adaptive capabilities of biotic nature,
- 4) the potential impact on flying animals, first of all, birds and bats – as shown in chapter 6.2.3., possibility of the adverse impact is low.

The cumulative impact of the planned wind farm on ecosystems was assessed as potentially minor.

As already mentioned (chapter 6.2.8.) esthetic assessments of wind turbines are subjective, dependent on personal feelings and preferences and, as a result, are extremely diverse – from negative, due to the presence of large technical structures in the landscape, to positive, with indication of their sophisticated, simple and modern shape. The "Głuszynko–Grapice" wind farm will transform the cultural-agricultural landscape, on a local and subregional scale. The range of significant, permanent landscape impact of the wind farm will cover first and foremost villages located in the direct neighborhood of the location, i.e.: Głuszynko, Grapice, Jeziorki, Rzechcino and Potęgowo.

As mentioned before (chapter 6.2.10.), operation of the wind farm may result in the cumulative impact on living conditions of people. Deterioration of living conditions may result from the lack of acceptance of changes in the living environment (first of all, changes in the landscape) and subjective concerns that environmental protection standards with regard to noise, infrasounds and non-ionising electromagnetic radiation will not be observed.

Generally, the cumulative positive impact of the wind farm", on the one hand, will limit emission of pollutants to the atmosphere, and, on the other hand, it will result in various environmental impacts, first of all, changes in the landscape. It should be emphasised that the landscape impact will be periodical (ca. 25-30 years) – after elimination of the turbines the landscape will be returned to the initial condition.

8.9.2. Assessment of the cumulative environmental impact of the "Głuszynko–Grapice" wind farm, wind farms within its vicinity and high voltage lines

Wind farms are already present in the surroundings of the planned location of the "Głuszynko–Grapice" wind farm. The closest one, the "Darżyno" complex, is located at the distance of ca. 3.1 km to the south-east (in the area of the village of Potęgowo – currently 6 wind turbines construction of subsequent 6 is planned).

Additionally, in the Potęgowo Commune and the neighbouring communes investment processes and planning procedures are underway (at various stages of advancement), related to locating other wind farms there.

According to information obtained by the authors of the report the following locations of wind farms are planned (Fig. 10):

- in The Potęgowo Commune – construction of two wind farms is planned:
 - the "Potęgowo Południe" complex consisting of 9 wind turbines, in the area of Łupawa, Grąbkowo and Darżyno (at the distance of ca. 4.4 km south of the "Głuszynko–Grapice" wind farm) – at the stage of submitting application for the environmental decision;
 - the "Wieliszewo" complex consisting of 17 wind turbines, in the area of Nowa Dąbrowa and Wieliszewo (at the distance of more than 10 km to the south-west) – at the stage of submitting application for the environmental decision;
- in the Damnica Commune – planned construction of a complex of 13 wind turbines, in the area of Bęcino and Karżniczka (at the distance of ca. 11.8 km to the west) – the environmental decision already issued;
- in the Głównicy Commune – planned construction of 2 wind farms is planned:
 - the "Drzeżewo III" complex consisting of 14 wind turbines, in the area of Wykosowo (at the distance of ca. 8.3 km to the north) – at the stage of submitting application for the environmental decision;
 - the "Drzeżewo I" complex consisting of 11 wind turbines, in the area of Drzeżewo-Lipno (at the distance of ca. 10.9 km to the north-west) – at the stage of submitting application for the environmental decision;
- in the Dębica Kaszubska Commune – according to "Study of the Conditions and Directions of Spatial Development for the Dębica Kaszubska Commune" (2010) location of wind turbines is planned in the following geodetic precincts: Skorszów

Górny, Starnice, Łabiszewo, Dobieszewo, Dobra, Kotowo, Ochodza, Budowo and Jawory (the closest one, Łabiszewo" is located at the distance of more than 13 km to the south-west). At the present stage only the draft local plan was drawn up for the Skorszków Górny district, however, it is yet to be adopted.

- in the Nowa Wieś Lęborska Commune – construction of wind farms is planned in two areas: the area of Łebień and Obliwice (at the distance of more than 20 km to the north-east) – at the stage of preparing local development plans;

In Cewice and Czarna Dąbrówka communes (February 2011) no construction of wind turbines is currently planned.

The cumulative environmental impacts of the turbines in the event of their construction will look as follows:

1. The cumulative landscape impact – wind turbines of the closest complexes (in the Potęgowo Commune) will be in observable together to a moderate degree (owing to the distance between them): from settlements located in their surroundings; from transport routes, including the national road no. 6, the Gdynia-Słupsk railway line and local roads; the turbines will be partly, and to a minor degree, visible from areas covered with forms of nature conservation, mainly from the Natura 2000 SCI "Dolina Łupawy" PLH220036.
2. Impact on fauna, especially avifauna, may result in lower attractiveness of areas of wind farms as feeding grounds, and possible collisions (barrier effect). This issue of accumulation with regard to reduction in the attractiveness of areas of wind farms should be examined at least for the entire district, looking for an answer to the question of whether not too many feeding grounds were potentially taken from birds. This problem will certainly become significant when the density of wind farms will increase up to the level observed in Germany or Denmark. Owing to the size of feeding grounds occupied by designed wind farms and distances between particular complexes, this risk is, at the present stage, low. Multiplication of the barrier effect will not be present either. For the "Głuszynko-Grapice" farm these issues were discussed in detail in the ornithological monitoring (Antczak 2010 – **Appendix 4**)
3. Construction of the "Głuszynko-Grapice" wind farm - its cumulative impact with other planned complexes - will not result affect Natura 2000 sites, in particular, it will not adversely affect the consistency of their network – all the planned complexes are to be located outside Natura 2000 sites.
4. The cumulative impact on the acoustic climate will be observed only on a local scale, in areas located close to complexes. In the case of the "Głuszynko-Grapice" wind farm, the minimum distance from the existing "Darżyno" complex is more than 3 km, and consequently accumulation of the acoustic impact is excluded.

The most important effect of the cumulative impact of wind turbines on the environment will be their impact on the landscape which will change the landscape of the region. The cultural-agricultural landscape (cultivations and settlements) dominant in the area will be replaced by the agricultural-industrial landscape in which physiognomy will be dominated by structures of wind turbines, observable in large complexes, individually from very different distances, in favourable weather, even up from to 20 km.

The landscape impact will be periodical (ca. 25-30 years) and will protect this area against excessive settlement development, permanently devaluating the landscape.

The cumulative impact on fauna, especially avifauna, (a large spatial barrier for movement of birds), may also affect wind farms and high voltage power lines.

8.10. Description of forecasting methods

The environmental impact assessment for the planned project was conducted in three stages.

Stage 1

Research of archive materials, field observation – eco-physiographic and landscape diagnosis, ornithological monitoring and of the project location of the project and its surroundings.

Stage 2

Conduct of specialist impact assessments (expert method) for the planned investment project with regard to impact on noise, electromagnetic radiation on the landscape, as well as avifauna and chiropterofauna, namely with regard to major impacts related to operation of wind turbines.

