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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

500 MW FULLY PERMITTED WIND FARM IN MELITOPOL AND PRIAZOVSK DISTRICTS OF ZAPORIZHIA REGION, UKRAINE, IN THE VILLAGE SETTLEMENTS OF DEVNINSKOE, DOBRIVKA, DUNAEVKA, GIRSIVKA, MORDVINIVKA AND NADESHINE VILLAGE COUNCILS, OUTSIDE THE BOUNDARIES OF THE VILLAGES

RAMBØLL ENVIRON

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1. INTRODUCTION

1.1 The Purpose of the Study

The Eurocape Ukraine I company (the Investor, the Developer, the Company) is developing a wind farm which will consist of:

- Wind turbine generators (WTGs) along with the technical infrastructure of service/manoeuvring yards, access roads and underground power transmission and steering cables;
- A main transformer station (MTS);
- An overhead power transmission line (PTL),

altogether referred further in this report as "the Project".

The Project is being developed in Zaporizhia Region, Priazovsk and Melitopol Districts, in the village councils of Devninskoe, Dobrivka, Dunaevka, Girsivka, Mordvinivka and Nadeshdine, south-eastern Ukraine, outside the boundaries of the village settlements. Moreover, the Nove village council will be crossed by the PTL, however, no other wind farm infrastructure will be situated there. The wind farm may comprise up to 167 WTGs for which the developer has the land secured. The rated output of each of the WTGs is up to 3.63 MW. The total capacity of the wind farm may therefore be 606.21 MW, however, due to limitations imposed by the technical conditions for connection to the national power grid the total capacity of the wind farm will be limited to 500 MW only. At the current stage of development it has not been decided yet which of the planned WTGs will not be constructed to maintain the maximum allowed capacity of the development.

The wind farm will be connected to the MTS which will transform the medium voltage energy generated by the WTGs to high voltage and then transfer the energy via a high voltage (330 kV) power line to the national power grid.

The Project has passed all required by Ukrainian law preparatory steps, inclusive of the environmental impact assessment and was granted building permit.

The purpose of this study is to assess environmental and social impacts generated by the project in line with the good international practice, as per International Finance Corporation (IFC) standards. The scope and methodology of the environmental and social impact assessment (ESIA) bases on the EU requirements but the report includes also assessment of the Company ability to meet the Performance Standards of IFC.

This report is accompanied with three stand-alone documents: a stakeholder engagement plan (SEP), a Environmental and Social Management Program (ESMP) and a non-technical summary (NTS), which altogether, in Ramboll Environ's opinion, constititute a full set of documents necessary for meaningful public consultations required by the international lenders to take a decision on Project financing.

1.2 The Assessment of the Necessity to Conduct the EIA

Ukrainian legislation requies execution of an environmental impact assessment as an element of the administrative procedure related to granting building permits. Such procedures were completed for certain elements of the planned wind farm, inclusive of the core part of the wind farm (WTGs and auxililary technical infrastructure of the access roads and assembly/service yards and cabling), Main Transformer Substation (MTS) and overhead power transmission line (PTL) which will connect the MTS with the national power grid.

In Ukraine the planned wind farm is not classified as a potentially hazardous project in accordance with the Methodology for Determination of Hazards and Their Design Levels (DNAOP - State Labour Protection Regulations) 0.00-8.21-02 and DNAOP 0.00-8.22-02)[1].

[1] Ministry of Industrial Policy of Ukraine STATE ENTERPRISE "STATE INSTITUTE FOR INDUSTRIAL DESIGNS" DIPROPROM SE 2010

In accordance with the requirements of DBN A. 2.2-1-2003 "Environmental Impact Assessment during Design and Construction", par. 2.17 and 2.18 of the preliminary information on the design characteristics of the planned structures and the geological conditions of soil environment around the foundations demonstrate the following:

- no negative impact on the sustainability of geological environment is expected from construction of the facilities;
- no negative impact on the facilities is expected from the geological environment[2].

Despite the fact that the national EIA procedures for the development were completed, the actual Ukrainian EIA standard is considered to be not compliant with the good international practice as e.g. per EU standards, namely:

- Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of certain public and private projects on the environment;
- Directive 2014/52/EU of 16 April 2014 amending Directive 2011/92/EU on the assessment of certain public and private projects on the environment (the amending directive became effective on 15 May 2014 and the member states shall transpose its resolution until 16 May 2017,

altogether referred further to "the EIA Directive".

The Project belongs to a group of investments described:

- in Appendix I (EIA is obligatory) of the EIA Directive, point 20 - Construction of overhead electrical power lines with a voltage of 220 kV or more and a length of more than 15 km;
- in Appendix II (EIA is subject to decision of competent authorities) of the EIA Directive, point 3i - Installations for the harnessing of wind power for energy production (wind farms).

This ESIA is being prepared by a team of international and Ukrainian experts to meet international standards as per EIA Directive as well as the standards and the policies of the international lenders as per IFC Performance Standards. Conclusions of this ESIA will be also used in the development of the detailed working documentation. NPC Ukrenergo has prepared the Statement on the Environmental Consequences of Project Activities according to the OVNS Standard DBN A.2.2-1-2003 and it will be the investor's commitment, binding for all its contractors, within the whole period of the Project.

Standards and Rules used in the Ukrainian EIA and considered also in this report are:

- DBN A. 2.2-1-2003 "Environmental Impact Assessment during Design and Construction"
- State Sanitary Regulations and Norms for Protection of Population against EMR, Order of Ministry of Health of Ukraine, No. 239, August 1, 1996;
- Sanitary Norms and Regulations (DSTU) approved by the Ministry of Health Protection of Ukraine (Order No. 476 of 18.12.2002);
- Rules for Guarding of Electricity Transmission Lines (1997) [Resolution of the Cabinet of Ministers of Ukraine of 04.03.97];
- GOST 12.1.007-76 "SSBT (System of Occupational Safety Standards). Harmful Substances. Classification and General Safety Requirements"
- DNAOP 0.00-8.21-02
- DNAOP 0.00-8.22-02
- SNiP 3.05.06-85 "Electric Devices"
- DSP-173 "State Sanitary Regulations for Planning and Development of Settlements"
- SNiP II – 12-77 "Protection from Noise",
- GOST 12.1.003-83 "Noise. General Safety Requirements"
- DSP 3.3.6.037-99 "Sanitary Regulations of Industrial Noise, Ultra- and Infrasound"

[2] Departament for urban planning, development and architecture of Zaporizha regional state administration, 15 October 2003, ref. No. 133/03-09

- "Sanitary Norms of Permissible Noise in Residential and Public Buildings and on the Territory of Residential Development. The Sanitary Norms SN # 3077-84"
- Sanitary Norms SN 2.2.4/2.1.8.583-96 "Infrasound at Workplaces, at Residential Public Premises and on the Territory of residential Development".
- Regulation No. 935 of the Cabinet of Ministers of Ukraine "On the Measures for Protection of Wetlands of International Importance" dated 23.11.1995
- Regulation No. 1287 of the Cabinet of Ministers of Ukraine "On the Procedure for Assignment of the Wetlands of International Importance Status to Wetlands" dated 29.08.2002
- Decree No. 154/2010 of the President of Ukraine dated 10.02.2010
- Ukrainian Building Code (DBN);
- CMU Resolution # 465 dated 25 March 1999, Kyiv On Approval of the Rules for Protection of Surface Waters against Pollution with Wastewater (as amended by CMU Resolution # 748 (748-2013-п) dated 07.08.2013)

1.3 Methodology and Scope of the Study

1.3.1 Methodology

This report has been prepared on the basis of data acquired from the Investor, nature data, results of the birds and bats monitoring, results of the acoustic analysis, results of the shadow flicker, and also from publicaly available literature data. Methodology stems from the authors earlier experience in preparing such studies. Methodological aspects of the description of birds and bats situation in the region are based on monitoring as presented in Appendix 3, Appendix 4, Appendix 5 and Appendix 6.

The authors have also used studies available on the web sites of the IBA areas[3]. The detailed methodology of preparing particular parts of this report has been included directly into the respective subchapters.

1.3.2 Scope of the Study

For the purpose of this ESIA the EIA directive scope is adopted which includes:

1. A description of the project, including in particular:
   a) a description of the physical characteristics of the whole project and the land-use requirements during the construction and operational phases;
   b) a description of the main characteristics of the production processes, for instance, the nature and quantity of the materials used;
   c) an estimate, by type and quantity, of expected residues and emissions (water, air and soil pollution, noise, vibration, light, heat, radiation, etc.) resulting from the operation of the proposed project.
2. An outline of the main alternatives studied by the developer and an indication of the main reasons for this choice, taking into account the environmental effects.
3. A description of the aspects of the environment likely to be significantly affected by the proposed project, including, in particular, population, fauna, flora, soil, water, air, climatic factors, material assets, including the architectural and archaeological heritage, landscape and the interrelationship between the above factors.
4. A description of the likely significant effects of the proposed project on the environment resulting from:
   a) the existence of the project;
   b) the use of natural resources;
   c) the emission of pollutants, the creation of nuisances and the elimination of waste.
5. The description by the developer of the forecasting methods used to assess the effects on the environment referred to in point 4.

[3] http://datazone.birdlife.org/home

6. A description of the measures envisaged to prevent, reduce and where possible offset any significant adverse effects on the environment.
7. A non-technical summary of the information provided under headings 1 to 6 (presented in a standalone document)
8. An indication of any difficulties (technical deficiencies or lack of know-how) encountered by the developer in compiling the required information.

1.4 Investor

The Investor of the Project is EuroCape Ukraine I, 50 Tsentralna Street, Girsivka Village Council, Priazovsk District, Zaporizhia Region, Ukraine, 72440.

1.5 Authors

The materials and information necessary for preparation of this ESIA report were collected and processed by:

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Birds and bats monitoring (Appendix 3, Appendix 4, Appendix 5 and Appendix 6) was made by Bogdan Khmelnitsky Melitopol State Teachers' Training University, Biodiversity Research and Training Centre, the Research Institute for Biodiversity of Ukraine's Terrestrial and Water Ecosystems, the Azov and Black Sea Interdepartmental Ornithological Station at I.I. Shmalgauzen Zoology Institute of the National Academy of Sciences of Ukraine and Bogdan Khmelnitsky MSTTU, Laguna Ecological Non-Government Organization

The shadow flicker and noise dispersion (Appendix 7 and Appendix 8 respectively) analysis were made by Andrzej Łuczak who also compiled the entire report. The works were conducted under supervision and management of Mr. Maciej Rozkrut.

The authors wish to thank the EuroCape Ukraine I employees, in particular Mr. Peter Jusin O'Brien and Mikhail Chulkov for their support and cooperation within the framework of this ESIA preparation.

2. THE DESCRIPTION OF THE PLANNED DEVELOPMENT

2.1 The Characteristics of the Entire Development and Land Use Conditions During Operational and Exploitation Phase

2.1.1 The Purpose of the Development

The planned development is aimed at utilization of wind energy for production of electrical energy. Following the Ministry of Industrial Policy of Ukraine, the goals and objectives of the wind farm development are:

- to promote electric power engineering efficiency by using renewable energy sources pursuant to the Law of Ukraine on Alternative Energy Sources;
- to reduce harmful emissions into the atmosphere by decommissioning the corresponding capacities of thermal power plants;
- to supply electric power to the south of Ukraine for the needs of national economy and reduce dependence of Zaporizhia Region on imported fuel; and
- to create a modern wind farm to train specialists in the use of renewable energy sources on the basis of Zaporizhia National Technical University[4]
- To support the deepening of Ukraine’s energy independence
- To support the economic and social development of the local communities in which our Wind Park is based

2.1.2 The Description of the Developoment

The considered development consists of construction of the wind farm along with the auxiliary technical infrastructure in the vicinity of Melitopol, south-eastern Ukraine. The wind farm will comprise up to 167 wind turbine generators (WTGs) of a rated output of 3.45 MW or 3.6 MW. For the time being the Investor holds a technical conditions for connection to the national power grid limited to 500 MW and rights to the land allocated for the wind farm configuration for 167 WTGs. Hence, the intention of the developer is construction of the wind farm of a total capacity of 500 MW, and completion of the entire project later, when technical conditions for acceptance of all possibly generated power (up to 601.2 MW) will exist.

The entire investment will include the following components:

- Up to 167 WTGs with integrated transformers,
- Underground cable networks (electric and fiber-optic control and communication cables),
- Internal access roads,
- Assembly yards,
- Main Transformer Station (MTS) with auxiliary equipment and repair and maintenance facilities with the administration and on-site facilities,
- Overhead high voltage power transmission line (PTL), to transfer the generated energy from the MTS to the receiving point of the national power grid operated by the public operator.

The WTGs will be installed within agricultural hedgerows (14-22 m wide), at a distance not less than 600 m between each other. The 35 kV underground power cables and fiber-optic control and communication cables will run from all WTGs to the 35/330 kV MTS along the dirt roads by the hedgerows.

For the purpose of the wind farm maintenance it is planned to reconstruct access roads with the total length of approximately 147.4 km in place of the existing public dirt roads, with junctions to asphalt concrete inter-settlement roads. Reconstruction will be done with sand, gravel, geo-textile and then a covering layer to keep the road in-place.

[4] Ministry of Industrial Policy of Ukraine STATE ENTERPRISE “STATE INSTITUTE FOR INDUSTRIAL DESIGNS” DIPROPROM SE 2010

The public roads are intended for temporary use during the wind farm construction and operation: for passage of construction machinery and for delivery of equipment and building materials. Further on, the roads are going to be used as part of the local road infrastructure and for the needs of the wind farm in order to carry personnel or repair units.

The project area of construction for the 330kV overhead PTL from the MTS to the Melitopol Substation is located within the lands of Nadezhdyne Village Council (Pryazovske District), Mordvynivka and Nove Village Councils (Melitopol District) in Zaporizhia Region.

The expected annual electric power generation at P50 probability is approximately 1.83 GWh.

2.1.3 The Development Location

The planned wind farm site is located in Zaporizhia Region, Priazovsk and Melitopol Districts, in the village councils of Devninskoe, Dobrivka, Dunaevka, Girsivka, Mordvinivka and Nadeshdine, outside the boundaries of the settlement area, south-eastern Ukraine.

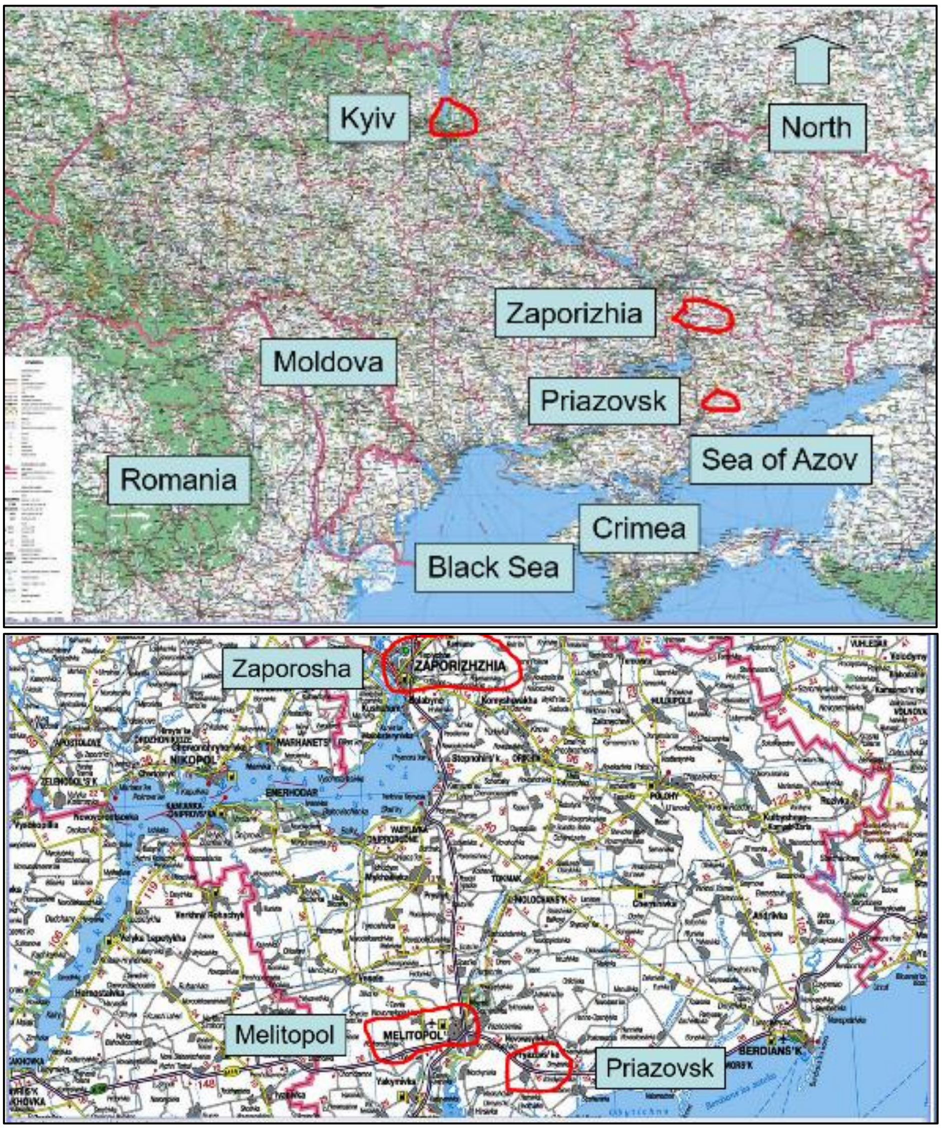

Figure 1. Geographical location of the Project

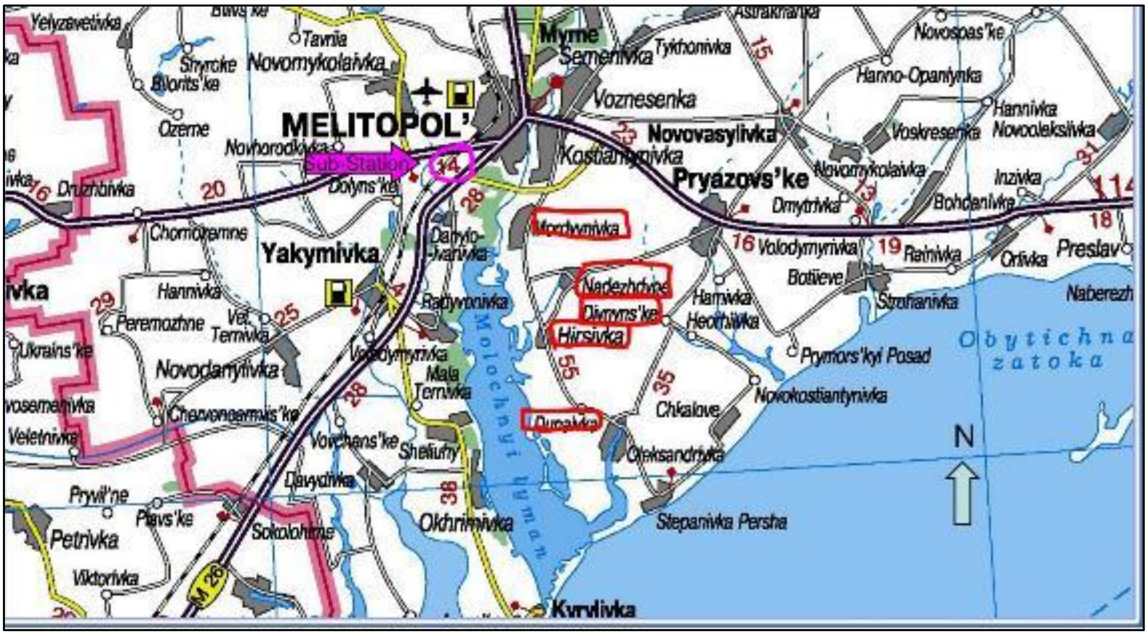

Figure 2. Location of villages which will host the wind turbine generators.

The total area of the land plots allocated for the construction of the WTGs currently equals 318 hectares, among which 260 hectares are the lands of Pryazovske District and 58 hectrares - on the lands of Melitopol District.

The wind farm construction site is surrounded as following:

- on the West side, by Molochna River with its estuary, which according to the State Sanitary Rules DSP-173 "The State Sanitary Rules for the Design and Development of Populated Settlements" has a 1-kilometer-wide protective strip from the water edge of the Molochnyi Estuary;
- on the South side, by the coastline of the Sea of Azov and Cape Kubek, which is an important place of intersection of large migration paths, as well as an area, which due to the nature of its environment attracts great number of birds;
- on the East side, the River Mius, which according to the State Sanitary Rules DSP-173 "The State Sanitary Rules for the Design and Development of Populated Settlements" has a 50-meter-wide protective strip;
- on the North side, the River Saiga, which according to the State Sanitary Rules DSP-173 "The State Sanitary Rules for the Design and Development of Populated Settlements" has a 50-meter-wide protective strip[5].

The residential developments closest to the outermost WTGs are located at the distance of 1626 m (Oleksandrivka Village), 1244 m (Dunaivka Village), 1411 m (Girsivka Village), 1285 m (Nadezhdyne Village), 1720 m (Divnynske Village), 1691 m (Dobrivka Village), 807 m (Volna Village), 2314 m (Novopokrovka Village), 1911 m (Mordvynivka Village), 2724 m (Nechkyne Village), 2857 m (Viktorivka Village).

The wind turbines are planned to be installed within agricultural hedgerows taking into account 600 m as a minimum distance between the neighbouring installations. The 35/330 kV MTS and the repair and maintenance facilities (RMF) with the administration and on-site facilities (AOSF), workshops and storage facilities, water treatment works and other auxiliary facilities are intended to be placed in the lands leased by EuroCape Ukraine I.

[5] According to MINISTRY OF HEALTHCARE OF UKRAINE STATE SANITARY EPIDEMIOLOGICAL SERVICE OF UKRAINE, April 29, 2016, Ref. # 03.02-07/15702

All the hedgerows in which the wind turbines are to be installed are allocated. The exclusion zones are planned directly in the places of wind turbine installation.

Detailed location of the WTGs, MTS and PTL is presented in Appendix 1. Appendix 2 shows coordinates of WTGs center points.

2.1.4 Land Ownership Background Information

In Soviet times (until 1991 and then for several years following Ukrainian independence), all of the agricultural land in Melitopol and Priazovsk districts was comprised of collective farms. When the collective farms were broken up, each former participant in the collective farm was given an equal portion of land from the former collective farm (the equation for division of the collective farm land was roughly total number of members in the former collective farm divided by total land in the former collective farm). These individual land plots (called 'PAI' in Ukrainian) averaged from 6-12 hectares in size. Once the collective farms were divided, not all of the new landowners wanted to farm their land however. Land owners that were not interested in farming their land then began to lease out their land plots to those people that were interested in farming the land, which very often tended to be the former collective farm director. Over a number of years then, a pattern of agricultural land usage developed where each village council came to be farmed by 1-2 individuals or companies that the Company refers to as 'main farmers'. This was the land ownership/use structure that Eurocape was introduced to in 2009 when it started working in the districts and is the land ownership/use structure that predominates today, in all seven village councils where Eurocape owns/leases/has servitude rights over the land.

The Company's legal rights to the specific portions of land vary depending on the planned use and can be presented as following:

- 'Wind turbine' land plots: such are leased directly from the district administrations as this was previously district reserve land (not in private ownership);
- 'additional foundation pad land plots' which have been acquired (in all but one case, in which the right to use the land plot was granted by the Court) from the land plot owners based on the voluntary compensation agreements;
- 'sub-station land plot': leased directly from regional land resources as this was previously district reserve land;
- 'infrastructure support land plot': leased directly from regional land resources as this was previosuly district reserve land;
- 'access road' land: leased from regional land resources as this land was previously in state ownership;
- 35 kV cable servitude land: servitude (third party use rights) from both regional land resources and private land plot owners, depending upon whether the land plot is publicly or privately owned;
- 330 kV PTL servitudes: both with public and private counter-parties (land plot owners), depending upon whether the land plot owner is public or private;
- triangle road plot leases/servitudes: with private land owners or public land counter-parties, depending upon the ownership pattern of the underlying land plot.

In general, land plots have tended to be leased from state-owned counter-parties and then servitude rights established with private land plot owners, other than as regards additional foundation plot lands, which have been acquired from private land plot owners based on the volunatary compensation agreements. In cases where servitudes have been established with land plot owners, the agreed financial compensation has been such that the land plot owners and land plot users come to an arrangement among themselves. Also, the sizes of the servitude land plots tend to be quite small and so tend to be inconsequential to 'main farmers' (either individual or legal entities), who are typically farming thousands of hectares and sometimes as many as 10,000-15,000 hectares.

The only time that the Company will primarily interact with land plot users as opposed to land plot owners relates to temporary and one-time compensation for land use during the wind turbine installation period, as damage to planted crops doesn't impact the land plot owner but rather the land plot user/main farmer. Such periodical land use has already been negotiated and agreed upon with four land users for the first phase of the development. 28 land plots of a total area of 2.332 ha have been identified as needed for temporary purposes (such as space needed for storage of blades or mounting of cranes) during construction. The average profability of that land was estimated based on actual prces of planted crops in 2017 as 1.68 UAH/m^2 and compensation price was agreed with land users at rates above the market rates. The same compensation scheme will be adopted in the phase 1B and next phases of the Project development.

2.1.5 Near-by Investments of Similar Nature

Based on the information provided by the Company, the nearest projects of similar nature are:

- a development of a 200 MW wind farm in a distance of approximately 40-60 km to the east of the Project area, in the vicinity of Botievo, Priazovsk District, Zaporizhia Region, Ukraine;
- a Swedish project of approximately 50 MW is located about an hour's drive to the west of the proposed EuroCape Wind Park in Kherson Region;

These are at this stage of assessment considered as located out of the potential area of the Project influence.

Based on visual observations, there are no high-voltage overhead power lines crossing the planned wind farm site. As established based on publicly available information, there is one of the major regional power lines passing in a distance of several kilometers to the north and northwest of the site. This and possibly other high voltage overhead power lines in the vicinity of the site are to be considered during the ESIA as of a potential for a cumulative impact of the project.

2.1.6 Conditions of Land Use at the Stages of Realization and Exploitation

The planned wind farm site is located in the village councils of Devninskoe, Dobrivka, Dunaevka, Girsivka, Mordvinivka and Nadeshdine, but settlement systems of these villages are located entirely outside of the area of the planned investment.

The Ukrainian law does not easily allow for change of agricultural land use to industrial purposes. The project will be developed mostly in a purely agricultural area which implies that WTGs must be located on the land which is not used for agricultural purposes, i.e. on the hedgerows that separate individual arable fields (most land plots have already been re-zoned from agricultural to industrial). Access to the WTGs will be provided by a network of local roads. Existing dirt roads will be utilized for this purpose.

The investment construction phase will include the following:

- preparatory works,
- construction of access roads,
- construction of assembly yards,
- construction of electrical, power and telecommunication/technical infrastructure,
- construction and assembly of wind turbines.

The MTS will be developed at the land plot currently not used for agricultural purposes, partly hardened with the concrete slabs. The overhead PTL will need to adopt small portions of land for pylons foundations. Both the area of the MTS and land used for pylons construction is negligible in comparison to the wind farm area.

2.1.6.1 The Construction Stage

The project to its permitted capacity of 500 MW will be developed in 5 phases (approx. 55MW, 3x110 MW, 115 MW). The construction stage of each of the phases will last a few months. Construction works will be conducted in stages. First roads along with the accompanying infrastructure described above will be built, whose realization may take a few months. Next WTGs will be constructed along with the accompanying infrastructure. The MTS will be constructed in the first phase and its construction may take 9 months.

The exact amount and types of vehicles and machines used during construction will be deter-mined at the stage of designing. In a typical implementation process the following devices and machines are used:

- car kits - with semi-trailers or trailers,
- special machines (mixers, excavators, bulldozers).

2.1.6.2 The Exploitation Stage

Conditions for the use of land at the stage of farm operation will not be substantially different from those before the period of its construction. It will run, as before, agricultural production, with the exception of areas permanently occupied by the elements of the wind farm.

2.1.7 Technological Description

2.1.7.1 Foundations and Hardened Assembly/Service Yards Construction

Due to the size and nature of the turbines it will be necessary to provide substantial foundations. Their construction will require significant transport of soil and construction materials (concrete, steel). Excavations for the purpose of the foundations will generate two types of soil: the topsoil which will be used for on-site landscaping, and deeper layer soil – which will be transferred off the site and used e.g. for infilling other excavations, or used as fill material for building embankments, berms etc.

At each WTG site the following will be constructed:

- A circular foundation of an approximate diameter of 20 m. The foundation has a truncated cone shape, being about 3 m thick at the central part and approx. 1.1 m in the outermost part. The part of the foundation above the soil surface has a diameter of approximately 6 m. Each base is supported by reinforced concrete piles. Each foundation will require approximately 800 m^3 of excavation and around 1140 m^3 of concrete.
- The conceptual design of the wind farm assumes that trapezoidal plots of land (either 60 or 75 m long and 15 m wide) wich will be adopted for the purpose of hardened (likely with crushed stone) assembly/service yards construction. An area of a single assembly yard will be approximately 1000 m^2 which corresponds to a total area occupied by the assembly yards of the final wind farm configuration of 167 000 m^2 (16.7 ha). In order to prevent the current function of the hedgerows it is recommended to reduce the width of the yards by 1 m (i.e. from 15 to 14 m) after construction of WTGs and plant there shrubs. This will reduce the longer length of plots to 14 m and the yard's area to approx. 940 m^2 each and the total occupied area to approx. 15.6 ha. Although such area seems to be large, it is just a small percentage of the total area occupied by the hedgerows at the territory of the wind farm. There will also be an access road within the plot of land.

2.1.7.2 Wind turbines

The wind turbines consist of a hollow steel tower with a nacelle to which the fibreglass rotor with three blades are attached. The nacelle houses the generator, gearbox, and control systems. A transformer is located in the base of each WTG tower. The wind turbine design and manufacturer has now been selected and it is likely to be:

- 16 wind turbine generators: type V-112 by Vestas Company (nominal capacity – 3.45 MW, rotor diameter – 112 m, tower height – 119 m); sound power L_{WA} [dB A]: 105.8,
- 151 wind turbine generators: type GE 3.6 137 by GE Company (nominal capacity – 3.60 MW, rotor diameter – 137 m, tower height 110 m); sound power LWA [dB A]: 108.5.

Total installed capacity of the wind farm may reach 601.2 MW, however, only 500 MW will be build under the current technical conditions for power supply to the network.

The wind turbines are large but are of a fairly "standard" size for on-shore designs wind farms. These larger units generate electricity more efficiently than smaller ones.

The turbine activates a three-phase asynchronous generator with a squirrel-cage rotor connected to the grid via a current transducer, which controls conversion of alternating frequency energy into fixed frequency alternating current energy with the desired levels of active and reactive power (as well as other grid connection parameters). A double-wound, three-phase, dry-type, self-extinguishing HV transformer shall be installed for transmission of electric power from the WTG to the step-up substation at the voltage of 35 kV. Electricity is transmitted via a high-voltage cable from the transformer to a switchgear. The auxiliary equipment (pump and fan motors, heaters, electric lighting) is powered from house needs transformers. The unit is supervised and controlled by means of control system.

The design includes a grounding system of the wind farm: a foundation grounding conductor along the perimeter of the wind turbine foundation and external grounding conductors which connect the main grounding strips of the WTG (substation) with an external grounding backbone.

The WTG will be protected against direct lightning impacts by a structure of the WTG tower, which is a natural vertical lightning conductor. The lightning protection consists of three independent groundings: grounding of the foundation, wiring of groundings for each turbine and interconnection wiring of groundings within the wind farm.

2.1.7.3 Underground Cable Network (Electric and Fiber-Optic Control and Communication Cables)

Each of the WTGs will be connected with the MTS with the underground medium voltage (35kV) cables and fiber-optic control and communication cables. Total length of the cable routes will amount approx. 311 km. All cabling will be executed in trenches at a depth of at least 1 m. The trenches will be constructed along the dirt roads passing along the hedgerows.

According to the design, a single-conductor XLPE cable with an aluminium conductor and a copper screen, grade АПвЭгАП, shall be installed for power transmission. The cable shall be laid by cut-and-cover method in the ground (trench) along the on-site roads of the wind farm, on the outer side of the road bed and in arable lands. In the substation territory, the cable line shall be laid in cable trays. Where it crosses the Dzhekelnia River, the cable line shall be buried in the river bottom. Where it crosses motor roads, it shall be laid in a pipe. Fiber-optic information cables shall be installed in the same trenches as the power cables.

The cables shall be laid in the ground in accordance with the following regulations:

- USSR Building Code and Regulations (SNiP) 3.05.06-85 "Electric Devices";
- Electrical Installations Code (EIC); and
- Cabling Instructions and Recommendations of the Cable Manufacturers[4].

In accordance with the current rules for protection of electrical networks, exclusion zones shall be installed above the underground cable lines of over 1 kV to the dimensions of the site: 1.0 m on each side from the outers in the trench[10].

2.1.7.4 Roads

The available engineering and transport infrastructure includes dirt and asphalt roads, about 5 m wide, running along the agricultural hedgerows and designed for motor transport and agricultural machinery traffic during field works.

Implementation of the project will call for construction of access roads and passages, up to approx. 147.4 km long in total, needed for delivery of equipment and for further operation of the wind farm. The available roads to be used by the vehicles to reach the construction sites are unsurfaced and they have to be reconstructed with arrangement of hard surface.

The public roads running through the dwelling settlements and along the agricultural hedgerows will be used during construction and operation of the wind farm for passage of lifting cranes and other construction machinery and delivery of equipment and materials for construction and operation to the places of wind turbine installation. The asphaltic concrete roads which run through the dwelling settlements, need to be repaired or reconstructed taking into account the vertical loads from heavy vehicles. The dirt roads running along the agricultural hedgerows have to be reconstructed with the use of local building material, which is crushed stone.

The decisions on the use of public road sections and the scope of their reconstruction will be made during the further phase of design.

An access road with asphaltic concrete pavement is planned to reach the MTS site.

2.1.7.5 Administrative and Technical Facility (ATF)

The location site of ATF is integrated with the site of the 35/330 kV MTS and is situated in the south-western portion of Nadezhdine Village in Pryazovske District of Zaporizhia Region. The site landscape is the coastal area of the River Dzhekelnia with the height difference from 6.00 to 12.7 m and the fall of elevations towards the south-east. The construction site has ruins of buildings and an insignificant amount of vegetation. The existing asphalt roads and grounds are not suitable for further operation. There are no engineering networks and communications on the plot.

The administrative and technical facility of the wind farm will include the following:

- administrative and on-site facility;
- Checkpoints 1 and 2 (for autotrucks);
- garage for 10 parking spaces;
- fire-fighting water supply reservoirs 2 x 150 m^3;
- potable fire-fighting water supply pump station with effectiveness of 134.72 m^3/hour;
- artesian well;
- sewage treatment facilities,;
- rainwater treatment facilities, about 80-400 l/s,
- radiation-proof shelter;
- radio tower;
- 35/330 kV substation.

The design provides for removal of chernozem (black earth soil) in the territory of ATF, amenities, landscaping and land plot lighting. Two entries are planned for functioning of the administrative and technical facility. Surfaced access motor roads and pads are planned. Rainwater shall be drained in roadway inlets and after the treatment at the treatment facilities it shall be discharged into the Dzhekelnia River.

2.1.7.6 Main Transformer Station (MTS)

In accordance with the recommendations of Ukrenergomerezhproject State Research & Design Institute, the power shall be delivered to the grid from the wind farm at the voltage of 330 kV. For this purpose, it is planned to build the 35/330 kV MTS[10].

The MTS will be situated in Nadezhdine Village outside the boundaries of the village settlement of Pryazovske District in Zaporizhia Region. The substation is intended for connection of the wind farm to the network of Dnipro Energy System.

The substation will consist of a 330 kV outdoor switchgear, a 35 kV outdoor switchgear and a 35 kV indoor switchgear. The 330 kV outdoor switchgear is designed with two busbars. The 35 kV indoor switchgear is designed with four sections, each of them having two busbars. Four 35/330 kV double-wound power transformers of type ТДЦН-200 000/330 У1 with the capacity of 200 MVA each shall be used as main step-up transformers. It is planned to install voltage suppressors on the 330 kV and 35 kV. The 35 kV outdoor switchgear shall use 35 integrated grounding arc suppression aggregates.

The following shall be installed in the building of 35 kV indoor switchgear with the substation control house:
- the substation control house with RPA panels,
- house needs panels and house needs transformers;
- a DC/AC board;
- a storage battery; and
- a diesel-generator set.

At the 35 kV outdoor switchgear, 35 kV grounding reactors for compensation of capacitive currents (16 ea.) shall be installed. The following shall be installed at the 330 kV outdoor switchgear:

- 330 kV SF6 breakers;
- 330 kV disconnectors;
- 330 kV oil current transformers;
- 330 kV oil voltage transformers;
- 330 kV surge suppressors installed on the bushings of power transformers, in the 330 kV line and on the 330 kV buses of the substation; and
- a 330 kV bus organized support.

Four transformers 35/0.4 kV shall be installed for powering of the house needs and operational networks. For uninterruptible power supply to the operator- and process-enabled control equipment of 35/330 kV Ukraine 1 wind farm Central Substation, GENMAC Duplex G 16 LOW diesel-generator set with the capacity of 16 kW shall be installed in a separate room. The diesel-generator set shall be connected to the power supply system of the operator- and process-enabled control equipment via the cabinet of a three-phase automatic standby activation (63 A).

The relay protection and automation of the 330 kV PTL shall use microprocessor terminals. The packages of main protections on the 330 kV PTL are independent in their current and operational circuits. The main technical solutions for the relay protection and automation of 35/330 kV wind farm Central Substation include:
- protection of the 330 kV line;
- protection of the 330 kV buses;
- protection of the 35/330 kV transformers;
- regulation of the transformer ratio for the 35/330 kV power transformers;
- control and automation of the 330 kV connections;
- a 35 kV RPA package;
- operational locking;
- a centralized locking system;
- a centralized system of signal recording; and
- a system of operational direct current.