Stage 3

Comprehensive environmental impact assessment for the investment project, including direct and indirect, secondary and cumulative, short-term, medium-term and long-term, as well as permanent and temporary impacts.

The following methods were used to forecast changes in the environment under the effect of the planned project:

- inductive-descriptive (from detailed studies to a synthesis);
- environmental analogies (on the basis of an assumption of the stability of natural laws);
- mathematical modeling (noise);
- environmental diagnosis on the basis of field mapping as the starting point of extrapolation;
- cartographic analyses (Fig. 1-9 and cart. appendices);
- photographic visualisation (landscape).

The above the methods are described, e.g. in Przewoźniak (1987, 1995, 1997) and "Problemy Ocen Środowiskowych" (nos. 1 – 49).

9. PROPOSED ACTIONS TO PREVENT OR REDUCE HARMFUL ENVIRONMENTAL IMPACTS AND COMPENSATE FOR ENVIRONMENTAL DAMAGES

Potential harmful impacts of the planned wind farm on the environment can be theoretically prevented and reduced by:

- 1) application an environmentally friendly technology of construction works;
- 2) selection of technical parameters of the planned turbines limiting their impact on the environment,
- 3) limitation of the potential impact on birds,
- 4) limitation of the potential impact on bats,
- 5) preparing variants for location of the turbines.

Re 1)

The environmental impact of the "Głuszyńko–Grapice" wind turbines at the construction stage can be limited by:

- appropriate storage of removed soil for its re-use to restore the initial condition after completing the construction;
- removal of material from excavations for foundations and transport of construction materials and construction elements of the turbines, bypassing developed areas of villages and, if possible, in the daytime (22.00 – 6.00);
- use of materials from excavations for foundations of the turbines to revegetate post-mining headings and other devastated areas in the Potęgowo Commune;
- conduct of construction work in the daytime (22.00 - 6.00), if possible;
- after completion of construction and installation works restoration of the area around the turbines to its primary condition.

Re 2)

The environmental impact of the "Głuszyńko–Grapice" wind turbines" within its location, through selection of parameters of the turbines, can be limited by:

- application of a similar type of turbine, so as to reduce the complex's impact on the landscape;
- not placing advertisements on the structure of wind turbines, in order to limit their impact on the landscape (except for a logo of the owner or the turbine manufacturer);
- painting the structure of the turbines mat white passing into light-gray in upper parts of the structure (this colour leads to disappearance of the turbines in the landscape to the greatest extent, especially in cloudy weather), and possibly using shades of green at the tower's base (to reduce the contrast with vegetation);
- using paints eliminating the visual (stroboscopic) effect;

- application of towers of the same height in order to limit the sphere of potential conflicts with flying animals;
- reduction in the noise power of particular turbines in order to limit their impact on acoustic conditions of the environment, only in the case of exceeded the noise level - in accordance with the acoustic analysis (see sec. 6.2.5.) at the assumed noise power of turbines, limitation of the turbine settings is not required.

Re. 3)

According to the recommendations of the ornithological monitoring (Antczak 2010 – **Appendix 4**):

- *leave the area around Karwieńskie Marshes and the area north of this area without wind turbines due to the presence of feeding grounds of cranes (up to 450 birds) and regularly used feeding grounds of European golden plover (up to 1,800 birds). In addition, the area of Karwieńskie Marshes groups together valuable breeding species, e.g. cranes, western marsh harriers, red-backed shrikes, woodlarks.* - a recommendation included in the final option of the planned layout of the wind turbines.
- *Thus, it is suggested to move two units beyond the endangered zone (EW 9, 14).* - in the final option of location of the wind turbines the decision was made to resign from location of the above turbines.
- *wind turbines and accompanying infrastructure should be moved away from other field reservoirs. Construction works should be conducted in a manner preventing dehydration of any boggy areas.* - the planned locations of the wind turbines were designated at a safe distance from the existing hydrological objects, and the technology of implementation of the investment project minimises hazards associated with the impact on underground and surface waters of this area (see sec. 6.1.)
- *preventing cultivation of corn within the wind park. This type of cultivation is preferred by cranes and geese. planning access roads to bypass field trees and shrubs. Such areas are breeding sites for small passerines which, apart from this, may use them as local migration corridors.*

Re. 4)

According to the guidelines provided and published in December 2009 by the Agreement on the Conservation of Populations of European Bats (EUROBATS) and recommended for use, among others, by the State Nature Conservation Council, it is recommended:

1. Not to use artificial lighting of the investment area, e.g. lamps, illuminations of turbines and masts (except for required by other legal regulations) – such light draws insects, providing a feeding ground for bats.
2. Not to afforest arable lands in the area of the planned investment project and not to introduce trees and shrubs especially of linear nature (e.g. espaliers of trees), that may constitute new migration routes and ecological corridors used by bats.
3. It is recommended to prevent formation of trees and shrubs (for instance, as a result of natural dispersion), especially of linear nature (as above), on lands leased by the investor, including at access roads to the wind turbines.

4. It is necessary to conduct minimum three-year post-investment monitoring consisting in examination of mortality of bats and their activity close to towers at the height of the rotor or otherwise, according to the guidelines applicable to the period of operation of the farm.

In accordance with "Report on the potential impact of the designed location of the "Grapice" Wind Farm on bats" (Kościów 2010 – **Appendix 5**):

It is recommended to make the post-execution monitoring: 1. one year, 2 years and 3 years from the date of start-up of the wind turbines.

One should also not create water reservoirs in the location of the designed project.

Re. 5)

At the stage of design of the planned project discussed options included one differing from the basic one in the number and the layout of the planned wind farm (see sec. 2.2.).

The option selected for implementation (up to 20 turbines) was prepared on the basis of the following assumptions:

- preservation of relevant distances between turbines and residential buildings – ensuring observance of acceptable noise standards for residential buildings;
- location of turbines according to the results of the ornithological and chiropterological monitoring;
- ensuring that locations of turbines will not collide with of ecologically valuable areas and that those will be located at a safe distance from the turbines.

10. ANALYSIS OF POSSIBLE SOCIAL CONFLICTS RELATED TO THE PLANNED INVESTMENT PROJECT AND SOCIAL CONSULTATIONS OF THE PROJECT

The planned "Głuszyńsko–Grapice" wind farm is supposed to be completed:

- partially within (a fragment of the route of the planned 110 kV HV cable line) SCI "Dolina Łupawy" PLH220036 and at the distance of ca. 1.3 km from documentation sites of inanimate nature "Grapice Esker" and ca. 1.8 km from several ecological sites;
- at the distance from few to over a dozen kilometers from other territorial forms of nature conservation (including the national park, nature reserves, the landscape park, the protected landscape area and Natura 2000 sites, including the special protection area "Ostoja Słowińska" PLB220003);
- in the vicinity of Głuszyńsko, Grapice, Jezioraki, Rzechcino and Potęgowo and further away from: Szczypkowice, Słowęcino, Górzyno, Nieckowo, Skórowo, Darzewo, Żychlin, Darżyno, Grąbkowo, Głuszyno, Dąbrówka, Bobrowniki and Łojewo;

The above conditions result in the fact that social conflicts may arise as a result of the designed construction of the wind farm in the case of:

- 1) a protest of environmentalists and so-called "ecologists"¹⁰ against implementation of the 110 kV HV cable line within the area of "Dolina Łupawy" PLH220036,
- 2) a protest of inhabitants of the nearby villages, from among which there are some that can protest in fear of deterioration of living conditions, including against:
 - excessive noise, infrasounds and electromagnetic radiation;
 - deterioration of landscape qualities of the environment and optical effects;
 and in connection with the limitation of the rights to dispose of their land properties.