The design includes arrangement of a system for commercial accounting of power consumption (ASCAPC) with integration to the ASCAPC of upper level, i.e. that of NEC Ukrenergo. For metering, SL/0.2S meters (the main and the redundant one) shall be installed on the 330 kV line.

An emergency control automation device, which is line shutoff locking, shall be installed on the 330 kV PTL.

The substation shall have electric lighting: operational, emergency, evacuation and repair electric lighting of the 35 kV indoor switchgear; outside electric lighting of the 35 kV outdoor switchgear.

For temporary power supply to the substation construction site, a packaged transformer substation of 10/0.4 kV with the capacity of 630 kVA shall be installed and powered via a cable line from Tower 96/1 of a 10 kV PTL from 35/10 kV Girsivka Substation.

For protection against electrocution, it is planned to arrange protective grounding, protective shutoff and lightning protection.

The Main Transformer Station will occupy an area of 10 ha.

2.1.7.7 Overhead Power Transmission Line (PTL)

Generated power will be transferred via a single-circuit 330 kV PTL from 35/330 kV wind farm Central Substation (330 kV Nadezhdine Substation) to 330/150 kV Melitopol Substation (330 kV outdoor switchgear) in the lands of Pryazovske and Melitopol Districts in Zaporizhia Region. The starting point of the route is the planned portal of 35/330 kV MTS and the end point is the portal of 330/150 kV at Melitopol Substation (330 kV outdoor switchgear).

According to the project documents, the PTL length is 23.2 km, within which 110 poles (towers) and 2 portals are to be installed. Border width of the designed 330 kV PTL is 56.4 m. The project documents were developed in accordance with the requirements laid down in the State Sanitary Norms and Rules of the Population Protection from the Impact of the Electromagnetic Interference, the State Standard of Ukraine, DSTU 4 11-2002.

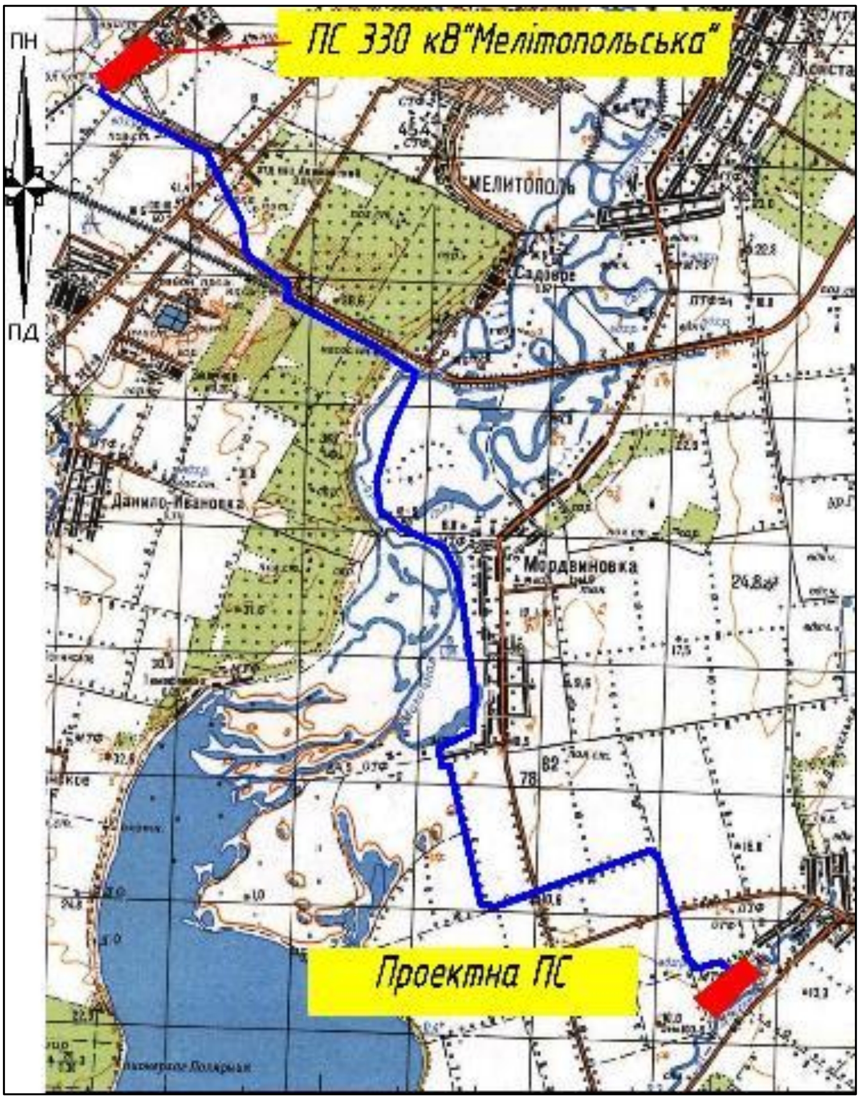

Figure 3. Route of the PTL

On the ground of Cabinet Resolution No. 209 "On Approval of the Rules for Protection of Electrical Networks" dated 4 March 1997, the exclusion zone from the 330 kV overhead transmission line is accepted as 30 m from the projection of the outer onto the ground on both sides along the full length of the 330 kV PTL route[10].

The route of the 330 kV PTL crosses the following infrastructure facilities and lines:

- motor roads (6 ea.);
- 10 kV PTL (3 ea.);
- 35 kV PTL (1 ea.);
- 150 kV PTL (3 ea.);
- 330 kV PTL (1 ea.);
- water conduit (1 ea.);
- gas (2 ea.);
- heating main (1 ea.);
- HV cable (3 ea.);
- communication cable lines (12 ea.); and
- water pipeline (9 ea.).

The 330 kV PTL also crosses natural obstacles, such as a canal and the Moskovka River. The design includes re-arrangement of the 10, 150 and 330 kV PTLs crossed with insufficient clearance. The communication lines shall also be protected against the influence of the 330 kV PTL and re-arranged.

2.2 The Main Characteristic Features of the Processes

The following technical details of the wind farm specification are generic, and the exact figures will depend on the final equipment selection.

The five steps of electricity production and distribution from wind power are:

- wind turbine blades are turned by the power of the wind;
- the blades turn a rotating generator which converts wind energy to electricity;
- a transformer installed in a WTG increases the electricity voltage for transmission to the Main Transformer Station by underground cables;
- the substation increases voltage for transmission over long distances;
- the electricity is transferred to the Melitopol Substation and distributed to national grid.

When the wind reaches and maintains constant speeds of over 3 m/s, the turbine rotor starts rotating and drives the gearbox that converts rotor shaft energy (i.e. mechanical energy) into electrical energy through an electrical generator. The wind turbine will start generating electricity at a minimum constant wind speed of 3 m/s. This will be held up to a constant speed of approximately 25 m/s. At higher wind speeds the turbine blades are stopped for safety reasons and to prevent excessive wear and tear on the mechanisms. Most of the electricity produced by the wind farm will be transferred to the grid but a small amount of electricity will be used by the on-site control facilities and the wind turbines themselves may use electricity when wind speed is constantly in excess of 25 m/s and requires the activation of the hydraulic braking system of the turbine rotor.
Table 1 shows characteristic features of processes related to activities of the wind farm.

Table 1. Characteristic features of processes related to activities related to wind farm, PTL and MTS with ATF

No.	Feature of production process (exploitation of the installation)	Wind farm Identification YES/NO	Main Energy Substation and Administrative and Technical Facility Identification YES/NO	Overhead Power Transmission Line Identification YES/NO
1	Water consumption • social-living purposes • technological purposes	 NO NO	 YES NO	 NO NO
2	Sewages: • sanitation-living • technological • precipitation water and melt water	 NO NO YES	 YES NO YES	 NO NO YES
3	Pollution emissions into the air: • gases • greenhouse gases (CO_2, CO, CH_4) • volatile organic compounds (VOCs) • dusts	 NO NO NO NO NO	 NO NO NO NO NO	 NO NO NO NO NO
4	Noise emission	YES	YES	YES
5	Waste generation: • hazardous waste • other than hazardous • mixed municipal waste	 YES YES YES	 YES YES YES	 NO NO NO
6	Risk of a major industrial failure: • major • increased	 NO NO	 NO NO	 NO NO
7	Other impacts: • vibration • PEM • on the ground surface • landscape • fauna • protected areas • human health	 YES YES NO YES YES YES YES	 NO YES NO NO NO NO YES	 NO YES NO YES YES YES YES

2.3 Climate Implications

Available data indicate with no doubts that evolution of climate is a natural phenomena which has occured for millions of years. Through millenia the planet has witnessed many periods of varying average temperature. During glacial periods it was much cooler and in other periods much warmer than nowadays. Through the last two centuries, however, the climate change is progressing much faster than ever before. Since the beginning of 20th centyry the average temperature of the the Earth surface has increasd by 0.75^{o}C and by the mid 21st century may increase by next 1.5-4^{o}C.

The main factors affecting the Earth's climate are solar activity, continental system, snow and ice cover, volcanic activity, aerosol concentrations in the atmosphere, and greenhouse gas emissions.

Among these factors human influence the most emission of greenhouse gases, such as CO2, methane, N2O and water vapour.

It is estimated that responsibility for the greenhouse effect is shared between vater vapour and clouds (75%), carbon dioxide (20%) and other greenhouse gases (5%). It is estimated, that human activities, mainly incineration of fossil fuels (coal, oil, natural gas) contribute approximatey 5% of the total emission of CO2 to the atmosphere. Since the late 1950s (since a systematic and very precise monitoring of atmospheric CO2 content), the concentration of this gas in the atmosphere has increased from 315 ppm to 398 ppm in 2013 (9 May even concentration of 400ppm). With the increase in fossil fuels, the increase in CO2 concentration in the air accelerates: nowadays it is growing by 2 molecules per million, if the CO2 growth rate remains unchanged by about 2040 we will reach 450 ppm. Hence, reduction of this gas emission by human beings should affect in a positive way climatic changes.

The Project belongs to so called "zero emission" developments, i.e. such, which operation does not cause any emissions to the atmosphere. Based on the preliminary study of the wind resources in the area, the initial energy yield calculation is approximately 1.8 million MWh/a (6.48 million GJ), with a wind park efficiency of 92.2%. Conventional coal fired CHP can achieve approximately 45% efficiency in electricity production. Therefore, production of 1 GJ of electricity may require utilization of 2.2 GJ of fuel. Based on the emission factors published in EMEP/EEA Emission Inventory Guidebook 2009 (updated June 2010, http://eea.europa.eu/emep-eea-guidebook), the annual energy production equal to expected production of the subject wind farm by a modern, coal-fired CHP[6)] would result in emissions of:

- 522 ton[7)]/a of particulate matter;
- 3,131 ton/a of NOx;
- 2,087 ton/a of SO_2;
- 4,860,000 ton/a of CO_2[8)]

and additionally generation of approximately 234,576,000 ton/a of ash[9)]. Although wind farms cannot entirely replace conventional power plants, supply of a certain amount of energy to the power grid leaves space for equivalent reduction of energy production by conventional plants and consequently avoidance of air emissions and generation of solid waste. Therefore the basic environmental benefit of the operation of the subject wind farm can be defined as an avoidance of air emissions and solid waste generation as shown above. Further, avoidance of almost 5 milllion tons of CO2 per year shall generate a positive impact on the climate.

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6) emission factors derived from emission limit values based on LCP Directive for new plants, 50-500 MW capacity for PM and NOx and 100-500 MW for SO2,

7) metric units are used in this report, "ton" corresponds to 1000 kg

8) calculated based on emission factor for coal fired CHP published by Department of Energy and Climate Change at http://chp.decc.gov.uk/cms/chp-emission-reductions/

9) calculated based on assumption of 99% effectiveness of emission controls

3. BASELINE CONDITIONS

3.1 Site Location and Relief

In accordance with the physical-geographical zoning of Ukraine, the territory of Zaporizhia Region is located within the Steppe Zone. The surveyed territory, including the wind farm area and the buffer areas within 5-20 km, are included in the Medium Steppe Zone and to the Area of Steppe South-Western Slopes of the Pryazovska Upland.

The Steppe South-Western Slopes of the Pryazovska Upland face the Sea of Azov in the south-east. The landscape structure of this area includes the average analogues of all the areas of the northern Azov Seaside steppes: from the raised octants watershed to the seaside areas. We can note wide terraces on the left bank in the lower reach of the Molochna River. The area is not vast, with variety of stows. It is an approximately 40-km strip of southern chernozems on the south-western slopes of the Pryazovska Upland stretching in a form of arch from the rear seam of the right-bank flood plain in the middle reach of the Tokmak-Molochna Rivers to the Berdianska and Obitochna Spits over more than 100 km. This area covers about 4,500 km^2. All the territory is located in the south-east of Zaporizhia Region.

The whole area lies within the Azov Sea basin. The rivers which drain this territory have a steep fall of profile and great erosion impact. The soil cover includes southern chernozems, which are medium- and heavily eroded, hydraulic fill layers in the bottoms of gullies and in thalwegs, often meadowy and slightly gley. The diluvial slope stows and the upper reach of erosion network are tilled. The plants on them are those of agricultural lands, anti-erosion forest plantations, and sown permanent grasses. Wild plants hold out on the steep slopes and bottoms of gullies (couch-grass, fescue, stipa, sagebrush, spurge), which is much degraded because of cattle pasturing. Along the periphery of the upland slopes, the ravine-gully reliefs pass into the ravine valley ones. The low outskirts of the area are partitioned with gullies. The erosional slope areas are developed along the river valleys. On the loesses, all the lands of the fluvial terraces are tilled. The vegetation of fescue-stipa, partially prairieficated steppes is replaced with agricultural grain crops of rotation.

The sea terraces within the area of the south-western slopes in the Pryazovska Upland consist of a latter-Pliocene (Kuyalnik) terrace. This is a seaside part of the area, which is a lowland plain with the true altitudes being 30-40 m. Here, the rocks of the craton are covered with neogenic marine sediments. The structural basis is formed with clay deposits of Sarmatian stage overlapped with latter-Pliocene argillo-arenaceous strata. On top of them, there are anthropogenic loess-like loamy clays, 15-25 m thick. The area is divided into separate plakor stows with the strips of erosion cutting. Southern olygohumic black soils with the vegetation of agricultural lands are developed on the plakors.

The areas of contemporary seaside plains are not covered with continuous soil and vegetation due to the specific composition of the surface strata (sand and fragmental shelly material) and the young age of the plains themselves represented by strips of beaches and are still in a process of reformation. The partial soil cover forms underdeveloped differences of turfing soils in combination with alkaline variants. The vegetation is sedge-grass and xerophytic-halophytic (foxtail, yellow everlasting, saltworts). These areas include stows of pits, beaches and white alkalis.

The natural territory called the Molochny Estuary Wetland has a special significance for the surveyed area. The typical landscape and biotope elements are aquatic biotopes, meadows, flood plains, salt marshes, gullies with shrub vegetation, spits and islands.

The landscapes of the Molochny Estuary Wetland also belong to Sivash-Azov Coast lowland steppe of the dry steppe landscape subzone and are subject to the law of geographical zoning. The territory generally includes some of the lowest altitude marks in the steppe zone of Ukraine, features the least amount of precipitation, the highest potential rate of evaporation, the least atmospheric moisture capacity and the least run-off.

3.2 Climate

The climate of the region is mildly continental. It features dry, moderately hot summer and relatively cold winter with thin snow cover. The snow cover is not stable. The average temperature of the coldest month (January) is from -5 °C to +2 °C, but considerable frost with strong wind also happens. In accordance with SNiP 2.01.01-82, the normative frost penetration in the soil does not exceed 80 cm. In accordance with the regional maps, the territory of the wind farm site is classified as Region 4 in terms of icing wall thickness. The ice formation in the cold (winter) season is observed for 10-19 days a year on average and is accompanied with icing of overhead transmission line (PTL) wires and equipment. Formation of crystal and granular rime is also observed for 7-11 days. The average temperature of July is from +23 °C to +25 °C. The average annual temperature is +8 °C.

In terms of climatic conditions, this is a zone of insufficient humidification and mostly year-round feed of groundwater at the cost of atmospheric precipitation. The annual average precipitation does not exceed 300 mm.

The seismic activity measures 6 in accordance with DBN B. 1.1-12-2006. In accordance with SNiP 2.01.01-82, the construction site belongs to Wind Region 4 and Group A (sea coasts and steppes). Under SNiP 2.01.01-82, the recurrence rate of wind is 26% at a speed under 1 m/s, 51% at a speed of 2-5 m/s and 12% at a speed of 8 m/s and over.

3.3 Acoustic Climate

The planned windfarm is situated at agricultural areas, however a few villages area also located in the neighbourhood which are: Devninskoe, Dobrivka, Dunaevka, Girsivka, Mordvinivka and Nadeshdine. All turbines are planned to be located in a distance of at least 1.2 km from the nearest residential area.

In the area where the planned wind farm is to be developed, there are no enterprises of heavy or or chemical industry, therefore this region may be considered environmentally safe. The noise emissions from agricultural machinery during seasonal field works have the only possible environmental impact in this region. However, such impact is not significant[10]. In conclusion in the area of the investment and in the area there is no industry that contributes to climate change acoustic.

3.4 Ambient Air Quality

The wind potential of the construction site is assessed as high. Typical for the region are considerably durable eastern and north-eastern wind currents as well as breeze winds, which are very important for arrangement of regular electric power output in this region.

No quantitative regional or local ambient air quality data were available. However, in the area of investment, there is no industry that contributes to the deterioration of air quality and the Project site is located in a rural area.

3.5 Geology

The plots for deployment of the wind power plants are located within the northern slope (margin) of the Black Seaside Depression, which is a monocline. The Precambrian granite-gneissic crystalline basement is inclined southward and deeply sunk. The embedding is benched. The northern border of the Precambrian abrupt sinking goes along Perekop-Berdiansk-Mariupol line. The crystalline basement faults and sinking occurred in the Jurassic period. After that the sediment accumulation processes prevailed until the early Pleistocene (beginning of the Anthropogene – Quaternary). The sediment accumulation process was complicated with oscillatory motions related to the continuing tectonic genesis.

[10] Accordance with 129a Peremogy St. Department for Urban planning, development and architecture of Zaporizhia regional state administration. 15 October 2010, Ref. No. 133/03-09

On the Precambrian crystalline basement in the range of depths 1.2 – 0.5 km there are upper cretaceous deposits consisting mainly of glauconitic sandstones.

Tertiary deposits.
Drilling of deep holes (Ukrvostokneftegazrazvedka) revealed a thick mass of Paleogene deposits above the top of Mesozoic (Cetaceous) deposits. These layers are studied in the most detail in the Molochna River basin in Pryazovske Rayon (the neighbourhood of Stepanivka, Dunayivka and Oleksandrivka Villages).

Here, the Paleogene deposits include carboniferous terrestrial formations of Buchak stage and marine sandy-argillaceous deposits of Kyiv and Kharkiv stages. The terrestrial carboniferous deposits include a series of alternate grey and black coaly sandy clays with lentils of brown coal and sandy secondary kaolins (terrigenous stratum). These deposits overlap the Cretaceous (or Precambrian) strata transgressively. The thickness of carboniferous deposits varies in a wide range and reaches 20 – 50 m in the lowest sections of the Pretertiary relief.

The carboniferous deposits are increasingly inclined southward, i. e. along the sinking of the crystalline basement. The coal-bearing series, like the whole series of Paleogene deposits, deepens steeply following the basement relief.

The marine deposits of Kyiv stage (stratigraphically overlaying the terrestrial carboniferous deposits) consist of marls.

In the region of Stepanivka, Dunayivka, Oleksandrivka and Prymorsky Posad Villages the lower part of Kyiv stage consists of glauconitic sands and brownish grey and greenish grey coarse sands with quartz gravel. In the Village of Stepanivka the marls of Kyiv stage occur on the Middle Eocene limestones.

A series of greenish glauconitic noncalcareous sandy and clay strata of Kharkiv Stage overlays the marl clays stratigraphically. The aggregate thickness of such strata is 62 – 150 m.

A thick series of Neogene deposits occurs above the top of Paleogene deposits. Within the surveyed area the thickness of such strata varies from 100 to 250 m.

Clays with bands of marl and fine sand are revealed in the neighbourhood of Stepanivka Village at a depth of 250 m. There are also pyrite nodules (Pliocene). In the Sivash neighbourhood and the plots adjacent to the valley of the Molochna River, the Neogene includes sandy strata with silicon pebble (lower Sarmatian stage) and narrow bands of limestones and sandy marls.

The Quaternary deposits (Anthropogene) consist mainly of terrestrial sediments. The estuary and marine deposits are only limited to the narrow band along the Azov Sea and the Sivash. The terrestrial beds include the mass of Aeolian soils and loess loams.

In the large drainless soles the mass of Aeolian soil and loess loams is transformed into greenish grey bottom loams and clays by gleization.

At the shore of the Azov Sea, the Sivash and the Molochny Estuary the stratum of Aeolian soil and loess loams sinks below the sea level in some places. Such sinking is caused by epeirogenic foundering of the seafloor section of the mainland in the Quaternary time.

This study focuses on the use of natural Quaternary and Tertiary strata (soils) as bases of foundations.

The geology of the surveyed sites (bottom-up) to the depth of drilled holes includes middle to upper Pliocene deposits consisting of clays.

Marine sandy-argillaceous Cimmerian-Kuyalnik deposits occur above the clays. Above such deposits there are red brown clays of late Pliocene and early Pleistocene. The Pleistocene loess soils cover the area as a continuous blanket essentially in all places except for erosion valleys and gullies.

The detailed data on the strata occurring on the building sites are shown in the strip logs and the engineering-geological passports of Sites 1-8 (Appendix 9).

3.6 Groundwater Conditions

The study area is located in the Azov Seaside Geomorphologic Region. This is a territory limited by Donetsky Ridge in the north, the Azov Sea in the south, the Molochna River with the estuary in the west and the Mius River in the east. In terms of origin it is a secondary plain. In hypsometric terms it is a plateau. Its surface is undulating, slightly graded towards the Azov Sea. The river valleys (the Molochna – the Estuary) in the southern part of the Azov Seaside Plateau have a complicated structure. Being deeply cut in and very expanded, they do not correspond to the contemporary river sizes. The surveyed area is located in the Dnipro-Molochna hydrogeological region.

The free aquifer is pervasive in the Anthropogene blanket terrestrial (recent) marine, estuary-marine and lacustrine-marine deposits. The level of the Azov Sea, the Sivash Bay and the Molochny Estuary is the hydrological basis of drainage for this aquifer. Upper and middle Pliocene loams and clays underlay water-bearing silica inequigranular argillaceous sands and less frequent loamy sands.

The phreatic aquifer in the region of Molochny Estuary is limited to the buried high-water bed.
The alluvial water-bearing deposits, which make up terraces I-III above the flood-plain of the Molochna River, consist mainly of argillaceous sands, 1 – 18 m thick. The depth of the level occurrence is 0.2 – 10 m. The water-bearing sedimentary alluvia are covered with aeoline-diluvial loams. The confining layer is Pliocene clay loams and clays, which make the first stable regional confining layer from the ground surface.

The fluctuations of water levels in the wells of the villages neighbouring the estuary are negligible. Only in spring the level rises by 1.0 – 1.5 m. As a whole, for the period of 30 – 40 years the level has fallen by 1.2 – 1.5 m. The reason is that the Molochny Estuary as the base level of drainage is blocked by surfy alluvium and the connection with the sea is disrupted and, therefore, the estuary is not being replenished. This leads to shoaling of the estuary, i. e. lowering of the hydrological base level of drainage. The result is general recession of water level in the wells. The groundwater is recharged only at the expense of precipitation, which does not exceed 300 mm a year. The stable thickness and essentially general occurrence of Kuyalnik clays limit the possibility for the aquifer to be replenished at the expense of the underlying Paleogene aquifer systems.

3.7 Plants

The flora of coastal territories of the Mochny Estuary Wetland includes about 700 species of vascular plants of 91 families (33 of the species have a protected status). The prevailing families of the flora are Minnie daisies Asreraceae, Poaceae, cabbage Brassicaceae, legumes Fabaceae, rose Rosaceae, goosefoot Chenopodiaceae, pink Caryophyllaceae, labiates Lamiaceae, ranunculaceous Ranunculaceae and figwort Scrophulariaceae. The heterogeneity of the flora is confirmed with the availability of Mediterranean (rush Juncus, cane Scirpus, horned pondweed Zannichellia) and boreal (sedge Carex and Polygonum) genera.

The vegetation is consolidated into six types of plant complexes listed in decreasing order in terms of the area they cover: water (including coastal and littoral swamps) associations, saline lands, meadows, littoral (including island actic) phytocenoses, man-planted forests and steppes. These plant complexes, in their turn, are divided into phytiums (plant formations). The water phytocenoses of the estuary include four phytiums (fennel-leaved pondweed Potamogetoneta pectinati, eelgrass Zostereta marinae, widgeon grass Ruppieta maritimae, and common reed

Phragmiteta australis). It is considered that after the estuary had joined the Sea of Azov, these plants replaced ultragaline associations, which are rare for this region. The halophytic phytocenoses consist of four groups of formations consolidated into two classes of formations: true alkaline lands and white alkalis. The meadows include one class: saline, which include nine groups of phytiums (the area of saline tall grass and small-grain and saline great rush prevails). In the steppe vegetation, we can mark out true (fescue-stipa), shrubby, sandy and alkaline steppes.

The influence of people on the natural and semi-natural phytocenoses of the Molochny Estuary Wetland as a whole (cattle grazing, pollution with domestic waste, picking bunches of flowers of some species, fires) depletes, simplifies and degrades the floristic composition of the phytiums.
During the research conducted in 2010 and 2012, a significant structural variety of hedgerows was confirmed, possibly due to their extensive degradation. In order to assess their values and conflict potential, an inventory with an assessment of hedgerows in lines with the planned WTGs and direct neighbourhood was conducted. The research on the structure of hedgerows landscape was performed in relation to their ornithology and chiropterology values assessment. The assumption was that the better the structure and floristic biodiversity of the hedgerows and shrubs, the better the conditions for fauna presence, including birds and bats. The hedgerows, when best preserved provide more ecologic niches for the birds and bats, which results in their higher conflict potential with the planned wind farm.

The inventory and assessment was focused on classifying hedgerows to one of the following groups:

A. Devastated and degraded hedgerows with removed patches of hedgerows or single trees left (of lowest potential for conflict due to low nature and fauna biodiversity value),
B. Hedgerows with degraded structure (young, single species, one level, scarce, often only with Black Locust of low floristic and fauna biodiversity),
C. Hedgerows with good structure – multi species, multi-level hedgerows with many species of trees and shrubs, providing favourable conditions for the high flora and fauna biodiversity, including birds and bats (numerous spots favourable for nesting, large feeding area, good shelter conditions),
D. Hedgerows of best preserved primary structure – tall forest shelter-belts with oak prevailing – valuable and natural for steppe forms of hedgerows, highest potential for conflict, local refuge for floristic and fauna biodiversity.

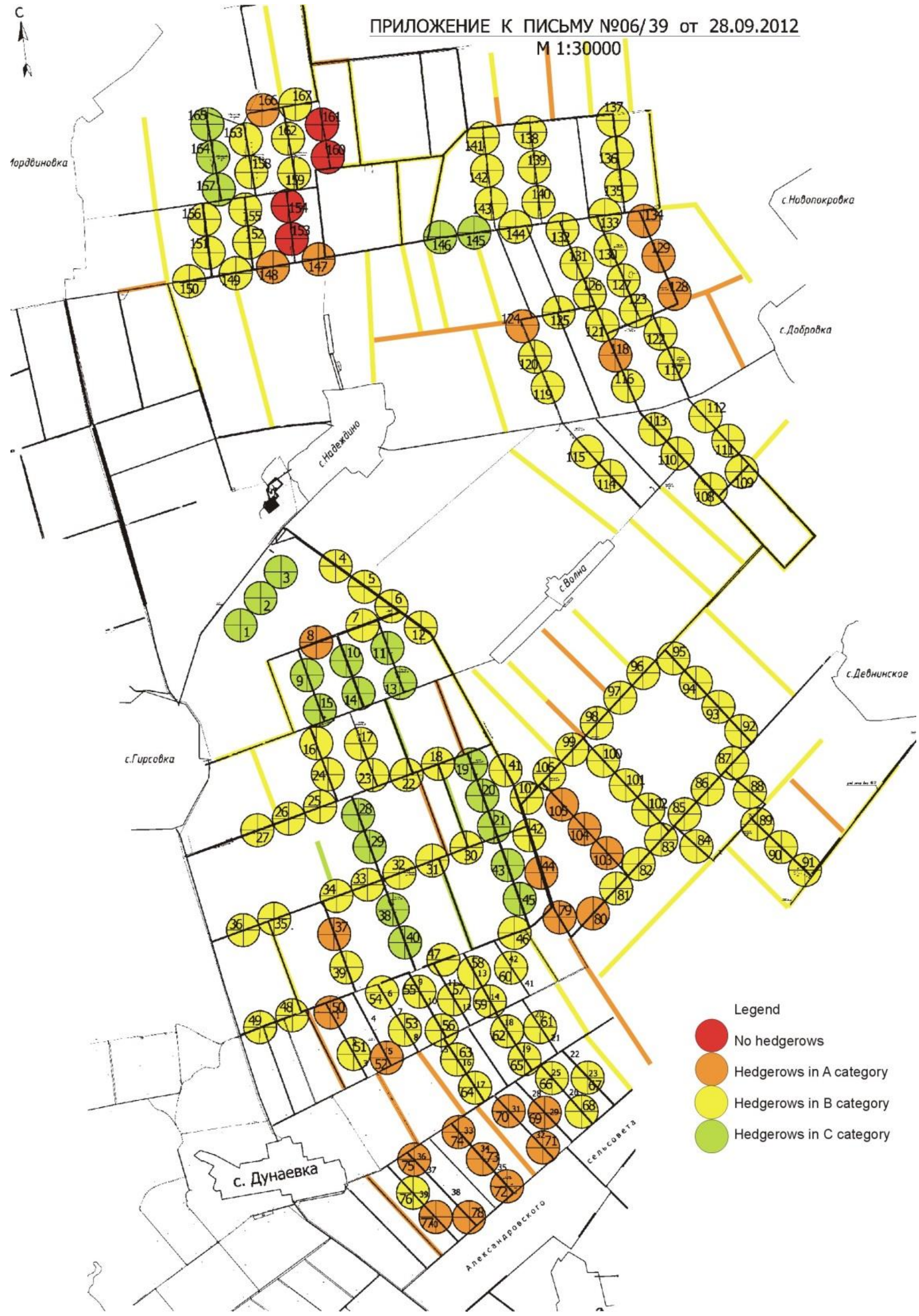

Figure 4. Results of hedgerows inventory at the area of the planned wind farm and adjacent area.

Synanthropic vegetation

The major part territory of the investment consists of various agrophytocenoses (agricultural fields, fallow land, pastures, etc.) covered with synanthropic spontaneous plant associations. They include four classes. Here, the prevailing associations of ruderal vegetation are: *Agropyretum repentis (Felf. 1942) Gors 1966; Cardario-Agropyretum Th. Muller et Gors 1969; Convolvulo-Agropyretum repentis Felf. (1942) 1943; Lepidietum drabae Timar. 1950; Xanthietum spinosi Felf. 1942; Melilotetum albi-officinalis Siss 1950; Artemisietum absinthii Schubert et Mahn. ex Elias 1982; Polygonetum avicularis Gams 1927 em. Jehlik in Hejny et al. 1979; Bromo-Hordeetum murini (Allorge 1922) Lohm. 1950; Ambrosio artemisifoliae-Cirsietum setosi Marjushkina et V. Sl. 1985; Erigero-Lactucetum serriolae Lohm. 1950 ap. Oderd. 1957; Cirsio-Lactucetum serriolae Mucina 1978; Cynancho acuti-Convolvuletum arvensis Bagrikova 2002; Bromo-Hordeetum murini (All.*

1922) Lohm. 1950; Atriplicetum tataricae Ubrizsy 1949; Plantagini-Polygonetum avicularis (Knapp. 1945) Pass. 1964. Also the above plant associations near settlements, farms, various buildings, etc. was found.

Steppe vegetation
The zonal steppe type of vegetation in the researched territory is a narrow strip of slope along the slope of the right bank of the right bank of the Molochna River and traffic routes.

The dominants of the steppe associations are most often xerophilous cereals: crested wheatgrass (*Agropyron pectinatum*), Volga fescue (*Festuca valesiaca*), dwarf feather-grass (*Stipa capillata*), feather grass (*S. lessingiana*) and needle grass (*S. ucrainica*).

The following occurs most often among the perennial miscellaneous herbs of steppe associations: yarrow (*Achillea leptophylla*), Austrian sagebrush (*Artemisia austriaca*), adpressed cornflower (*Centaurea adpressa*), pilose crinitaria (*Crinitaria villosa*), sea grape (*Ephedra distachya*), globe thistle (*Echinops ruthenicus*), Seguiers spurge (*Euphorbia segueriana*), steppe spurge (*E. stepposa*), lady's bedstraw (*Galium ruthenicum*), forage kochia (*Kochia prostrate*), Jerusalem sage (*Phlomis tuberose*), Astracan cinquefoil (*Potentilla astracanica*), nodding sage (*Salvia nutans*), hardy salvia (*S. tesquicola*), leafy tansy (*Tanacetum millefolium*), meadow rue (*Thalictrum minus*), dimorphous thyme (*Thymus dimorphus*), purple mullein (*Verbascum phoeniceum*), annual strawflowers (*Xeranthemum annuum*), etc. The ephemeroids in the steppe plots of the researched territory include Sarmatian Bellevalia (*Bellevalia sarmatica*), bulbiferous gagea (*Gagea bulbifera*), dwarf iris (*Iris pumila*), Gusson ornithogalum (*Ornithogalum gussonei*), Schrenkii Tulip (*Tulipa schrenkii*), tuberiferous valerian (*Valeriana tuberose*), etc.

The steppe shrubs include such species as Russian peashrub (*Caragana frutex*), blackthorn (*Prunus spinosa*) and representatives of the brier (Rosa) genus.

In total, there are eight species of higher vascular plants included in various nature-conservation lists in the steppe associations of the researched region (Table 2).

Table 2. Protected species in the steppe associations of the researched region

Taxon name	RBU*	ERL*	BC*
Stipa capillata L.	+	-	-
Stipa lessingiana Trin. et Rupr.	+	-	-
Stipa ucrainica P. Smirn.	+	-	-
Phlomis hybrida Zelen.	-	+	-
Ferula orientalis L.	-	-	+
Caragana scythica (Kom.) Pojark.	+	+	
Calophaca wolgarica (L. fil.)DC.	+	-	-
Tulipa schrenkii Regel.	+	-	-

* - **RBU** – Red Book of Ukraine; **ERL** – European Red List; **BC** - Bern Convention.

Moreover, there are three plant associations put to the Green Data Book of Ukraine, which are found as part of the steppe sections of the studied area (Table 3).

Table 3. Steppe plant associations included to the Green Book of Ukraine, which are found in the studied area

Item #	**English name**	**Scientific name**
1	Feather grass formation	*Stipeta lessengianae*
2	Needle grass formation	*Stipeta ucrainicae*
3	Dwarf feather grass formation	*Stipeta capillatae*

Meadow vegetation

Meadow vegetation is located in the low plots of the flood plains and former riverbeds in the contact zones of steppes with halophytic vegetation. The typical dominants of such complexes are *Elytrigia elongata*, *Elytrigia repens* and *Elytrigia preudocaesia* and the co-dominants are creeping meadow foxtail (*Alopecurus arundinaceus*) and others. Chee reedgrass (*Calamagrostis epigeos*), meadow brome (*Bromopsis riparia*), Poa angustifolia and others can also be very often observed in these associations. As of the time of observation, the meadow phytocenoses are very degraded plant associations. As a result of great grazing pressure, the gramineous basis is almost absent and its place is taken by annual species with wide ecological range not eaten by cattle. There was very often observed land trampled by cattle.

Halophytic vegetation
It occurs on saline soils confined to the low plots of the upper reaches of the Molochnyi Estuary. Most extended species here are: marsh samphire (*Salicornia europaea L.*), herbaceous seepweed (*Suaeda prostrata Pall.*), opposite leafed saltwort (*Salsola soda L.*), verrucous halimione (*Halimione verrucifera* (Bieb.) Aell.), stalked halimione (*Halimione pedunculata* (L.) Aell.), Ausher's saltbrush (*Atriplex aucheri* Moq.), Meyer's marsh-beet (*Limonium meyeri* (Boiss.) O. Kuntze), etc.

The halophilic vegetation does not usually have high projective cover here and has a relatively poor species composition. Plant associations with a pronounced role of one species accompanied by several others are common here.

Associations of succulent species are generated in a form of narrow belt around the periphery on wet loamy salines and on depressed plots of the coast.

Along the edge of the central part of the depression near the Village of Mordvynivka, associations of marsh samphire are generated accompanied by seepweed, common sea aster (*Tripolium vulgare Nees*), dwarf mud-grass (*Aeluropus littoralis* (Gouan) Parl.), verrucous halimione, opposite-leaf petrosimonia (*Petrosimonia oppositifolia* (Pall.) Litv.) and others.

Towards the periphery of the depression, wet salt marshes are replaced with vif solonchaks, on which the second narrow belt is generated of torose sarzasan (*Halocnemum strobilaceum* (Pall.) Bieb.) followed by the third belt of Caspian (*Limonium caspium* (Willd.) Gams.) and Meyer's marsh-beets.

No plant associations referred to the Green Book of Ukraine are represented in the area's halophytic vegetation.

Aquatic
This type of vegetation is confined to the Molochna River and the upper reaches of the Molochnyi Estuary. Due to high salinity of the surface waters, the flora and vegetation is quite poor and in some small landlocked salt embayments (girts) it is actually absent because of high saltiness of water and regular drying up in summer.
Aquatic vegetation. This group includes plant associations growing in water mass or on the surface of water level. The following species are common plants which create stable plant associations:

- fennel-leaved pondweed (*Potamogeton pectinatus* L.);
- star duckweed (*Lemna triscula* L.);
- morass-weed (*Ceratophyllum demersum* L.).

Aquatic and uliginous vegetation.
This group includes edaphophytes which have their rootage and the lower part of their stalk in water and the upper part with leaves and generative part above water.

Common reed (Phragmites australis (Cav.) Trin. ex Steud.) is the main dominant here. It is the prevailing plant that creates monodominant thickets in lakes and long the Molochna river banks. Narrowleaf cattail (*Typha angustifolia* L.) occurs much less often in the reed associations.

The vegetation becomes uliginous in landlocked damp depressions. Here we can observe such species as saltmarsh bulrush (*Bolboschoenus maritimus*), flowering rush (*Butomus umbellatus*), onescale spikerush (*Eleocharis uniglumus*), sofstem bulrush (*Schoenoplectus tabernaemontani*) and others.

Trees and shrubs
Arboreal species occur as man-made plantations (agricultural hedgerows) on agricultural lands and along roads and in a form of small standing forests.

Black locust (*Robinia pseudoacacia* L.) occurs most often as part of man-made tree plantations. In addition to the above species, the man-made tree plantations include maple ash (*Acer negundo* L.) and Tatarian maple (*A. tataricum* L.). Average age of the plantations is 40-50 years. There are virtually no younger plantations. Large portion of the plantations is in extremely poor state. As a result of cutting down, fires and drying up, actually all of them have transferred to a shrubwood state, with low quality of locality and productivity. Shrub species are significantly more numerous. Here we can observe Russian peashrub (*Caragana frutex*), specients of small-flowered black hawthorn (*Crataegus pentagyna*), black elderberry (*Sambucus nigra* L.) and brier (Rosa).

Individual specimens of Russian olive (*Elaeagnus angustifolia*) occur along the coast of the Molochnyi Estuary and along the Molochna River.

This type of vegetation does not include any protected species or any plant associations from the Green Book of Ukraine. It is also necessary to highligh the extremely important role of this vegetation type for the region. It serves for protection of the arable lands from air erosion, moisture retention during the winter period, as well as plays environment and landscape forming role.

Flora is given in Appendix 3 and Appendix 4.

3.8 Animals

3.8.1 Birds

The detailed birds' data on the building sites are shown in Appendix 3 and Appendix 4. Following is a summary of the key information contained in the monitoring of birds. The methodology of birds on wind farm is described in the Appendix 4.

Wind Farm Area

Territories for monitoring were determined in coordinate system in the first years of execution of works and were compulsory during following years. They included monitoring territories, transects, migration points within the wind farm sites No. 1 and No. 2 and buffer zones (Figure 5). Important complex monitoring plots in the adjacent territories are: – coastal plots and water area of the Molochnyi Estuary (outskirts of Dunaivka Village); – coastal plots of upper reaches of the Molochnyi Estuary (between the Villages of Girsivka and Mordvynivka).

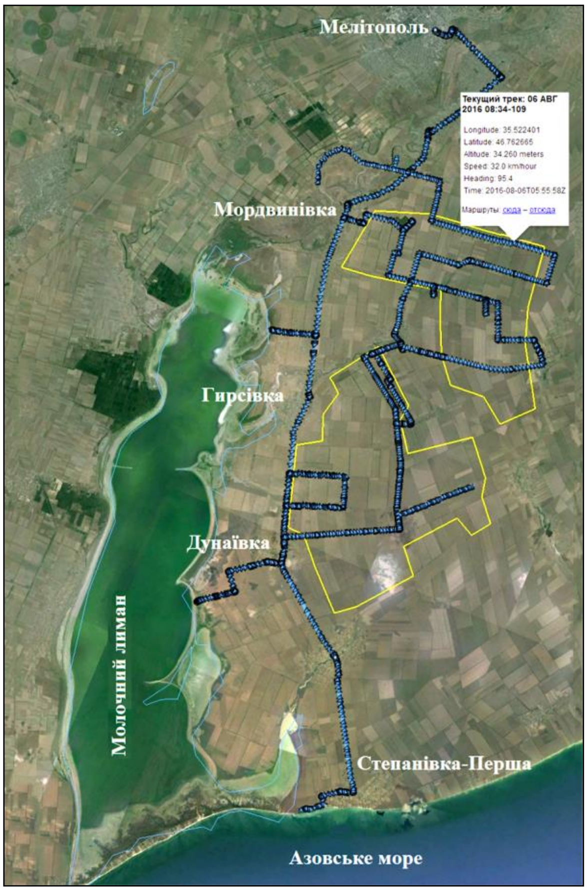

Figure 5. Classic route for carrying out of researches (birds and bats) (- boundaries of wind farm

Migration monitoring grounds for census of birds

At this stage of design activity on creation of the sites WP 1 and WP 2 with total power of 576.15 MW and carrying out of monitoring works, three migration monitoring grounds were established in 2016 (Figure 6). Location and functional meaning of the grounds is characterized by following features.

Figure 6. Layout diagram of migration monitoring grounds (1 - 3)

Migration monitoring ground No. 1 (Figure 6) is located in the designed territory of the wind farm site No. 1 (northern territory). Characterizes the state of migratory complexes within agrocenoses and agricultural hedgerows and is a matrix also for description of the wind farm site No. 2 (southern one). This territory mainly characterizes migratory state of land birds (feeding and transit) and transit semi-aquatic birds. In general terms, obtained information on bird migrations in the designed territory of the wind farm reflects the species composition of land birds, their quantity and seasonal activity.

Migration monitoring ground No. 2 (Figure 6) is located in adjacent territories (partially include buffer zone of 2 km) to the wind farm sites and includes coastal plots and water area of the Molochnyi Estuary. Researches enable assessment of seasonal migratory complexes of semi-aquatic birds and their feeding migration to the wind farm sites. Partially characterizes the state of transit migrations of semi-aquatic birds.

Migration monitoring ground No. 3 (Figure 6) is located on the Stepanivska Spit (near Stepanivka Village), at the distance of 11 - 18 km from the wind farm site. This migration monitoring ground exists in the course of last 15 years for the control of transcontinental migrations and seasonal gatherings of semi-aquatic birds of migratory complex. Monitoring data from the ground No. 3 are important for determination of the place of the wind farm sites in the main migratory corridors of semi-aquatic birds. For example, on 18 - 19.07.2016 transit migrations of Arctic birds were observed at this ground. At the same time transcontinental migrations at the wind farm sites practically have not been observed. It is quite clear that different types of biotopes have also different migratory properties both on species composition and quantity.

List of compulsory monitoring parameters
Description of seasonal ornithological complexes within the wind farm sites, buffer zones of 1 - 2 km, adjacent territories included following main parameters:

1. Species description of seasonal ornithological complexes
2. Quantity and dynamics of seasonal ornithological complexes
3. Frequency of bird observing by time and biotopes
4. Directions of migrant passages, including feeding and transit ones
5. Altitude characteristics of migrations and feeding movements
6. Behaviour characteristics of birds during the period of migrations within the wind farm site
7. Degree of the wind farm site attractively for seasonal ornithological complexes
8. Trophic migrations and usage factor of biotopes as forage plots
9. Determination of influence factors of anthropogenic and natural character on the state of seasonal ornithological complexes.

Description of ornithological complex in the winter period of 2012/2013
Special field researches were carried out on the 26 of January 2013. Plots of the Molochnyi Estuary from its upper reaches to the lower part have been observed.

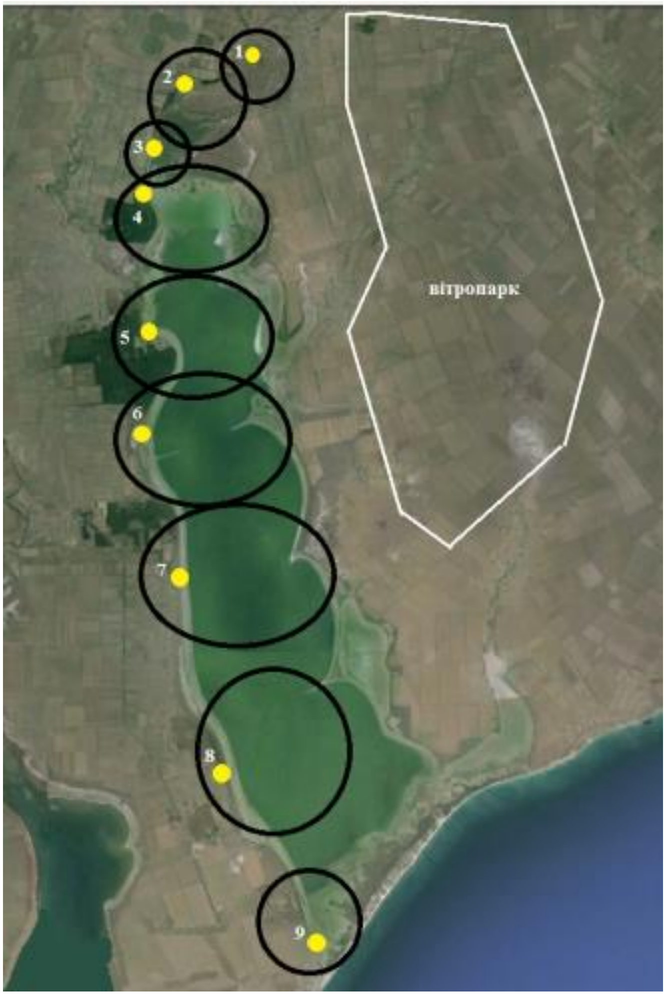

Figure 7. Observation point and areas included in the consuses on January 26-27, 2013

According to the results of winter count carried out on the 26 of January 2013, diversity of birds numbered was 32 species with total quantity of 24 820 birds. The upper part of the Molochnyi Estuary (observation points 1 - 4 in Figure 7) became a refuge for 2 654 specimens (or 10.7% of all registered), 14 300 specimens (57.6%) were registered in the middle part (points 5 – 7 in Figure 7), and 7 866 specimens (31.7%) were observed in the lower part of the estuary (points 8 – 9 in Figure 7). So we can see that birds use the area of the whole estuary unevenly, preferring its middle and lower parts. Species diversity on these plots of the Molochnyi Estuary had other regularities. Most of all – 26 species were registered in the upper part, and in the middle and the lower parts of the estuary - 17 and 16 respectively.

Representatives of wetland complex dominated, namely, common gull – 20 090 specimens, mute swan – 1 240 specimens and common shelduck – 1 018 specimens. Only these three species made up 90% of all birds.

Description of the ornithological situation in winter period of 2013/2014

Researches of ornithological situation in the winter period of 2014 have been carried out within all-European Christmas bird censuses. Depending on weather-climatic conditions, the execution of works was carried out during the most suitable periods for registration of winter ornithological complex before the beginning of pre-migration change of behaviour. Those very conditions were observed during the second ten days of February. Our researches were carried out on the 13 - 14 of February, 2014. Counts comprise the territory adjacent to the wind farm owned by EuroCape Ukraine Company within the part of Pryazovske district (the Villages of Dobrivka, Georgiyivka, and Novokostiantynivka). Both territories of agricultural areas, agricultural hedgerows and man-planted wood areas, and water area of the Tubalskyi Estuary and the Sea of Azov in the outskirts of the Villages of Novokostiantynivka and Prymorskyi Posad are included.

In 27 - 29 of January the accessibility of forage on the agricultural fields within the wind farm owned by EuroCape Ukraine Company was extremely hard, therefore most of birds, especially of synanthropic group, stayed near the residential settlements. These were, first of all, the representatives of perching birds (*Passeriformes*): rook (*Corvus frugilegus*), European starling (*Sturnus vulgaris*), hooded crow (*Corvus cornix*), European magpie (*Pica pica*), and Eurasian tree sparrow (*Passer montanus*).

All recorded birds (710 specimens, 100% of the total number), which were registered during the censuses within the buffer zones and in the adjacent territories, had been observed either on the ground or in flight within the altitude interval under 20 m (128 specimens). So, 582 specimens (82%) were registered directly on the ground, 9 specimens (1.3%) - at the altitude up to 5 metres, 89 specimens (12.5%) - over 5 to 10 m, 17 specimens (2.4%) - over 10 to 15 m and 13 specimens (1.8%) - over 15 to 20 m. Such data are anticipated and the pattern of birds' distribution by the altitudes of flights is traditional for winter period, when birds perform only feeding migrations in search of forage at small altitudes.

Description of the ornithological situation in winter period of 2016

In 2016, cold weather of the third ten-day period of January the forage resources on the agricultural fields within wind farm were impoverished, therefore most of birds, especially of synanthropic group, stayed near the residential settlements. These were, first of all, representatives of perching birds (*Passeriformes*): rook (*Corvus frugilegus*), European starling (*Sturnus vulgaris*), hooded crow (*Corvus cornix*), European magpie (*Pica pica*), and Eurasian tree sparrow (*Passer montanus*).

25 species of birds with the total number of 555 specimens have been registered in all, according to the results of ornithological research carried out within wind farm, buffer zones and adjacent territories on the 30 of January, 2016.

All registered birds pertained to 6 taxonomic series – goose-like birds (*anseriformes*), birds of prey (*falconiformes*), fowl-like birds (*galliformes*), shore birds (*charadriiformes*), pigeons (*columbiformes*) and perching birds (*passeriformes*). Representatives of perching birds were dominating – 12 species with the total number of 307 specimens; shore birds – 3 species with quantity of 118 specimens and goose-like birds – 3 species with quantity of 78 specimens were subdominants.

The buffer zones attracted shore birds (black-headed gull), pigeons (woodpigeon) and perching birds (219 specimens, 39.5%), and 205 specimens of 5 taxons (36.9%) were observed in the adjacent territories.

Western direction prevailed among directions of feeding migration movements of wintering birds. 65 specimens (52.0% of the total number of migrants) flew in this direction. Mainly they were starling and Eurasian tree sparrow. Also there were a certain percentage of birds, which flew in the southern (19.2%), north-eastern (11.2%) and northern (10.4%) directions (generally they were semi-aquatic birds), in other directions passage of birds was not numerous.

Following species listed in the Red Data Book of Ukraine (2009) were registered in the course of censuses in January 2016: hen harrier (*Circus cyaneus*) – 1 specimen and white-tailed eagle (*Haliaeetus albicilla*) – 1 specimen in the adjacent territories.

The overwhelming majority of recorded birds (555 specimens, 100% of the total bird quantity), which were registered at wind farm site, within the buffer zones and in the adjacent territories, had been observed either on the ground (430 specimens) or in flight within the altitude interval under 50 m (125 specimens). So, 430 specimens (77.5%) were registered directly on the ground, 96 specimens (17.3%) - at the altitude up to 5 metres, and 29 specimens (5.2%) - from 5 to 10 m, at higher altitudes birds have not been recorded. Such data are anticipated and the pattern of birds' distribution by the altitudes of flights is traditional for winter period, when birds perform only feeding migrations in search of forage.

Description of ornithological situation during the spring migration of 2014

All birds registered in the spring passage pertain to 12 taxonomic series – pelicans (*pelecaniformes*), grebes (*podicipediformes*), goose-like birds (a*nseriformes*), crane-like birds (*gruiformes*), fowl-like birds (*galliformes*), hoopoe-like birds (*upupiformes*), birds of prey (*falconiformes*), shore birds (*charadriiformes*), owl-like birds (*strigiformes*), swift-like birds (*apodiformes*), pigeons (*columbiformes*) and perching birds (*passeriformes*). Representatives of perching birds were dominating – 19 species; subdominants: anseriformes – 10 species and shore birds – 11 species. Availability of high species diversity resulted in high quantity of birds of a concrete group. So, perching birds (4 430 specimens) head the list, then shore birds (3 311 specimens) and anseriformes (2 165 specimens) follow.

Perching birds had the highest species diversity both in March and in April, and dominated also quantitatively. But such tendency has been lost for the representatives of perching birds in the adjacent territories (the Molochnyi and Tubalskyi Estuaries) in March. Anseriformes (8 species, 1 479 specimens) occupied the first position, shore birds (6 species, 557 specimens) – the second one, but perching birds were only the third (9 species, 244 specimens).

The situation radically changed in April. High diversity of the representatives of perching birds was not observed in the adjacent territories at all; shore birds (9 species, 1 034 specimens) occupied the first position and anseriformes (5 species, 395 specimens) – the second one.

In general, the situation was different in the adjacent territories of high diversity. Representatives of anseriformes (10 species, 1 874 specimens) dominated here in spring 2014, and then followed shore birds (10 species, 1 600 specimens). Only 9 species, 244 specimens of perching birds were observed.

The total quantity of 52 registered species of birds is 10 572 specimens, 6 708 specimens of which (or 63.5% of all registered birds) were observed in the buffer zones and in the territories adjacent to the wind farm, and 3 867 specimens (36.5%) – at the monitoring plots of high biological diversity (the Molochnyi and Tubalskyi Estuaries). Such correlation of birds by different territories is unusual, owing to small area of the wind farm in comparison with the area of the adjacent plots, and higher diversity of biotopes in the latter.

The most numerous were rook (*Corvus frugilegus*), Mediterranean gull (*Larus melanocephalus*) and European starling (*Sturnus vulgaris*), 4 189 specimens of which were observed. Quantity of other bird species was 2 519 specimens. 2 068 specimens of semi-aquatic birds have been registered and 4 637 specimens of upland birds.

4 species of birds listed in the Red Data Book of Ukraine were recorded in the researched territory in spring 2014. The pattern of their distribution has following features. Out of 4 bird species recorded in spring, 1 species (whimbrel - *Numenius phaeopus*) had been observed at the Tubalskyi Estuary, other 3 species (red-crested pochard - *Netta rufina*, black-winged stilt - *Himantopus himantopus*, pied avocet - *Recurvirostra avosetta*) – at the Molochnyi Estuary.

North-eastern (34.2%), northern and eastern directions prevailed among passage directions.

High-altitude bird movements in spring 2014 were distributed in the following way. In March the vast majority of birds (2 372 specimens, or 96.3% of the total number of birds) was observed either on the ground (1 569 specimens) or in flight within the altitude interval under 50 m (803 specimens). Only 135 specimens (3.7%) of birds were recorded within the interval of 50 - 100 m. In April such tendency has remained further. 1 151 specimens or 100% of birds were observed within the altitude interval under 50 m. Also there are certain regularities in the passage of feeding and transit migrants. The situation with feeding migrants in March is interesting: 25% of birds stayed on the ground or near it and 43.1% - at the altitude of 10 - 25 m that differs from April (65.1 and 18% respectively). Such data are anticipated and the pattern of birds' distribution.

Description of ornithological situation during the spring migration of 2016

All birds registered in the spring passage pertain to 11 taxonomic series – grebes (*podicipediformes*), pelicans (*pelecaniformes*), ciconiiformes (*ciconiiformes*), goose-like birds (*anseriformes*), birds of prey (*falconiformes*), fowl-like birds (*galliformes*), crane-like birds (*gruiformes*), shore birds (*charadriiformes*), pigeons (*columbiformes*), hoopoe-like birds (*upupiformes*) and perching birds (*passeriformes*). Representatives of perching birds were dominating – 25 species; subdominants: shore birds – 12 species. Availability of high species diversity resulted in also high quantity of birds of the concrete group. So, perching birds (1 354 specimens) head the list, then shore birds (923 specimens) follow, and then anseriformes (301 specimens).

Perching birds had the highest species diversity within the wind farm in March, which were dominating quantitatively (17 species, 238 specimens) at this time, anseriformes (1 species, 65 specimens) took up the second position, and shore birds (2 species, 26 specimens) were the third. In the adjacent territories, shore birds (7 species, 103 specimens) were dominating in March; anseriformes (4 species, 54 specimens) were subdominants.

The situation has not changed much in April. In the territory of the wind farm ark perching birds (22 species, 938 specimens) also took up the first position, and shore birds (2 species, 185 specimens) – the second one. And in the adjacent territories shore birds (12 species, 609 specimens) were dominating, perching birds (10 species, 155 specimens) - subdominants.
The total quantity of 54 registered species of birds is 2 702 specimens, 754 specimens of which (or 27.9% of all registered birds) were observed directly at the sites of wind farm, 861 specimens (31.9%) – in the buffer zones of 1 and 2 km, and 1 087 specimens (40.2%) – in the adjacent territories. Such correlation of birds by different territories is slightly unusual, owing to relatively small area of the wind farm in comparison with the area of the adjacent plots, and higher diversity of biotopes in the latter, and may be caused by transit migratory movements of birds through the territory of the designed wind farm ark.

European starling (*Sturnus vulgaris*), greater white-fronted goose (*Anser albifrons*) and corn bunting (*Emberiza calandra*) were the most numerous at the wind farm sites and in the buffer zones, 848 specimens of them (or 46.1%) were observed. Quantity of other bird species was 993 specimens. 612 specimens of semi-aquatic birds and 1 229 specimens of upland birds have been counted at the wind farm sites and in the buffer zones.

In consideration of the location of the Molochnyi Estuary Wetland near to wind farm sites, the domination of semi-aquatic bird species would be expected in the adjacent territories; analysis of obtained results shows just very regularity. So, 896 specimens (or 82.4%) of bird species that are biotopically attracted to wetlands have been registered here over the whole period of spring observations.

Following species dominated here: ruff (*Philomachus pugnax*), black-headed gull (*Larus ridibundus*) and dunlin (*Calidris alpina*). Quantity of upland species in the adjacent territories was 191 specimens over the whole period of observations. The most numerous among them were white wagtail (*Motacilla alba*), European starling (*Sturnus vulgaris*) and yellow wagtail (*Motacilla flava*).

North-eastern (49.2% of all migrants) and northern (30.5%) directions prevailed among directions of the spring passage. 1 412 specimens flew in these directions. Generally they were semi-aquatic birds (gulls, ruff and greater white-fronted goose), as well as small perching birds (corn bunting, wagtails and starling). In addition, migration bird movements were observed in southern (152 specimens, 8.6%), eastern (72 specimens, 4.1%) and north-western (64 specimens, 3.6%) directions. Birds' passage in other directions was not numerous.

Such directions are typical for given terrain and season, and a little percentage of migrants that flew in southern direction may be explained by feeding movements of perching birds and shore birds.

When analysing the directions of migration in different months of observations, we shall say about the classical pattern of passage both in March and in April (the majority of birds flew to the north and the north-east)

3 species of birds listed in the Red Data Book of Ukraine were recorded in the researched territory in spring 2016: pied avocet – *Recurvirostra avosetta*, Eurasian oystercatcher – *Haematopus ostralegus* and Eurasian curlew – *Numenius arquata*. All of them have been observed in the adjacent territories.

High-altitude bird movements within wind farm and adjacent territories in spring 2016 were distributed in the following way. In March the majority of birds (192 specimens, or 70.8% of the total number of migrants), which were registered at the sites of wind farm, within buffer zones and in the adjacent territories, had been observed either near the ground (192 specimens) or in flight within the altitude interval under 25 m (33 specimens). There has not been counted any flock in the interval of 50 - 170 m potentially dangerous for birds. Besides, 93 specimens (29.2%) of birds were counted at the altitudes over 200 m.

In April the tendency has slightly changed. 1 315 specimens, or 90.5% of birds were observed within the altitude interval under 50 m. 138 specimens (9.5%) more were registered at the altitudes over 200 m. Also there are certain regularities in the passage of feeding and transit migrants. If transit migrants selected altitudes up to 10 m (small perching birds) – 30.6%, 25 - 50 m (gulls, cormorant, rook) – 49.2% and over 300 m (greater white-fronted goose), then feeding migrants were counted mainly near the ground (69.5%), or at the altitudes of 10 - 25 m (23.0%). Such data are anticipated and the pattern of birds' distribution by altitudes of flights is traditional for the territory of the wind farm sites and for this season.

Description of the nesting ornithological complex in 2014

Current assessment of ornithological situation within the wind farm site and buffer zones during nesting period was carried out on 20 - 22.04.2014 and on 20 - 21.05.2014.

Assessment of ornithological situation in the buffer zones (1 - 2 km) during the nesting period of 2014

Bird nesting complex in the buffer zones includes birds of anthropogenic complex and partially birds of saline biotopes.

In 2014 following species were dominating: European starling (*Sturnus vulgaris*), sparrows (house – *Passer domesticus* and Eurasian tree – *Passer montanus*), European greenfinch (*Chloris chloris*), barn swallow (*Hirundo rustica*), crested lark (*Galerida cristata*), white wagtail (*Motacilla alba*), and hoopoe (*Upupa epops*). Due to considerable areas of the residential settlements, the complex is characterized by relatively large quantity of birds and numbers approximately 280 – 320 nests. Species listed in the national or international Red Lists have not been registered within these biotopes.

Agricultural areas with agricultural hedgerows. Open spaces (agricultural areas) and agricultural hedgerows with different state of tree and shrub plantations prevail in the anthropogenic complex of agricultural areas within 1 - 2- km zone of the project. Skylark (*Alauda arvensis*) is a dominating nesting species of agricultural areas. Single nesting couples of grey partridge (*Perdix perdix*) have been registered. Tree and shrub complex of birds in the buffer zones is slight by its species composition and quantity. Following species are dominating at nesting: common kestrel (*Falco tinnunculus*), hooded crow (*Corvus corone*), European magpie (*Pica pica*), lesser grey shrike (*Lanius minor*), common whitethroat (*Sylvia communis*), European greenfinch (*Chloris chloris*). Vigorous plural-row agricultural hedgerows with shrubs are a place of nesting mainly for perching birds. Other agricultural hedgerows are without shrubs, but with tall trees, in which mostly small birds of prey and Corvidae family are found, the quantity of perching birds here becomes considerably less. Birds listed in the national or international Red Lists also have not been recorded in ornithological complex of this type of biotopes.

Birds of mentioned biotopes located in the buffer zones occasionally use the wind farm site as a feeding territory. Operation of the wind farm does not pose a threat to any of species - inhabitants of the biotopes of anthropogenic complexes, and possible impact shall be characterized as very low. It is caused by such facts that, first of all, dimensions of feeding plots for the overwhelming majority of species are small in area, and secondly, coincide with the location of nesting territory. Only two bird species (European starling – *Sturnus vulgaris* and barn swallow – *Hirundo rustica*) were registered within the wind farm site during the period of feeding migrations. The wind farm site does not pose a threat to these species, as their quantity is very small, and altitudes of movement do not exceed 10 m.

Semi-aquatic complexes are partially situated only within 2- km zone and include the coastal territories of the Molochnyi Estuary and flood plain plots of the Molochna River. Practically there are no semi-aquatic ornithological complexes in connection with the lack of water in the major part of the Molochnyi Estuary in 2012 – 2014. Saline and partially meadow phytocenosis were the main biotopes. Following species have been recorded: Northern lapwing (*Vanellus vanellus*), white wagtail (*Motacilla alba*), yellow wagtail (*Motacilla flava*), northern wheatear (*Oenanthe oenanthe*), common redshank (*Tringa totanus*), and pied avocet (*Recurvirostra avosetta*). Probably the nesting complex of these biotopes numbered approximately 40 - 65 nests in 2014. Operation of the wind farm does not pose a threat to these birds, and it is caused by following factors:

- nesting ornithological complex is represented only by semi-aquatic species of birds, life cycle of which takes place outside the wind farm;
- small quantity of birds;
- low active feeding movements in 1 - 2- km zones are characterized by safe altitude interval of 5 – 10 m.

Assessment of ornithological situation within the site of wind farm during the nesting period of 2014

In 2014, 22 species of birds were registered during nesting at the wind farm site.

By biotopic distribution, birds of agricultural hedgerows dominated (12 species), 8 species - in the man-planted forest, and only 2 species - within the agricultural areas. Censuses of 2014 enable to state following. The major quantity of bird species (12) was registered in the agricultural hedgerows and was the most numerous – 249 nests. 9 species were registered in the man-planted forest area, but with small quantity – 11 nests. Nesting complexes of birds of open biotopes were represented exclusively by two species – skylark (*Alauda arvensis*) and common quail (*Coturnix coturnix*), also with small quantity (38 nests). The last biotope is the largest in area, but density of nests' placement is characterized by rather low indices.

The most important factor, which influences the formation of nesting complexes at the agricultural areas, is annual crop rotations that set the selection of these territories for nesting in direct dependence on the kind of cultivated products.

According to the results of censuses, 298 nests of birds were registered within the wind farm site in 2014. Rook (*Corvus frugilegus*) is the dominant in nesting – 250 nests. In consideration of the total area of the wind farm territory, the quantity of other species is extremely small. So, only for skylark (*Alauda arvensis*) 36 nests have been recorded, and for all other species nesting quantity is 1 – 2 couples. 50 points of birds' nesting have been registered and it characterizes very low density of nest distribution.

According to data of the censuses of 2014, 3 rookeries of rooks have been registered within the wind farm site.

Colonies of rook (*Corvus frugilegus*) in buffer 2- km zone are the important factor of nesting quantity. 4 colonial habitations with the total quantity of 1 120 nests have been recorded. Degradation of these colonies is observed in recent years. Feeding migrations of birds from these colonies to the wind farm site has been recorded lately, but altitudes of their movement are 10 – 15 m.

Description of the ornithological situation during the nesting period 2016

Study of birds during the nesting period was carried out in the course of several field visits, which covered the territory of the wind farm, buffer zones in 1 and 2 km, with compulsory investigation of the adjacent territories (plots of upper and middle part of the Molochnyi Estuary). It shall be noted that phenological terms of nesting period for different species are very time-expanded, that is why first observations of nesting behaviour have been started during the study of migration state of birds in April, when nesting behaviour is typical for the majority of species (herons, cormorants, gulls, larks, starlings and others). Observations in May gave indubitable evidences of nesting of different species in the researched territory, since almost all birds were sitting on nests. So, collection of information on ornithological situation during nesting period was carried out on: April 23 - 25, May 10 - 15, as well as June 28, 2016.

Assessment of ornithological situation in the territory of wind farm

Out of 44 bird species, which were observed over the whole territory of researches, 33 ones (or 75.0%) were recorded at the wind farm site. Quantity of these species was 652 specimens, or 46.8% of all registered birds.

The majority of birds are nesting; however, the wind farm territory is visited also by non-nesting species (gulls, herons). Special investigations gave information about 26 species of birds, nesting of which had been proved. As proved nesting we understand the availability of a nest, nestlings, nesting behaviour (mating song, «drawing aside» from a nest, courtship display, aggressive behaviour etc.) or those facts when destroyed nests, dead nestlings, eggs have been found. Thus, the total quantity of nests in the territory of wind farm reaches 200. In consideration of extremely hiding behaviour of certain bird species (lark, partridge, quail, owls, warblers and others), undercount according to our estimations is about 20%, which enables to assert the availability of about 250 nests of not less than 30 bird species in the territory of the wind farm and its buffer zones.

Rook (*Corvus frugilegus*) was dominating species. 4 colonies of rook had been revealed within wind farm sites, 3 of them were inhabited during the nesting period of 2016. It shall be said that 3 colonies have been recorded within upper (Site 1) wind farm site, and one more – in 1- km buffer zone.

As regards other representatives of Corvidae family, which nest in the territory of wind farm sites, was found the nests of hooded crow (*Corvus cornix*) (6 nests) and European magpie (*Pica pica*) (4 nests). Colonies of hooded crow together with rook have not been revealed within wind farm sites. All of them were located individually, except for one nest, near which also the nest of little owl (*Athene noctua*) was recorded. Birds built their nests in the agricultural hedgerows in the trees of black locust (*Robinia pseudoacacia* L.).

Colonies of European magpie together with rook also have not been revealed in the territory of wind farm sites. All 4 nests were located one by one, and 3 of them at that were at the wind farm sites and one more – in 1-km buffer zone. As in the case of other Corvidae, birds built their nests in the agricultural hedgerows in the trees of black locust (*Robinia pseudoacacia* L.).

So, when carrying out research on distribution of nests of single species of Corvidae family, 6 nests of hooded crow (1 nest is included in group colonies and 5 nests of individual nesting) and 4 nests of European magpie (all of them – nests of individual nesting) have been found within wind farm sites. Quantity of other bird species is extremely small and lies within the range from individual nests of concrete species (scops owl, little owl, common kestrel, and yellowhammer) to several couples (lark, garden warbler).

The overall composition of ornithological complex of wind farm sites includes 33 species of 8 taxons, out of which 19 species (57.6%) pertain to perching birds series with quantity of 535 specimens, or 82.1%.

When comparing species diversity and quantity of birds at individual plots, we shall state that the wind farm sites with the largest indices of species diversity (33 species) have also the highest indices of bird quantity (652 specimens, 46.8%) mainly at the expense of rook colonies and occurrence of certain percentage of birds that do not breed. Paradoxical situation had emerged in the adjacent territories: both the smallest species diversity and the lowest birds' quantity were observed there.

<u>Ornithological situation in the buffer zones (1 - 2 km) during the nesting period of 2016</u>
Nesting complex of birds within 1- and 2- km zone of the project is represented mainly by the birds of anthropogenic complex. Special attention was paid to one-kilometre buffer zone, as the nearest to the designed wind farm sites.

Anthropogenic complexes, which are the place of birds' nesting, in turn, are represented by two types: rustic units (villages) and agricultural areas with agricultural hedgerows.

Rustic units. Nesting ornithological complex of rustic units located within the buffer zones of the project is typical for the maritime villages of the region, with identical species composition of birds. Usually these are such species as: European starling (*Sturnus vulgaris*), sparrows (house – *Passer domesticus* and Eurasian tree – *Passer montanus*), barn swallow (*Hirundo rustica*), crested lark (*Galerida cristata*), white wagtail (*Motacilla alba*), European greenfinch (*Chloris chloris*), and hoopoe (*Upupa epops*). There are no species listed in the national or international conservation lists among them. In 2016, birds at nesting were not recorded here, but such ones, which had not bred, were observed.

Agricultural areas with agricultural hedgerows. Open spaces (agricultural areas) and agricultural hedgerows with different state (by vigour and age) of tree and shrub plantations prevail in the anthropogenic complex of agricultural areas within 2- km zone of the project. Skylark (*Alauda arvensis*) is a dominating nesting species of agricultural areas, but it is characterized by very small quantity. Single nesting couples of grey partridge (*Perdix perdix*), common quail (*Coturnix coturnix*) and tawny pipit (*Anthus campestris*) have been registered. Tree and shrub complex of birds in the buffer zones is slight by species composition and quantity. Following species are observed at nesting here: rook (*Corvus frugilegus*), common kestrel (*Falco tinnunculus*), European magpie (*Pica pica*), lesser grey shrike (*Lanius minor*), garden warbler (*Sylvia borin*), woodpigeon (*Columba palumbus*), European greenfinch (*Chloris chloris*) and yellowhammer (*Emberiza citrinella*).Vigorous multi-row agricultural hedgerows with shrubs are a place of nesting mainly for perching birds. Other agricultural hedgerows are without shrubs, but with tall trees, in which mostly small birds of prey and Corvidae family are found, the quantity of perching birds becomes considerably less. The birds listed in the national or international Red Lists also have not been recorded in the ornithological complex of this type of biotopes. On the whole, 67 nests of 12 species have been registered in 1- km buffer zone, out of 200 nests of 26 species.

<u>Ornithological situation in the adjacent territories during the nesting period of 2016</u>
Gatherings of migrating birds are typical for these territories in the course of spring migration. However, since the Molochnyi Estuary was separated from the Sea of Azov in recent years, and existed in semi-closed mode, its salinity has risen considerably, but the area of water zone has decreased. Semi-aquatic ornithological complexes were practically absent in connection with lack of water on the major part of the Molochnyi Estuary in 2012 - 2014. Saline and partially meadow phytocenosis were the main biotopes.

The total quantity of recorded birds here was 220 specimens of 14 species. Birds had not created considerable gatherings at this period of annual cycle; on the whole, only 15.8% of recorded birds were observed in the adjacent territories.

Situation with the species listed in the Red Data Book of Ukraine – Eurasian curlew (*Numenius arquata*) deserves special consideration.

Comparative characteristic of nesting ornithological complex by the results of monitoring researches in 2014 and 2016
Species composition of nesting ornithological complex. In 2014 - 2016 nesting ornithological complex of these territories included 28 species. 22 species were recorded at nesting within the wind farm sites in 2014, and 26 species – in 2016. Number of species of nesting birds was slightly larger at Site No. 1 (2014 – 18 species, 2016 – 22 species) and fewer their quantity was recorded within Site No. 2 (2014 – 15 species, 2016 – 19 species). In spite of the fact that design dimensions of Site No. 2 are considerably larger than of Site No. 2, small majority of nesting birds have been registered at the latter. These indices, from our point of view, are connected with larger diversity of biotopic complexes within Site No. 2 (man-planted forest area, natural steppe and shrub vegetation in the wadies of small rivers). At the same time, Site No. 2 is mainly represented by agrocenosis with agricultural hedgerows. In comparison with 2014, following bird species, which had not been observed before, were recorded in 2016 - turtle dove (*Streptopelia turtur*), chaffinch (*Fringilla coelebs*), red-footed falcon (*Falco vespertinus*), hoopoe (*Upupa epops*), little owl (*Athene noctua*), scops owl (*Otus scops*). At the same time, following species, which had been registered in 2014, were not recorded in the censuses of 2016 - great tit (*Parus major*), tree pipit (*Anthus trivialis*). It is possible that such differences are mainly connected also with undercount of nesting birds.

Quantity. Difference between the total quantity of nesting ornithological complexes by years, in comparison, is: 298 nests in 2014; 239 nests in 2016. Slight fluctuations of quantity are mainly connected with change in the number of rook (*Corvus frugilegus*) nests, which is a dominant by quantity as compared to the whole nesting ornithological complex: in 2014 - 72.2%; in 2016 -

63.6%. Quantity of rooks within the wind farm sites decreased by 52 nests in 2016. It shall be noted that number of rook (*Corvus frugilegus*) colonies decreased considerably also in the adjacent territories. So, in 2014 number of colonies in these territories was 1 120 nests, and in 2016 they were absent.

Description of the ornithological situation during the autumn migration 2014

Beginning of the period of post-nesting birds' migrations and creation of pre-migration gatherings falls on the middle of August. The majority of birds have lost relation with nesting territories by this time and move freely throughout the region.

Researches were carried out on 13 - 15.08.2014. Counts cover the water areas of the Molochnyi Estuary and adjacent biotopes (agricultural fields and agricultural hedgerows, as well as residential settlements).