Re. 1)

A protest against the location of the electric power connection (the 110 kV HV cable line between the "Grapice" main power take-up point and the "Bięcino" main power take-up point) and a fibre-optic cable connections, partially within the boundaries of SCI "Dolina Łupawy" PLH220036 (on the section of ca. 1,070 m) and partially along its boundaries (on two sections of ca. 110 m and ca. 360 m) may be related to concerns regarding destruction of protected habitats crossed by the cable route and desintegration of the area. As it was proved in the "Report..." (chapter 7.1.), the impact of the 110 kV HV cable line on the Natura 2000 site "Dolina Łupawy" PLH220036 will be limited only to the investment stage and rehabilitation of land will be conducted after its completion. In addition, a technology of performing the works (including application of directional drill under the riverbed) and planned botanist

¹⁰ An ecologist is a representative of a discipline of natural sciences, which deals with research concerning relations between organisms or groups of organisms and their environment. The so-called "The ecologist" is a representative of any other profession propagating (for numerous reasons), less frequently implementing, eco-minded views.

supervision of the work progress will eliminate the threat to protected elements of the environment in the area.

Any possible protest against the location of the wind turbines close to forms of nature conservation (including at the distance of ca. 1.8 km from ecological sites, 3.5 km from the SCI "Dolina Łupawy" PLH220036 and ca. 15.7 km from the SPA "Ostoja Słowińska" PLB220003), as shown in "Report.", would be completely unsubstantiated – the planned project not will create hazard for natural values protected in its surroundings (see sec. 7.1.).

A protest against the location of the "Głuszyńko–Grapice" wind power farm in the vicinity of the Słowiński National Park, the "Dolina Słupi" Landscape Park and areas of protected landscape may, first of all, relate to the process of anthropological transformation of the landscape – possible statements (slogans) include: destruction, devaluation or devastation of the landscape. In fact, transformation of the landscape will relate to the project area and its environment, which will be transformed from the natural-cultural landscape of open areas into the natural-cultural landscape with specific elements of contemporary pro-environmental technology. The wind turbines will be visible to a minor degree or will not be visible from the aforementioned forms of nature conservation and will not violate regulations applicable to their objects of protection. The impact of the wind turbines on the landscape of those areas will be minor (see sec. 6.2.8.). Such a protest would not be legally and formally justified.

Re. 2)

There is no objective premises of health nature for social conflicts for fear of exceeding acceptable noise levels. There are no detailed objective premises of health nature for social conflicts for fear of infrasounds (emission from modern turbines are very low).

The issue of the impact of the planned turbines on the landscape was presented in chapter 6.2.8. Since perception of the landscape is always subjective, dependent on personal feelings, any possible protests in this respect will also be subjective and, at the same time, probably strongly emotional. As it has been already mentioned, aesthetic assessments of wind turbines are extremely diverse – from negative, due to the presence of a large technical structure in the landscape, to positive, indicating their sophisticated, simple and modern shape.

In practice, the source of conflicts in the case of locations of turbines include also financial issues. They result mostly from concerns related to the decrease in prices of lands. As it has been reported in chapter 6.2.9., operation of the turbines will not adversely affect agricultural activity, and consequently lands used for agricultural purpose will not lose their value.

The source of conflicts is also the fact that the value of plots on which turbines area located will increase due to income from lease. This material benefit will apply only to plot owners and not their neighbours (there are protests against so-called "unjust" location of the wind farm).

Under the procedure for the environmental impact assessment of the designed project, related to issuing the decision on environmental conditions of a permit for implementing the investment project, it is required to ensure public participation. Principles of public participation in the procedure concerning the environmental impact assessment of the investment project are determined by the provisions of the Act of 3 October 2008 on the Disclosure of Information on the Environment and Its

Protection, Participation of the Public in Environmental Protection and Environmental Impact Assessments (Journal of Laws No. 199, item 1227, as amended).

11. PROPOSED ENVIRONMENTAL IMPACT MONITORING OF THE DESIGNED PROJECT

The designed "Głuszyńko–Grapice" wind farm, after putting into operation, will require the monitoring in the scope of:

- 1) measurements of noise level in the surroundings,
- 2) control of a possible effect on behaviours and mortality of birds;
- 3) control of a possible effect on bats.

Re. 1)

For evaluation of changes of the acoustic climate in the area of the wind turbines at least two cycles of measurements of noise in the environment should be performed.

The first cycle of measurements should be performed after obtaining a respective building permit, but before beginning of the construction works, or after successful implementation of the project, together with the 2nd cycle, with turbines switched off. These measurements will present the existing condition of the acoustic climate and will constitute a point of reference for evaluation of changes that will take place as a result of construction of other wind turbines. Measurement points should be located near extreme residential or farmstead buildings of the closest towns. The location of points should be selected so that the measured level of noise is not affected by noise coming from buildings.

The second series of measurements should be performed after construction of the designed wind turbines and putting them into operation in the same measurement points. These measurements should be performed in conditions possibly identical (time, land cover, temperature, wind speed) to conditions, in which the first series of measurements was performed.

In the case of exceeding values of acceptable noise levels, one should reduce settings of the wind turbine, located closest to measurement points where exceedances were observed, and perform control measurements.

Subsequent control measurements may prove necessary in the event of building other wind turbines close to the "Głuszyńko–Grapice" wind farm, at distances that may have the cumulative impact on shaping the acoustic climate.

Re. 2)

As stated in "Report on the monitoring of avifauna of the >Grapice< Wind Farm (Potęgowo Commune, Pomeranian Province, Poland). Pre-implementation stage: September 2009 – August 2010" (Antczak 2010 – **Appendix 4**):

Establishment of the planned "GRAPICE" wind farm should imply that the post-implementation monitoring be started. As a result of conducting the monitoring after construction of the wind turbine it will be possible to assess the real impact of the investment on avifauna. The post-implementation monitoring in most locations should last 3 years in subsequent 5 years from the moment of start-up of the wind park . Selection of years (for instance in 1st, 2nd and 3rd, or 1st, 3rd and 5th) may depend

on agreements concluded with the investor and authorities issuing environmental decisions (PSEW 2008).