All registered birds are divided into three plots, in accordance with biotopes. The northern part covers the territory from the place where the Molochna River flows into the estuary and till the Village of Girsivka. The middle plot stretches between the Villages of Girsivka and Okhrimivka. The southern part includes the lower part of the Molochnyi Estuary and adjacent territories. According to results of the censuses 64 bird species in all with the total number of 15 519 specimens have been registered. Gradual increase in birds' quantity is observed from the north to the south, and considerable increase in species diversity has been recorded at the south plot.

Black-headed gull (5 864 specimens) and ruff (5 773 specimens) were indubitable dominants. Only these two species formed 75% of all registered ones. The northern plot did not have large bird gatherings, and the total quantity of the most distributed here barn swallow was 235 specimens. Ruff was a background species in other places. Such situation is typical for August. Just these very species (black-headed gull, ruff and barn swallow) start their slow movement to the south at this period, forming large gatherings in the Azov and Black Sea region.

When analysing birds' behaviour for the purpose of determination of their attraction to the sites of the wind farm, we considered dominants, which are characterized by wide spatial movement in search of forage, roosts, or in the course of migration passages.

In September 2014 the counts were carried out thrice, it enabled to trace the dynamics of change of species composition of birds during autumn migration and the fluctuation of quantity. Standard routs in the upper part of the Molochnyi Estuary were included in the counts. Special attention was paid to waterfowl, owing to their large quantity and high flying activity during daylight hours.

44 species in all were registered in September. Species diversity had slight deviations during all September counts and was equal to 25 - 27 species. However, species composition had some distinctions. A number of species were observed only in early September (6.09) and were absent on other census days (Montagu's harrier, Eurasian wigeon, broad-billed sandpiper, gull-billed tern). Instead other species were registered only at the end of month (22.09) – Eurasian sparrowhawk, sanderling, slender-billed gull and others. Such change of species composition is caused by migratory waves and periods of domination of one or another taxon.

In October 2014 researches were carried out within the same monitoring plot, as in September (upper reaches of the Molochnyi Estuary). It shall be noted that October is a period of active migration of not only local bird species, but also many northern populations. Just such change of species composition we have observed in the course of censuses.

Such "northern" species as white-fronted goose, Eurasian wigeon, and common crane have appeared in the region. Distinct dynamics of growing quantity is observed for some species – common shelduck, Northern pintail, common teal, Eurasian wigeon; reduction for other group – black-headed and slender-billed gulls, ruff.

The total quantity of birds at the end of September and in October is comparatively the same. Changes of species composition took place, but common shelduck dominated, as the upper reaches of the Molochnyi Estuary were very attractive for it in October. Only this species was registered with quantity almost 70% of the total one.

Censuses, which were carried out on the 11 of November at the monitoring permanent point at the upper reaches of the Molochnyi Estuary, indicate the ceasing of migratory process for the majority of bird species, which is followed by reduction in species diversity and the total quantity.

Registration of rough-legged buzzard, hen harrier, white-winged lark and great grey shrike is the change indicator of species composition of the ornithological complex in November. All these species are typical migrants and appear in our region at the end of autumn migration. Usually all of them stay in the south of Ukraine during winter period.

Reduction in quantity of common shelduck indicates the redistribution of places of migration stops and gatherings, as well as birds' flying away to the traditional wintering areas at the Central Syvash.

Following species had the largest quantity: common shelduck (over 5 000 specimens), slender-billed gull (over 4 000 specimens) and black-headed gull (about 2 500 specimens). Quantity of other species was considerably less.

Researches of ornithological situation during autumn migration were also carried out on the 5 - 6 of November, 2014. Migrants registered in the course of active passage, and this is only 4 bird species, were observed singly (hen harrier – 9 occurrences), or in flocks of from 7 (mallard) to 450 (white-fronted goose) specimens. Mean size of flocks varied from 1 (hen harrier) to 1 451 (white-fronted goose) specimens in a flock. This result shall be considered high, since birds form migration gatherings during seasonal and especially autumn migrations. In addition, we see that white-fronted goose dominates among migrating birds, it has been observed in 16 flocks, from 36 to 450 specimens in a flock. The total quantity of migrants is 2 398 that are 39.9% of all registered birds.

The part of birds, which were not migrating but were observed during counts, comprises 32 species with quantity of 3 609 specimens. Ducks, black-headed gull and rook dominated. These species made up almost 70% of all registered ones.

The overall picture of birds' autumn migration in the Azov and Black Sea region shall be characterized by the domination of south-western directions that is to some extent caused by stretching of the coastline of the Sea of Azov.

11 species of birds listed in the Red Data Book of Ukraine were registered in all. Quantity of the vast majority of them is small, and 6 species were observed with quantity less than 10 specimens. Only lesser short-toed lark, which is regular migrating and wintering species in recent years, was observed with quantity of 250 specimens at the coast of the Molochnyi Estuary on the 10 of October.

If we analyse birds of wetland complex, just which dominated in the results of censuses at the permanent point on the Molochnyi Estuary, then the distribution according to passage altitudes is a little more various. It was found that more than half of all registered birds (55.8%) use altitudes of 25 - 50 m (gulls, birds of prey, some species of sandpipers). Altitudes less than 10 m, which are typical for the majority of the species of perching birds, are less popular among waterfowl, only 2.26%. However, the part of birds of medium altitudes (10 - 25 m) is essential and amounts to 36.24% of all registered. Transit migrants that use altitudes over 200 m amounted to 5.65%, i.e. there were no many such birds at the Molochnyi Estuary over the whole period of observations. Less than 1% of birds were recorded at the altitudes of 50 - 100 m. So, 94.3% of birds have used safe altitude intervals under 50 m.

Description of birds' ornithological complex within wind farm, buffer zones and adjacent territories in summer 2016

The total quantity of 68 registered bird species is 4 049 specimens, out of which 354 specimens (or 8.7% of all registered birds) have been observed at the sites of wind farm, 607 specimens (14.9%) in the buffer zones of 1 and 2 km, and 3.088 specimens (76.4%) – in the adjacent territories (upper and middle part of the Molochnyi Estuary, as well as its Oleksandrivska Gulf and coastal plots of the water area of the Sea of Azov). Such correlation of birds by different territories is typical, owing to relatively small area of the wind farm in comparison with the area of adjacent plots, and higher diversity of biotopes in the latter.

Following species were the most numerous at the wind farm sites and in the buffer zones: barn swallow (*Hirundo rustica*), small perching birds (*Passer spp.),* rock pigeon (domestic type) (*Columba livia varia domestica*) and lesser grey shrike (*Lanius minor*), 594 specimens of which have been observed, or 61.8%. Quantity of other bird species was 367 specimens. Semi-aquatic birds have not been recorded at the wind farm sites and in the buffer zones and quantity of upland birds was 961 specimens.

In consideration of location of the Molochnyi Estuary Wetland and (to a lesser extent) the Sea of Azov near to the sites of e wind farm, we can observe the domination of semi-aquatic bird species here. So, 3 006 specimens (or 97.3%) of bird species that are biotopically attracted to wetlands were registered in the adjacent territories over the whole period of observations in summer 2016. Following species dominated here: ruff (*Philomachus pugnax*), black-headed (*Larus ridibundus*) and yellow-legged (*Larus cachinnans*) gulls. Quantity of upland species in the adjacent territories was 82 specimens over the whole period of observations.

North-western and south-eastern directions prevailed among directions of passage.

5 species of birds listed in the Red Data Book of Ukraine were recorded in the researched territory in summer 2016. Quantity of rare bird species, which stay in the region of investigations, is low and equal to 38 specimens (0.9% of the number of counted birds).

High-altitude bird movements within wind farm and adjacent territories during autumn migration of 2016 were distributed in the following way. Toward the end of August the overwhelming majority of birds (347 specimens, or 85.3% of the total number of migrants), which were registered in the wind farm territory, within the buffer zones and in the adjacent territories, had been observed at the altitudes under 10 m. Besides, 60 specimens (14.7%) of birds were counted in flight within the altitude interval of 10 - 25 m. Birds have not been observed in potentially dangerous altitude interval of 50 - 170 m. The same tendency has been observed also in September: 339 specimens (91.1%) of birds were observed near the ground and only 33 specimens (8.9% of birds) – at the altitudes of 10 - 25 m.

Description of birds' ornithological complex within wind farm, buffer zones and adjacent territories during the autumn migrations of 2016

The total quantity of 71 registered species of birds is 6 943 specimens, 936 specimens of which (or 13.5% of all registered birds) were observed directly at the sites of wind farm, 1 626 specimens (23.4%) – in the buffer zones of 1 and 2 km, and 4 381 specimens more (63.1%) – in the adjacent monitoring plots (the Molochnyi Estuary). Such correlation of birds by different territories is understandable owing to higher diversity of biotopes in the adjacent territories. European starling (*Sturnus vulgaris*), Eurasian tree sparrow (*Passer montanus*), rook (*Corvus frugilegus*), ruff (*Philomachus pugnax*), European goldfinch (*Carduelis carduelis*) and rock pigeon (domestic type) (*Columba livia varia domestica*) had been the most numerous at the wind farm sites and in the buffer zones, 1 772 specimens of which were observed, or 69.2%. Quantity of other bird species was 790 specimens. 2 275 specimens of upland birds were counted in the territory of wind farm and in the buffer zones, 287 specimens - of semi-aquatic ones.

5 species of birds listed in the Red Data Book of Ukraine were recorded in the researched territory in autumn 2016. Out of 5 bird species counted in autumn, 3 species were observed in the adjacent territories (Eurasian oystercatcher – *Haematopus ostralegus*, Eurasian curlew – *Numenius arquata* and long-legged buzzard – *Buteo rufinus*), 1 species was observed in the buffer zones (long-legged buzzard – Buteo rufinus), and 3 species - directly in the territory of the designed wind farm (long-legged buzzard – *Buteo rufinus,* stock pigeon – *Columba oenas* and European roller – *Coracias garrulous*.

The south-eastern direction (41.2% of all migrants) prevailed among passage directions. 1 258 specimens flew in this direction; generally they were semi-aquatic birds (gulls, terns, and ruff) and small perching birds (wagtails, chaffinch, and European goldfinch). In addition, migration bird movements were observed in the south-western (537 specimens, 17.6%), southern (508 specimens, 16.6%) and western (408 specimens, 13.4%) directions. Birds' passage in other directions was not numerous. Such directions are typical for given terrain.

High-altitude bird movements within wind farm and adjacent territories during autumn migration of 2016 were distributed in the following way. Toward the end of August the overwhelming majority of birds (347 specimens, or 85.3% of the total number of migrants), which were registered in the wind farm territory, within the buffer zones and in the adjacent territories, had been observed at the altitudes under 10 m. Besides, 60 specimens (14.7%) of birds were counted in flight within the altitude interval of 10 - 25 m. Birds have not been observed in potentially dangerous altitude interval of 50 - 170 m. The same tendency has been observed also in September: 339 specimens (91.1%) of birds were observed near the ground and only 33 specimens (8.9% of birds) – at the altitudes of 10 - 25 m.
In October the tendency has changed. 795 specimens, or 34.9% of birds were observed within the altitude interval under 10 m, 257 specimens (11.4%) – at the altitudes of 10 - 25 m, and more than a half of registered migrants (1 223 specimens, 53.7%) flew at the altitude of 25 - 50 m.

Based on data from tables and annexes related to ornithological monitoring of the wind farm, the authors of the report managed to divide the species into those belonging to the farm and those of the buffer zone. The collected data included winter and summer birds, as well as spring and autumn migrations. Table 4 shows data on the general amount of birds. Table 5 shows data divided into flight ceiling and direction of the flight. Table 6 shows data collected when searching for bird nests.

Table 4. Accountings

Number	Species	Quantity	sp/hour[11]	Wind Park	sp/hour[12]	Buffer Zones	sp/hour[13]
1	Black-headed Gull (*Larus ridibundus*)	1828	41.55	66	3.00	1762	80.09
2	Ruff (*Philomachus pugnax*)	1160	26.36	40	1.82	1120	50.91
3	Rook (*Corvus frugilegus*)	534	12.14	118	5.36	416	18.91
4	European starling (*Sturnus vulgaris*)	273	6.20	141	6.41	132	6.00
5	Barn swallow (*Hirundo rustica*)	234	5.32	8	0.36	226	10.27
6	Eurasian tree sparrow (*Passer montanus*)	231	5.25	143	6.50	88	4.00
7	Small passerine birds (*Passer spp.*)	219	4.98	144	6.55	75	3.41
8	Domestic pigeon (*Columba livia var. domestica*)	195	4.43			195	8.86
9	Yellow-legged gull (*L.cachinnans*)	154	3.50	97	4.41	57	2.59
10	Grey partridge (*Perdix perdix)*	92	2.09	54	2.45	38	1.73
11	Lesser grey shrike (*Lanius minor*)	88	2.00	72	3.27	16	0.73
12	Mallard (*Anas platyrhynchos*)	86	1.95			86	3.91
13	Hooded crow (*Corvus cornix*)	84	1.91	53	2.41	31	1.41
14	Chaffinch (*Fringilla coelebs*)	78	1.77	55	2.50	23	1.05
15	Skylark (*Alauda arvensis*)	76	1,73	32	1.45	44	2.00
16	White wagtail (*Motacilla alba*)	76	1,73	16	0.73	60	2.73
17	Corn bunting (*Emberiza calandra*)	73	1.66	42	1.91	31	1.41
18	European greenfinch (*Chloris chloris*)	63	1.43	57	2.59	6	0.27
19	Common kestrel (*Falco tinnunculus*)	59	1.34	38	1.73	21	0.95
20	European magpie (*Pica pica*)	59	1.34	48	2.18	11	0.50
21	Eurasian coot (*Fulica atra*)	51	1.16			51	2.32
22	Dunlin (*Calidris alpina*)	50	1.14			50	2.27

[11] The value obtained by dividing the total research time (44 hours)
[12] The value obtained by dividing the research time in wind farm area (22 hours)
[13] The value obtained by dividing the research time in buffer zone (22 hours)

Number	Species	Quantity	sp/hour[11]	Wind Park	sp/hour[12]	Buffer Zones	sp/hour[13]
23	Eurasian collared dove (*Streptopelia decaocto*)	50	1.14	9	0.41	41	1.86
24	European goldfinch (*Carduelis carduelis*)	45	1.02	45	2.05		
25	House sparrow (*Passer domesticus*)	42	0.95	32	1.45	10	0.45
26	Passerinae spp.	42	0.95	42	1.91		
27	Black tern (*Chlidonias niger*)	36	0.82			36	1.64
28	Yellow wagtail (*Motacilla flava*)	32	0.73	8	0.36	24	1.09
29	Crested lark (*Galerida cristata*)	29	0.66	8	0.36	21	0.95
30	Woodpigeon (*Columba palumbus*)	29	0.66	28	1.27	1	0.05
31	Common gull (*Larus canus*)	28	0,64			28	1.27
32	Blackbird (*Turdus merula*)	27	0,61	12	0.55	15	0.68
33	Calidris spp.	23	0.52			23	1.05
34	Red-backed shrike (*Lanius collurio*)	23	0.52	20	0.91	3	0.14
35	Sandwich tern (*Thalasseus sandvicensis*)	21	0.48			21	0.95
36	Common swift (*Apus apus*)	20	0.45			20	0.91
37	Greater scaup	20	0.45			20	0.91
38	Northern lapwing (*Vanellus vanellus*)	19	0.43			19	0.86
39	Cormorant (*Phalacrocorax carbo*)	18	0.41			18	0.82
40	Pied avocet (*Recurvirostra avosetta*)	18	0.41			18	0.82
41	Yellowhammer (*Emberiza citrinella*)	18	0.41	17	0.77	1	0.05
42	Turtle dove (*Streptopelia turtur*)	17	0.39	17	0.77		
43	Fieldfare (*Turdus pilaris*)	16	0.36	16	0.73		
44	Common redshank (*Tringa totanus*)	15	0.34		0.00	15	0.68
45	Common shelduck (*Tadorna tadorna*)	15	0.34		0.00	15	0.68
46	Eurasian curlew (*Numenius arquata*)	14	0.32		0.00	14	0.64
47	Linnet (*Acanthis cannabina*)	14	0.32	14	0.64		
48	Common buzzard (*Buteo buteo*)	13	0.30	8	0.36	5	0.23

Number	**Species**	**Quantity**	**sp/hour[11]**	**Wind Park**	**sp/hour[12]**	**Buffer Zones**	**sp/hour[13]**
49	Rough-legged buzzard (*Buteo lagopus*)	13	0.30	7	0.32	6	0.27
50	Great crested grebe (*Podiceps cristatus*)	12	0.27			12	0.55
51	Northern wheatear (*Oenanthe oenanthe*)	12	0.27	3	0.14	9	0.41
52	Ruddy turnstone (*Arenaria interpres*)	12	0.27			12	0.55
53	Great egret (*Egretta alba*)	11	0.25			11	0.50
54	Great tit (*Parus major*)	11	0.25	3	0.14	8	0.36
55	Red-footed falcon (*Falco vespertinus*)	11	0.25	8	0.36	3	0.14
56	Little gull (*Larus minutus*)	10	0.23			10	0.45
57	Common redstart (*Phoenicurus phoenicurus*)	9	0.20	8	0.36	1	0.05
58	Common tern (*Sterna hirundo*)	8	0.18			8	0.36
59	Glossy ibis (*Plegadis falcinellus*)	8	0.18			8	0.36
60	Little egret (*Ardea cinerea*)	8	0.18	1	0.05	7	0.32
61	Mute swan (*Cygnus olor*)	8	0.18			8	0.36
62	Whiskered tern (*Chlidonias hybrida*)	8	0.18			8	0.36
63	Eurasian sparrowhawk (*Accipiter nisus*)	7	0.16	7	0.32		
64	Hoopoe (*Upupa epops*)	7	0.16	4	0.18	3	0.14
65	Whooper swan (*Cygnus cygnus*)	7	0.16			7	0.32
66	Common raven (*Corvus corax*)	6	0.14	5	0.23	1	0.05
67	Great white egret (*Egretta alba*)	6	0.14			6	0.27
68	Black-winged stilt (*Himantopus himantopus*)	5	0.11			5	0.23
69	European bee-eater (*Merops apiaster*)	5	0.11	5	0.23		
70	European robin (*Erithacus rubecula*)	5	0.11	3	0.14	2	0.09
71	Eurasian oystercatcher (*Haematopus ostralegus*)	4	0,09			4	0.18
72	Long-legged buzzard (*Buteo rufinus*)	4	0.09	3	0.14	1	0.05
73	Stock pigeon (*Columba oenas*)	4	0,09	4	0.18		
74	Thrush nightingale (*Luscinia luscinia*)	4	0.09	3	0.14	1	0.05

Number	**Species**	**Quantity**	**sp/hour[11]**	**Wind Park**	**sp/hour[12]**	**Buffer Zones**	**sp/hour[13]**
75	Winter wren (*Troglodytes troglodytes*)	4	0.09	3	0.14	1	0.05
76	Golden oriole (*Oriolus oriolus)*	3	0.07	3	0.14		
77	Jackdaw (*Corvus monedula*)	3	0.07			3	0.14
78	African stonechat (*Saxicola torquata*)	2	0.05	2	0.09		
79	Common pochard (*Aythya ferina*)	2	0.05			2	0.09
80	Common quail (*Coturnix coturnix*)	2	0.05	2	0.09		
81	European roller (*Coracias garrulus*)	2	0.05	2	0.09		
82	Grey plover (*Pluvialis squatarola*)	2	0.05			2	0.09
83	Leaf warbler (*Phylloscopus sp*)	2	0.05			2	0.09
84	Merlin (*Falco columbarius*)	2	0.05			2	0.09
85	Tawny pipit (*Anthus campestris*)	2	0.05	2	0.09		
86	Eurasian jay (*Garrulus glandarius*)	1	0.02			1	0.05
87	Garden warbler (*Sylvia borin*)	1	0.02	1	0.05		
88	Hen harrier (*Circus cyaneus*)	1	0.02			1	0.05
89	Little owl (*Athene noctua*)	1	0.02			1	0.05
90	Ring-necked pheasant (*Phasianus colchicus*)	1	0.02			1	0.05
91	Syrian woodpecker (*Dendrocopos syriacus*)	1	0.02			1	0.05
92	White-tailed eagle (*Haliaeetus albicilla*)	1	0.02			1	0.05
		6645	**151.02**	**1579**	**71.77**	**5066**	**230.27**

Table 5. Migrations

No	species	Quantity	sp/hour [14]	intervals of birds' movement							Directions of migrations								wind farm	sp/hour[15]	Buffer Zones	sp/hour[16]
				0-10	10-25	25-50	50-100	100-150	150-200	>200	N	NE	E	SE	S	SW	W	NW				
1	European starling (*Sturnus vulgaris*)	1760	40.00	177	23	1560					61	466		915	11	250	44	13	464	21.09	1296	58.91
2	Ruff (*Philomachus pugnax*)	707	16.07	371	72	264					241	103		7	314		42		7	0.32	700	31.82
3	Black-headed Gull (*Larus ridibundus*)	503	11.43	348	154	1					36	10		267	59	1	130	0	34	1.55	469	21.32
4	Rook (*Corvus frugilegus*)	382	8.68	111	201	70					86	11			142	111	27	5	79	3.59	303	13.77
5	Greater white-fronted goose (*Anser albifrons*)	231	5.25							231	99	132							70	3.18	161	7.32
6	European goldfinch (*Carduelis carduelis*)	228	5.18	193	35							41		35		122	5	25	11	0.50	217	9.86
7	Chaffinch (*Fringilla coelebs*)	191	4.34	191							16	73		37	12	16	22	15	122	5.55	69	3.14
8	Corn bunting (*Emberiza calandra*)	183	4.16	183							68	8		10	26		48	23	99	4.50	84	3.82
9	White wagtail (*Motacilla alba*)	122	2.77	122							8	42		3	60	4	5		3	0.14	119	5.41
10	Calidris spp.	100	2.27	100							100										100	4.55
11	Barn swallow (*Hirundo rustica*)	96	2.18	71	25						19	7			19		26	25	53	2.41	43	1.95
12	Passerinae spp.	88	2.00	58	30							53			35				23	1.05	65	2.95
13	Yellow-legged gull (*L. cachinnans*)	86	1.95	63	21	2					36	2			22	7	16	3	23	1.05	63	2.86
14	Eurasian tree sparrow (*Passer montanus*)	71	1.61	71							19			12	6	12	15	7	29	1.32	42	1.91
15	Dunlin (*Cal. alpina*)	65	1.48	65							28				6	21		10			65	2.95
16	Fieldfare (*Turdus pilaris*)	47	1.07	47											12			35	35	1.59	12	0.55
17	Yellow wagtail (*Motacilla flava*)	45	1.02	45								17		12	11	5			16	0.73	29	1.32
18	Mallard (*Anas platyrhynchos*)	31	0.70	6		25					25				6						31	1.41
19	Black tern (*Chlidonias niger*)	29	0.66	29											8	21					29	1.32
20	Blackbird (*Turdus merula*)	29	0.66	29							7			12	10				29	1.32		
21	European magpie (*Pica pica*)	29	0.66	29							17					5	7		10	0.45	19	0.86
22	Little gull (*Larus minutus*)	29	0.66	29											29						29	1.32
23	Great crested grebe (*Podiceps cristatus*)	28	0.64	28											28						28	0.82
24	Small passerine birds (*Passer spp.*)	28	0.64	28										28							28	1.27
25	Hooded crow (*Corvus cornix*)	27	0.61	27							2	4		11	6	2		2	16	0.73	11	0.50
26	Brambling (*Fringilla montifringilla*)	23	0.52	23							12	11							23	1.05		
27	Woodpigeon (*Columba palumbus*)	23	0.52	23							5				9	3	6		19	0.86	4	0.18
28	Sandwich tern (*Thal. sandvicensis*)	22	0.50	22											15			7	0	0.00	22	1.00
29	Bank swallow (*Riparia riparia*)	20	0.45	20										20							20	0.91
30	Linnet (*Acanthis cannabina*)	15	0.34	15												5		10			15	0.68
31	Terns (*Chlidonias spp.*)	15	0.34	15												15					15	0.68
32	European greenfinch (*Chloris chloris*)	13	0.30	13											8	5			8	0.36	5	0.23
33	Chlidonias spp.	12	0.27	12								12									12	0.55
34	Cormorant (*Phalacrocorax carbo*)	12	0.27		12										12						12	0.55
35	Mediterranean gull (L. *melanocephalus*)	12	0.27	9	3									3	9				3	0.14	9	0.41
36	Pied avocet (*Recurvirostra avosetta*)	10	0.23	10							8							2			10	0.45
37	Common kestrel (*Falco tinnunculus*)	9	0.20	9							1	1		2	2	1	2	0	7	0.32	2	0.09
38	Yellowhammer (*Emberiza citrinella*)	9	0.20	9								1						8	1	0.05	8	0.36

[14] The value obtained by dividing the total research time (44 hours)

[15] The value obtained by dividing the research time in wind farm area (22 hours)

[16] The value obtained by dividing the research time in buffer zone (22 h)

				intervals of birds' movement							**Directions of migrations**								**wind farm**	**sp/hour[15]**	**Buffer Zones**	**sp/hour[16]**
No	**species**	**Quantity**	**sp/hour [14]**	**0-10**	**10-25**	**25-50**	**50-100**	**100-150**	**150-200**	**>200**	**N**	**NE**	**E**	**SE**	**S**	**SW**	**W**	**NW**				
39	Ruddy turnstone (*Arenaria interpres*)	8	0.18	8											8						8	0.36
40	Skylark (*Alauda arvensis*)	8	0.18	5	3									3				5			8	0.36
41	European pied flycatcher (*Ficedula hypoleuca*)	7	0.16	7											2			5	7	0.32		
42	Black redstart (*Phoenicurus ochruros*)	6	0.14	6								6							2	0.09	4	0.18
43	Eurasian collared dove (*Streptopelia decaocto*)	6	0.14	6													6		6	0.27		
44	Slender-billed gull (*L. genei*)	6	0.14	6											6						6	0.27
45	European robin (*Erithacus rubecula*)	5	0.11	5							3	2							3	0.14	2	0.09
46	Mute swan (*Cygnus olor*)	5	0.11			5											5				5	0.23
47	Common raven (*Corvus corax*)	4	0.09		1	3					1					3					4	0.18
48	Turtle dove (*Streptopelia turtur*)	4	0.09	4													4		4	0.18		
49	Western marsh-harrier (*Circus aeruginosus*)	4	0.09		4									3		1					4	0.18
50	Common buzzard (*Buteo buteo*)	3	0.07	1	1	1								1	1	1			1	0.05	2	0.09
51	Common tern (*Sterna hirundo*)	3	0.07	3							3										3	0.14
52	Eurasian sparrowhawk (*Accipiter nisus*)	3	0.07	3													3		2	0.09	1	0.05
53	Hoopoe (*Upupa epops*)	3	0.07	3													3		3	0.14		
54	Collared flycatcher	2	0.05	2								2							2	0.09		
55	Common redstart (*Ph. phoenicurus*)	2	0.05	2												2			2	0.09		
56	Rough-legged buzzard (*Buteo lagopus*)	2	0.05	2							2										2	0.09
57	Long-legged buzzard (*Buteo rufinus*)	1	0.02			1										1			1	0.05		
		5412	**492.00**	**2664**	**585**	**1932**	**0**	**0**	**0**	**231**	**903**	**1004**	**0**	**1381**	**894**	**614**	**416**	**200**	**1217**	**55.32**	**4195**	**190.23**

Table 6. Nesting

Number	species	Quantity	wind farm	Buffer Zones
1	Athene noctua (*Athene noctua*)	1	1	
1	Hooded crow (*Corvus cornix)*	1	1	
2	Yellowhammer (*Emberiza citrinella)*	1*		1
2	Barred warbler *(Sylvia nisoria)*	1*		1
2	Garden warbler *(Sylvia borin)*	2*		2
2	Sylvia communis (*Sylvia communis*)	1		1
2	Long-eared owl *(Asio otus)*	1*		1
2	European greenfinch (*Chloris chloris*)	1*		1
2	Red-backed shrike *(Lanius collurio)*	1		1
2	Chaffinch (*Fringilla coelebs*)	1		1
3	Turtle dove *(Streptopelia turtur)*	1	1	
4	Woodpigeon (*Columba palumbus*)	1	1	
5	Common kestrel (*Falco tinnunculus*)	1	1	
6	Thrush nightingale (*Luscinia luscinia*)	1*	1	
7	Hooded crow (*Corvus cornix*)	1	1	
8	Woodpigeon (*Columba palumbus*)	1	1	
9	Red-backed shrike *(Lanius collurio)*	1	1	
10	Tawny pipit *(Anthus campestris)*	1	1	
11	Garden warbler *(Sylvia borin)*	1	1	
12	Rook (*Corvus frugilegus)*	12	12	
13	Long-eared owl *(Asio otus)*	1*	1	
14	European magpie (*Pica pica*)	1	1	
15	Common kestrel (*Falco tinnunculus*)	1	1	
16	Lesser grey shrike *(Lanius minor)*	1	1	
17	Thrush nightingale (*Luscinia luscinia*)	1*	1	
18	Red-footed falcon (*Falco vespertinus*)	1	1	
19	European magpie (*Pica pica*)	1	1	
20	Hooded crow (*Corvus cornix*)	1	1	
21	Turtle dove *(Streptopelia turtur)*	1	1	
22	Tawny pipit *(Anthus campestris)*	1		1
23	Rook (*Corvus frugilegus)*	42		42
24	European magpie (*Pica pica*)	1		1
25	Yellowhammer (*Emberiza citrinella)*	1*		1
26	Skylark (*Alauda arvensis*)	6*		6
27	Grey partridge (*Perdix perdix*)	1*		1
28	Lesser grey shrike *(Lanius minor)*	1		1
29	Common quail (*Coturnix coturnix*)	1*		1
30	Rook (*Corvus frugilegus)*	98	98	
31	Tawny pipit *(Anthus campestris)*	1		1
32	Chaffinch (*Fringilla coelebs*)	1	1	
32	Red-backed shrike *(Lanius collurio)*	1	1	
32	European goldfinch (*Carduelis carduelis*)	1*	1	
33	Woodpigeon (*Columba palumbus*)	1		1
33	Garden warbler *(Sylvia borin)*	1		1

Number	species	Quantity	wind farm	Buffer Zones
33	Common kestrel (*Falco tinnunculus*)	1		1
33	Yellowhammer (*Emberiza citrinella)*	1		1
34	Lesser grey shrike *(Lanius minor)*	1	1	
35	Woodpigeon (*Columba palumbus*)	1		1
36	Common kestrel (*Falco tinnunculus*)	1		1
37	Long-eared owl *(Asio otus)*	1	1	
38	European magpie (*Pica pica*)	1	1	
39	Lesser grey shrike *(Lanius minor)*	1	1	
40	Yellowhammer (*Emberiza citrinella)*	1*	1	
41	Hooded crow (*Corvus cornix*)	1	1	
42	Common kestrel (*Falco tinnunculus*)	1	1	
43	Hoopoe (*Upupa epops*)	1	1	
44	Grey partridge (*Perdix perdix*)	1	1	
45	Skylark (*Alauda arvensis*)	4*	4	
46	Common scops owl *(Otus scops)*	1*	1	
47	Skylark (*Alauda arvensis*)	6*	6	
48	Thrush nightingale (*Luscinia luscinia*)	1*	1	
49	Lesser grey shrike *(Lanius minor)*	1	1	
50	European goldfinch (*Carduelis carduelis*)	1*	1	
51	Golden oriole (*Oriolus oriolus*)	1*	1	
52	Chaffinch (*Fringilla coelebs*)	1	1	
53	Hooded crow (*Corvus cornix*)	1	1	
54	Common kestrel (*Falco tinnunculus*)	1	1	
55	Yellowhammer (*Emberiza citrinella)*	1*		1
56	European greenfinch (*Chloris chloris*)	1*		1
57	Woodpigeon (*Columba palumbus*)	1	1	
58	Skylark (*Alauda arvensis*)	2*		2
59	Tawny pipit *(Anthus campestris)*	1*		1
60	Common kestrel (*Falco tinnunculus*)	1		1
61	Woodpigeon (*Columba palumbus*)	1		1
62	Hooded crow (*Corvus cornix*)	1	1	

Note: * - the nesting behavior.

PTL Route

Studies of the ornithological situation within the 330 kV PTL route were conducted in all seasons of 2016 (Appendix 4).

Area covered by the bird censuses was equal to at least 90% of the designed 330 kV PTL territory, its buffer zones and adjacent territories. On the wetlands, census was performed within the borders of specially allocated areas on pedestrian and vehicle routes along water basins with stops in locations from which there was a good view of the open water and their inspection through telescopes. Spot censuses, each with duration of 10 to 30 minutes, were performed on the adjacent territories and in the center of the designed 330 kV PTL sections. The methodology is described in the Appendix 4.

Description of birds' ornithological situation in the winter period 2016

Totally, upon results of the ornithological studies carried out on 30 January 2016, there were 19 bird species with the total number of 642 specimens recorded within the 330 kV PTL, buffer zones and adjacent territories.

All recorded birds belonged to 6 taxonomic ranges - *anseriformes, falconiformes, charadriiformes, columbiformes, piciformes and passeriformes*. The prevailing birds were representatives of the passeriformes with the total number of 365 specimens, subdominant were charadriiformes - 3 species with the number of 185 specimens, and anseriformes - 3 species with the number of 78 specimens. Most numerous taxons, in terms of the species, in addition to the *passeriformes*, were also *charadriiformes* and *anseriformes*. More detailed analysis of the territorial birds distribution showed ambiguousness in the dominance of particular taxons. For example, immediately within the 330 kV PTL route there were observed representatives of only 2 taxons (*paciformes* and *passeriformes*), though there were only 36 specimens recorded (5.6%). Buffer zones attracted *charadriiformes* (black-headed gull and common gull), *columbiformes* (Eurasian collared dove) and *passeriformes* (104 specimens or 16.2% were recorded there in total), and on the adjancent territories 502 specimens of 5 taxa (78.2%) were observed - only *piciformes* were missing.

Such pattern structure is explained by the presence of relevant biotopes which are chosen by a certain group of birds. So, for *charadriiformes* and *anseriformes* attractive are mostly adjacent territories where there is a fodder base sufficient for them, by contrast with the territory of the designed 330 kV PTL.

Among directions of the feeding migrations of the wintering birds prevailing is north-eastern one.

The majority of the registered birds (642 sp., 100% of the total number of birds) which were recorded in the territory of the designed 330 kV PTL, within buffer zones and adjacent territories were observed either on the ground (452 sp.) or in the flight at the height of up to 50 m.
So, 452 specimens (70.4%) were registered directly on the ground, 53 sp. (8.3%) - at the height of up to 5 m, 25 sp. (3.8%) - at the height of 5 to 10 m, 82 sp. (12.8%) - at the height of 10 to 25 m, 30 specimens (4.7%) - at the height of 25 to 50 m; no birds were registered at greater heights. Such data is expected, and the nature of birds distribution by passage heights is traditional for the winter period, when birds carry out only feeding migrations in searches for food.

Among the species listed in the Red Book of Ukraine (2009) only white-tailed eagle (*Haliaeetus albicilla*) was registered during the January 2016 censuses - 1 specimen on the adjacent territories

Description of birds' ornithological situation during the spring migration 2016
Total number of the registered 32 species of birds equals to 1069 specimens, of which 71 specimens (or 6.6% of all registered birds) were observed directly within the 330 kV PTL, 203 specimens (18.9%) were observed in the buffer zones within 500-meter range, and 795 specimens (74.5%) were observed in the adjacent territories. Such distribution of birds by different territories is understandable due to a small area of the power transmission line compared with the area of the adjacent plots, and larger diversity of habitats located on the latter.

Most numerous within the area of 330 kV PTL and in the buffer zones were European starling (*Sturnus vulgaris*), ruff (*Philomachus pugnax*) and Chaffinch (*Fringilla coelebs*), which were counted 183 specimens or 66.8%. Number of other bird species counted 91 specimens. Semi-aquatic birds counted 70 specimens, upland birds - 204 specimens.

Since near the research territory there are primarily farmed ecosystems and hedgerows and, in a lesser degree, Molochnyi Estuary Wetland, we would expect the dominance of upland bird species in the adjacent territories; the analysis of the obtained results shows exactly this trend. So, during the entire period of spring observations we registered 659 specimens (or 82.9%) of the bird species which lead toward upland habitats.

The dominant here were European starling (*Sturnus vulgaris*), rook (*Corvus frugilegus*) and white wagtail (*Motacilla alba*). Number of the semi-aquatic species in the adjacent territories over the entire period of observations was 136 specimens. Most numerous of them were greater white-fronted goose (*Anser albifrons*), Mallard (*Anas platyrhynchos*) and Eurasian coot (*Fulica atra*).

Among the spring passage directions the dominant was north-eastern - 43.1% of all migrants. 334 specimens flew in this direction.

Height passages of the birds in spring 2016 broke down as follows. In March, the majority of the birds (166 sp., 87.9% of the total number of migrants) which were recorded in the territory of the designed 330 kV PTL, within buffer zones and adjacent territories were observed either near the ground (152 sp.) or in the flight at the height of up to 25 m (14 sp.). Additionally, 22 specimens (11.6%) of the birds were registered at heights over 200 m.

The trend went down in April. In the height range 0-10 m 206 specimens or 35.2% of the birds were observed, while no birds were registered at the heights from 10 to 25 m, and 352 specimens (60.1%) were observed in the height range 25-50 m. Another 28 specimens (4.7%) were registered at heights over 200 m. There also are certain trend in the passage of feeding and transit migrants. While the transit migrants chose heights in the range 0-10 m (small passeriformes), 25-50 m (gulls, cormorant, rook) and over 300 m (greater white-fronted goose), the feeding migrants were mainly observed near the ground or at heights 10-25 m. This data is expected, and the nature of distribution of birds by passage heights is traditional for this region and season.

In spring 2016 in the research territory there were registered 2 species of the birds referred to the Red Book of Ukraine. Pied avocet (*Recurvirostra avosetta*) and Eurasian curlew (*Numenius arquata*). All they were observed in the adjacent territories.

Description of birds' ornithological situation in the nesting

Out of 19 bird species for which nesting in the research area is proved only 1 (or 5.3%) species was encountered directly within the area of 330 kV PTL, and 3 species – in the buffer zones

Total number of nests in the territory reaches as many as 37. Considering extremely covert behavior of certain bird species (lark, partridge, quail, owls, warblers etc.), we estimate that the undercount is around 20% what allows us to claim about the presence in the project area of approximately 50 nests belonging to at least 20-25 bird species.

The dominant species were lesser grey shrike (*Lanius minor*) – 5 nests and hooked crow (*Corvus cornix*) – also 5 nests. No colonial settlements of birds were found within the project territories, although in the man-made forest plantation located in the adjacent territories near Mordvynivka Village we observed 9 nests of 8 species which were situated close to each other.

As regards representatives of the Corvidae family which nest in the project territory, we found nests of hooked crow (*Corvus cornix*) (5 nests) and European magpie (*Pica pica*) (2 nests). They all were located individually except for one nest near which we also registered a little owl (*Athene noctua*) nest. The birds built their nests in hedgerows on trees of black locust (*Robinia pseudoacacia L.*).

Number of other bird species is extremely low and finds itself within the range from individual nests of a particular species (kestrel, yellowhammer, shrikes, chaffinch etc.) to several couples (garden warbler).

Overall composition of the ornithological complex of 330 kV PTL includes 19 species of 5 taxa, of which 13 species (68.4%) belong to the passeriformes range, with the number of 54 specimens or 73.0%.

In 2016 in the nesting period no birds listed in the Red Book of Ukraine were registered in the research territory.

Description of birds' ornithological situation in the summer and autumn migration in 2016

Summer 2016 (during post-nesting and pre-migratory)

Total number of the registered 31 species of birds equals to 586 specimens, of which 2 specimens only (or 0.3% of all registered birds) were observed in directly within 330 kV PTL, 389 specimens (66.4%) were observed in 500-meter buffer zones, and 195 specimens (33.3%) - in the adjacent territories. Such distribution of birds by different territories is understandable due to a small area of 330 kV PTL compared with the area of the adjacent plots, and larger diversity of habitats located on the latter.

Most numerous in the buffer zones were barn swallow (*Hirundo rustica*), small passeriformes (*Passer spp*.) and rock pigeon (*Columba livia varia domestica*), which were found 327 specimens or 84.1%. Number of other bird species was 62 specimens. No semi-aquatic birds were registered here, all 398 specimens were land birds.

Since near the research territory there are primarily farmed ecosystems and hedgerows and, in a lesser degree, Molochnyi Estuary Wetland, we would expect the dominance of upland bird species in the adjacent territories; the analysis of the obtained results shows exactly this trend. So, during the observations we registered 148 specimens (or 75.9%) of the bird species which lead toward upland habitats.

The dominant here were rook (*Corvus frugilegus*), small passeriformes (*Passer spp*.) and lesser grey shrike (*Lanius minor*). Number of the semi-aquatic species in the adjacent territories was 47 specimens. Most numerous of them were sand martin (*Riparia riparia*) and great crested grebe (*Podiceps cristatus*). It should be noted that only 14.3% of the registered birds (84 specimens) made feeding migratory passages within the 330 kV PTL, buffer zones and adjacent territories, searching for the food.

The south-eastern direction of the passages prevailed over other directions.

Analysis of the research results showed that all birds (84 specimens or 100% of the total number of migrants) which make feeding migratory passages in the summer, flew at heights under 50 m. These are primarily small passeriformes and rooks which advance along the hedgerows and through the open space at a small height. Most of them were registered in the near-ground range under 10 m (90.5%). In the height range 10-25 m we registered 6 specimens (7.1%) and in the range 25-50 m - only 2 specimens of yellow-legged gull (2.4%).

In summer 2016 in the research territory there was registered 1 species of the birds listed in the Red Book of Ukraine - long-legged buzzard (*Buteo rufinus*) - with the number of 2 species (0.3% of the number of registered birds).

Autumn migration

Total number of the registered 24 species of birds equals to 8654 specimens, of which 219 specimens (or 2.5% of all registered birds) were observed in the very 330 kV PTL project area, 216 specimens (2.5%) - in 500-meter buffer zones, and other 8219 specimens (95.0%) - in the adjacent territories. Such distribution of the birds by different territories is understandable due to a large biotopic diversity in the adjacent territories. Most numerous in the area of 330 kV PTL and in the buffer zones were rock pigeon (*Columba livia varia domestica*), rook (*Corvus frugilegus*), and small passeriformes (*Passer spp*.) which were found 305 specimens or 70.2%. Number of other bird species was 130 specimens. In the area of 330 kV PTL and in the buffer zones we registered 414 specimens of land birds and 21 specimens of semi-aquatic birds.

Since near the research territory there are primarily farmed ecosystems and hedgerows and, in a lesser degree, Molochnyi Estuary Wetland, we would expect the dominance of upland bird species in the adjacent territories; the analysis of the obtained results shows exactly this trend. So, during the entire period of the autumn observations we registered 6893 specimens (or 83.9%) of the bird species which lead toward upland habitats.

The dominants here were European starling (*Sturnus vulgaris*) and rook (*Corvus frugilegus*). Number of the semi-aquatic species in the adjacent territories over the entire period of observations was 1326 specimens. Most numerous of them were black-headed gulls (*Larus ridibundus*), ducks (*Anas spp*.) and mallard (*Anas platyrhynchos*).

Total number of birds which were registered at the autumn passage is 8654 specimens. Major part of these birds was in the state of migration (5425 specimens, 62.7%) which is divided into the transit migration when birds pass big distances without stopping within the project area, and the feeding migration when birds pass small distances searching for the food. Analysis of such distribution showed that all migratory birds were just making their feeding passages.

More detailed characteristic of the species composition and distribution of birds during the winter period, spring migration nesting period 2016 and autumn migration within the area of 330 kV PTL, in buffer zones and in adjacent territories is given in Appendix 4.

Among the passage directions the prevailing was north-western - 40.6% of all migrants.

The majority of the registered birds (5 355 sp., 98.7% of the total number of birds) which were recorded in the territory of the designed 330 kV PTL, within buffer zones and adjacent territories were observed in the flight at the height of up to 50 m. Moreover, one flock of black-headed gulls (*Larus ridibundus*) was reported at the height of 200 m (70 specimens, 1.3%).
At the height under 10 m we registered 281 specimens (5.2%), at heights from 10 to 25 m - 652 specimens (12.1%), and at heights from 25 to 50 m we observed the main number of the migratory birds (4 422 specimens, 81.4%).
Such data is expected, and the nature of birds distribution by passage heights is traditional for this period, when birds already begin to stop active transit passages in the project territory and carry out only feeding migrations in searches for food.

No representatives of the Red Book of Ukraine were observed in the research territory in autumn 2016.

In the case of research conducted under the overhead power line, the authors of the EIA Report have managed to divide the species on the planned line and in the buffer zone. The results are in Table 7 and Table 8 Results of the censuses of birds nesting in the area of 330 kV PTL, conducted on 23-25 April and 10-15 May 2016 are in Table 9.

Table 7. Bird censuses

No.	Species	Quantity	sp/hour[17]	PTL 330 kV route	Buffer Zones
1	Rook (*Corvus frugilegus*)	669	31.86	27	642
2	Rock pigeon (*Columba livia var. domestica*)	170	8.10	120	50
3	Barn swallow (*Hirundo rustica*)	155	7.38		155
4	Small passeriformes (*Passer spp*.)	135	6.43		135
5	Eurasian tree sparrow (*Passer montanus*)	132	6.29		132
6	Common gull (*Larus canus*)	96	4.57		96
7	Mallard (*Anas platyrhynchos*)	54	2.57	7	47
8	Passerinae sp.	42	2.00		42
9	European starling (*Sturnus vulgaris*)	40	1.90	32	8

[17] The value obtained by dividing the total research time (21 hours)

No.	Species	Quantity	sp/hour[17]	PTL 330 kV route	Buffer Zones
10	Eurasian collared dove (*Streptopelia decaocto*)	36	1.71	2	34
11	Yellow-legged gull (*Larus cachinnans*)	34	1.62		34
12	Hooded crow (*Corvus cornix*)	31	1.48	4	27
13	Lesser grey shrike (*Lanius minor*)	28	1.33		28
14	Black-headed gull (*Larus ridibundus*)	25	1.19		25
15	Eurasian coot (*Fulica atra*)	25	1.19		25
16	Greater scaup (*Aythya marila*)	20	0.95		20
17	Chaffinch (*Fringilla coelebs*)	19	0.90		19
18	Skylark (*Alauda arvensis*)	19	0.90		19
19	Common blackbird (*Turdus merula*)	12	0.57		12
20	Common kestrel (*Falco tinnunculus*)	11	0.52	1	10
21	Great egret (*Egretta alba*)	11	0.52	11	
22	House sparrow (*Passer domesticus*)	10	0.48		10
23	European magpie (*Pica pica*)	9	0.43		9
24	Pied avocet (*Recurvirostra avosetta*)	7	0.33		7
25	Whooper swan (*Cygnus cygnus*)	7	0,33		7
26	Woodpigeon (*Columba palumbus*)	7	0,33		7
27	Red-backed shrike (*Lanius collurio*)	6	0.29		6
28	European greenfinch (*Chloris chloris*)	5	0.24		5
29	Great crested grebe (*Podiceps cristatus*)	5	0.24		5
30	Great tit (*Parus major*)	5	0.24	5	
31	White wagtail (*Motacilla alba*)	5	0.24		5
32	Yellowhammer (*Emberiza citrinella*)	5	0.24		5
33	Fieldfare (*Turdus pilaris)*	4	0.19		4
34	Common redstart (*Phoenicurus phoenicurus*)	3	0.14		3
35	Corn bunting (*Emberiza calandra*)	3	0.14		3
36	Grey heron (*Ardea cinerea*)	3	0.14		3
37	Winter wren (*Troglodytes troglodytes*)	3	0.14		3
38	African stonechat (*Saxicola torquata*)	2	0.10		2
39	Common raven (*Corvus corax*)	2	0.10		2
40	Eurasian curlew (*Numenius arquata*)	2	0.10		2
41	Eurasian jay (*Garrulus glandarius*)	2	0.10		2
42	Hoopoe (*Upupa epops*)	2	0.10		2
43	Northern lapwing (*Vanellus vanellus*)	2	0.10		2
44	Rough-legged buzzard (*Buteo lagopus*)	2	0.10		2
45	Thrush nightingale (*Luscinia luscinia*)	2	0.10		2
46	Common buzzard (*Buteo buteo*)	1	0.05		1
47	Golden oriole (*Oriolus oriolus*)	1	0.05		1
48	Northern wheatear (*Oenanthe oenanthe*)	1	0.05		1
49	Syrian woodpecker (*Dendrocopos syriacus*)	1	0.05	1	
50	Turtle dove (*Streptopelia turtur*)	1	0.05		1
51	White-tailed eagle (*Haliaeetus albicilla*)	1	0.05		1
		1873	**89.19**	**210**	**1663**

Table 8. Migrations

No	species	Quantity	sp/hour [18]	intervals of birds' movement							Directions of migrations								PTL 330 kV route	Buffer Zones
				0-10	10-25	25-50	50-100	100-150	150-200	>200	N	NE	E	SE	S	SW	W	NW		
1	Rook (*Corvus frugilegus*)	4049	192.81	43	136	3870						11		350	96	1342	50	2200		4039
2	European starling (*Sturnus vulgaris*)	984	46.86	74	450	460						266		700			18		5	966
3	Black-headed gull (*Larus ridibundus*)	521	24.81		101	350				70				71		350	100			521
4	European goldfinch (*Carduelis carduelis*)	142	6.76	142												142			20	122
5	Chaffinch (*Fringilla coelebs*)	119	5.67	119							16	33		40		30			46	73
6	Small passeriformes (*Passer spp.*)	117	5.57	117							12			75				30	25	92
7	Passerinae sp.	85	4.05	85								85							85	
8	Ruff (*Philomachus pugnax*)	67	3.19			67					45	22								67
9	Skylark (*Alauda arvensis*)	55	2.62	25		30							30			25				55
10	Common gull (*Larus canus*)	50	2.38		50							50								50
11	Greater white-fronted goose (*Anser albifrons*)	50	2.38							50	28	22								50
12	White wagtail (*Motacilla alba*)	44	2.10	44										24	20					44
13	Mallard (*Anas platyrhynchos*)	31	1.48	6		25					25				6					31
14	Eurasian tree sparrow (*Passer montanus*)	28	1.33	28							8				6	14				28
15	Bank swallow (*Riparia riparia*)	20	0.95	20										20						20
16	Corn bunting (*Emberiza calandra*)	20	0.95	20							20								20	
17	Yellow-legged gull (*Larus cachinnans*)	18	0.86	6	10	2					6	7				3	2			18
18	Chlidonias niger	12	0.57	12								12								12
19	Fieldfare (*Turdus pilaris*)	12	0.57	12											12					12
20	Common blackbird (*Turdus merula*)	9	0.43	9										6	3					9
21	Grey partridge (*Perdix* perdix)	9	0.43	9													9			9
22	Hooded crow (*Corvus cornix*)	6	0.29	6								2			4				2	4
23	European magpie (*Pica pica*)	5	0,24	3	2								3			2				5
24	Linnet (*Acanthis cannabina*)	5	0,24	5												5				5
25	Common raven (*Corvus corax*)	3	0,14			3							1			2				3
26	Mediterranean gull (*Larus melanocephalus*)	3	0,14		3									3						3
27	Turtle dove (*Streptopelia turtur*)	3	0.14	3												3				3
28	Woodpigeon (*Columba palumbus*)	3	0.14	3												3				3
29	Common kestrel (*Falco tinnunculus*)	2	0.10	1	1										1	1			1	1
30	Goshawk (*Accipiter gentilis*)	1	0.05									1							1	
31	Western marsh-harrier (*Circus aeruginosus*)	1	0.05		1											1				1
		6474	**308.29**	**792**	**754**	**4807**	**0**	**0**	**0**	**120**	**160**	**511**	**34**	**1289**	**148**	**1923**	**179**	**2230**	**205**	**6246**

[18] The value obtained by dividing the total research time (21 hours)

Table 9. Nesting

Number	species	Quantity	PTL 330 kV route	Buffer Zones
1	Little owl *(Athene noctua)*	1		1
1	Hooded crow (*Corvus cornix)*	1		1
2	Yellowhammer (*Emberiza citrinella*)	1*		1
2	Barred warbler (*Sylvia nisoria*)	1*		1
2	Garden warbler (*Sylvia borin*)	2*		2
2	Common whitethroat (*Sylvia communis*)	1		1
2	Long-eared owl (*Asio otus*)	1*		1
2	European greenfinch (*Chloris chloris*)	1*		1
2	Red-backed shrike (*Lanius collurio*)	1		1
2	Chaffinch (*Fringilla coelebs*)	1		1
3	Turtle dove (*Streptopelia turtur*)	1		1
4	Woodpigeon (*Columba palumbus*)	1		1
5	Common kestrel (*Falco tinnunculus*)	1		1
6	Thrush nightingale (*Luscinia luscinia*)	1*		1
7	Hooded crow (*Corvus cornix)*	1		1
8	Lesser grey shrike (*Lanius minor*)	1		1
9	Common quail (*Coturnix coturnix*)	1*		1
10	Tawny pipit (*Anthus campestris*)	1		1
11	Chaffinch (*Fringilla coelebs*)	1		1
12	Red-backed shrike (*Lanius collurio*)	1		1
13	European goldfinch (*Carduelis carduelis*)	1*		1
14	Woodpigeon (*Columba palumbus*)	1		1
15	Garden warbler (*Sylvia borin*)	1		1
16	Common kestrel (*Falco tinnunculus*)	1		1
17	Yellowhammer (*Emberiza citrinella*)	1		1
18	European magpie (*Pica pica*)	1		1
19	Woodpigeon (*Columba palumbus*)	1		1
20	Hooded crow (*Corvus cornix)*	1	1	
21	Common kestrel (*Falco tinnunculus*)	1		1
22	Hooded crow (*Corvus cornix)*	1		1
23	Lesser grey shrike (*Lanius minor*)	1		1

Note: * - nesting behavior

3.8.2 Bats

Data on chiropterofauna on the area set aside for the realization of the wind farm and to assess the impact of the planned investment on bats were presented in Appendix 5 and Appendix 6. The following is a summary of the key information contained in the reports of monitoring bats made in the 2011-2012 year and 2016. The methodology of assessment on impact of wind farm on bats is described in Appendix 5 and Appendix 6.

Determination of duration of biological cycle phases is of great importance to understand the peculiarities of bat population dynamics of the mentioned animals. Among which the key are:

- Departure from hibernation places, spring migrations and formation of nidifugous colonies;
- Breeding and subdivision of nidifugous colonies and the beginning of autumn migrations;
- Formation of colonies and autumn migrations.

In 2011-2012 (1 June 2011 – 1 April 2012) research carried out in Melitopol District of Zaporizhia Region. Among 5 species the most numerous were: Kuhl's Pipistrelle (74.9%); Common Noctule (12.3%) and Serotine Bat (8.9%). Very rare were Whiskered Bat (3.2%) and Common Pipistrelle (0.7%).

Analyzing the change in bat population regarding mentioned biological characteristics, it is clear that in spring their abundance is small (Table 10). Among 2 recorded species, Kuhl's Pipistrelle has the biggest one.

Table 10. Average number of bats (specimens) counted within 10 minutes in spring (17 March – 31 May)

Species of bats	Number of specimens	M ± m	Min	Max	Std. Dev.
Common Noctule	11	1.1±0,11	1	2	0.33
Kuhl's Pipistrelle	263	4.0±0,43	1	15	3.47
Total:	**274**	**3.6±0.39**	**1**	**15**	**3.39**

After the waking from hibernation and the end of spring migration, more species appear in the investigated area, and population of the dominant species doesn't increases but decreases (Table 11). This is due to the eviction of the part of animals which is especially noticeable in August, and in some warm years - in the first half of September as well.

Table 11. Average number of bats (specimens) counted within 10 minutes in summer (01 July - 15 August)

Species of bats	Number of specimens	M ± m	Min	Max	Std. Dev.
Common Noctule	65	1.5±0.19	1	6	1.23
Kuhl's Pipistrelle	303	2.5±0.19	1	10	2.07
Common Pipistrelle	7	1.2±0.17	1	2	0.40
Serotine Bat	23	1.3±0.14	1	3	0.58
Whiskered Bat	1	–	–	–	–
Total:	**399**	**2.2±0.16**	**1**	**10**	**1.90**

In relatively close to the Azov Seaside Districts (The Black Sea Biosphere Reserve), large concentrations of Common Noctules, Common and Nathusius' Pipistrelles, occasionally – Whiskered Bats, Giant and Lesser Noctules have recently been observed from the second half of August. The bats used hollows, cracks and holes in the tree bark, different covers in domestic buildings, haystacks, as well as rodents and carnivores holes as shelters (Abelentsev V.I., 1967).

In autumn the species composition of bats in the area of examination is practically unchangeable (Table 12), but due to migrants number of Kuhl's Pipistrelle population increases approximately in 2 times, and population of Common Noctule increases in 3 times.

Table 12. Average number of bats (species) counted within 10 minutes during autumn (16 August – 10 September)

Species of bats	Number of specimens	M ± m	Min	Max	Std. Dev.
Common Noctule	130	4.5±1.15	1	23	6.20
Kuhl's Pipistrelle	687	5.5±0.78	1	56	8.76
Common Pipistrelle	2	–	–	–	–
Serotine Bat	126	24.6±8.73	4	56	19.51
Whiskered Bat	54	27.0±17.00	10	44	24.04
Total:	**999**	**6.2±0.77**	**1**	**56**	**9.79**

At the end of September, Kuhl's Pipistrelles can be found in attics, vent holes under ledges and other parts of various buildings. Individual animals can be observed in the air in warm evenings in October and even November. According to the results of ringing, many Common Noctules from

Central Russia fly through the Azov Seaside for hibernation in the foothills of the Crimea (Panyutin K. Bats, 1980).

Especially notable in autumn is the increase of Serotine Bat and Whiskered Bat population by several times which is now a rare inhabitant of the region.
Conducting bat population studies an important indicator of thie population is the distribution of animals by the size of colonies. Within the plots of the planned wind farm, the largest values of this index, strange as it may seem, were established in the colonies of Whiskered Bat and Serotine Bat.

In general we can say that the dynamics of bats population during the year has specific features in different areas. In the north, south and east it increases in spring, then stabilizes in early summer and grows in early autumn. It also demonstrates a general tendency to decrease. In the west, on the contrary it rapidly increases from spring to late summer, then declining sharply as a result of departure of a significant number of animals.

Through the territory of its location during the year, including the periods of spring and autumn migrations, a small number of the mentioned animals fly. Their migration routes are in the form of narrow bands, one of which passes through the upper part of of the Milk Estuary on the northern boundaries of the wind farm plot, the other - along the coast of the Azov Sea, that is outside the wind farm plot at all. On the territory of the wind farm plot there are no registered shelters of bats and their main places of residence are the adjacent villages. The territory of the plot is used by bats as a feeding area with different intensity and sizes depending on crop rotation which determines the concentration of the main objects of feeding.

In 2016 a bat research was again conducted at the planned wind farm.

Spatial distribution and flying activity of bats have been determined at 12 stationary points, with counting of quantity of sounds received by Pettersson D 240x ultrasonic detector within 10 minutes of listening to air space. While moving by motor car from point to point, we have also carried out visual observation, as far as illumination permits.

Additional observations were also carried out in the territories adjacent to the sites of Zaporizhia wind farm by means of more powerful ultrasonic detector Pettersson D 500x. Following places were selected as stationary listening points: Melitopol City (in the middle of the area of single story buildings); Stepanivka Persha Village; the Obytichna Spit (woodland) and Botieve Village (agricultural hedgerow). The study was conducted from August to October 2016. .

When analysing summary Table 13, we can see the domination of Kuhl's pipistrelle (*Pipistrellus kuhlii* Kuhl, 1817) in the region, the part of which (415 voices) varied from 25.4% to 78.6% over the whole period of observations, on the average equal to 44.1% of all identified voices (n = 941). Subdominants were following: common noctule (*Nyctalus noctula* Schreber, 1774) and Nathusius' pipistrelle (*Pipistrellus nathusii* Keyserling et Blasius, 1839) with indices of 149 sounds (15.8%) and 130 sounds (13.8%) respectively. So, only these three species of bats made up 73.7% of all identified ones.

Other 4 bat species had the part from 2.9% for common pipistrelle (*Pipistrellus pipistrellus* Schreber, 1774) to 6.6% for parti-coloured bat (*Vespertilio murinus* Linnaeus, 1758).
Representatives of genera: Myotis (*Myotis*) – 9 voices and Long-eared bat (*Plecotus*) – 5 voices, undetermined till species, made up 0.9% and 0.5% respectively.

Table 13. Species Diversity of Bats in the Region of Researches in August - October of 2016

No.	Species	Dates, a type of detector and results of observations																						Total	
		6 - 7.08				7 - 8.08		23 - 24.08				15 - 16.09		20 - 21.09		6 - 7.10				11 - 12.10					
		500x		240x		240x		500x		240x		240x		240x		500x		240x		500x		240x			
		abs.	%	abs.	%	abs.	%	abs.	%	abs.	%	abs.	%	abs.	%	abs.	%	abs.	%	abs.	%	abs.	%	abs.	%
1	Common noctule *Nyctalus noctula* Schreber, 1774	49	28.3	-	-	4	7.3	82	18.4	2	3.4	7	18.9	-	-	3	11.1	-	-	2	14.3	-	-	**149**	**15.8**
2	Kuhl's pipistrelle *Pipistrellus kuhlii* Kuhl, 1817	55	31.8	27	57.4	26	47.3	195	43.7	15	25.4	17	46.0	21	55.3	18	66.7	30	73.2	11	78.6	-	-	**415**	**44.1**
3	Nathusius' pipistrelle *Pipistrellus nathusii* Keyserling et Blasius, 1839	24	13.9	8	17.0	7	12.7	47	10.5	13	22.0	9	24.3	7	18.4	1	3.7	9	21.9	1	7.1	4	100	**130**	**13.8**
4	Common pipistrelle *Pipistrellus pipistrellus* Schreber, 1774	5	2.9	6	12.8	-	-	12	2.7	-	-	-	-	2	5.3			2	4.9	-	-	-	-	**27**	**2.9**
5	Pygmy pipistrelle *Pipistrellus pygmaeus* Leach, 1825	8	4.6	-	-	2	3.6	32	7.2	-	-	-	-	-	-			-	-	-	-	-	-	**42**	**4.5**
6	Parti-coloured bat *Vespertilio murinus* Linnaeus, 1758	14	8.1	-	-	3	5.5	36	8.1	5	8.5	3	8.1	-	-	1	3.7	-	-	-	-	-	-	**62**	**6.6**
7	Serotine bat *Eptesicus serotinus* Schreber, 1774	9	5.2	2	4.3	9	16.4	26	5.8	2	3.5	1	2.7	-	-			-	-	-	-	-	-	**49**	**5.2**
8	Myotis *Myotis sp.*	-	-	-	-	1	1.8			-	-	-	-	8	21									**9**	**0.9**
9	Long-eared bat	-	-	-	-	1	1.8	4	0.9	-	-	-	-	-	-			-	-	-	-	-	-	**5**	**0.5**

	Plecotus sp.																								
	Pipistrelle *Pipistrellus sp.*	-	-	-	-					11	18.6	-	-	-	-			-	-	-	-	-	-	**11**	**1.2**
	Undetermined	9	5.2	4	8.5	2	3.6	12	2.7	11	18.6	-	-	-	-	4	14.8	-	-	-	-	-	-	**42**	**4.5**
	Total	**173**	**100**	**47**	**100**	**55**	**100**	**446**	**100**	**59**	**100**	**37**	**100**	**38**	**100**	**27**	**100**	**41**	**100**	**14**	**100**	**4**	**100**	**941**	**100**

Analysis data for the whole obtained field material over the period of August - October 2016 enable to state the absence of unique living conditions for bats within the whole region of investigations in the course of summer feeding, autumn migrations and search of winter hiding places, and existing distinctions between different functional zones indicate water areas as more attractive for animals against the background of the least attractivity of the wind farm sites.

Species composition of bats of the north-western Azov Sea region, in comparison with other natural zones, is the poorest one. Analysis of literature data and identification of sounds by means of ultrasonic detectors enables to assume that pipistrelles dominate in species composition of migrants, in particular, Kuhl's pipistrelles.

Species range is represented by taxons widely distributed in Ukraine. Lack of natural and artificial hiding places for troglophil group eliminates potential negative impact of construction and operation of the wind farm on species of endangered category.

Spatial distribution of migrants over the wind farm is uneven. Bats fly sparsely in a wide front. The highest intensity of passage has been recorded since the middle of August and till the middle of September. We have revealed migration corridor, which pass over the water area of the Molochnyi Estuary and along the coast of the Sea of Azov.

We have not observed mass seasonal migrations, when bats fly in flock, like birds.

3.9 Natural Protected Areas

In accordance with the national legislation, natural protected areas are subdivided into the natural protected areas of the first order (wildlife preservations and national parks) and of the lower orders (preserves of national and local importance).

There are no natural protected areas of the first order (wildlife preservations and national parks) within the wind farm site and adjacent territories up to 4 km. The natural protected areas of the lower orders (preserves of local importance) also are not represented within the wind farm sites.

Only one natural protected area is located in the territories adjacent to the wind farm sites - the Molochnyi Estuary Wetland of International Importance, which is a part of the Azov Seaside National Natural Park. The Molochnyi Estuary also belongs to IBA (Important Bird Areas), as important places for seasonal habitation of semi-aquatic birds.

The biological complex of the wetland is charachterized by quite a high diversity including:

- 274 species of birds (112 species nest, 213 were encountered during the migration period and 98 species were observed in winter) with the total number of birds in different seasons exceeding 250 thousand specimens;
- 700 species of vascular plants;
- 33 species of fish;
- 2 species of amphibians and six species of reptiles;
- 30 species of mammals;
- more than 300 species of other representatives of the biological complex.

The Molochny Estuary is an important territory for preservation of rare animals and plants:

- 149 species of birds pertain to Pan-European Conservation Importance (SPEC). 15 species are protected by the International Union for Conservation of Nature (IUCN), 259 species are protected by the Bern Convention and 147 species are protected by the Bonn Convention. 96 species are guard-protected by the Agreement on the Conservation of African-Eurasian Migratory Waterbirds - AEWA; 41 species fall within the scope of the Convention on International Trade in Endangered Species (CITES). Besides, 44 species of birds are listed in the Red Data Book of Ukraine
- 33 species of insects are listed in the Red Data Book of Ukraine and the European Red List

- 33 species of vascular plants are under protection at World, European and state levels. 9 species are listed in the World Red List (IUCN), 16 species are booked in the European Red List. Vascular plants grow at the researched area, out of 439 species of vascular plants - 17 species are listed in the Red Data Book of Ukraine.

The area of the planned investment is located in a proximity to the so-called Important Bird Area of International Importance, as classified by the BirdLife International. Within the scope of 30 km from the location of the planned undertaking, the following IBA areas are situated:

- **UA071 Molochnyj Liman (or Molochnyi Estuary):**
  - 4.2 kilometers from the wind farm site,
  - 4.7 kilometers from the main transformer station,
  - 2.0 kilometers from the overhead power transmission line.
- **UA072 Molochna River Valley:**
  - 2.6 kilometers from the wind farm site,
  - 5.5 kilometers from the main transformer station,
  - Through to the overhead power transmission line.
- **UA070 Utlyuk Lyman:**
  - 19.7 kilometers from the wind farm site,
  - 28 kilometers from the main transformer station,
  - 27.5 kilometers from the overhead power transmission line.

The enlisted areas are discussed in details below.

Molochnyj Liman UA071 (or Molochnyi Estuary)

Area: 22 450 ha

The estuary of the Molochnaya river, near Kirilovka village. The total number of breeding waterbirds is 12 000 - 15 000 pairs, while the total number of waterbirds staging on passage is 197 000 - 286 000 individuals, including up to 20 000 Fulica atra. The total staging is dependent on weather and water conditions. Populations, protection status and habitats of Molochnyj Liman IBA shows Table 14 - Table 16.

Table 14. Populations of IBA trigger species (Molochnyj Liman UA071)

Species	Current IUCN Red List Category	Sason	Year(s) of estimate	Population estimate	IBA Criteria Triggered
Mute Swan *Cygnus olor*	LC	passage	1992	2000-5000 individuals	A4i, B1i
Greylag Goose *Anser anser*	LC	winter	1992	10000-12000 individuals	A4i, B1i
Greater White-fronted Goose *Anser albifrons*	LC	passage	1992	25000-40000 individuals	A4i, B1i
Smew *Mergellus albellus*	LC	winter	1992	5000-12000 individuals	A4i, B1i
Greater Scaup *Aythya marila*	LC	winter	1992	80000-100000 individuals	A4i, B1i
Mallard *Anas platyrhynchos*	LC	winter	1992	25000-30000 individuals	B1i
Great Crested Grebe *Podiceps cristatus*	LC	passage	1992	5000-12000 individuals	A4i, B1i
Black-necked Grebe *Podiceps nigricollis*	LC	passage	1992	5000-10000 individuals	A4i, B1i
Grey Heron *Ardea cinerea*	LC	passage	1999	4500-6000 individuals	A4i, B1i

Species	Current IUCN Red List Category	Sason	Year(s) of estimate	Population estimate	IBA Criteria Triggered
Purple Heron *Ardea purpurea*	LC	passage	1999	700-750 individuals	B2
Great White Egret *Ardea alba*	LC	passage	1999	800-1000 individuals	A4i, B1i
Great Cormorant *Phalacrocorax carbo*	LC	breeding	1992	1000-3000 breeding pairs	A4i, B1i
Pied Avocet *Recurvirostra avosetta*	LC	breeding	1992	50-250 breeding pairs	B1i, B3
Collared Pratincole *Glareola pratincola*	LC	passage	1992	400-600 individuals	A4i, B1i
Larus cachinnans	NR	breeding	1992	4000-5500 breeding pairs	A4i, B1i
A4iii *Species group - waterbirds*	n/a	winter	1992	100000-499999 individuals	A4iii
A4iii *Species group - waterbirds*	n/a	passage	1992	50000-99999 individuals	A4iii

Table 15. Protection status (Molochnyj Liman UA071)

Protected Area	Designation	Area (ha)	Relationship with IBA	Overlap with IBA (ha)
Molochnyi Liman	Wetlands of International Importance (Ramsar)	22 400	protected area contained by site	22 400

Table 16. Habitats (Molochnyj Liman UA071)

IUCN Habitat	Habitat detail	Extent (% of site)
Grassland	Steppes and dry calcareous grassland	-
Wetlands (inland)	Tidal rivers and enclosed tidal waters, Sand dunes and beaches, Standing freshwater, Rivers and streams, Water fringe vegetation	-
Sea		-

Molochna river valley UA072

Area: 3800 ha

A stretch of the Molochnaya valley, near the villages of Svetlodolinskoe, Kamenskoe and Rubalovka, with numerous reedbeds Phragmites. Populations and habitats of Molochna river valley IBA shows Table 17 and Table 18.

Table 17. Populations of IBA trigger species (Molochna river valley UA072)

Species	Current IUCN Red List Category	Sason	Year(s) of estimate	Population estimate	IBA Criteria Triggered
Ixobrychus minutus	NR	breeding	1997	200-240 breeding pairs	B2
Eurasian Bittern *Botaurus stellaris*	LC	breeding	1997	140-160 breeding pairs	B2
Himantopus himantopus	NR	breeding	1997	120-200 breeding pairs	B1i
Common Redshank *Tringa totanus*	LC	breeding	1997	275-315 breeding pairs	B2

Species	Current IUCN Red List Category	Sason	Year(s) of estimate	Population estimate	IBA Criteria Triggered
Collared Pratincole *Glareola pratincola*	LC	breeding	1997	60-80 breeding pairs	A4i, B1i, B2
Savi's Warbler *Locustella luscinioides*	LC	breeding	1997	300-500 breeding pairs	B3
Whinchat *Saxicola rubetra*	LC	breeding	1997	260-500 breeding pairs	B3

Table 18. Habitats (Molochna river valley UA072)

IUCN Habitat	Habitat detail	Extent (% of site)
Grassland	Humid grasslands	-
Wetlands (inland)	Standing freshwater, Rivers and streams, Water fringe vegetation	-
Artificial - terrestrial	Arable land, Forestry plantations, Other urban and industrial areas	-

Utlyuk lyman UA070
Area: 75 200 ha
An estuary on the coast of the Sea of Azov, with adjoining areas of steppe and arable land, near Genitchesk town. The total number of breeding waterbirds is 600-800 pairs, while 30 000 - 70 000 waterbirds stage here during migration. Populations and habitats of Utlyuk lyman IBA shows Table 19 - Table 20.

Table 19. Populations of IBA trigger species (Utlyuk lyman UA070)

Species	Current IUCN Red List Category	Sason	Year(s) of estimate	Population estimate	IBA Criteria Triggered
Mute Swan *Cygnus olor*	LC	passage	1992	11000-16000 individuals	A4i, B1i
Greylag Goose *Anser anser*	LC	passage	1992	200-3000 individuals	B1i
Greater White-fronted Goose *Anser albifrons*	LC	passage	1992	19000-22000 individuals	A4i, B1i
Greater Scaup *Aythya marila*	LC	passage	1992	2000-3000 individuals	B1i
Larus cachinnans	NR	passage	1992	6000-7000 individuals	A4i, B1i
A4iii *Species group - waterbirds*	n/a	passage	1992	20000-49999 individuals	A4iii

Table 20. Habitats (Utlyuk lyman UA070)

IUCN Habitat	Habitat detail	Extent (% of site)
Grassland	Steppes and dry calcareous grassland, Humid grasslands	-
Wetlands (inland)	Sand dunes and beaches, Standing brackish and salt water, Water fringe vegetation	-
Sea	Sea inlets and coastal features	-
Artificial - terrestrial	Arable land	-

3.10 Nature Connections

The estuary is an area of international importance recognized at the world level and inclouded in the Ramsar Convention's list of wetlands. Therefore any activity within the land is also governed by Regulation No. 935 of the Cabinet of Ministers of Ukraine "On the Measures for Protection of Wetlands of International Importance" dated 23.11.1995 and Regulation No. 1287 of the Cabinet of Ministers of Ukraine "On the Procedure for Assignment of the Wetlands of International Importance Status to Wetlands" dated 29.08.2002. As a result of establishing the Azov Seaside National Natural Park (Decree No. 154/2010 of the President of Ukraine dated 10.02.2010), the Molochnyi Estuary Wetland became its part. Ornithological associations have the greatest value in the Molochny Estuary biota. 98 of 101 species of waterfowl occurring at the water bodies in the south of Ukraine are encountered on the water area of the Molochny Estuary in different seasons. The Ramsar areas include those which provide the nesting possibility to 1% of a geographical population of any waterfowl specie or where the number of birds exceeds 20.000 specimens in any season. The substantial number of birds visiting the water body once each (over 40-45 thousand specimens in some seasons) determine the international importance of the estuary and its inclusion in the official list of the Ramsar areas. For all the years of surveys, 272-273 species of birds have been observed at the estuary and on the adjacent plots, 149 (54%) of which are are of the Pan-European protection importance (SPEC). These species include those of global nature-preservation importance: 10 (3.6%); those of mainly European habitat but an unfavourable status: 18 (6.6%); those of not only European habitat but of an unfavourable status: 72 (26%); and those of mainly European habitat but a favourable status: 49 (17.9%). Many species (15 – 5.4%) are protected by the International Union for Conservation of Nature (IUCN) and under the Bern (259) and the Bonn (147) Conventions. A considerable part of birds (96 – 35%) is protected under the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA); and CITES applies to 41 (15%) of the species. Besides, 44 (16%) species of birds are included in the Red Data Book of Ukraine.

The Molochny Estuary Wetland of International Importance is a key element in the overall structure of ecological network at the regional and Pan-European levels. This territory is included in the Azov and Black-Sea Above-Sea Environmental Corridor, which runs from the Danube in the west to the Don in the east along the coasts of the Black and Azov Seas and covers the seaside parts of Odessa, Mykolayiv, Kherson, Zaporizhia and Donetsk Regions. The most intensive flyway of birds in the Eastern Europe within the African-Eurasian Migration Region runs along this corridor. The Molochny Estuary is connected with the Sivash by general passages. If taken together with the Sivash, the importance of this territory for birds exceeds that of the common Danube Delta (Ukraine and Romania) together with the water bodies of the Bulgarian seaside.