The purpose of conducting the post-implementation monitoring of fauna will be:

- *formulation of empirical assessment of the wind farm's impact on breeding, visiting, staying and wintering avifauna present within its limits and in the direct neighbourhood,*
- *verification of the potential impact assessment prepared for this project at the pre-investment stage,*
- *analysis of actual effects of operation of this wind turbines on birds in this part of Pomerania.*

Observations and information collected in the course of works should be used to assess the risk for birds and suggest possible emergency or compensatory actions.

The monitoring should be conducted by people professionally prepared for research (research workers), or amateurs who completed the field training (in this case - supervised by the coordinator with qualifications to conduct ornithological tests).

The studies conducted during the post-implementation monitoring should consist of the following basic modules:

- *observations within the investment area, being a repetition of the monitoring conducted at the pre-investment stage;*
- *observations outside the working area of turbines, being a repetition of pre-investment tests;*
- *observations of behaviour of birds and their reaction to working, or motionless turbines;*
- *documentation of all cases of collisions.*

The framework division of works is suggested for the planned investment, keeping, at the same time, minimum number of field controls necessary for relevant assessments.

The scope of works along with a detailed programme of the post-implementation (post-investment) monitoring should be prepared specifically for the "GRAPICE" wind farm after its construction, taking account the final location of turbines and access roads.

In accordance with "Guidelines regarding assessment of the impact of wind turbines on birds" (2008, PSEW Szczecin), the post-implementation ornithological monitoring of wind turbines should include the annual cycle being a repetition of pre-implementation tests and should be repeated three times within 5 years after putting the farm into operation, in years selected by the expert ornithologist (for instance in the 1st, 2nd and 3rd year, or the 1st, 3rd and 5th year), due to the presence of effects delayed in time. It is advised to conduct studies on the impact of the farm on the use of space by birds simultaneously with studies on collision mortality.

Principles of the basic monitoring:

1. Duration: 3 years, including all phenological periods.
2. Object of observation: (1) species composition and (2) number of population, and with regard to birds observed in flight also (3) the height of flight with breakdown

into 3 ranges (up to the height of the lowest reach of the propeller, in the working area of the propeller, above the highest reach of the propeller) and (4) direction of flight, as well as mortality due to collisions.

3. Scope of tests: 1-4 modules as above and additionally the mortality monitoring.

Re. 3)

In accordance with "Temporary guidelines related to the impact of wind turbines on bats (version II, December 2009)" and "Report on the potential impact of the designed location of the "Grapice" Wind Farm on bats" (Kościów 2010 – **Appendix 5**), it is necessary to carry out a minimum three-year post-investment monitoring consisting in the study of mortality of bats and their activity in the vicinity of towers at the height of the rotor's axis, in accordance with guidelines applicable for the period of operation of the farm.

12. SPECIFICATION OF DIFFICULTIES RESULTING FROM TECHNOLOGICAL SHORTAGES OR GAPS IN THE CONTEMPORARY KNOWLEDGE ENCOUNTERED DURING PREPARATION OF THE REPORT

No difficulties resulting from technological shortages or gaps in contemporary knowledge were encountered when preparing "Environmental impact report for the "Głuszynko–Grapice wind farm (the Słupsk District, the Pomeranian Province)", except for the lack of knowledge about avifauna and bats. In order to clarify this gap the following studies were conducted:

- the ornithological monitoring within the area of the "Głuszynko–Grapice" wind farm in the period from March 2008 to February 2009 (Antczak 2010 – **Appendix 4**);
- the chiropterologic monitoring in the period from 15 March 2010 to 12 November 2010 (Kościów 2010 – **Appendix 5**).

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14. SUMMARY OF THE REPORT IN A NON-SPECIALIST LANGUAGE

1. THE SCOPE AND THE LEGAL BASIS OF THE STUDY

The subject of the study is a report on the environmental impact of the project consisting in the construction of the "Głuszynko–Grapice" wind farm consisting of 20 wind turbines with the maximum power of 3 MW, each with access roads, assembly yards and power infrastructure: MV/110 kV power station, MV fibre-optic cable and 110 kV fibre-optic cable line, in Potęgowo and Damnica communes.

The report has been drawn up on the basis of the Act of 3 October 2008 on the Disclosure of Information on the Environment and Its Protection, Participation of the Public in Environmental Protection and Environmental Impact Assessments (Journal of Laws of 2008 no. 199, item 1227, with later amendments) and the Regulation of the Council of Ministers of 9 November 2010 on investment projects that may significantly affect the environment (Journal of Laws No.213, item 1397) as an appendix to the application for issuing the decision on environmental conditions.

2. DESCRIPTION OF THE PLANNED PROJECT

The planned project – basic option

The "Głuszynko–Grapice" wind farm will consist, in the basic option selected for implementation, of the following basic elements:

- 20 wind turbines developed on reinforced concrete foundations and equipped with assembly platforms with hardened pavement;
- access roads connecting them with public roads;
- MV/110 kV end-user power substation (the "Grapice" main power delivery point);
- cable (to earth) MV power grid connecting wind turbines with the substation;
- cable (to earth) HV/110 kV power line connecting the "Grapice" main power take-up point with the "Bięcino" main power take-up point;
- cable (to earth) telecommunication network connecting turbines with the automated control centre.

Particular wind turbines will comply with the following parameters:

- power of the generator - 3 MW;
- the tip height of up to 170 m above ground level (hub height of up to 120 m);
- maximum acoustic power at the level below the limits of acceptable noise level, as specified by the environmental protection law, on the border of areas of residential development or other buildings intended for permanent stay of people and on borders of such areas designated in local spatial development plans;
- marking of air obstacle (tips of blades painted in stripes of the same width, perpendicular to blade's axis, covering 1/3 of its length – 3 red or orange stripes and 2 white);
- the structure of the wind turbine in a colour not contrasting with the environment (standardised colours of the entire wind farm).

- ban on placing advertisements, except for symbols (logo) of the manufacturer or the investor, or the equipment owner.

Total surface of the area intended for location of the "Głuszynko–Grapice" wind farm (wind turbines and their assembly yards, transformer station, internal service and maintenance roads, as well as the route of the 110 kV cable line) will be ca. 12.18 ha (including 10.54 ha in the Potęgowo Commune and 1.64 ha in the Damnica Commune). The investment project will require temporary occupation of parts of land for implementation of the investment project (for the time of construction). It will apply to assembly yards of wind turbines, routes of MV and HV cable power lines, etc. After completion of the construction stage the agricultural function of these areas will be restored.

Options of the project and their assessment

Apart from the basic option of the project (presented above), an option of not beginning the project (zero option) and extended options were considered. In addition, variants were also prepared for the course of the 110 kV cable line, including its implementation as an overhead line.