Inclusion of the Molochny Estuary in the econogical network is instrumental in the following:

- preservation and restoration of the territorial and functional integrity of the natural seaside, littoral and aquatic ecosystems;
- preservation of territorial integrity of lands under the main migration routes, primarily for avifauna;
- preservation of the natural landscape diversity; and
- enhancement of the natural rare diversity protection.

The uplands and agrocenoses around the estuary are not environmentally significant in their own right but their supply of migratory birds with food resources is integral to the overall value of the territory. The agricultural hedgerows and forest plantations, especially those along the south-western border of the wind farm plot, are important for nesting of small falcon species, long-legged buzzards, etc.

Ecosystem importance. The Molochny Estuary is a unique integrated ecosystem, which is a patchwork of associations including dry steppe, man-made forest plantations of the right bank and diverse wetland biotobes with peculiarities of the regimen on which the biodiversity and bioproductivity depend.

Landscape and biological diversity. In terms of ecosystem, the most valuable are the seaside abrasion and accumulation (old and contemporary sea terraces) landscape complexes with various biotopes, as well as streamside landscape complexes with relatively preserved wild steppe and flood-plain vegetation.

The special role is played by the mouth reaches of small rivers of the Azov Seaside, where the contrast of landscapes has lead to generation of unique wetland forms, which are the habitats of many semi-aquatic birds for the whole year. These mouth reaches play a key role in supporting the species diversity of birds. Apart from that, the rivers and gullies which flow into the estuary serve as ecological landscape corridors connecting the Azov Seaside Massif with the coastal area.

Natural state. The specialists who researched the estuary have yet to determine which of its states shall be considered natural: the water body isolated from the sea or the lagoon connected with the Sea of Azov. Irrespective of the connection with the sea (such connection was either natural or man-made in the different stages of the estuary existence), the Molochny Estuary Wetland of International Importance was generated naturally and it has mostly natural indicators of functioning and development. The areas changed by people are the watersheds adjacent to the estuary and the terraces above the flood plains with intensively developed agricultural activity, as well as some territories of the right bank modified by recreational activity.

Uniqueness. The peculiar feature of the Molochny Estuary ecosystem is the specificity of its salt relations in its semi-enclosed state. The contact of the water and land environments makes the researched territory a most valuable area in the North-Western Azov Seaside.

Vulnerability. The Molochny Estuary Wetland of International Importance is quite vulnerable. This is accounted for by the drastic change of its hydrological regime depending on the degree of its connection with the Sea of Azov and, as a result, the change in biodiversity and fish productivity.
Typical nature. The typical nature of the Molochny Estuary is caused by the wide spread of such formations along the Ukrainian coast of the Azov and Black Sea: the Utliuk Estuary, the Sivash Bay, the Dnipro Estuary, the Dniester Estuary and others, which have typical conditions for generation of wetland habitats and the typical biota due to their geographical features (terrain, climatic conditions, etc.)

Besides the territories of the natural protected areas of the first order, preserves of local importance are located in the adjacent territories (Table 21).

Table 21. List of Preserves of Local Importance Located in the Territories Adjacent to wind farm Sites

No.	Object name	Type	Area, ha	Location
1	Virgin plot	botanical	332.6	Melitopol District, near the Molochna River bed behind Mordvynivka Village
2	Virgin plot	botanical	10.0	Melitopol District, near Mordvynivka Village
3	Virgin plot	botanical	502.0	Melitopol District, flood plain of the Molochna River, outskirts of Mordvynivka Village
4	Agricultural hedgerow	botanical	3.0	Pryazovske District, within the lands of Dunaivka Village

In addition to high level natural reserve fund (NRF) territories there are local importance wildlife preserves on the adjacent territories (Table 22).

Table 22. List of local importance wildlife preserves located on the territories adjacent to the 330 kv PTL route

Object name	Type	Area, ha	Location
Virgin land	Botanic	332.6	Melitopol district, near the Molochna river course behind Mordvynivka Village
Virgin land	Botanic	10.0	Melitopol district, near Mordvynivka Village
Virgin land	Botanic	502.0	Melitopol district, Molochna River flood plain, near Mordvynivka Village

Figure 8 shows ecological corridor zones.

Figure 8. Ecological corridor zones for low migration routes for the birds and bats crossing the wind farm are a direct result of the optimisation of the WTGs' location.

3.11 The description of the Protected Monuments Found in the Neighborhood or the Direct Range of the Impact of the Planned Development

Within the planned wind farm the following high cultural and historic value areas were distinguished:

- Girsivka Village - Archaeological finds: remains of a Scythian settlement (IV century B.C.). Common graves and memorial complexes (local category of protection): a common grave of the Soviet warriors and the monument to the fellow-villager warriors (63 persons buried),
- Dunaivka Village - Common graves and memorial complexes (local category of protection): the monument to the fellow-villager warriors,
- Mordvynivka Village - Archaeological finds: remains of a Sarmatian settlement near the village. Historical heritage: the blindage which housed the command posts of Streletskaya Division 118 and Artillery Regiment 117, the place where Votan German defence line was broken through by the Soviet troops (the memorial tablet).

All cultural/historic value areas are located inside the villages. As wind turbines are placed at least 1,200 meters from the boundaries of any village (in two cases this distance was exceptionally lowered to 800 meters), the wind farm operations will come nowhere close to values of cultural/historic value. The planned elements of the investments will not degrade or devastate the high value landscape areas.

Figure 9. Location of the excavated Scynthian burials.

Among the identified Scythian burials (see Figure 9) one was removed during the preparation phase of the wind farm construction (the burial was located in the planned technological road route). The works were conducted after prior consent and were supervised by the national historic preservation authorities. Three more Scythian burial mounds were excavated in summer, 2016 as they were considered to be too close to future planned operations and the conservative/responsible decision was deemed to be to excavate the site. The excavations were performed by trained and licensed archaeologists. We are not aware of any other potential conflict issues with Scythian burial mounds.

Figure 10. Excavatory works at Scynthian burials.

3.12 Landscape characteristics

Wind Farm Site

Apart from low diversity of the land use at the planned wind farm, its natural topography is not very diverse as well. Plain seaside areas dominate. The Molochny Estuary is a slight depression in this area. Only the north-western part of the area, close to the estuary, is characterised by a more diverse border zone with upland areas. The characteristic feature of the planned wind farm landscape includes simple, one- or two-level panoramas, with the foreground delineated by arable land, then the hedgerows or the village's built-up line. The estuary was historically a popular place for fishing. Currently, the estuary is less popular for for this purpose as the water table is lower than historically and the entrance to estuary is clogged with sand. The estuary is, however, still used for recreational purposes. While it is theoretically possible that the estuary could flood, the tendency over the past 20 years has been for the water level to decrease.

The only areas of high landscape value, where construction work will be conducted and the wind farm's direct and indirect impact will occur, include:

- northern part of Molochny Estuary, where an overhead power transmission line will be constructed. Part of the wind farm of an area less than 1 ha is located in the Molochny Estuary National Park. The Ukrainian legislation allows construction of PTL across the national parks.
- small valley of Dzhekelnia river between Nadjeżdno and Girsivka villages, where the substation and power distribution cables are planned.

The landscape structure of the territory within the Molochny Estuary Wetland consists of five areas (Figure 11):

- areas of fluvial terraces (the stows of fluvial terraces 1-2, 3-4 and 5-6 above the flood plain). The left bank within the 200 m zone includes terrace 1-2 above the flood plain partially covered with agricultural lands. Typical biotopes: clay precipices, remnants of steppe vegetation on the slopes, man-made forest plantations on the terraced slopes, man-made forest plantations on sands along the right bank, salt marshes, paddocks and pastures, old orchards and children recreational facilities;
- floodplain areas (the near-firth part of the Molochna and the Tashchenak Rivers) with the strips of cutoff lakes and the main stream canal. There occur areas of low seaside plakors covered with agricultural lands, which have replaced former wermuth-grass steppes. Typical biotopes: sand-and-uliginous beaches, meadows, shoals, deep water in the main stream canal, thickets of rushes and wetland vegetation, cutoff lakes;
- areas of sea-coast halogenic plains (developed on the spits) with the stows of depressed loam loess plains, depressed plains with argillo-arenaceous white alkalis combined with saline white alkalis of marshes, argillo-arenaceous and uliginous saline lands, shell-rock and sand bay-bars, spits and islands with underdeveloped sod gleyey and alkali soils. Typical biotopes: alkali depressions, thickets of rushes in the coastal part, sand-and-uliginous beaches, shoals, small islands and buildings. The large accumulative islands (Pidkova, Dovgy) situated along the left bank of the estuary have the status of a separate landscape area. Their isolation, irregular water relationships (waterlogging, drainage), intensive abrasion and accumulation processes, oversaturation of the soil with nitrogen caused by rookeries lead to development of pioneer plant associations (annuals). Typical biotopes: shoals, lean growth, beds of rushes;
- seaside abrasion areas along the precipitous banks of the estuary with stows of fresh abrasion ledges, short bank ravines and beach strips of abrasion material processed by waves. Typical biotopes: argillo-arenaceous precipices and sand-and-uliginous beaches;
- seaside abrasion halogenic areas (along the left bank of the estuary), which consist of gullies with gentle slopes slightly noticeable in the relief and hollows with wide saline bottoms and diluvial slopes with chestnut and chestnut-pratal dry steppe white alkalis. Typical biotopes: scrubs, agriculturad hedgerows, stand-alone trees, salt swamps, white alkalis and shoals.

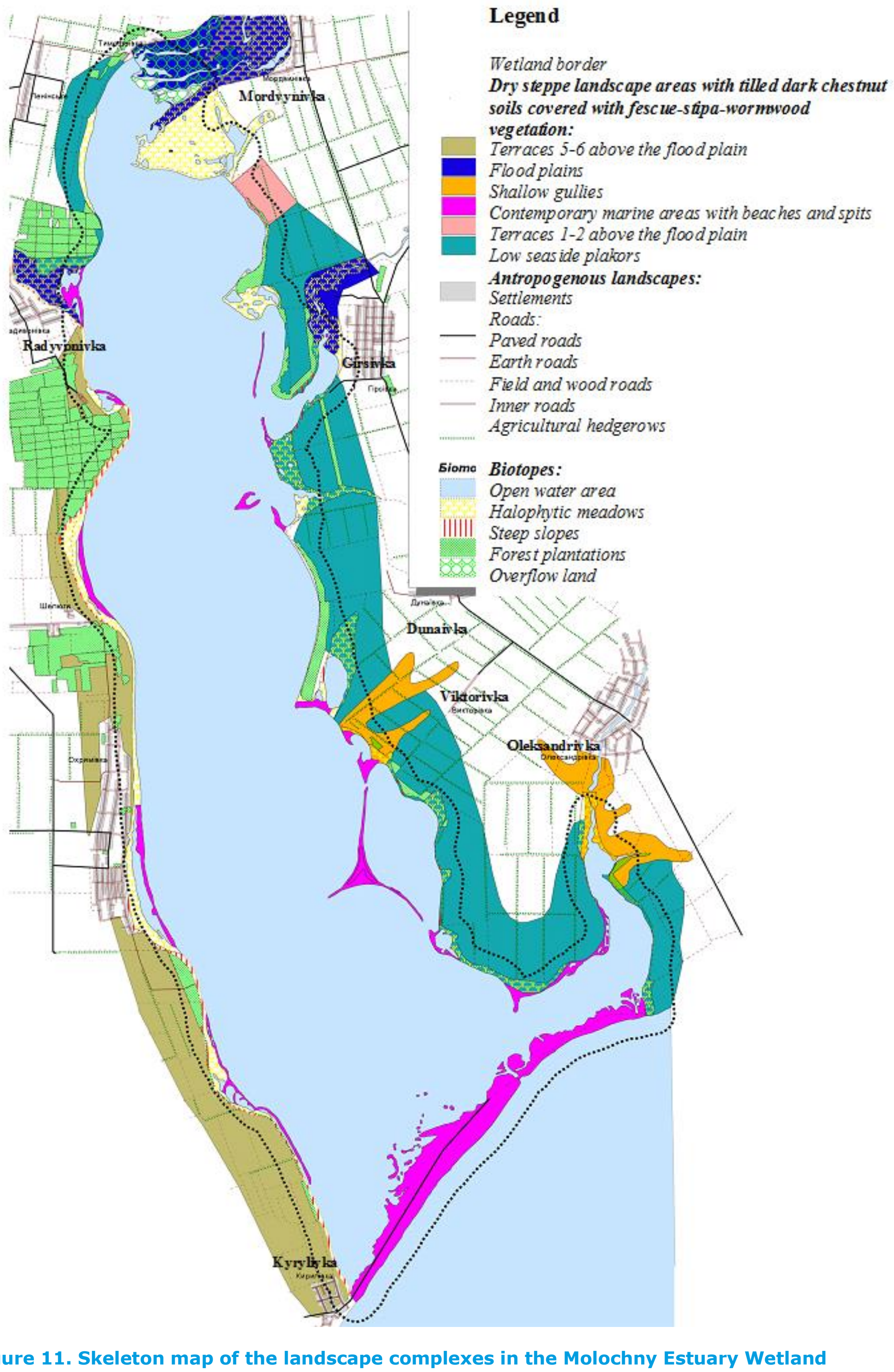

Figure 11. Skeleton map of the landscape complexes in the Molochny Estuary Wetland

PTL Route

The landscape structure within the route of 330 kV PTL between the wind farm Central Substation and Melitopol Substation consists of 4 areas:

- areas of fluvial terraces (the stows of fluvial terraces 1-6 above the flood plain). The left bank includes terrace 1-2 above the flood plain partially covered with agricultural lands. Typical biotopes: clay precipices, remnants of steppe vegetation on the slopes, man-made forest plantations, salt marshes, paddocks and pastures, old orchards;
- floodplain areas (the near-firth part of the Molochna River) with the strips of cutoff lakes and the main stream canal. There occur areas of low seaside plakors covered with agricultural lands.

Typical biotopes: meadows, shoals, deep water in the main stream canal, thickets of rushes and wetland vegetation, cutoff lakes;

- areas of sea-coast halogenic plains with the stows of depressed loam loess plains, depressed plains with argillo-arenaceous white alkalis combined with saline white alkalis of marshes, argillo-arenaceous and uliginous saline lands. Typical biotopes: alkali depressions, thickets of rushes in the coastal part, shoals.
- abrasion halogenic areas (along the left bank of the estuary), which consist of gullies with gentle slopes slightly noticeable in the relief and hollows with wide saline bottoms and diluvial slopes with chestnut and chestnut-pratal dry steppe white alkalis. Typical biotopes: scrubs, agricultural hedgerows, stand-alone trees, and white alkalis.

Main landscape and biotopic complexes are represented by the following types:

- man-made forest plantations (trees and shrubs);
- agricultural hedgerows (trees and shrubs);
- flood-plain biotopes (aquatic and uliginous vegetation);
- salt marshes (meadow and halophytic vegetation);
- farmed ecosystems (agricultural lands);
- laylands;
- urban landscapes (settlements, buildings);
- technical landscapes (waste dump).

3.13 **Social Environment**

3.13.1 General

The subject development will be located in Melitopol and Priazovsk districts.

The Melitopol district, according to the publicly available information, occupies territory of 1,780 km^2 and has a population of approximately 49,700 (2015). The Capitol of the District is situated in Melitopol, which, however, has a status of a separate administrative unit. Melitopol is the largest city in the site area as well as the second largest city in the Zaporizhia Region. Melitopol has an area of 51 km^2 and its population (as for 2015) counts 156 thousand.

The Melitopol District is administratively divided into 1 village council and 15 rural councils, bringing together 68 settlements which are subject to the Melitopol district council. The basis of the industrial potential of Melitopol district is machine engineering and food companies. In the district there are 152 active agricultural enterprises, including 31 - limited liability companies, 3 cooperatives, 12 private enterprises, 3 public enterprises, and 100 farms.

Today in the District there are 57 educational institutions (33 secondary schools of all levels, 1 high school, 1 college, 1 Teaching and Educational Complex, 15 kindergartens). The health facilities include: 7 rural district hospitals, 40 village health centers, 3 medical clinic and a central district hospital.

The city of Melitopol is an important regional center of machine engineering, light and food industry. The machine engineering complex of the city is represented by 8 large plants and more than 100 small and medium-sized enterprises formed after 1991. Mechanical engineers of the city mainly produce goods for the agricultural sector: a wide range of spare parts, components and assemblies for mobile equipment of local and foreign producers. Production capacity and availability of experienced, qualified staff allows entrepreneurs to design and produce parts of any complexity, including large ones. All the processes necessary to create parts can be made in the city: starting with metallurgical operations (casting) and ending with assembly and testing.

According to the publicly available sources, the Priazovsk district has an area of 1,947 km^2 and population of approx. 27,630. The Capitol of the district is Priazovske settlement with a population of approximately 7,000.

In the district there are 283 enterprises, among which 23 are cooperatives, 4 - private enterprises and 256 farms. The farms produce mainly crops, however, livestock industry (18 companies involved) are also present in the area.

There are numerous schools in the District. Medical services are provided by 2 hospitals and 32 health posts.

An average monthly salary (average for the 1st four months of 2017) in Ukraine is 238 USD, while in Zaporizhia region 230 USD. No village specific information with respect to average salary was available.

3.13.2 Site specific data

The project will be developed in a proximity to the villages of Devninskoe, Dobrivka, Dunaevka, Girsivka, Mordvinivka and Nadeshdine, however outside the boundaries of the villages.

Below we provide the basic data about the population of each individual Village Council, based on certificates issued by the village councils.

Devninskoe Village Council

The land belonging to Devninskoe Village Council occupies an area of 4236 ha. Population of the village is 579. The structure of the population is as following:

- Men: 259 of which
  - 43 are up to 17 years old;
  - 167 are between 18 and 59 years old;
  - 49 are over 59 years old;
- Women: 320
  - 51 are up to 17 years old;
  - 166 are between 18 and 59 years old;
  - 103 are over 59 years old.

Since 2012 the number of deaths prevail over the number of births and the headcount of the village gradually decreases, except for the year 2015 (in brackets number of daths per 1000 inhabitants and number of births per 1000 inhabitants is provided):

- 2012: 624 (16/8);
- 2013: 602 (16.6/6.6);
- 2014: 570 (36.8/8.7);
- 2015: 579 (12.1/5.2).

The structure of population over 17 years old versus individual education is as following (in brackets the number of men and women are presented respectively):

- Higher: 83 (39/48);
- Incomplete higher: 78 (27/53);
- Secondary: 175 (87/100);
- Incomplete secondary: 130 (62/68);
- Elementary: 1 (1/0)
- Unknown: 18.

In the village the working population counts 333 (57.5% of the population, 167 men, 166 women) and unable to work population counts 195 (33.6% of the population, 92 men, 103 women). Approximately 16.5% of the village population are employed outside the village, in the district and regional centers. The second largest percentage of the population is employed in a state sector (approx. 14.4%) and the third one in agricultural sector (approx. 10%).

No data about enterprises registered in the village were available.

There are the fist aid station, public school (I-III stage), kindergarten, Cultural Building of the Dyvinskoye Village Council, library and disco club in the village.

Dobrivka Village Council

The land that belongs to Dobrivka has an area of 4758 ha.The Village Council has 510 inhabitants (as for May 1, 2017) of which 266 are women and 244 are men. The populations' distribution by age is as following (in brackets the number of men and women are presented respectively):

- Pre-productive age (0-17): 93(44/49);
- Productive age (18-59): 312 (162/150);
- Post-productive age (60 and older): 105 (38/67).

Since 2013 the number of deaths prevails over the number of births, except for the year 2016, and counts respectively (data collectively for Dobrivka and Novopokrivka villages):

- 12 to 7 per thousand inhabitants in 2013;
- 6 to 4 per thousand inhabitants in 2014;
- 11 to 1 per thousand inhabitants in 2015;
- 4 to 7 per thousand inhabitants in 2016.

In 2017 two deaths and no births were recored by May 1. Small number of births, given the aging distribution of the population, may indicate that the living conditions in the village as well as prospects for the future are assessed negatively by the inhabitants. The headcount of both villages has reduced from 530 in 2013 to 510 in 2017.

The structure of population over 17 years old versus individual education is as following (data for two mentioned above villages):

- Higher: 60;
- Incomplete higher: 45;
- Secondary: 77;
- Incomplete secondary: 20;
- Other education: 215

In Dobrivka, 64.5% of the population (i.e. 242 people) is able to work (33.5% men and 31% of women) and 21.3% is unable. In the village 32.8% of polulation, i.e. 123 people (19.5% of men and 13.3% of women) is employed. The available data are not precise enough to conclude sectors in which the citizens are employed, however, the data indicate clearly large percentage of employed works in district center (41) and regional center (47).

There are no healthcare, educational, cultural, sport and leisure facilities in the village.

Two agricultural companies are registered in the village.

Dunaivka Village Council

The land of Dunaivka Village Council occupies territory of 7048 ha. Population of the village is 504, among which:

- 296 are men and 327 are women;
- 116 are at age 0-17 years old (61 men and 55 women);
- 341 are at age 18-60 years old (172 men and 169 women);
- 166 are 61 and older (63 men and 103 women).

Available data for the years 2006-2015 indicate continuous decrease of the number of habitants, from 690 in 2006 to 629 in 2015. In 2016 the structure of the population versus education was as following (in brackets number of men and women is given respectively):

- Higher: 99 (34/65);
- Incomplete higher: 17 (9/8);
- Secondary: 297 (149/148);
- Incomplete secondary: 79 (35/44);

- Elementary: 15 (3/12).

In Dunaivka village the working population counts 341 (55% of the population, 172 men, 169 women) and the unable to work population counts 281 (45% of the population, 123 men, 158 women). Approximately 33% of the village population are employed outside the village, in the district and regional centers. The second largest percentage of the population is employed in an agricultural sector (approx. 13%) and the third one in education (approx. 10%).

Nine enterprises are registered in the village of which:
- 7 are active in agricultural production (farming enterprises);
- 2 are local shops (one grocery and one retail of manufactured goods).

There is one first aid station present in Dunaivka, one kindergarten and one general eudcation school of I to III stage. The cultural facilities in the village include the Cultural Building of Dunaivka Village and a public library. There are no leisure or sport facilities present in the village.

Girsivka Village Council
The land that belongs to Gorsivka village has 8081 ha. The population of the village is 1045. The structure of the population is as following:
- 489 people are men, of which:
  - 96 are 17 years old or younger;
  - 19 are 18 to 59 years old;
  - 74 are 60 years old or older;
- 556 people are women, of which:
  - 115 are 17 years old or younger;
  - 308 are 18 to 59 years old;
  - 133 are 60 years old or older.

The number of inhabitants of the village continuously decreases since 2006 and the deaths rate prevails or is equal to births rate (in brackets number of deaths and births per 1000 inhabitants is presented):
- 2006: 1176 (19/11);
- 2007: 1164 (20/10);
- 2008: 1123 (24/9);
- 2009: 1106 (20/11);
- 2010: 1105 (11/11);
- 2011: 1082 (18/18);
- 2012: 1067 (17/17);
- 2013: 1061 (14/11);
- 2014: 1051 (22/7);
- 2015: 1045 (14/7).

The structure of population older than 17 versus its education level is as following (in brackets number of men and women is given respectively):
- Higher: 103 (49/54);
- Incomplete higher: 72 (29/13);
- Secondary: 577 (279/298);
- Incomplete secondary: 63 (28/35);
- Elementary: 19 (8/11)

In the village the working population counts 628 of which 320 are men and 308 are women. 205 people are unable to work (74 are men and 131 are women). 296 people are employed (164 men and 132 women) and 295 are unemployed (140 men and 155 women). The vast majority of population is employed outside the village (115 people – 18.3%). The largest employment in the village is in education (5.4%) and agricultural sector (4.6%).

There is a first aid station and pharmacy present in the village. Education (I-III stage) is secured by the General Education School, there is also a kindergarten in the village. The cultural facilities include Girsivka Cultural Building and a public library. The cultural and leisure facilities include a coffe bar only. There are 5 enterprises registered in the village, four of which are farming enterprises.

Mordvynivka Village Council

The Mordvinivka village land occupies terrirory of 6552 ha which is inhabited by 1198 people. The structure of the population is as following:

- 552 people are men, of which:
    - 158 are 17 years old or younger;
    - 320 are 18 to 59 years old;
    - 74 are 60 years old or older;
- 564 people are women, of which:
    - 93 are 17 years old or younger;
    - 305 are 18 to 59 years old;
    - 167 are 60 years old or older.

Neither data about death and birth rate nor about change in number of inhabitants was available for review.

The structure of population older than 17 versus its education level is as following (in brackets number of men and women is given respectively):

- Higher: 73 (31/42);
- Secondary: 809 (371/438);
- Unknown: 65

In the village the working population counts 582 of which 317 are men and 275 are women. 277 people are unable to work (85 are men and 182 are women). 442 people are employed (218 men and 224 women) and 139 are unemployed (88 men and 51 women). The vast majority of population is employed in agricultural sector (378) and outside the village, in district or regional centers (187).

No data about enterprises, medicare, cultural and leisure facilities in the village were available for review.

Nadeshdine Village Council

Nadeshdine Village Council includes the villages of Nadeshdine and Volna. The land occupied by Nadeshdine village has an area of 6000 ha. The population of the Village Council is 500, which is distributed as following:

- 250 people are men, of which:
    - 35 are 17 years old or younger;
    - 161are 18 to 59 years old;
    - 54 are 60 years old or older;
- 250 people are women, of which:
    - 26 are 17 years old or younger;
    - 137 are 18 to 59 years old;
    - 87 are 60 years old or older.

The number of inhabitants of the village council decreases almost continuously since 2007 and the deaths rate prevails or is equal to births rate (in brackets number of deaths and births per 1000 inhabitants is presented):

- 2007: 560 (8/8);
- 2008: 556 (11/2);
- 2009: 551 (11/2);
- 2010: 546 (3/2);

- 2011: 513 (4/0);
- 2012: 513 (8/2);
- 2013: 516 (5/2);
- 2014: 512 (10/5);
- 2015: 504 (5/3)
- As for December 1, 2016: 500 (5/3).

In the Village Council the working population counts 275 of which 148 are men and 127 are women. 225 people are unable to work (101 are men and 124 are women). 138 people are employed (75 men and 63 women) and 137 are unemployed (73 men and 64 women). The vast majority of population is employed outside the village council (89, i.e. over 32%) and in agricultural sector (63, i.e. 22.9%).

10 enterprises are registered in the village council, all active in agricultural production. In the village there is a fist aid station which operates also an ambulance and a veterinary station. There is a school in the village, as well as a village club and library.

Nove Village Council
The Nove Village Council has an area of 4723 ha and population of 2884. There are six villages in the Council: Nove, Danylo-Ivanivka, Sadove, Zelene, Pishchanske and Tashchenak. No WTGs are planned for development in this Village Council, however, its territory will be crossed by the PTL. A structure of the population is as following:

- 1425 are men, of which:
  - 228 are 17 years old or younger;
  - 977 are between 18 and 59, and
  - 220 are 60 years old or older;
- 1458 are women, of which:
  - 200 are 17 years old or younger;
  - 905 are between 18 and 59, and
  - 354 are 60 years old or older.

No information on deaths/births rate was available.

In the Village Council the working population counts 1882 of which 977 are men and 905 are women. 1002 people are unable to work (448 are men and 554 are women). 1278 people are employed (741 men and 537 women) and 604 are unemployed (277 men and 327 women). The vast majority of population is employed outside the village council (556, i.e. 29.6%) and in agricultural sector (377, i.e. 29.5%). Over 20% of the population works in private and state sector.

The majority of the Village Council population has secondary level education (1799 people, 870 – men, 929 – women) and incomplete secondary level education (360 people, 170 – men, 190 – women). Higher education have 326 people (211 men and 115 women), incomplete higher education 78 people (35 – men, 43 – women), the rest of the population of 17 years old and older has elementary education.

No information about social infrastructure in the Village Council as well as about registered enterprises was available.

4. THE DESCRIPTION OF THE PREDICTED ENVIRONMENTAL IMPACT IF THE INVESTMENT IS NOT UNDERTAKEN

In the case of the variant oriented towards abandoning the investment, the area where the investment was supposed to be made would not be changed in any way or form. The failure to realize the investment in question would mean no wind turbines being built and no interference with bats living and/or migrating there. The impact of the discussed scenario on the aforementioned group of animals would be nonexistent. The condition of environmental factors will be dependent on other functions that may be assigned to the area in an unspecified future.

Then, the land where the farm was supposed to be created may be transformed in other ways, possibly by means of intensified agricultural production, which will affect the local fauna in a negative manner (predominantly due to the utilization of plant protection-oriented substances). The failure to realize the investment would help avoid interfering with the environment which would surely take place in the process of wind farm construction and possible disassembly. The choice of the aforementioned alternative would not, however, positively influence the attempts to counter climate changes caused by the accumulation of greenhouse gases in the atmosphere. It has to be stated at this point that such attempts are a part of key political and economic doctrines of the European Union.

Furthermore, it has to be highlighted that even though there are no data on the impact of the local changes of microclimate on chiropteran fauna, it is known that on the global scale, the increase in humidity and higher temperatures during winter seasons (being climate parameters dependent on the exploitation of coal ores) negatively influences such variables as reproduction and survivability. In consequence, they may lead to significant changes in the quantity of bats in general (Sherwin H.A., Montgomery W.I. & Lundy M.G., in press. 2012.)

One can also assume that if the investment is not realized, all the interferences with the animal habitats of key importance, including IBA and other protected spots, would not occur. Abandoning both the discussed and other investments alike would only empower the dominance of conventional sources of energy exploitation. Therefore, there would be no decrease in the emission of greenhouse gases and pollutants (such as particulates and sulphur or nitrogen compounds).

In a long run, it may directly translate into the poorer vegetation condition and atmosphere pollution (damages to the green parts of flora, stoma clogging). The aforementioned negative phenomena would have an indirect impact on the fauna in the IBA and Estuarium Molochny areas as well.

The scenario oriented towards abandoning the investment at all does not seem to be the most beneficial way out in terms of environment protection, as the necessity to protect it, mainly by ensuring air cleanness, encourages various countries to look for energy sources different than liquid and solid fuels (coal, petrol, and gas). The alternative are the so-called renewable sources of energy, which utilize, among others, gusts of wind.

In the conventional power system, production of 1 MWh of energy based on hard coal results in emission of 0.9 t CO_2, and based on brown coal: 1.05 t CO_2. Replacing conventional sources by renewable energy sources therefore allows to avoid the emission of large quantities of carbon dioxide to the atmosphere.

In conclusion, the unrealized project will mean no impact on the environment at the stage of construction and operation of the investment. The project variants under consideration will cause some nuisance, especially in terms of noise emission and possible impact on birds and bats.

However, the potential negative impact on the environment upon completion of the investment will not be significant given the recommended preventive measures and limiting negative impact. In the general balance of profits and losses, the benefits gained from the operation of the project prevail and support the implementation of the investment. The development of wind energy, which incorporates this investment intention, is an alternative to using conventional energy sources.

5. THE DESCRIPTION OF ANALYZED VARIANTS OF THE UNDERTAKING

The undertaking consists in the construction of the wind farm in the vicinity of Melitopol, south-eastern Ukraine with technical infrastructure such as: cable connections and connect the wind farm to the substation and overhead power line 330 kV. The planned wind farm site is located in Zaporizhia Region, Priazovsk and Melitopol Districts, Zaporizhia Region, in Priazovsk and Melitopol Districts, in the village councils of Devninskoe, Dobrivka, Dunaevka, Girsivka, Mordvinivka and Nadeshdine, south-eastern Ukraine. The wind farm will consist of up to 167 WTGs.

5.1 The Variant Proposed by the Investor

The investor's variant of the planned development assumes construction of up to 167 WTGs in a close proximity to the village councils of Devninskoe, Dobrivka, Dunaevka, Girsivka, Mordvinivka and Nadeshdine, south-eastern Ukraine.

The choice of the location of the aforementioned WTGs was mainly determined by environmental factors, predominantly by chiropterology and ornithological observations of the chosen area, as well as by the necessity to comply with the noise level norms on the areas neighboring with the investment site, where noise levels cannot exceed a set threshold. What is more, the economic aspect was also taken into account. The layout of the wind farm and alternative PTL routes are presented in Appendix 1.

The wind farm, together with auxiliary structures (access roads and utility infrastructure) would be situated on the leased land plots, the access to which would be ensured by means of the currently existing local roads, that may be – if need be – modernized or modified. The area utilized to build 167 wind turbines on would constitute only a negligible part of the leased plots of land on which foundations would be laid on the area of approximately 625 m^2 (for each of the turbines) and roads would be built, the width of which would be equal to approximately 5 m. The WTGs would be built within the borders of an open area serving agricultural functions. Current land exploitation level and type would not be subject to any changes, aside from spots taken by turbine foundations, assembly/service yards and roads.

The localization of the wind farm in the case of the investor's variant is optimal in terms of ecology, economy, and societal issues. The presented plan meets the requirements relating to environment protection, which has been confirmed by chiropterology and ornithological observations. The turbine erection spots will not negatively impact the protected IBA areas nearby. The installed wind turbines will also not cause the excessive noise increase which would be harmful for the local environment. The development will additionally be of key importance in terms of the attempted fight with climate changes caused by the accumulation of greenhouse gases in the atmosphere.

5.2 An Alternative Rational Variant

The initial location-related variant of the discussed investment was prepared by the Investor in 2009 (wind farm evacuation) and 2012 (PTL Routing). At the stage of concept works, areas where a wind farm could be built were specified. Such aspects as the availability of the land, acoustic norms, and the necessity to establish such a farm outside of protected areas and bird habitats were all taken into consideration. The variant in question which assumed construction of 222 wind turbines type Eviag V-90-2.500, hub height 100 m and rotor diameter 90 m was considered in terms of noise level and shadow flickering.

In order to protect the natural values as well as reduce threats for birds and bats, a spatial optimisation of the WTGs allocation was performed. The number of WTGs was reduced from 222 to 167, which results in reducing its impact on the local ecologic and physiognomic landscape. The spatial optimisation of the WTGs on the wind farm made it possible to group them in three zones, divided by nature corridors, which enable birds and bats migration without collisions with the turbines (Figure 8 above, in chapter 3.10). Further, in order to minimize the environmental impacts the Developer:

- located the wind farm well north of the shoreline of the Sea of Azov;
- doubled the minimum separation distance required by law in Ukraine between the Milk Estuary and the wind farm;
- tripled the minimum distance required by law for separation between a WTG and a village council boundary.

The route of the PTL was also subject to detailed analysis. Three concepts were considered, as presented on Figure 12. The variant considered by Ramboll Environ as the least affecting the natural properties of the area, which minimum possible interference with valuable area of Molochny Estuary was selected for realization. The route in large extent passes along already existing power transmission lines hence the possible impacts will be reduced. The power transmission line will originate outside the boundaries of Nadeshdine village, cross into Mordvinivka village (outside the boundaries of the village), then enter Nove village council (also outside the boundaries of the village), before connecting into the grid sub-station.

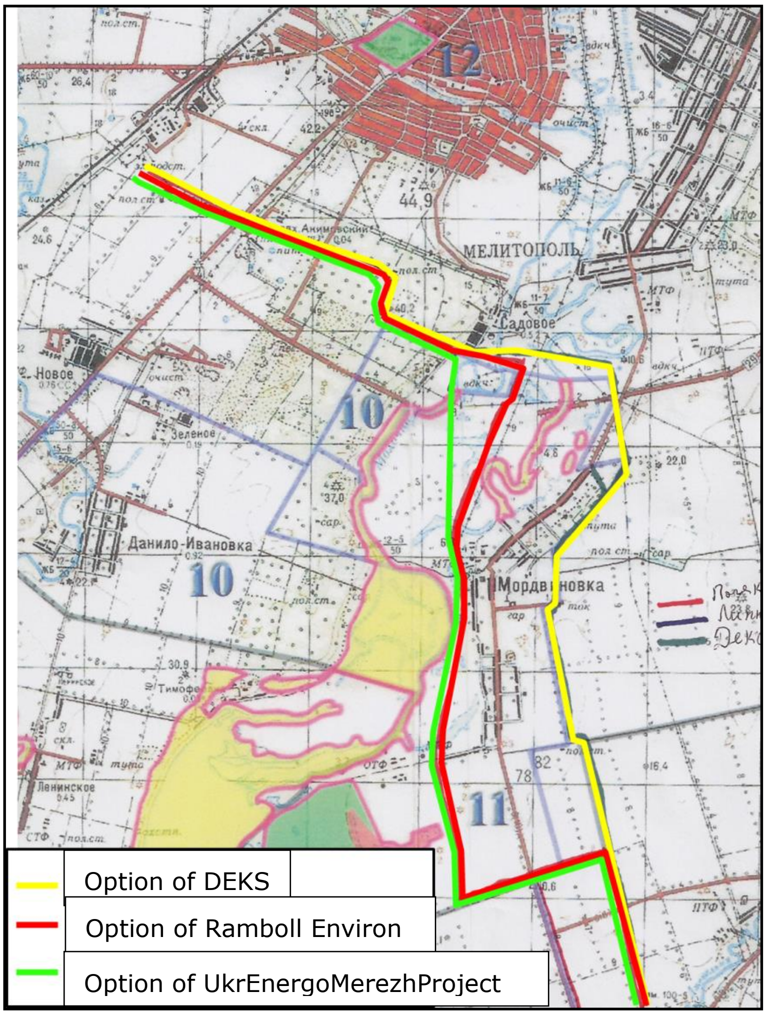

Figure 12. Alternative routes of the PTL

5.3 The Variant Most Favorable for the Environment

The variant that is the most favorable for the environment shall be understood as the one not decreasing the condition of the local environment and not interfering with the local fauna and flora. It would be a variant based on the construction of 167 wind turbines of minimal power of 3.45MW each (the total power of the entire farm is estimated to be approximately 576.15MW with the maintenance of the acoustic power on the law-compliant level).

The localization proposed by the investor and the manner of realization of the investment in question should be considered to be the most favorable one for the environment, as they will surely not contribute to the deterioration of its quality. The planned investment will additionally have a positive impact on the decrease of the level of greenhouse gases emission. It has to be pointed out as well that the utilized technological solutions and installations will be taken advantage of to generate the so-called "green energy" and limit the exploitation of non-renewable energy sources. The yearly production of the "green energy" will amount to approximately 1.83 GWh and will not cause any other harmful emissions of pollutants. The production of such an amount of energy in a conventional power plant requires burning about 865 tons of bituminous coal, which directly translates into the emission of about 1.7 tons of sulphur dioxide; 2.6 tons of dust, and over 1629 tons of CO_2.

The project will be executed with the principle of not interfering with the environmental resources such as groundwater, soil, and air in mind, with the additional focus being put on the protection of vulnerable resources and the limitation of interference with neighboring areas. The technological and technical solutions to be implemented within the scope of the project are on a very high national level and their utilization is justified from the point of view of economy and environment protection.

When it comes to the personal opinion of the authors of the report, the most environmentally beneficial variant among all the considered ones will be the one selected for realization and discussed in chapter 7.2. It allows for generating wind energy being a renewable source of energy while at the same time complying with all the environment protection-related requirements. The choice of the said variant is also justified economically.

The impact of the selected and alternative variant on the environment is discussed in detail in chapter 6 of this report. Additionally, the impact of the failure to realize the investment are provided in chapter 3.13.

6. THE DESCRIPTION OF PREDICTED MAJOR ENVIRONMENTAL IMPACTS

In this chapter the analysis of an environmental impact of the investor's variant has been presented, which includes 167 wind turbines together with the auxiliary infrastructure.

Moreover, the impact of the rational alternative variant on the environment has been analyzed. It includes 222 WTGs together with the auxiliary infrastructure and is touched upon in chapter 7.2).

The analysis has been carried out for a normal operation mode of wind turbines. In a separate chapter 8.7 the likelihood of occurrence of emergency situations, such as malfunctions is analyzed together with their expected impact on the environment.

In the chapter 8.9 information on the possible transboundary impact of the subject investment is presented.

6.1 Impact at the Exploitation Stage

It has been found that the wind farm (at the stage of its construction, exploitation and liquidation) can potentially exert an impact of the following environmental components:

- Acoustic climate (by noise emission) - at the stage of construction, exploitation and liquidation,
- Ground surface (by excluding a part of the area from the current way of its use, loss of soil quality and waste generation) - at the stage of construction, exploitation and liquidation,
- Surface and ground waters (by their pollution) - at the stage of construction and liquidation,
- Air (by air pollution - at the stage of construction and liquidation, or improving air quality - exploitation stage),
- electromagnetic fields (emissions and radiation of the electromagnetic fields) – at the stage of exploitation,
- People's living and health conditions (by noise, dust and disturbing the current living conditions) - at the stage of construction, exploitation and liquidation,
- Flora and fauna (by destroying habitats and disturbing the functioning of the population) - at the stage of construction, exploitation and liquidation,
- Landscape (by causing visible changes in it) - at the stage of construction, exploitation and liquidation,
- Material goods, monuments and cultural landscape (by damages or decreasing the value of material goods, damages to monuments and changes in cultural landscape) - at the stage of construction, exploitation and liquidation.

6.2 Methods of the ESIA

In the description of impacts their charcter have been indicated (direcy/indirect/secondary, simple/cumulative, short-, mid-, long-term, permanent/temporary) resulting from the existence of the deve, uopment, use of environmental resources, protection against noise, waste management and protection against electromagnetic fields. The predicted impact on particular environmental components have been defined taking into account particular phases of the undertaking. There have been mentioned measures aiming to prevention, limiting and nature compensation of negative environmental impacts.

The character of impacts on particular environmental components has been differentiated into positive, neutral or negative.

The scale of impacts has been assessed where it was possible on the basis of quantitive approach and qualitive approach with an expert method. Impacts have been classified as:

- Lack of impact,
- Small (negligible),

- Average (moderate),
- Big (major),
- Critical.

Big (major) and critical negative impacts are those which may cause lasting disturbances of the proper status of protection of plant and animal species and habitats or their lasting degradation in mid-term and long-term periods or their total destruction, and also those impacts which may cause a temporary or lasting loss of human lives. The general impact assessment results from the assessment of a character and scale of the impact (for example, negligible impacts of a negative character).

6.3 Impacts During Construction Phase

6.3.1 The Impact on the Acoustic Climate

Environmental noise emission analyses at the stage of the investment construction was based on the noise measurements results presented in "Database for prediction of noise on construction and open sites", prepared by Helpworth Acoustics for DEFRA (Department for Environment, Food and Rural Affairs).

Data presented in the document are based on measurements conducted at various construction sites.

Table 23. An exemplary emission level during construction works

Type of a machine	Typical noise level in a distance of 7 m from an operated machine
Removal of a soil layer with a bulldozer	87dB(A)
Pneumatic hammer (e.g. during the works related to disassembly of concrete elements)	90dB(A)
Crawler excavator	85dB(A)
Trucks (dumpers, concrete pumps, concrete mixer trucks)	82dB(A)

For the needs of this analyses the acoustic field was calculated according to statistic construction conditions (operation of the lift and other machines with acoustic efficiency of 105 dB(A), assuming 8 hour operation during the day). For the above listed conditions, 55 dB(A) noise level is observed in a distance of approximately 90 m from the construction site area, and 50 dB(A) noise level in a distance of 160 m. In such a distance there are no residential buildings, therefore construction works are not expected to be a significant acoustic nuisance for the nearest residential areas.

Road transport is considered to be a separate nuisance source during the construction phase. It is estimated that in order to provide construction materials, raw materials, break-stones and ready-made turbine parts necessary for construction of one turbine, at least 800 trucks will have to access the location. Therefore construction of the whole wind farm will require access of approximately 133 600 trucks. It has to be stressed that the trucks will not access the location at the same time, but during the whole investment period and different roads will be used. Due to the above, the road transport is considered to be a temporary source of nuisance and to be terminated after the construction works are completed (therefore they are also reversible). The available transportation network, types of transport service and their standard accessibility is in conformity with the Ukrainian Building Code (DBN).

During the construction works, it is recommended to try to limit potential acoustic impact, i.e.

- Road transport of soil from excavations for foundations, from cable ditches and of other construction waste should be planned so that the trucks transportation route crossing noise

protected areas is limited to the minimum. It is recommended to organize transportation of construction materials and parts of the wind farm to the construction site in a similar way.
- Construction works periods during each phase should be limited to the minimum and well organized.
- Construction works and construction materials transport should be conducted only during day time (6 am -10 pm), excluding the periods, when permanent operation is required (e.g. when foundations of the wind farm are performed) and excluding the wind farm parts transportation.
- Drilling of boreholes for foundation piles (if necessary) should be performed only during daytime and using specialized machines, equipped with acoustic protection.
- The works should be performed using proper construction equipment, it is recommend to perform regular technical inspections and to monitor the equipment’s technical efficiency.
- In order to limit potential acoustic nuisance it is crucial that the equipment is in good technical condition.
- It is important to locate the auxiliary construction sites as far from residential areas as possible.
- It is required to turn off the machines’ engines during breaks.
- Heavy equipment, auxiliary construction sites and construction materials storage yards should be located as far as possible from the residential areas.

The impact of the project chosen for realization on the acoustic level will be moderately negative in character. In the case of the realization of the rational alternative variant (assuming the construction of 222 wind turbines) the potential noise level increase would be even higher due to the more extensive scale of the undertaking and less favorable placement of some turbines in relations to the existing housing units.

6.3.2 The Impact on Soil Surface

During the construction phase the impact will be generated by use of building machines (excavators, bulldozers, cranes, dump and other trucks and potentially, depending on a selected founding technology also pile-drivers) and by disturbing the natural soil structure. The use of construction machines will be limited to the time of construction of WTGs foundations and assembly of towers, blades and nacelles, construction of assembly/service yards, local access roads, buildings, transformer stands and other civil and technical structures at the MTS and construction of supporting pylons of the overhead PTL. Potentially use of the machines may generate subsurface impacts with hydrocarbons originating from uncontrolled leakages of technological fluids (e.g. hydraulic oils, coolants, lubricants) or fuel (while refuelling or on-site storage of fuels). As the worst case scenario a spill of stored fuel can be assumed. In order to reduce such a risk the following mitigation measures should be implemented:
- All fuel stored on-site should be kept in dedicated tanks or drums. Storage area should be hardened and the tanks/drums should be equipped with secondary containments. Storage volume of drums’ containments should be sufficient to take over capacity of all stored drums.
- Machines refuelling should be conducted with attention to avoid spillage of fuels due to e.g. tanks’ overfilling or spreading of residuals from refuelling hoses;
- Technological fluids should not be exchanged at the construction site except for emergency situations (e.g. uncontrolled unsealing of hydraulic installation). All leakages should be immediately liquidated with use of spill response kits. Used absorbents as well as contaminated soil should be handled as hazardous wastes and stored prior to removal from the site in dedicated, tight containers. Efficiency of spillage remediation should be confirmed by soil testing.

While taking into account possible threats for water and soil, the possibility of polluting water with waste from the construction site has to be taken into account. On the site, there may be portable toilets installed that are typically serviced by professional, certified companies. In such a case, waste is transported right to the nearest sewage plant.

Summing up all of the above, it can be stated that at the stage of construction, the project may interfere with soil and water, but the impact will be of marginal importance if recommendations presented above are implemented.

The increase in waste produced by builders may also to some extent impact the soil.

During construction phase of the wind farm and auxiliary structures of the access roads, assembly/service yards, underground cabling, MTS and PTL some wastes characteristic for construction and finishing works will be generated. These typically include (waste codes according to consolidated EU waste catalogue[19], asterisk indicates hazardous wastes):

Waste types, other than hazardous ones, that may be produced while building the wind farm together with auxiliary infrastructure: Group No. 17: construction and demolition wastes (including excavated soil from contaminated sites):
17 01 01 - concrete - approximately 450 tons/year,
17 01 03 - tiles and ceramics - approximately 12 tons/year
17 02 03 – plastic – approximately 35 tons/year,
17 03 02 – bituminous mixtures other than those mentioned in 17 03 01– approximately 57 tons/year,
17 04 01 – copper, bronze, brass – approximately 115 tons/year,
17 04 05 – iron and steel – approximately 4.6 tons/year,
17 04 11 - cables other than those mentioned in 17 04 10 – approximately 0.7 tons/year,
17 05 04 - soil and stones other thanmentioned in 17 05 03 - approximately 318 800 tons/year,
17 05 06 - deepening spoil other than those mentioned in 17 05 05 - approximately 22 850 tons/year,
17 06 04 – insulation materials other than those mentioned in 17 06 01 and 17 06 03 – approximately 0.7 tons/year.

Hazardous waste that may be produced while building:
17 03 01* - bituminos mixtures contaninig coal tar – approximately 4.6 tons/year,
17 03 03* - coal tar and tarred products – approximately 0.7 tons/year,
17 09 03* - Other construction and demolition wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03)– approximately 4.6 tons/year.

In the case of the realization of the rational alternative variant (222 turbines), the amounts of wastes generated would be 15 % higher than the amounts indicated above.

Wastes generated during construction works should be collected locally in dedicated containers. Preferably, wastes should be collected separately, mixing of non-hazardous and hazardous wastes should be banned. Wastes should be transferred off the construction site by certified companies for final treatment.

Soil excavated during construction of foundations, access roads and assembly/service yards will constitute substantial waste stream. The topsoil should be treated by spreading in the vicinity of the construction site, while other kinds of excavated soil should be disposed at the dump site(s) agreed upon with the local authorities. The company should investigate possible locations of such dump sites prior to commencement of the construction works. Should no location is available in reasonable distance (i.e. up to a few km), a detailed waste transportation plan should be worked out by the company, local authorities and road transport authorities and police.

The specificity of the impact of the planned investment in the investor’s variant on soil should be considered marginally negative. The assessment of its impact will be negligibly negative. In the case of the selection of the alternative variant (based on the construction of 222 wind turbines) the interference with soil would be remarkably higher (mainly due to the greater scale of the undertaking and therefore – a greater amounts of wastes produced).

[19] https://www.epa.ie/pubs/reports/waste/stats/wasteclassification/EPA_Waste_Classification_2015_Web.pdf

6.3.3 The Impact of Surface Waters and Groundwater

At the stage of wind farm construction, there may be an identifiable impact of the development on surface and underground waters, which may be connected with the establishment of road infrastructure and digging trenches for turbine foundations, pylons, and cable connections. Nevertheless, while taking into account shallow foundation laying, there should not be any interference with the first-level underground waters. However, threat to surface and underground waters may also be posed by the possible contamination with waste water, the improper storage of construction materials, as well as malfunctions of construction machines and means of transport causing leaks of operational liquids (including oil-related substances).

The foundation laying procedure will not pose any threat in terms of the possible contamination of underground waters.

Within the scope of the investment, it is planned to take advantage of MV electric cable lines. The custom-made cables will be predominantly laid in open trenches of the depth of at least 1 meters and then buried in the together with telecommunication cables. Cable trenches will be buried immediately after placing cables in them, which will ensure that the soil will not be softened as a result of the increased exposition to precipitation water, as well as will limit the risk of small animals falling into the trenches.

The construction of the cable grid will not affect the local soil and water in a significant manner.

The potential contamination of water environment may be caused by uncontrolled leaks of operational fluids and waste generated as a result of human errors and malfunctions. In order to protect the environment, all the access roads and assembly yards will be additionally enforced. Temporal assembly works will be performed on the area up to 1000 m^2 each and the yards will be made from the same materials as the access roads. Portable toilets will be located within such yards. Finally assembly yard will be approximately 940 m^2 each.

Construction sites will, however, not incorporate fixed sanitary installations. Water will not be gathered from local sources as well. The amount of generated waste (including filling portable toilets with waste neutralizing chemical substances) will amount to 200 l/week per every 10 workers employed at the site. The said waste will be regularly removed from the site to a nearby sewage plants by septic tanker trucks.

Both surface and underground waters may also be directly contaminated by operational fluids, including oil-related substances leaking from construction machinery, devices, and means of transport. Such contaminations may be indirectly dangerous for animals inhabiting the discussed area (in the case of water contamination). Nevertheless, with a proper site preparation (enforcement), satisfactory work organization and construction machinery maintenance, the risk of such an event occurrence should be considered to be low. The aforementioned situations should be eliminated by means of device monitoring and regular conservation. Specific chemical substances should also be supplied to construction sites in order to allow for leaked liquids neutralization.

The impact of the variant chosen for realization on surface and underground waters will be negligibly negative. It should be assessed as marginally negative.

In the case of the realization of the rational alternative variant (assuming the construction of 222 wind turbines) the potential water contamination risk would be even higher due to the more extensive scale of the undertaking.

To sum up all the analyses above, it has to be pointed out that the construction of the farm may interfere with surface and underground waters in a negative manner, but the intensity of the interference will be marginal.

6.3.4 The Impact on Air Quality

The following sources of air emission will be present during the construction stage:

- combustion of the diesel fuel in machine engines
- works related to the preparation of the excavations for the foundation (earthworks).

Diesel fuel combustion will be the source of air emissions of nitrogen oxides, carbon oxide, hydrocarbons, suspended particulates PM10 and PM 2.5. Works related to preparation of the excavations for the foundation will be sources of dust emission of various granulation, including a fraction of aerodynamic grain diameter lower than 10 µm.

Due to lack of indicators of the emission for PM 2.5, the assumption of the analysis was that the dust charge can in 100% be PM 2.5.

The size of emission (Table 24) was determined based on emission indicators for diesel engines (position: low-speed vehicles, tractors, machinery) set out in the publication: Podstawy Inżynierii Ochrony Atmosfery", Wydawnictwo Politechniki Wrocławskiej, Wrocław 1993 r. The publication does not differentiate hydrocarbons on aliphatic and aromatic, therefore an assumption was made that the total share here are the aromatic hydrocarbons, which are substances with lower baseline values.

The emissions were calculated taking into account a monthly usage of diesel oil at 800 l. The area of the works was replaced with 20 replacement emission sources.

Table 24. Size of emission – diesel oil combustion in machinery engines during the construction of 1 wind turbine

No.	Substance			
	NO_2	CO	HC	PM10
	[kg/h]	[kg/h]	[kg/h]	[kg/h]
1	0.13138	0.16094	0.03226	0.01378
	[tons/year]	[tons/year]	[tons/year]	[tons/year]
2	0.02628	0.03219	0.00645	0.00276
	[g/s* emission source]	[g/s* emission source]	[g/s* emission source]	[g/s* emission source]
3	0.00182	0.00224	0.00045	0.00019

The calculations for the load capacity of dust pollutions related to earthworks (excavating humus, relocating soil masses) were conducted with the use of methodology described in AP-42 "Heavy construction operations". The size of emission was defined by the equation EPM10=2.69 * s% tons/hectare/month, where s% equals percentage share of the fraction loaded during conducted works. It was assumed that the area on which emission occurs is 0.1 ha and that it has 20 replacement emission sources. Time of emission: 200 h, share of the carried fraction is equal to the floatable fraction, i.e. 25%. Taking into account the above assumptions, the size of PM10 emission is as follows:

Table 25. PM10 emission – earthworks during construction of 1 wind turbine

No.	PM 10		
	[kg/h]	[tons/year]	[g/s* emission source]
1	0.3363	0.6725	0.00467

This impact will recede after the completion of construction works, therefore it is categorized as short-term and fully reversible.

The following measures are proposed to mitigate a negative impact of the construction stage on the air:

- Roads used for dug soil transportation and waste removal should be chosen in such a way to be located as far from built-up areas as possible. Similar planning-oriented undertakings should be implemented while establishing a transportation network of construction materials and wind turbine components.
- Duration of construction at the every stage of project realization should be limited by means of properly planning the construction process.
- Amount of generated dust can be limited by transporting loose materials by trucks equipped with tarpaulin. Emission of exhaust fumes can be limited by means of a proper work organization, eliminating unnecessary vehicle running. Works should be performer by taking advantage of fully operational construction devices only. They should also be regularly checked and maintained.
- In order to limit the emission of polluting agents to the air, fully operational machinery should be utilized.
- Construction yards should be located as far from built-up areas as possible.
- Vehicle engines should be turned off during breaks.

The impact of the variant chosen for realization on air will be negligibly negative. In the case of the realization of the rational alternative variant (assuming the construction of 222 wind turbines) the potential air contamination risk would be even higher due to the more extensive scale of the undertaking.

6.3.5 The Impact of Electromagnetic Field

During the construction stage of the investment no devices will be used, that might result in environmental threat as a result of field emission or electromagnetic radiation. The optional electric devices will be powered by portable power generators and will operate at 230V or 400V, i.e. by low voltage, similar to household appliances, therefore the electromagnetic fields generated by them will be negligible in relation to the existing electromagnetic background.

The only source of electromagnetic radiation in the medium and microwave range will be stationary geodetic devices, used for precise geodetic measuring with the standard GPS technology, such as radio reference points. Due to a very low power of such devices, their range is low, limited to the few centimeters around their reception antennae.

Impact of electromagnetic radiation on the construction phase will not occur in any of the variants.

6.3.6 The Social Impacts

In accordance with DSP-173 “State Sanitary Regulations for Planning and Development of Settlements”, construction of a wind park is characterized by the following criteria under the sanitary classification:

- the noise exposure limit shall not exceed 45 dBA at the border of the housing development area;
- the permissible vibration level shall not exceed 67/25/91 Hz (vibration velocity/acceleration/displacement) at the border of the housing development area;
- the permissible level of electric intensity shall not exceed 5 kV/m at the border of the exclusion and buffer zone;
- the permissible level of electric intensity shall not exceed 1 kV/m at the border of the housing development area;
- the aggregate specific weight of natural radionuclides in the building materials for construction of main wind park facilities shall not exceed 370 Bq/kg;
- the aggregate specific weight of natural radionuclides in the building materials for construction of public roads shall not exceed 740 Bq/kg**Error! Bookmark not defined.**.

During the construction stage, noise, air pollution, and vibration levels at the construction sites will vary. However, it is not expected for the levels to exceed set thresholds and be a nuisance for the citizens inhabiting the nearby built-up areas. Wind turbines will be built on agricultural areas that are located remarkably far from housing estates (.

A procedure that may interfere with the everyday life of the citizens may be the transportation of construction materials and elements of the WTGs to the site, and excess of soil from the site. These transports will predominantly use public roads and will also cross the villages in proximity of the construction site. As indicated in section 6.3.1 noise generated by moving trucks reaches 82 dB(A) and gives the noise level of 55 dB(A) at a distance of approx. 90m. Hence, the citizens of the villages crossed by a transport can be exposed to noise exceeding slightly the permitted value, even taking into account that most of the houses are distant from the roads and are often separated from the roads by a barrier of trees and bushes. Such noise impact, however, will be of a temporary and short-term character and is not expected to cause the local population to complain. Further, traffic of heavy trucks may also generate vibrations and fugitive emissions, both primary (emission from fuel combustion) and secondary (dust generation). These are not considered as an issue of potential social concern as during the dry periods of year a fugitive emission of dust occurs anyway (dust raised by wind blow) in the rural areas and vibrations generated by heavy trucks are not expected to reach houses which are approx. 20 m distant from the roads.

In June 2017 a noise background measurements were conducted in the Mordinivka and Garsivka villages. Noise measurements were conducted for the period from 18.06.2017 to 20.06.2017 at daytime, as well as at nighttime, according the requirements of GOST 23337-78 «Noise. The methods of noise measurements on the residential area and in the residential and public buildings premises». Common time of automotive noise measurements is of 48 hours.
Automotive noise measurements was conducted at three points of Mordvynivka village:

- beginning of the village— residential building on Tsentralna str., 171;
- village center — preschool facility and medical aid post on Suvorova str., 1;
- village end — residential building on Suvorova str., 55.

and at three points of Girsivka village:

- beginning of the village— residential building on Tsentralna str., 2;
- village center — educational institution on Tsentralna str., 56;
- village end — residential building on Tsentralna str., 97.

Summary of the results is presented in Table 26.

Table 26. Summary of noise background measurements

Village	Measurment Point	Working day/ Weekend	**Noise Equivalent Value (middle) measurment result, dBA**	Noise Equivalent Normative Value, dBA	Max Noise value, dBA	**Avarage Equivalent Noise Value (middle) by Village , dBA**				Avarage **Maximum** Noise Value by Village			
						Working day		**Weekend**		Working day		Weekend	
						Day	**Night**	**Day**	**Night**	**Day**	**Night**	Day	Night
Mordvynivka	Mordvynivka 1	Weekend	**59**	55	79	**57**	**56**	**57**	**58**	77	75	75	77
			67	45	82								
			64	55	82								
		Working day	**61**	45	82								
			62	55	82								
	Mordvynivka 2	Weekend	**47**	55	67								
			48	55	67								
			47	45	67								
		Working day	**48**	55	67								
			47	45	67								
	Mordvynivka 3	Weekend	**62**	55	82								
			64	55	82								
			61	45	82								
		Working day	**61**	55	82								
			59	45	77								
Girsivka	Girsivka 1	Weekend	**70**	55	87	**58**	**49**	**64**	**53**	77	67	82	72
			71	55	87								
			53	45	72								
		Working day	**62**	55	82								
			54	45	72								
	Girsivka 2	Weekend	**50**	55	67								
			66	55	87								
			47	45	67								
		Working day	**48**	55	67								
			44	45	62								
	Girsivka 3	Weekend	**58**	55	77								
			70	55	87								
			59	45	77								
		Working day	**63**	55	82								
			49	45	67								

The planned transportation routes during the construction phase are presented on Figure 13. A detailed traffic plan for delivery of WTGs elements have been elaborated by GE Wind Energy. The Plan assumes delivery of WTGs components from Hirsivka to the acceptance point to the north of Mordinivka village. No new roads will be constructed, rather existing roads will be reconstructed. All bridges have been inspected by bridge expertize and no bridges need to be widened or reinforced. The majority of traffic will take place in agricultural fields, far away from village boundaries. Villagers that live on intra-village roads will experience higher traffic patterns than normal but traffic will also be minimized by locating an infrastructure support land plot as close as possible to the wind park construction zones, thus reducing traffic.

Another traffic related impact may occur whereas the increased humidity of the area may results in the contamination of public roads with mud from access roads. In order to minimize the negative impact of the discussed works, it is vital to set optimal material and soil transportation routes and – if possible – limit the said transportation and machine operation to daytime only.

All other proposed protective measures are provided in the chapters 6.3.1, 6.3.2 and 6.3.4.

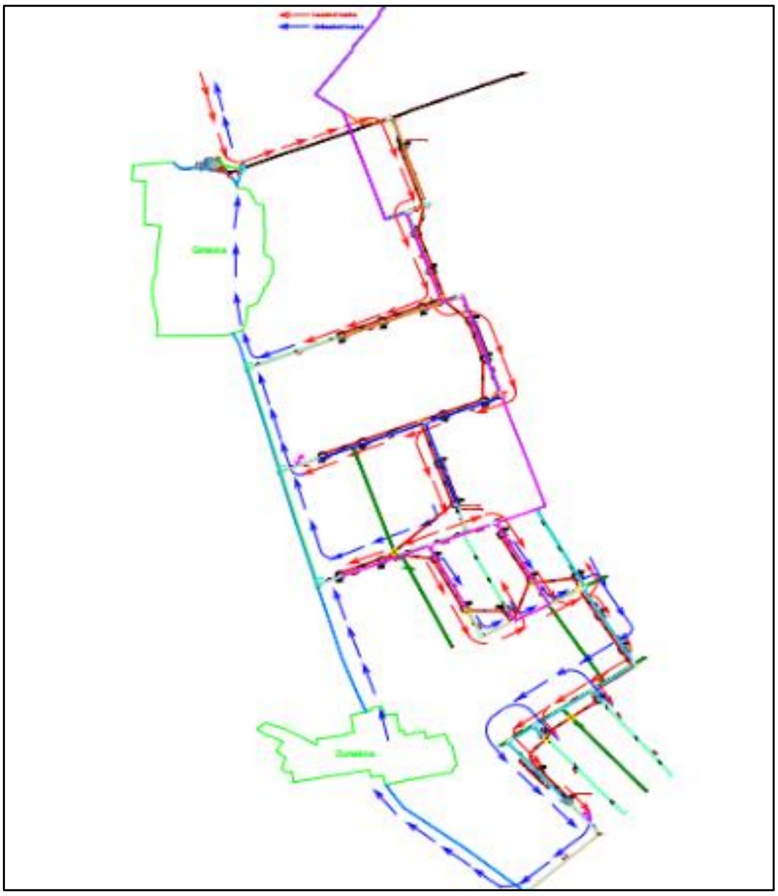

Figure 13. Traffic plan at the Project site

The construction works as well as vehicle drives, operation and maneuvering may create risks to the health of workers and inhabitants. The elimination of such risks requires a proper organization of the works, compliance with work safety principles, and following traffic regulations.

Construction of the wind farm may alo impact the farming operations of the main farmers (i.e such, who lease a material amount of land for farming purposes, well identified by the Company) in peripheral and minor ways as follows:

- Temporary disruptions to field access roads as they are reconstructed. This impact will be mitigated by trying to reconstruct the access roads during the non-farming months. In situations where accesss is restricted to fields during the agricultural season, compensation payments will be agreed with farmers on a 'field-by-field' basis
- Temporary disruptions to farming operations while wind turbines are installed, 35 kV medium-voltage cables are installed, and a 330 kV high-voltage power line is installed.
    - In the case of wind turbine installation, disruption to adjacent farm land will be quite limited (810 m^2 for temporary blade storage or temporary crane pads – see figure Figure 14) and if farming operations are disrupted, compensation will be agreed on a turbine-by-turbine basis.
    - In the case of 35 kV medium voltage cable installation, cables will be installed at a depth of minimum 1.0 meters (below farming operations) and will have varying widths. Maximum effort wil be made to install the medium voltage cables during non-farming months. In cases where farming operations will be disrupted, compensation will be agreed on a field-by-field basis. It should be noted however that 35 kV servitudes are already executed and so compensation will be paid in this case only when farming is accidentally disrupted outside of a leased servitude zone
    - In the case of the 330 kV PTL, disruption to farming operations will be extremely limited (about 109 towers with an average tower land plot size of less than 25 m^2). Maximum effort will be made to construct the PTL during the non-farming season. In cases where

farming operations will be disrupted, compensation will be agreed on a tower-by-tower basis when farming operations outside of the servitude zone are disrupted.

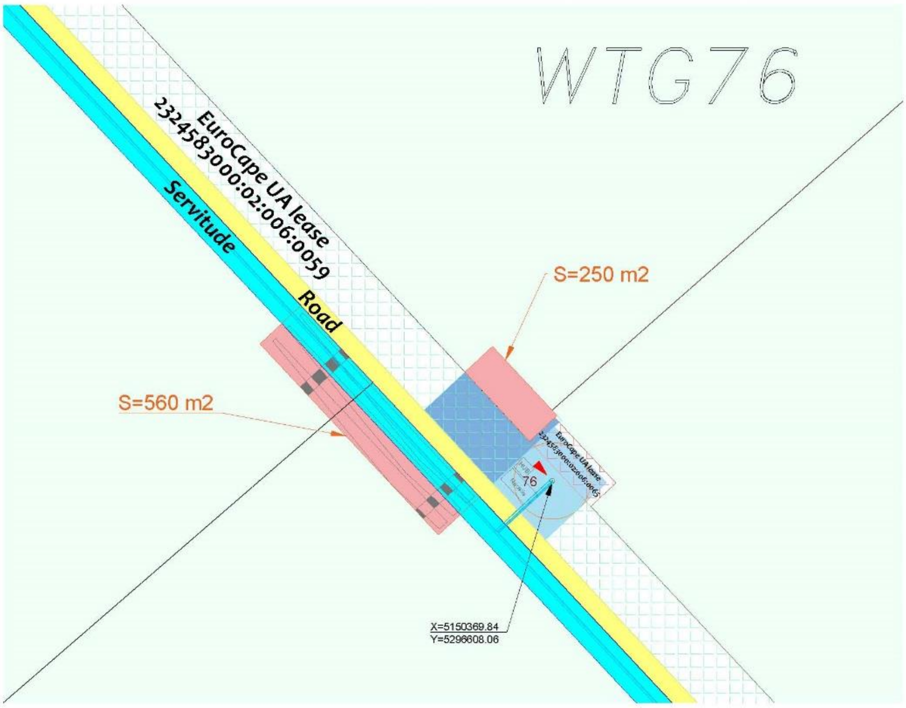

Figure 14. Example of a land use for construction of a WTG.

As reported by the Company, during construction of a similar wind farm about 40-60 km to the east of the site no major traffic complaints were registered and are not expected for the subject development, if all given recommendations are implemented.

Maximum efforts have been and will be taken by the Company to hire local labour. For unskilled and semi-skilled labour, there is a ready supply of labour. During construction, it is expected that at least 100 positions will be created per 100 MW of wind farm construction. These positions will range from highly skilled (crane operators, welders, civil engineers concrete workers, electricians and electrical engineers) to lower skilled (security, aggregate transport of sand and gravel). Such attitude of the Company will pose a positive social impact on the local society.

The impact of the variant chosen for realization on the health and safety of people will be negligibly negative. In the case of the realization of the rational alternative variant (assuming the construction of 222 wind turbines) the potential risk would be even higher due to the more extensive scale of the undertaking. The impact on social conditions will be positive due to the fact that construction works will positively influence local economy by creation of new working places.

6.3.7 Water and Wastewater

At the construction stage water will be used for social and technological purposes. Drinking water will be provided to the construction camps in bottles or drums on as needed basis. No portable showers are planned to be installed at the site, the workers will use sanitary facilities at their place of stay. Sanitary needs of the workers will be secured by means of portable toilets which will be emptied on as needed basis by specialized services.

Technological water will be used for production of concrete and then to keep the concrete moisture while drying. It is expected that during production of concrete some 460 m^3/day of water will be used. Water will be supplied from municipal waterworks only.

6.3.8 The Impact on Flora and Fauna

The construction stage will have an adverse impact on birds, however most of the negative impact will be short term and reversible. The impact will be related to the construction works, vegetation clearance and installation of the turbines, PTL pylons and towers as well as transport. In addition to the vegetation clearance under the rotor blades, the works will be focused on small areas: yards destined for turbine installation, service yards under the turbines, PTL pylon yards and PTL towers. These areas will be subject to habitat change and habitat loss. In the scale of the whole wind farm area, these will be point impacts which will cover small areas. It is worth mentioning that all areas exposed to changes have low avifauna values and comprise arable fields, roadsides of access roads, hedgerows of A and B category, i.e. devastated and with degraded structure. The installation of turbines will require clearance of arborescent vegetation in the 60 m strip along the tower in both ways. The impact of such clearance should be categorized as long-term and reversible effect. The clearance will cover altogether 16.4 km of hedgerows under 137 WTGs (see detailed recommendations for aerial optimisation of hedgerows). As a result of the reduction of hedgerows areas, the number of species nesting in those biotopes may decrease. According to the aerial optimisation of hedgerows developed as part of documentation, as many as 145 of WTG are located in the A and B class of hedgerows, i.e. degraded and devastated hedgerows with degraded structure (single-species, one-storey). This type of woodlot structure does not facilitate multi-species, diverse flocks of breeding birds and does not serve as migration corridor for passerines. However, the number of some vital breeding bird species may be decreased as a result of vegetation clearance, including common species, but also: the red-footed falcon, shrike, common buzzard, common kestrel, European turtle dove, European roller, barred warbler, collared flycatcher. Therefore, the process of planting and forming vegetation, as described in detail in the landscape part, is recommended as the compensating measures.

Assessment of impacts on birds caused by the construction of the designed territory of the wind farm in the four season of 2016 is shown in Table 27.

Assessment of impacts conditioned by the 330 kV PTL construction in the 2016 years is shown in Table 28. Assessment comes from Appendix 3 and Appendix 4.

Table 27. Impacts caused by the construction of the wind farm

Impacts caused by the construction of the wind farm	Winter period 2016	Spring migration 2016	Nesting period 2016	Autumn migration 2016
emissions of hazardous substances	Emissions of hazardous substances will not exceed the permissible rates during the construction, owing to small quantity of machinery and equipment, absence of stationary sources of pollution and short period of construction works. There is no negative impact on birds.	Emissions of hazardous substances will not exceed the permissible rates during the construction, owing to absence of stationary sources of pollution and short period of construction works. There is no negative impact on migrating birds.	Emissions of hazardous substances will not exceed the permissible rates during the construction, owing to small quantity of machinery and equipment, as well as absence of stationary sources of pollution. There is no negative impact on nesting birds.	Emissions of hazardous substances will not exceed the permissible rates during the construction, owing to absence of stationary sources of pollution and short period of construction works. There is no negative impact on migrating birds.
deterring by visual effects and noise	Factor of deterring by noise is practically absent, due to the absence of considerable gatherings of birds in the territory of the wind farm sites. Slight by quantity feeding migrants move throughout the territory, are characterized by low density, short period of staying due to low feeding value of the plots of the site and have large areas of alternative forage territories in 2-kilometres zone and outside it. Impact of these factors shall be characterized as low	Factor of deterring by noise is practically absent, due to the absence of considerable in quantity migration gatherings in the territory of the wind farm sites. Feeding migrants move throughout the territory and have large areas of alternative forage territories in 2-kilometre buffer zone and outside it. There are greater sources of noise in the adjacent zones (agricultural engineering, local motor roads). In addition, for the birds recorded at the wind farm sites, the forage territories are more connected with crop rotations than with the project work. Deterring by visual effects is not threatening; therefore impact of these factors on birds shall be characterized as low. From our point of view, effect of this factor for the period of migrations will lessen the risks concerning the negative impact of the wind farm on birds.	Stay of machinery and people within the site, as well as noise originated by them, may have insignificant negative impact on birds when this activity is carried out within nesting plots, or near to them. It is actual, first of all, for larks and birds of agricultural hedgerows (European magpie – *Pica pica*, common kestrel – *Falco tinnunculus*). Effect of this factor decreases owing to availability of alternative nesting places not only within the wind farm sites, but also outside them (even more suitable than in the territory of the wind farm); it enables birds to select safe territories. So, negative impact of this factor may be estimated as very low.	Factor of deterring by noise is practically absent, due to the absence of considerable in quantity migration gatherings in the territory of the wind farm sites. Feeding migrants move throughout the territory and have large areas of alternative forage territories in 2-km buffer zone and outside it. There are greater sources of noise in the adjacent zones (agricultural engineering, local motor roads). In addition, for the birds recorded at the wind farm sites, feeding territories are more connected with crop rotations than with the project work. Deterring by visual effects is not threatening; therefore impact of these factors on birds shall be characterized as low. From our point of view, effect of this factor for the period of migrations will lessen the risks concerning the negative impact of the wind farm on birds.
occupying the territory by working platforms and equipment	Impact of this factor in winter period shall be estimated as low, and in the course of the wind farm operation it is absent.	Physical dimensions of the wind farm sites are rather large (generally, about 13 000 ha), which enable birds to fly easily past the working platforms with equipment located on them during the construction. The territory, which will be occupied by working platforms and equipment, will not exceed 1% of the total area. It will enable birds to fly easily past the working platforms with equipment located on them during the construction. Besides, the slight density of the placement of working platforms and equipment will not obstruct feeding flights of birds, due to large total area of the wind farm sites and considerable distances between the wind turbines (about 500 m). According to personal observations at already operating wind parks, birds get accustomed quickly to the constructed wind parks. Therefore this negative impact on migratory birds during the construction is low, and during the operation of the wind farm it is absent.	Physical dimensions of the wind farm sites and buffer zones are rather large; therefore the infrastructure in the course of the wind farm construction has local character by scale and is characterized by the short period of process works. In spite of large quantity of wind turbine generators their density, as well as density of placement of working platforms and equipment, are characterized by low indices, therefore they will not obstruct feeding migrations of birds and placement of nests. This negative impact on birds during the construction shall be estimated as low, and during the operation of the wind farm it is absent.	Physical dimensions of the wind farm sites are rather large (generally, about 13 000 ha), which enable birds to fly easily past the working platforms with equipment located on them during the construction. The territory, which will be occupied by working platforms and equipment, will not exceed 1% of the total area. It will enable birds to fly easily past the working platforms with equipment located on them during the construction. Besides, the slight density of the placement of working platforms and equipment will not obstruct feeding flights of birds, due to large total area of the wind farm sites and considerable distances between the wind turbines (about 500 m). According to personal observations at already operating wind parks, birds get accustomed quickly to the constructed wind parks. Therefore this negative impact on migrating birds during the construction is low, and during the operation of the wind farm it is absent.
loss of breeding places	Negative impact of this factor is absent in winter period.	Negative impact on transit migrating birds is absent, and on feeding migrants it is low. For that species,	For bird species, which nest within the wind park sites, loss of breeding places is not significant. Small	Negative impact on migrating birds is absent. For that species, which remain for wintering within wind farm

Impacts caused by the construction of the wind farm	Winter period 2016	Spring migration 2016	Nesting period 2016	Autumn migration 2016
		which remain within wind farm for nesting on completion of the migration, the loss of breeding places is not significant. Low density of birds nesting, small species composition makes possible to select nesting places without obstacles. Slight loss of nesting places, owing to the wind farm construction, will have not continuous, but mosaic pattern, leaving the major part of the wind farm territory for free selection of nesting places. Besides, the majority of species recorded in the course of nesting are common and widely distributed in the region, with their high quantity. Negative impact of this factor shall be estimated as low	species composition and their small quantity will enable to select without obstacles nesting places at the wind farm sites. Approximate percentage of occupation by the equipment will be small. Slight loss of nesting places owing to the wind farm construction will have not continuous, but extremely mosaic pattern, leaving the major part of the wind park territory for free selection of nesting places. Besides, the majority of species recorded in the course of nesting is common and widely distributed in the region. Negative impact of this factor shall be estimated as low.	on completion of the migration, the loss of breeding places is not significant. Low density of birds nesting, small species composition makes possible to select nesting places without obstacles. Slight loss of nesting places, owing to the wind park construction, will have not continuous, but mosaic pattern, leaving the major part of the wind park territory for free selection of nesting places. Besides, the majority of species recorded in the course of nesting are common and widely distributed in the region, with their high quantity. Negative impact of this factor shall be estimated as low.
loss of individual specimens of protected species	2 species: (hen harrier – *Circus cyaneus,* white-tailed eagle – *Haliaeetus albicilla)* were registered within the territories adjacent to the wind park sites in the winter period of 2016. Possibility of their feeding migrations to the wind park territory is extremely low due to unsatisfactory state of forage resources for birds of prey. Negative impact of the wind park shall be characterized as low.	3 rare species of birds have been registered in the territory of researches, which are observed in the adjacent territories: pied avocet – *Recurvirostra avosetta*, Eurasian oystercatcher – *Haematopus ostralegus* and Eurasian curlew – *Numenius arquata*. The possibility to meet rare species is rather slight. During the registration of species in the territory of the wind farm sites, the negative impacts of the wind farm on them are very low. This is due to the fact that counted rare species are mainly attached to the semi-aquatic biotopes, within which their main transit movements and feeding migrations take place. Negative impact of the wind farm shall be estimated as low.	In 2016, 2 rare bird species were recorded within the sites of wind farm: long-legged buzzard **–** *Buteo rufinus* and scops owl **–** *Otus scops*. Long-legged buzzard has not nested at the sites of wind farm in 2016, and in the case of scops owl – only one nesting couple has been observed. The possibility of loss of certain protected species, which is caused by the wind farm construction, is extremely low, and there is no such threat for semi-aquatic birds. Negative impact shall be estimated as low.	5 rare bird species have been registered in the territory of researches, 3 of which were observed in terrestrial biotopes of the wind farm sites (long-legged buzzard – *Buteo rufinus*, stock pigeon – *Columba oenas* and European roller – *Coracias garrulus*), 1 species – in the buffer zones and 3 species – in the adjacent territories. The possibility to meet rare species is rather slight. During the registration of species in the territory of the wind park sites, negative impacts of the wind farm on them are very low. This is due to the fact that birds of prey have a good sense of direction in the course of passage relative to existing towers of electric networks and other high-rise structures in the adjacent territories, and are not characterized by migration movements at night. Other counted rare species are mainly attached to the semi-aquatic biotopes, within which their main transit movements and feeding migrations take place. Negative impact of the wind farm shall be estimated as low.