1. The zero option would be the most environmentally beneficial for the project area and its environment, but, at the same time, unfavourable in the aspect of global emission of engineering pollutants to the atmosphere and counteracting climate changes (instead of the so-called source of clean energy, it will be necessary to establish a conventional source elsewhere).
2. Alternative options envisaged the location of, accordingly, 30 and 22 wind turbines, which would require new land for the investment (including foundation of additional wind turbines, their assembly yards, as well as construction of new sections of access roads), it would also result in higher noise emission, increased impact of the landscape and potentially higher impact on birds and bats.
3. Alternative courses of the 110 kV cable line would require, among others, logging of forest stand on these routes, and, in the case of the option with the overhead line, would substantially affect the landscape.
4. The option selected for implementation was prepared taking account of recommendations contained in the annual ornithological monitoring (Antczak 2010 – **Appendix 3**, including resignation from 2 wind turbines within the area important to birds) and chiropterological monitoring (Kościów 2010 – **Appendix 4**), and, in the case of construction of the line – with a view to not logging trees. This option is characterised by limited effects on vegetation, minimisation of the risk for birds and bats of this area and limitation of acoustic nuisance in the areas of residential buildings. As such, it is the most environmentally beneficial option.

Conditions of land use at the stages of construction and operation of the project

The investment process will require to temporarily set aside areas where structure will be located, assembly yards, temporary storage yards and access roads (including sections of existing roads), as well as routes of cable lines.

After completion of installation works temporary storage yards around the wind turbines and routes of cable lines will be reclaimed and restored to agricultural use. Agricultural use will not be restored only on areas where wind turbines and assembly

yards are founded, along with their access roads. Access roads will be become publicly available.

Location of residential buildings, farming buildings and protected services in the operation phase of the project will be forbidden within the range of over-standard noise emitted by turbines – it complies with "Local spatial development plan Głuszynko and Grapice wind farm in Potęgowo.

Solutions protecting the environment for the option selected for implementation – the option most beneficial for the environment

Wind turbines are the source of so-called green energy. Their use, thanks to replacing conventional sources of energy, contributes to a decrease in the emission of CO₂, SO₂, NO_x and dusts to the atmosphere, which results in beneficial environmental effects in both local (decrease in air pollution, better aerosanitary conditions of people's lives) and global scale (limitation of climatic and derivative effects of the greenhouse effect). Application of renewable energy sources complies with the required principles of sustainable development and complies with international commitments of Poland, especially those resulting from membership in the European Union and accession to the Kyoto Protocol. At the same time, wind turbines are investment projects belonging to the category of projects that may potentially significantly affect the environment, especially with regard to noise emission, impact on birds and the landscape.

The following solutions protecting the environment were adopted for the planned complex at the design stage:

- location of the wind turbines at a distance from residential buildings (limiting the acoustic impact), in the agriculturally utilised areas (with no environmental qualities), except for areas of protected landscape (for the purpose of preserving their protected values) and at a safe distance from Natura 2000 sites (in order to eliminate the risk of significant impact on protected species of plants and animals and their habitats);
- Application of similar types of wind turbines in the planned complex and their uniform colours, non-contrasting with the environment, in order to limit the impact on the landscape;
- equipping the transformer station in oil sumps and a system monitoring and separating oil from stormwater, minimising the risk of transformer oil leakage to the environment;
- underground course of the 110 kV line, determination of its route in a way so as to bypass forests and tree stands (in connection with existing roads) and construction of passages of the line under watercourses and through protected habitats by means of a directional drill – minimising the environmental impact

3. CHARACTERISTICS OF THE NATURAL ENVIRONMENT

The area of the "Głuszynko–Grapice" wind farm is located within the Damnicka Upland mesoregion, belonging to the Koszalin Coast macroregion.

The location of the project is, in most part, located within the top part of the moraine upland with numerous post-glacial depressions and small hills.

The north-western part of the location of the "Głuszynko–Grapice" wind farm (including locations of 5 wind turbines, the main power take-up point and a fragment of

the 110 kV cable line), is located within the range of the Major Groundwater Reservoir no. 115 "Łupawa" and its buffer zone, and the south-eastern edge of the area (including locations of 2 wind turbines), is located within the boundaries of the buffer zone of the Major Groundwater Reservoir no. 107 "Łeba".

Vegetation of the area does not stand out in terms of botany. It is represented, first of all, by agrocenoses of arable lands, meadows and pastures with numerous small patches and strands of trees and bushes. There are forest complexes around the project area.

The atural environment of the location of the "Głuszynko–Grapice" wind farm and its surroundings is antropised, first of all, as a result of the dominance of agricultural land use of soil. The results are, first of all, synanthropisation of vegetation and clear depletion of the ecological structure.

In the areas of the planned location of wind turbines and the transformer station there are only agrocenoses of arable lands with periodic segetal vegetation.

On the route of the 110 kV cable line there are valleys of watercourses, including Łupawa, whose bottoms and slopes are covered with forests. The cable route was determined in a way so as to bypass forest complexes, or along roads existing in their area.

In the period from September 2009 to August 2010 the ornithological monitoring (Antczak 2010) and chiropterological monitoring (Kościów 2010) were conducted in the project area. The results of the above-mentioned studies were used in "Report..." (**Appendix 4 and 5**).

The ornithological monitoring in the area of the planned investment project confirmed the presence of 96 bird species, of which 83 are strictly protected, 7 – partially, and the remaining 7 are protected in certain months (hunting protection). Furthermore, from among the confirmed species there are 11 species from Appendix I to the Birds Directive (Antczak 2010 – **Appendix 4**).

The chiropterological monitoring (Kościów 2010 – **Appendix 5**) confirmed the presence of 3 species of bats. These were: Natterer's bat, common pipistrelle and serotine bat. All the observed bat species are strictly protected (Regulation of the Minister of Environment of 28 September 2004 on protected animals living in the wild – Journal of Laws of 2004, No. 220, item 2237). None of these speces is recorded in the Polish Red Book of Animals, nor in Annex II to Council Directive 92/43/EEC.

4. FORMS OF NATURE AND LANDSCAPE CONSERVATION IN THE PROJECT AREA

The "Głuszynko–Grapice" wind farm is located beyond forms of nature conservation as defined in the Act on Nature conservation of 16 April 2004 (Journal of Laws No.92 of 30 April 2004, item 880 with later amendments), except for **the planned 110 kV HV cable line**, which on the section of ca. 1,070 m will run through, and on two sections (ca. 110 m and ca. 360 m) will run along the border of the Natura 2000 SCI "Dolina Łupawy".

In the vicinity of the project area (at a distance of up to ca. 20 km) there are the following spatial forms of nature and landscape conservation:

- **The Słowiński National Park and its buffer zone** – at the minimum distance of ca. 15.7 km north of the nearest planned location of wind turbines and ca. 14.4 km

from the planned 110 kV cable line and accordingly ca. 12.8 and ca. 8.2 km north – the boundary of the buffer zone of the Park;

- **nature reserves:**

- **"Grodzisko Runowo"** (ca. 7.3 km south-east of the nearest planned location of the wind turbines and ca. 11.8 km from the planned 110 kV cable line);
- **"Czarne Bagno"** (ca. 7.8 km north-east of the nearest planned location of the wind turbines and ca. 10.3 km from the planned 110 kV cable line);
- **"Łebskie Bagno"** (ca. 10.6 km north-east of the nearest planned location of the wind turbines and ca. 12.7 km from the planned 110 kV cable line);
- **"Torfowisko Pobłockie "** (ca. 11 km north of the nearest planned location of wind turbines and ca. 11.1 km from the planned 110 kV cable line);
- **"Bagna Izbickie"** (ca. 13.3 km north of the nearest planned location of wind turbines and ca. 12.3 km from the planned 110 kV cable line);
- **"Jałowce"** (ca. 14.3 km north of the nearest planned location of wind turbines and ca. 10.3 km from the planned 110 kV cable line);
- **"Karwickie Źródłiska"** (ca. 15.5 km south-east of the nearest planned location of the wind turbines and ca. 20.3 km from the planned 110 kV cable line);
- **"Las Górkowski"** (ca. 17.3 km north-east of the nearest planned location of the wind turbines and ca. 17.6 km from the planned 110 kV cable line);
- **"Nowe Wicko"** (ca. 19 km north-east of the nearest planned location of the turbines and ca. 19.6 km from the planned 110 kV cable line);

- **The "Dolina Słupi" Landscape Park and its buffer zone** – at the minimum distance of over 20 km south-west of the nearest planned location of wind turbines and ca. 14.4 km from the planned 110 kV cable line and accordingly ca. 11.7 and 6.4 km to the south – the boundary of the buffer zone of the Park);

- **Protected Landscape Area "Fragment of the Łeba Urstromtal and moraine hills south of Lębork"** (ca. 5 km south-east of the nearest planned location of wind turbines and ca. 9.8 km from the planned 110 kV cable line);

- **Area of Protected Landscape "Coastal strip east of Ustka"** (more than 25 km north-west of the nearest planned location of wind turbines and ca. 14.4 km from the planned 110 kV cable line);

- **Natura 2000 areas :**

– special protection areas for birds:

- **"Ostoja Słowińska" PLB220003** – at the minimum distance of ca. 15.7 km north of the nearest planned location of wind turbines and ca. 14.4 km from the planned 110 kV cable line (non-governmental organizations proposed to extend the area to the buffer zone of the Słowiński National Park);
- **"Dolina Słupi" PLB220002** – at the minimum distance of over 20 km south of the nearest planned location of the wind turbines and ca. 14.4 km from the planned 110 kV cable line;
- **"Baltic Coastal Waters" PLB990002** – at the minimum distance of more than 25 km north-west of the nearest planned location of wind turbines and ca. 19 km from the planned 110 kV cable line;

– sites of Community importance:

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- **"Dolina Łupawy" PLH220036** – at the minimum distance of ca. 3,5 km south and west of the nearest planned location of wind turbines;
 - **"Łebskie Bagna" PLH220040** – at the minimum distance of ca. 7.8 km north-east of the nearest planned location of wind turbines and ca. 10.3 km from the planned 110 kV cable line;
 - **"Torfowiska Pobłockie" PLH220042** – at the minimum distance of ca. 11 km north of the nearest planned location of wind turbines and ca. 11.1 km from the planned 110 kV cable line;
 - **"Bagna Izbickie" PLH220001** – at the minimum distance of ca. 13.8 km north-east of the nearest planned location of wind turbines and ca. 12.5 km from the planned 110 kV cable line;
 - **"Karwickie Źródlika" PLH220071** – at the minimum distance of ca. 14.6 km south-east of the nearest planned location of wind turbines and ca. 19.4 km from the planned 110 kV cable line.
 - **"Ostoja Słowińska" PLH220023** – at the minimum distance of ca. 15.7 km north of the nearest planned location of wind turbines and ca. 12.8 km from the planned 110 kV cable line;
 - **"Las Górkowski" PLH220045** – at the minimum distance of ca. 17.3 km south-east of the nearest planned location of wind turbines and ca. 17.6 km from the planned 110 kV cable line;
 - **"Klify Poddębskie" PLH220100** – at the minimum distance of over 29 km north-west of the nearest planned location of wind turbines and ca. 18.1 km from the planned 110 kV cable line;
- "Shadow List 2010" sites:
- **"Dolina Słupi"** – at the minimum distance of ca. 14.1 km south of the nearest planned location of the wind turbines and ca. 10 km from the planned 110 kV cable line;
 - **nature monuments** – closest to the planned wind turbines in forest complexes within the Protected Landscape Area "Fragment of the Łeba Urstromtal and moraine hills south of Lębork" and in the area of Poganice – more than 5 km from the nearest planned location of the wind turbines; closest to the planned 110 kV cable line – in Karżniczka, at the minimum distance of ca. 2.6 km to the south;
 - **ecological lands** – closest, at the minimum distance of ca. 1.8 km north of the nearest planned location of wind turbines and the 110 kV cable line, within a forest complex;
 - **documentation site of inanimate nature "Oz Grapice"** – at the minimum distance of ca. 1.3 km south-west of the nearest planned location of wind turbines and ca. 2.3 km from the planned 110 kV cable line;

5. DESCRIPTION OF MONUMENTS PROTECTED ON THE BASIS OF REGULATIONS ON PROTECTION OF MONUMENTS AND CARE OVER MONUMENTS AND OTHER OBJECTS OF CULTURAL HERITAGE IN THE PROJECT AREA

In the area of the "Głuszyńko–Grapice" wind farm there are no objects entered in the register of monuments on the basis of regulations on conservation of monuments and care over monuments and objects of significant cultural value.

The closest objects entered in the register of monuments of the Provincial Conservator of Monuments in Gdańsk are located in Głuszyno, at the distance of more than 2.2 km from the area of the wind turbines. These are palace-park and manor-park complexes. Monuments are also found in Damnica, Bobrowniki, Damno and Bięcino located near the route of the 110 kV HV cable. The nearest of these objects is The Juda Tadeusz Parish Church in Damno, located ca. 300 m west from the route of the cable.

None of the planned wind turbines, nor their access roads, create a risk for such objects.

In the vicinity of the area of the complex there are numerous archaeological sites. None of the planned wind turbines and their access roads, nor the main power delivery point and the 110 kV cable line, are located within the buffer zones of archeological sites. The minimum distance between the planned location of the wind turbines with related technical infrastructure and buffer zones of archeological sites exceeds 160 m.

6. ENVIRONMENTAL IMPACT ASSESSMENT OF THE OPTION SELECTED FOR IMPLEMENTATION

Construction stage

The impact of the designed wind farm and its accompanying infrastructure on the abiotic environment will occur mainly at the investment stage, usually lasting a few months. It will involve significant transformations of the soil surface (levelling of the land for new roads and turbines), elimination of the plant cover (mainly agrocenoses and fallow vegetation), and generation of considerable amounts of waste (soil from excavations).

Liquidation of vegetation will also take place in connection with construction of MV cable connections and the 110 kV HV cable line. It will affect mainly to agrocenoses, fallow vegetation and ruderal vegetation along roads. Only on a part of the section running through the Łupawa valley the route of the designed 110 kV HV cable line (within the Natura 2000 site) will pass through meadows, where temporary elimination of vegetation will be required (herbaceous vegetation with the dominance of grasses). On a predominant section, within the "Dolina Łupawy" Natura 2000 site, where there are protected habitats, as well as under the riverbed, the cable line will be built by a directional drill (of ca. 500 m), preserving local vegetation. Tree protection is planned along the entire course of the 110 kV HV cable line. Tree protection is planned along the entire course of the 110 kV HV cable line.

Implementation of the planned investment project will not adversely affect surface and underground waters. In particular, it will not result in creation of risks for water resources of the Major Groundwater Reservoirs no. 115 "Łupawa" and no. 107 "Łeba". Passages of the planned 110 kV cable line under the watercourses will be made by a directional drill, which will eliminate risks for these courses, including for the Łupawa river within the area of the "Dolina Łupawy" Natura 2000 site PLH220036.

Potential environmental inconveniences will also be associated with vehicle traffic related to performance of earthworks, transport of excavated material and construction elements of the wind turbines. As demonstrated in the analysis, concentration of all

transport pollutants produced in the construction phase of the designed wind farm will be negligible.

Operation stage

Operation of the area of the "Głuszynko–Grapice" wind farm will have a minute effect on water conditions and local climatic conditions.

According to the ornithological monitoring (Antczak 2010 – **Appendix 4**) *the planned investment project, assuming that the specified recommendations to minimize the risk of adverse impacts, especially relocation of turbines further from Karwieńskie Marshes and a water reservoir adjacent to them, and leaving feeding grounds of cranes and European golden plovers in the sector 2 undeveloped [which was fulfilled in the final project option selected for implementation], will not constitute an above-average threat for breeding, migrating, or winter birds.*

According to the conclusions of the chiropterological monitoring (Kościów 2010):

- *(...) in the neighbourhood of the designed location of the wind farm the distances ensuring effective buffering of a potential impact of the wind turbines on bats are preserved. (...)*
- *(...) the designed location of the wind farm does not constitute an ecological barrier for bats as well (...)*
- *(...) the designed location of the concerned wind farm does not expose bat to the risk of losing habitats (...)*
- *(...) the designed location of the wind farm also does not constitute an ecological barrier for bats to fly to their feeding grounds and watering places (...)*
- *(...) it is assessed that the location of the project also will not contribute to a substantial increase in the mortality of bats, as local bat species are living mostly in developed areas.*

The acoustic analysis of operation of the wind farm was conducted for the "Głuszynko–Grapice" wind farm (for turbines with the sound power $L_{AW} = 107$ dB). The conducted calculations indicate that the analysed investment project may be implemented in its planned form. The designed wind farm may operate without limitation, in the daytime and nighttime, at full acoustic power of each turbine.

The planned project, including operation of turbines, will not create a risk for people insofar as emission of infrasounds is concerned.

The project will not be a source of emission of over-standard electromagnetic radiation.

It seems from the landscape analysis that the planned complex of 20 wind turbines will be a new, one-of-the-kind element of anthropisation of the landscape in the Potęgowo Commune. It will be visible in the landscape from villages surrounding the location of the project, mainly from those located the closest, i.e.: Głuszynko, Grapice, Jezioraki, Rzechcino and Potęgowo (from a distance ranging between a few hundred meters to ca. 5 kilometers) and villages located in at the further distance. From transport routes in the project area, including Pobłocie-Potęgowo, Wiszno-Grapice-dr.39309 and Nieckowo-Potęgowo district roads (from the minimum distance of a few hundred meters), from the national road no. 6 (visibility from the distance of more than 2.6 km (to a significant extent limited by village buildings, trees and hills), from the Gdynia – Słupsk railway line running at the minimum distance of ca. 1.1 km to the

south and from local roads with hardened and pavement and dirt roads, running through the project area and its surroundings.

As for forms of nature conservation in the surroundings, the turbines will be visible only (to a small extent) from SCI "Dolina Łupawy" PLH220036 – the landscape does not constitute the object of conservation in Natura 2000 sites. Due to the distance and the presence of forest areas the turbines will be visible to a very limited extent or will not be visible at all from the remaining forms of nature conservation (including of the protected landscape area and ecological sites, as well as the national park, and the landscape park) located at the further distance.

In the cases above presented the visibility of wind turbines will be limited or even eliminated due to the presence of roadside trees, minor forest patches, trees and shrubs, and structures.

The location of the wind turbines intended to operate for 25-30 years (temporary impact on the landscape) within the areas left in agricultural use will contribute to landscape conservation before introducing permanent, devaluating development of settlements.

Elimination of the wind farm will result in restoring the landscape back to the original condition (provided that the area will continue to be used agriculturally).

Material goods are represented in the location of the project by the network of district, communal and private roads (mostly dirt roads), and in the surroundings by village buildings, diversified in terms of architecture and technical condition. During construction of the "Głuszynko–Grapice" wind farm it will be necessary to reconstruct and modernise a part of communal roads and other local dirt roads, as well as to construct new service roads. It will improve the condition of the road network in the location of the wind farm and in its surroundings and will contribute to the improvement of the living conditions of the local community.

Apart from the road network, construction of the wind farm will not affect other material assets. In particular, construction of the "Głuszynko–Grapice" wind farm will not exert adverse impact on management of villages.

The impact of the wind farm at the stage of operation on material goods will affect the scope of disposal of lands within the range of over-standard impact of wind turbines on acoustic conditions. The location of the wind farm and the area of its over-standard noise impact is and will remain in agricultural use. Owners of the lands will not be allowed to apply for changing the land use to construction purposes associated with permanent stay of people (homesteads, single-family buildings, etc.). Operation of the wind turbines will not affect agricultural activity, and consequently arable lands will not lose their value. The value of plots on which the wind turbines will be located will increase due to income from lease of the lands (direct economic benefits). The local government of the Potęgowo Commune will obtain indirect economic benefits after raising the property tax.

Elimination stage

At the liquidation stage of the planned project, the following environmental impact is planned:

- temporary emission of pollutions to the atmosphere and noise emission (cars and demolition equipment).
- generation of waste of building materials (debris, scrap, etc.);
- generation of other waste, including hazardous waste (e.g. used oils and lubricants);

- bringing the landscape back to the original condition.

7. ASSESSMENT OF THE IMPACT OF THE PROJECT ON LEGAL FORMS OF NATURE AND LANDSCAPE CONSERVATION

Construction and operation of the "Głuszynko–Grapice" wind farm will not create a risk for protected species of plants (location in the agriculturally utilised area) and animals, except for potential risk for flying animals. As reported in the environmental monitorings the risk for bats and birds is low. One cannot, however, exclude the impact on protected species, but of rather individual nature, not threatening the entire population.

Due to the distance, implementation of the project does not create a risk for protected features of the Słowiński National Park (located ca. 15.7 km to the north) and nature reserves (of which the closest ones – "Grodzisko Runowo" and "Czarne Bagno" - are located at the minimum distance of more than 7 km) and will not violate the regulations of the Act on Environmental Protection (Journal of Laws of 2004, No. 92, item 880 with later amendments) binding in the Słowiński National Park and nature reserves.

Implementation of the project does not create a risk of devaluation of protected features of the "Dolina Słupi" Landscape Park. Due to the distance (over 20 km) and due to the presence of field obstructions (trees, village buildings and hills), the wind turbines will not be visible from the area of the Park.

The location of the "Głuszynko–Grapice" wind farm will not create a risk for protected features of areas of protected landscape and their functions as ecological corridors. The planned complex will be located at the minimum distance of ca. 5 km from the boundaries of the nearest Protected Landscape Area "Fragment of the Leba Urstromtal and moraine hills south of Lębork" and will be visible in from its borders to a small extent.

Implementation of the designed project will not result in deterioration of the condition of natural habitats and habitats of plant and animal species, it would also not adversely affect species for which Nature 2000 sites were designated in the surroundings. In particular, species of birds qualifying for establishment these areas will not be exposed to risk in connection with construction of the wind wind turbines, as demonstrated by the ornithological monitoring (Antczak 2010). According to the recommendations of the annual ornithological monitoring (Antczak 2010), a fragment of the area, for which one reported *visiting flocks of cranes with sleeping places in Krakulice* (located in the area of "Ostoja Słowińska" PLB220003) will not be a part of the project area, , *among others, in order to provide feeding grounds for cranes. For other species related to this refuge no threats were found.*

In SCI "Dolina Łupawy" PLH220036 one plans construction of the 110 kV HV cable line. Effect of the planned investment will be limited only to the investment stage and will consist in short-term elimination of vegetation on a part of the route of the cable. Passage of the cable under the bed of Łupawa, as well as meadows and forests in habitats protected under the Natura 2000 network will be made by means of a directional drill in order to avoid transformations of the river ecosystem.

Construction and operation of the "Głuszynko–Grapice" wind farm will not result in disintegration of any Natura 2000 site and will not affect the consistency of the Natura 2000 network (the turbines will be located beyond Natura 2000 sites, and no

important migration routes of birds between Natura 2000 sites were observed over the surface).

To sum up, the planned wind farm will not result in significant impact on the Natura 2000 sites.

Implementation of the planned investment project will not have any impact on nature monuments, ecological sites and documentation sites of inanimate nature existing in the surroundings.

8. DIAGNOSIS OF POTENTIALLY SIGNIFICANT IMPACTS OF THE PLANNED PROJECT, INCLUDING CROSS-BORDER IMPACTS, AND THE DESCRIPTION OF APPLIED FORECASTING METHODS

At the stage of construction of the planned project the following environmental impacts will occur: transformation of the upper layer of lithosphere (excavations) Elimination of the soil cover, elimination of vegetation, the impact on fauna, emission of pollutions to the atmosphere (cars and construction equipment) noise emission (cars and construction equipment) generation of waste (mainly soil from excavations). However, these will be insignificant impacts, limited in time.

At the stage of operation of the planned project potentially significant environmental impacts will include: limitation of emission of pollutants to the atmosphere from conventional sources of energy, noise emission from turbines and anthropisation of the landscape (mainly direct and long-term impacts). Other impacts are: very low emission of infrasounds from turbines, insignificant emission of electromagnetic radiation at the level not exceeding approved standards in places accessible for people, weak optical effects (minute stroboscopic effect and weak shadow flicker effect) and potential impact on subjectively assessed environmental conditions of human well-being (the effect of cumulative impact). There will be no adverse impact on people's health.

At the stage of elimination of the planned project potentially significant environmental impacts will include generation of waste of building materials (direct, short-term and temporary impacts). Other environmental impacts are: emission of pollutions to the atmosphere and noise emission (cars and demolition equipment). The landscape will be restored to the original condition.

The designed "Głuszynko–Grapice" wind farm along with its technical infrastructure will not require establishment of a limited use area, moreover, it is not classified as lower or upper tier establishments.

The wind farm, owing to the scale of the project and its location at the distance of ca. 25 km from the seashore (+ 12 nautical miles to the maritime borders of Poland), will not result in cross-border effect on the environment.

In the surroundings of the "Głuszynko–Grapice" wind farm there already are wind farms (the closest at the distance of ca. 3.1 km to the south-east – the "Darżyno" complex) and investment and planning works aimed at location of other wind farms there are underway. The most important cumulative environmental impact of the planned complexes of wind turbines will be their impact on the landscape - they will change the landscape of the region. The cultural-agricultural landscape (cultivations and settlements) dominant in terms of surface will be replaced the agriculturally-infrastructural (industrial) landscape.

Impact on fauna, especially avifauna may consist in reduction in the attractiveness of areas of wind turbines as feeding grounds, and creation of barriers

for movement of birds on a local scale. As demonstrated by the ornithological monitoring (Antczak 2010), due to the size of areas occupied by the designed wind farms and distances between the complexes, reduction in the attractiveness of areas of wind turbines as feeding grounds, at the present stage of development of wind power engineering in Pomerania, is minor. Multiplication of the barrier effect will not be present either.

Due to the distance from the other wind farms and their complexes, accumulation of acoustic impact of the "Głuszynko–Grapice" wind farm can be excluded.

9. PROPOSED ACTIONS TO PREVENT OR REDUCE HARMFUL ENVIRONMENTAL IMPACTS AND COMPENSATE FOR ENVIRONMENTAL DAMAGES

Limitation of the environmental impact of the designed "Głuszynko–Grapice" wind farm can be achieved by application of an eco-minded technology of construction works, selection of technical parameters of the designed wind farm so as to limit its environmental impact and shape of the natural environment of the location and its surroundings. To prevent the risk of destruction of habitats and localities of plants protected under the Natura 2000 network, it is recommended to conduct works related with laying of the 110kV HV cable line under supervision of a qualified botanist.

Detailed solutions are presented in chapter 9.

10. ANALYSIS OF POSSIBLE SOCIAL CONFLICTS RELATED TO THE PLANNED INVESTMENT PROJECT AND SOCIAL CONSULTATIONS OF THE PROJECT

The designed construction of the "Głuszynko–Grapice" wind farm may give rise to social conflicts in the form of:

- a protest of environmentalists and so-called "environmentalists" against the laying of the 110 kV HV cable line in the area of "Dolina Łupawy" PLH220036;
- protests of inhabitants of the nearby villages, some of whom can protest in fear of noise, deterioration of landscape qualities and limitation of the rights to dispose of their land properties.

The above social conflicts would either be disputable or subjective (impact on the landscape), or even deprived of substantive, formal and legal grounds (effect on noise, forms of nature conservation and land properties). Any possible protests will be strongly emotional, sometimes based on economic elements.

Under the procedure concerning the environmental impact assessment of the designed project related to issuing the decision on environmental conditions of a permit for implementing the investment project, it is required to ensure public participation in accordance with valid regulations.

11. PROPOSED ENVIRONMENTAL IMPACT MONITORING OF THE DESIGNED PROJECT

The designed "Głuszynko–Grapice" wind farm, after being put into operation, will require the monitoring in the scope of measurement of noise level in the environment and control of potential effect on the behaviour and the mortality of birds and bats.

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