Table 28. Impacts caused by the construction of the 330 kV PTL

Impacts caused by the construction of the 330 kV PTL	Winter period 2016	Spring migration 2016	Nesting period 2016	Autumn migration 2016 (summer and autumn)
hazardous substances emissions	During the construction hazardous substances emissions will not exceed allowable limits due to insignificant number of machinery and equipment, absence of stationary pollution sources, and short period of construction works. No negative impact on birds is observed.	During the construction hazardous substances emissions will not exceed allowable limits due to the absence of stationary pollution sources and short period of construction works. No negative impact on migratory birds is observed.	During the construction hazardous substances emissions will not exceed allowable limits due to insignificant number of machinery and equipment, and absence of stationary pollution sources. No negative impact on the nesting birds is observed.	During the construction hazardous substances emissions will not exceed allowable limits due to the absence of stationary pollution sources and short period of construction works. No negative impact on migratory birds is observed
hazing by visual effects and noise	Noise hazing factor is almost absent due to extremely low number of birds along the power transmission line in the winter period. The land plot planned for construction of 330 kV PTL has low fodder value, and adjacent farmed ecosystems serve as an alternative option for the feeding birds. Noise and visual effects impact is characterized as low, and for most wintering birds it is absent at all.	Noise hazing factor is almost absent for migratory birds. Visual effects and noise have no influence at all on the transit migrants which pass at large heights (over 200 m). Feeding migrants which relocate at small heights may enter specific areas with construction in progress but scale of such event in physical figures is insignificant (hundreds meters), and action of these man-induced factors is dropped out if there are large alternative areas. Moreover, hazing by visual effects and noise during migration may have positive effect as the birds need to choose open spaces.	Presence of machinery and people on the site, as well as noise they generate, may have insignificant negative effect on the birds if such activity is carried out within the nesting areas or near them. This is primarily applicable to larks and hedgerow birds (European magpie - *Pica pica*, common kestrel – *Falco tinnunculus*). This factor action decreases due availability of alternative nesting places not only in the project territory but also outside it (even more suitable), what allows the birds to choose safe nesting stations. Therefore, negative effect of this factor can be estimated as very low.	Noise hazing factor is almost absent since there are not large migratory gatherings of birds in the wind farm sites. Feeding migrants quickly travel throughout the territory and have large areas of alternative feeding territories within a 500-meter buffer zone and outside it. There are larger noise sources (agricultural machinery, local motor roads) in the adjacent zones. In addition to it, feeding territories for birds are connected more with rotation of crops than with project works. Hazing by visual effects is not a threat so impact of these factors on birds is considered as low.
occupation of the territory by working sites and equipment	Impact of this factor in the winter period is evaluated as low, and it is absent during operation of 330 kV PTL.	Physical dimensions of the 330 kV PTL construction sites are not large thus allowing the birds to freely pass by the work sites with the equipment during the construction period. Moreover, insignificant density of the work sites and equipment will not obstruct feeding passages of the birds because of a large overall length of 330 kV PTL and significant distances between the power poles. As own observations conducted on the installed overhead power lines showed birds quickly get used to their infrastructure, therefore their negative impact on the migratory birds during the construction period is low.	During construction fo 330 kV PTL the infrastructure has local nature by the scale and is characterized by short period of technological works. Despite of a significant number of power poles, their density, location of the work sites and equipment - are characterized by low indicators, so they do not obstruct the feeding migrations of the birds and placement of nests. This negative impact on birds during the construction period is estimated as low, and it is absent during the wind farm operation.	Physical dimensions of the project territory allow the birds to freely pass by the work sites with the equipment during the construction period. Territory to be occupied by the work sites and equipment will not exceed 1% of the total area. Moreover, insignificant density of the work sites and equipment will not obstruct feeding passages of the birds because of a large overall length of 330 kV PTL and significant distances between the power poles. Negative impact on migratory birds during the construction period is estimated as low, and it is absent during the wind farm operation.
loss of the breeding places	This factor has no negative impact in the winter period.	No negative impact on transit migratory birds is observed, and it is low for the feeding migrants. As regards the species which after the end of migration remain for nesting within the 330 kV PTL, the loss of the breeding places is not significant for them. Low density of the birds nesting, insignificant species composition enable to freely choose nesting places. Insignificant loss of the nesting places due to construction of the overhead power line will have not a continuous but a mosaic nature thus leaving a larger part of the area free for selecting the nesting places. Moreover, most species registered at nesting are common and widely spread in the region, with large numbers. Negative impact of this factor is estimated as low.	As regards the birds which nest within the 330 kV PTL, the loss of the breeding places is not significant for them. Insignificant species composition and their low number enable to freely choose nesting places. Expected area to be occupied by the equipment will be small in term of the size. Insignificant loss of the nesting places will have not a continuous but a mosaic nature thus leaving a larger part of the project territory free for choosing the nesting places. Moreover, most species registered at nesting are common and widely spread in the region. Let us stop for a moment on some aspects of the biology of certain species which may be positively affected by the 330 kV PTL construction and operation. The point is about bird species which may use 330 kV PTL poles for nesting. These are primarily representatives of the Corvidae family (common raven - *Corvus corax*, hooded crow - *Corvus cornix*, jackdaw - *Corvus monedula*) and certain falcons (saker falcon - *Falco cherrug*). In the niches of the poles we registered nesting of such species as Eurasian tree sparrow (*Passer montanus*) and common kestrel (*Falco tinnunculus*).	No negative impact on migratory birds is observed in the autumn. Negative impact of this factor is estimated as low.

Impacts caused by the construction of the 330 kV PTL	Winter period 2016	Spring migration 2016	Nesting period 2016	Autumn migration 2016 (summer and autumn)
			Negative impact of this factor is estimated as low and as such that may have positive effect.	
loss of individual specimens of the protected species	Only white-tailed eagle (*Haliaeetus albicilla*) was reported within the territories adjacent to the future power transmission line in the winter period of 2016. Since this species in the winter period leans toward waterfowl (ducks) gatherings where eagles find food, it is unlikely to meet the species within the 330 kV PTL area and if the meeting happened, it is occasional. The literature states that eagles and other large carnivorous birds (buzzards, falcons, hawks) can use PTL poles for rest. Due to this fact, it is necessary to make a provision in the design of 330 kV PTL poles ornithological protective gear that disables birds death from electrical shocks. Negative impact is found to be moderate.	In spring 2016 in the research territory there were registered 2 species of the birds referred to the Red Book of Ukraine: Pied avocet (*Recurvirostra avosetta*) and Eurasian curlew (*Numenius arquata*). All they were observed in the adjacent territories. Probability of the loss of individual specimens during migration exists only for periods with adverse weather and climate characteristics (fog, strong wind), but in the light of extremely low number of rare birds in general, and especially of those which may use sections of 330 kV PTL, and short duration of adverse weather periods, we find this factor to have low impact.	During the nesting period of 2016 we registered within the project territory no nesting of the bird species included to the nature conservation lists. The negative impact is evaluated as low.	No representatives of the Red Book of Ukraine were observed in the research territory in autumn 2016. Probability to find rare species is rather low. At registration of the species in the project territory, negative impacts on them are very low. This relates to the point that carnivorous birds have good sense of direction with respect to power poles, other tall structures available in the adjacent territories and are not characterized by migratory relocations at night. Other rare birds registered in the adjacent territories are mainly bound to semi-aquatic habitats within which their main transit relocations and feeding migrations occur. Probability of the loss of individual specimens during migration exists only for periods with adverse weather and climate characteristics (fog, strong wind), but in the light of extremely low number of rare birds in general, and especially of those which may use sections of 330 kV PTL, and short duration of adverse weather periods, we find this factor to have low impact. The negative impact of the wind farm is evaluated as low.

Intensely used transport roads, construction of new access roads, construction and installation works will cause birds to deter these areas. Birds mostly susceptible for such impact include the *anseriformes*, in particular geese and ducks, which can avoid the areas or even abandon their feeding grounds. The schedule of the works should consider periods of time where arable fields are mostly used as feeding grounds for these species. Such impact will be however of short-term character and can pass when the installation works are finished.

All installation works, in particular the clearance and forming of vegetation should be conducted outside the breeding period for birds and under an ornithology supervision, with the maximum use of existing access roads. In the event when the ornithology supervision finds nests of corvidae birds under the turbines in the tree clearance area, which could potentially serve the red footed falcon or common kestrel, the location of such WTG should be changed.

Due to observed lack of shelters for bats which could be potentially destroyed during construction of the wind turbines, there are no specific restrictions in this respect. Monitoring of activity of bats and of changes in the environment during the construction of the wind farm should be performed.

As it can be concluded from the analysis above, the designed investment will not affect fauna and flora in a negative manner at the stage of construction, providing that the Investor implements protective and impact minimizing measures described above.

The impact of the variant to be realized on the local fauna and flora should be considered to be marginally negative. In the case of the construction of the rational alternative variant of the project (222 turbines), the threat would be remarkably higher, mainly due to the scope of the undertaking (the exploitation of a bigger acreage), as well as due to the less favorable location of some parts of the wind farm.

6.3.9 The Impact on Landscape and Cultural Landscape

The impact of any investment on physiognomic values of Landscape is a phenomenon difficult to measure. Their reception is completely subjective.

In the phase of the wind farm construction there will be a temporary lowering of esthetic values of landscape resulting from conducting works and organizing supporting facilities. It will be a shot-term impact.

The construction of a farm in the aforementioned alternative variant could also alter the local landscape to a greater degree (due to the bigger scale of the undertaking and the creation of more turbines).

6.3.10 The Impact on Historic Monuments

There are no protected archaeological territories or burial mounds of archaeological value in the places for installation of the wind farm facilities and structures.

The impact of both the variant chosen for realization and the alternative one on landmarked buildings can be assessed as marginally negative.

6.3.11 The Impact on Material Goods

The investment will be developed in the rural area distant from the human settlements. No negative impact on material goods is expected at the construction stage of the project. The positive impact will be development of local roads for transport of goods which, however, will serve local society for local transport as well. The impact is assessed as positive.

6.4 Impact at the Exploitation Stage

6.4.1 The Impact on the Acoustic Climate

Currently in Ukraine there are no guidelines, recommendations or executive orders related to introduction of methodology of noise impact calculations of various investments, in particular wind farms. The permissible noise values are set in SNiP II – 12-77 "Protection from Noise", GOST (Sate Standard of the USSR) 12.1.003-83 "Noise. General Safety Requirements" and DSP 3.3.6.037-99 "Sanitary Regulations of Industrial Noise, Ultra- and Infrasound", which sets regulatory value of 45 dB(A).

Due to the above, it is recommended to use threshold values suggested by international analyses of noise impact on human health. According to the research presented in Guidelines for community noise (WHO, 1999) a threshold value outside buildings is 45dB(A). In the case of lower noise levels outside the buildings, no correlation between the noise level and its impact on human health (mainly related to sleep disorders of people present in the buildings) was observed. For noise levels higher than 45dB(A) it was observed that the higher the noise level, the more frequent the sleep disorders.

In 2009 World Health Organization prepared a document entitled Night Noise Guidelines for Europe. According to the document the expected noise level at night time outside the buildings is 40dB(A). Such level is a maximum acceptable one, which allows to protect people, particularly the most vulnerable groups, such as children, chronically ill and old people.

Due to the above the following acoustic nuisance criteria for the subject investment are recommended:

- the allowable noise level for night time outside residential buildings: 45dB(A)
- the permissible noise level for night time outside hospitals, home day care facilities for old people and for children and young people (if they are operated at night): 40dB(A).

Taking into account the human health protection, it is crucial to ensure that acoustic conditions at night time are correct. During daytime higher noise levels are acceptable and they are not expected to impact human health. It is crucial that the noise level does not breach 50 dB(A).

The wind farm operation will be a source of noise emission. In the case of the subject investment, a few major emission sources can be listed:

- operation of wind turbines,
- road traffic related to the wind farm operation,
- operation of main transformer station (MTS) and overhead power line (PTL).

The following two wind farm parts are considered to be major source of noise emission:

- noise generated by a rotor's operation,
- aerodynamic noise related to air masses flow passing in a direct vicinity of the blades.

The main noise source of the wind installation are rotor's blades, which perform a circular movement against the air resistance. The noise is generated due to vibrations of the blades edges caused by air masses flow. When analyzing the spatial distribution of the emitted noise level, it should be concluded that the most significant emission is observed at the ends of the blades, where rotational speed is the highest. Such noise has balanced spectral-response characteristics, and it is not possible to separate major tonal components despite the fact that sometimes this type of noise resembles in a sort of 'buzzing'.

The inconvenient humming is also generated by the system, which processes energy (rotator, gear unit, generator), however the noise generated in this way is less intensive than the aerodynamic noise.

Acoustic impact of the road traffic related to the wind farm operation

The planned wind turbines are maintenance-free machines and they are operated by microprocessor controllers and telecommunication means. During the operation of the wind farm the roads will not be often used. It is planned that individual wind turbines will be occasionally accessed by cars or trucks in order to conduct necessary maintenance and technical inspection.
The impact of the road traffic related to the operation of the wind farm is considered to be insignificant and therefore it is not expected to be found inconvenient by the inhabitants.

Impact of the main transformer station

Noise generated by the transformer stations is mainly related to the corona discharge phenomenon, typical for power conductors and to avalanche breakdown, typical for insulation materials. Such phenomena appear when the power conductors-wires are not clean and due to change of physical properties of the conductors related to meteorological conditions. The most significant noise emission is observed during bad weather, particularly drizzles, when water remains at the wires.

During operation of the main transformer stations the noise level is 76 dB(A). Such a level is relatively low, and taking into account the location of the transformer station the noise level at the border of the transformer station will not exceed 45dB(A) and it will not be inconvenient for the inhabitants.

Impact of the overhead power line

Noise is generated by the power lines as a result of the following: corona discharge from live conductors (mainly from auxiliary conductors) and discharge currents at the elements of electro-insulation system (isolators). Corona discharge is an electrical breakdown, which appears when a maximum current intensity exceeds the critical value.

If weather conditions are stable, the maximum intensity of electric field at the wires surface is 15-17kV/cm, while the intensity critical value 19-20kV/cm. If weather conditions are bad (high air humidity, medium rainfalls), the maximum intensity of electric field at the wires surface lowers to 10-12kV/cm. It causes intensive corona discharge and consequently a significant rise of the level of emitted environmental noise.

On the basis of the previous measurements it may be concluded that the emitted noise level is not the same for the whole power line, even if the weather conditions are good. Most often it is related to the properties of the wires, mainly with their irregularity, but also potential damage of the wire, cleanliness of the wire or its constructional defect.

Higher noise level is observed whenever the wires are unclean. Significant electrical breakdowns at the insulation equipment also raise noise emission.

Power lines' noise level depends on three factors:

- nominal voltage of the line – in this case a power line of 330kV is planned,
- height on which the wires are placed at wire piles (therefore the construction and height of the piles),
- height, on which the wires are placed at the central part of the span.

Estimated level of the acoustic power of the power line in a distance of 10m from the HV power line is 45dB(A), which allows to set the acoustic power for the representative section of 1m at the level of 65dB(A). It is true and correct only if the weather conditions are bad. On the basis of the previous measurements it may be concluded that during good weather conditions the noise level emitted by power lines is always lower than the acoustic background, so not possible to scale. If the weather conditions are bad (high humidity, drizzle) in a distance of 10 m from the power line axis route, noise level should not be higher than 45dB(A), and it gets smaller when the distance grows. Consequently if the power line is constructed outside residential areas, its operation will not cause nuisance.

Impact of the wind farm

The calculation model is provided in WindPro 3.0.639 software by its licensed user, Vestas Wind Systems A/S Company (Appendix 8). The calculations are provided within the boundaries of the distances from the WTGs in the 11 zones in the direction of situation of the village settlements. The calculations are conducted with the nominal wind speed of 10 m/sec. at the elevation of 10 m above the ground level. According to the acoustic calculations provided, the equivalent noise levels at the boundaries of the closest residential developments in different directions from the WTGs were as follows: Volna Village – 39.2 – 43.3 dBA (at the distance of 807 m from the WTG), Dunaivka Village – 34.0 – 36.6 dBA (at the distance of 1244 m from the WTG), Nadezhdyne Village – 36.4 – 39.4 dBA (at the distance of 1285 m from the WTG), Girsivka Village – 33.4 – 36.8 dBA (at the distance of 1411 m from the WTG), Oleksandrivka Village – 26.2 – 36.5 dBA (at the distance of 1626 m from the WTG), Dobrivka Village – 35.0 – 38.1 dBA (at the distance of 1691 m from the WTG), Devninskoe Village – 34.0 – 36.6 dBA (at the distance of 1720 m from the WTG), Mordvynivka Village – 30.4 – 35.3 dBA (at the distance of 1911 m from the WTG), Novopokrovka Village – 32.7 – 35.0 (at the distance of 2314 m from the WTG), Nechkyne Village – 31.1 – 33.7 (at the distance of 2724 m from the WTG), Viktorivka Village – 27.9 – 30.9 (at the distance of 2857 m from the WTG) which does not exceed the permissible noise norms according to the "Sanitary Norms of Permissible Noise in Residential and Public Buildings and on the Territory of Residential Development. The Sanitary Norms SN # 3077-84" (the norms for the permissible noise on the territory of residential development is 55 dBA during daytime and 45 dBA during nighttime according to the equivalent noise levels).

The wind power units do not emit any audible infrasound. These levels are much lower than the audible threshold. The level of infrasound emitted by the WTG does not exceed 65 dB, which is much lower than the normally permissible boundary level of infrasound of 90 dB according to the Sanitary Norms SN 2.2.4/2.1.8.583-96 "Infrasound at Workplaces, at Residential Public Premises and on the Territory of Residential Development". With regards to the above mentioned, it could be stated that the recommended protective zone for the wind farm in Pryazovske and Melitopol Districts of Zaporizhia Region under the condition of the noise impact may be established at 800 m from the outermost wind turbine generators in all directions; this zone will ensure acoustically safe conditions for the health of the population. The planned undertaking will be situated approximately 807 m (in the case of the investment-related variant) from the closest inhabited buildings.

The movable parts of the wind power unit, its rotor and the blades in particular, constitute the source of the vibration for its load-bearing part. The vibration of individual rotating elements of the WTG attenuates completely at the level of the load-bearing element of its base, and it does not affect the adjacent area. Therefore, there is no need for vibration prevention measures[5].

To sum up, basing on the carried out examinations of noise propagation for a wind farm incorporating 167 (investment variant) or 222 (rational alternative variant) wind turbines situated in Zaporizhia Region, in Priazovsk and Melitopol Districts, no possibility of exceeding the set noise thresholds by wind turbines working both during the day and at night has been identified. Hence, it should be assumed that the exploitation of the aforementioned investment in one of the discussed variants will not pose a threat to acoustic comfort of the locals and the generated noise will be lower than the threshold specified for protected areas.

It has to be highlighted at this point that the variant incorporating 167 turbines will be more beneficial in terms of economy (higher productivity) and social issues (lower noise levels).

6.4.2 The Impact on Soil Surface

During its operation, the wind farm does not produce any emissions or waste of any harmful substances classified by GOST (State Standard of the USSR) 12.1.007-76(1999) "SSBT (System of Occupational Safety Standards). Harmful Substances. Classification and General Safety Requirements"**Error! Bookmark not defined.**. A normal exploitation of the wind farm together with its auxiliary infrastructure will not have an impact on the surface of the land. However, there may be an indirect pollution due to waste generation.

During exploitation phase of the project the major waste streams will be generated by WTGs service and maintenance which typically comprise:

- Group 13: Oil Wastes and Wastes of Liquid Fuels (except edible oils, and those in chapters 05, 12 and 19):
  - 13 01 05* - non-chlorinated emulsions - approximately 150 tons/year;
  - 13 02 05* - mineral-based non-chlorinated engine, gear and lubricating oils - approximately 150 tons/year;
- Group 15: Waste Packaging; Absorbents, Wiping Cloths, Filter Materials and Protective Clothing not otherwise specified:
  - 15 02 02* absorbents, filter materials (including oil filters not otherwise specified), wiping cloths, protective clothing contaminated by dangerous substances – approximately 150 tons/year;
  - 15 02 03 absorbents, filter materials, wiping cloths and protective clothing other than those mentioned in 15 02 02 – approximately 0.5 tons/year;
- Group 16: Wastes not otherwise specified in the list:
  - 16 01 07* - oil filters – approximately 4.6 tons/year;
  - 16 02 13* discarded equipment containing hazardous components other than those mentioned in 16 02 09 to 16 02 12 – approximately 2.9 tons/year;
  - 16 02 14 - discarded equipment other than those mentioned in 16 02 09 to 16 02 13 – approximately 2.9 tons/year;
  - 16 02 15* - hazardous components removed from discarded equipment –2.5 tons/year;
- Group No. 17: construction and demolition wastes (including excavated soil from contaminated sites):
  - 17 04 01 copper, bronze, brass – approximately 0.6 tons/year;
  - 17 04 05 - Iron and steel – approximately 15 tons/year;
  - 17 04 11 cables other than those mentioned in 17 04 10 - approximately 15 tons/year.

In the case of the realization of the rational alternative variant (222 turbines), the amount of waste generated would be 15 % higher than the amount indicated above.

Besides, some wastes may be generated at MTS, which occasionally may include waste transformer oil (either 13 03 06* mineral-based chlorinated insulating and heat transmission oils other than those mentioned in 13 03 01, or 13 03 07* mineral-based non-chlorinated insulating and heat transmission oils, or 13 03 08* synthetic insulating and heat transmission oils – depending on transformer type) and some amounts of mixed municipal wastes (20 03 01).

Should oil-water separator will be installed, periodically the following wastes will be generated:

- 13 05 02* sludge from oil/water separators – 5.8 tons/year;
- 13 05 07* oily water from oil/water separators – 5.8 tons/year.

Uncontrolled spillage of transformer oil at the MTS is considered to be of a greater potential to generate substantial subsurface impact. In order to reduce such a risk the transformers should be placed on secondary containments (tight concrete tanks). Drainage of the secondary containment should be equipped with oil-water separator. As a matter of good management practice all hardened surfaces at the MTS site should be also drained via an oil-water separator.

Similarly to waste handling during construction phase, wastes generated during wind farm exploitation should be collected at dedicated places at the MTS or other site out of the wind farm. All maintenance liquids will be stored at a separate Vestasfacility and will be their contractual responsibility. Transformer oil will be loaded by the transformer supplier (ZaporizhiaTransformer). Wastes should not be mixed, in particular no mixing of hazardous and non-hazardous wastes should take place. Collected wastes should be transferred off the site by certified waste company for final treatment.

Regardless of the amount of waste generated at the stage of investment exploitation, it is not expected that it would pose a significant threat to the environment, providing that all the applicable regulations will be complied with.

The impact of the variant chosen for realization on the environment should be considered to be moderately negative. In the case of the realization of the alternative project, the interference caused by exploitation would be similar to the investor's one, but the amount of waste generated would be notably bigger.

6.4.3 The Impact on Surface Waters and Groundwater

During exploitation phase of the project the subsurface impacts may be generated by:

- uncontrolled spillages of oils during WTGs maintenance;
- uncontrolled spillages of oils, fuel or other technological fluids from cars and specialized equipment used for WTGs service or maintenance;
- accidental release of transformer oil at the MTS.

No fixed sanitary devices will be installed next to individual turbines, there will also be no water gathering schemes adopted. Thanks to the hands-free character of the operation of the wind farm, the planned investment will not be a source of an excessive industrial or domestic waste.

The interference of the undertaking with the local soil and waters at the stage of exploitation will be predominantly based on local precipitation water infiltration limitation.

The water in question will be washed over foundations and access roads to be absorbed by the ground in a close proximity to the said structures. Nevertheless, the analyzed precipitation water can be classified as clean and there will be no need to additionally purify it, providing that there will be no direct contact with pollutants.

While taking into consideration hardened access roads and platforms, the infiltration of precipitation waters will be limited only marginally due to a satisfactory permeability of the utilized materials.

The amount of precipitation water absorbed by the soil will be as follows:
Area covered by foundations: 167 turbines (approximately 625 m^2 each) =104 375 m^2

$$Q_1 = f\ (ha) \times 0.95 \times 131$$

$$Q_1 = 1298.9\ [dm^3/s]$$

Clean precipitation water will be absorbed by the ground on the land leased by the Investor.

Detailed principles governing the occurrence and maintenance of groundwater table, expected filtration coefficient, and ground type are going to be agreed upon at the stage of construction project creation, during which geological and technical requirements of wind farm creation will be specified. The area of the planned development is located outside of protective areas of communal water intake and other groundwater intake areas.

Within the areas of MTS and administrative and technical facility, some sanitary paths may be created, the outpour from which will be gathered in a non-permeable container and collected by a chosen company.

The impact of the planned station and administrative facilities on ground waters will be negligible and based on a local limitation of infiltration in hardened spots. Due to the fact that there are protective measures planned to be implemented, there are no other expected interferences of the investment with both surface and ground waters. Possible leaks of operational liquids to be used to maintain turbines and the station in a proper condition will be removed by means of neutralizing agents in order to limit the risk of water pollution.

At the stage of exploitation of the 330 kV electric grid, there will be no additional surface or ground water pollutions.

The exploitation of the wind farm in a standard manner will not exact a toll on ground and surface waters (the lack of impact or neutral impact). The case would be identical while opting for the rational alternative variant (222 turbines).

6.4.4 The Impact on Air Quality

The exploitation of the wind farm, regardless of the chosen variant, will not have an impact on air pollution. On the contrary, energy production based on the utilization of a renewable source will make it possible to avoid the emission of gas and dust pollutants that may be generated by conventional power plants (for example coal-fuelled ones) of a similar capacity. Energy generated by the turbines is considered to be ecologically clean and its source is virtually unlimited. Wind farms are in fact ecologic solutions which limit the emission of energy generation-related pollutants to the atmosphere.

Therefore, the undertaking will positively influence the quality of air. In the process of investment exploitation, electric power will be generated without polluting the atmosphere with greenhouse gases. Thanks to such a form of energy generation, it will be possible to limit the amount of said gases produced globally, mainly due to the use of conventional sources. The positive impact will be identifiable for the entire lifespan of the power plant (25-30 years).

This is a significant contribution to air quality and the quality of the climate, which follows one of the main decisions of the United Nations Framework Convention on Climate Change of 1992 and the Kyoto Protocol. Wind energy is a no-emission technology – lack of greenhouse gases emissions, i.e. carbon dioxides, sulphate oxides, nitrogen oxides or dust emission.

This technology does not pose any risks (such as reactor failure, which is related to nuclear power production).

This technology largely contributes to realisation of decision of the new Directive 2009/28/EC of 23 April 2009 on the promotion of the use of energy from renewable sources.

During the plant exploitation, there will be increased road traffic caused by the need to service and inspect individual turbines. However, it has to be indicated that the increase will be so low, that it will not impact the quality of air and the emission of exhaust fumes will be marginal.

The investment will also have an indirect, positive impact on the quality of air. It would be even higher while opting for the rational alternative variant (due to a greater amount of turbines installed).

6.4.5 The Impact of Electromagnetic Field

Ukrainian requirements are regulated by the State Sanitary Norms and Rules of Population from Impacts and Electromagnetic Fields approved by the Order of the Minister of Health N 239 of 01 August 1996. The document define maximum permissible levels of electric field (at the height 1.8 m) which vary depending on the type of area.

Table 29. Maximum permissible eletric field

Area	Intensity, kV/m
In buildings	0.5
Territory of settlements	1

Vegetable gardens and orchards	5
Roads of categories 1-4	10
Territory accessible for people, agricultural land	15
Hard to access areas, inaccessible areas protected by fences	20

The construction of wind farm results in few potential types of electromagnetic field sources. These include:

- Wind Turbine Generator,
- WTG transformer,
- Cable inside the WTG tower,
- Underground cable network,
- Transformer station with auxiliary equipment,
- Overground high voltage power transmission line, which transports the energy from the main transforming station to the receiving point of the public operator.

Analyses, simulations and measurements conducted abroad (mainly in Australia, New Zealand, Great Britain and Canada) have indicated that only the high voltage transformer stations together with outputs of overground power lines are able to generate the level of a field that is significant from the environmental point of view, which does not imply that these elements pose a threat to the electromagnetic climate, as their range of impact is usually very limited.

6.4.5.1 Impact of the Wind Farm within the Electromagnetic Field

For the purpose of this analysis the parameters for the reference turbine Vestas V112 and Vestas V126 of a capacity of 3.45MW were used, which is the most considered model for use at the wind farm. Basic technical parameters of the wind farm are presented in Table 30.

Table 30. Basic technical parameters of single elements of a typical wind farm of a capacity of 3.45MW

Technical parameter	**Value**
Construction parameter	
Hub height	Set individually
Rotor diameter	112 m 126 m
Maximum wind speed	25.0 m/s
Maximum output	3.45 kW
Parameters of the generator	
Hub	Rigid
Main bearing	Dual-row conical bearing
Generator	Asynchronous, 100Hz

Parameters of the converter	
Output voltage	400V
Grid frequency	50Hz
Parameters of the output transformer	
Primary voltage of the transformer	400V
Secondary voltage of the transformer	30kV
Grid frequency	50Hz

The main sources of the electromagnetic field, related directly to the wind farm, are the wind turbine generators and the output transformer. These elements are inside the gondola of the WTG on the top of the tower, i.e. ca. 117-119 m. As illustrated in the above table, all elements of the WTG operate in low voltage 400V. Only the output of the transformer features medium voltage 30kV, which is transferred to the cable network. Other manufacturers' solutions include elements of the WTG which operate in 690V.

Due to the location of the wind turbine at ca. 117-119 m, the level of the electromagnetic field generated by the elements of the wind farm at the ground level (at 1.8 m) is practically negligible. This applies for lower turbines as well. In case of the designed devices they will be equipped with generators of a relatively low capacity. These devices will be assembled inside the gondola, i.e. at a significant height, therefore their impact on the level of the electromagnetic field, measured on ground level (at 1.8 m) will be small, if measurable at all. It should also be taken into account that the devices are inside the gondola and will be locked in a space with a metal conductor with screening characteristics, which in consequence will cause the impact of the wind farm on the electromagnetic environment to equal zero.

By adopting relative simplifications, which do not cover the screening role of the gondola case, the level of electromagnetic field generated by the wind farm elements can be assessed approximately. The field generated by the generator will have a frequency of 50Hz. In case of the WTGs of ca. 100 m height, the resultant intensity of the electric field at 1.8 m will total ca. 9V/m, i.e. significantly below the naturally occurring value. The resultant magnetic field will be ca. 4.5 A/m, also below the natural magnetic field. WTGs with higher towers will have even lover values. In case of using WTGs with lower towers the intensity of the electromagnetic field can be slightly higher, but it will still be around much lower level than the values permitted for areas available to residents.

The planned wind farm together with technical infrastructure will not be a source of electromagnetic radiation at the level that would exceed the hygienic normative according to the State Sanitary Norms and Regulations DSNiP # 239-96[5]. The only possible source of such impact may be telecommunication broadcasting antennas used for steering and control of the wind farm operations. These devices are usually characterized by very low power of the transmitters and a directional characteristics of the antennas radiation and do not pose threat for the environment, due to the fact that they are installed on the top of the WTGs towers. In case of the cable joints (optical), which are most often used for controlling the work of single turbines, the use of electromagnetic sources of medium and high frequency is completely eliminated.

As a summery it should be stated that wind farms are equipped in energy devices, which operate with the frequency 50Hz or 60Hz (in case of other manufacturers) and do not pose threat for the environment. The intensity of such fields is much lower than that of the Earth fields, hence their impact on the environment is negligible, often not measurable with current measuring devices.

6.4.5.2 Impact of the Cable Line Connecting the Generator and Transformer

In case of the planned WTGs, electric energy generated by the generator is taken off and directed via the cable line to the internal transformer of low power. The wind farm transformer is planned to be put inside the steel WTG tower, and access to the transformer will only be granted to maintenance service authorities.

An output transformer is planned of an input voltage of 400V (or in the case of some other manufacturers of a capacity 690V) of a frequency of 50Hz, and an output medium voltage of a frequency of 50Hz. In case of some solutions, devices of a frequency of 60Hz are used. The transformer itself is a very weak source of electromagnetic radiation – this type of devices are often used as end-transformer, installed on electric poles near the development, providing power to residential areas and single detached family houses. A cable line will run between the generator and the transformer, of a working voltage of 400V (or in case of other manufacturers 690V), which is comparable to the three-phase voltage commonly used in households (400V). In this case the impact of such connection, which also runs inside the steel construction of the WTG tower, is of marginal character and practically zero impact on the electromagnetic climate of the environment. The intensity of the electric field in the direct neighbourhood of such type of power lines is below 0.1kV/m, which combined with the screening effect of the steel WTG tower construction results in negligible impact of the line.

6.4.5.3 Impact of MV Medium Voltage Power Lines With Respect to Electromagnetic Field

Power lines are another source of electromagnetic field of 50Hz frequency, related to the construction of a wind farm. They deliver power generated by the wind turbines to the transformer station. As a part of the wind farm it is planned to construct a net of medium voltage power lines. The cables will be placed in ditches, as it is required by the respective norms (at a depth of at least 1.0 m). There will also be fibre optic telecommunication and IT net installed. It is not a source of any electromagnetic radiation.

Medium voltage cable nets generate electromagnetic fields, whose level is low and it is not a hazard to the environment. For typical medium voltage power lines the electric field intensity reaches up to 0.6 kV/m. A typical intensity of the magnetic field does not exceed 5A/m.

It should be emphasized that the planned cable net is located outside the residential areas, therefore the presence of people in the vicinity of the power line route will be occassional. Summing up, the planned medium voltage power line does not influence the electromagnetic conditions and it will not pose a risk to human health.

6.4.5.4 Impact of Main Transformer Station (MTS) With Respect to Electromagnetic Field

In case of the planned investment, the main transformer station will be the only significant source of electromagnetic filed. The wind farm will be connected to the station. The transformer station will transform the electricity generated by the wind farm and delivered by medium voltage lines into high voltage of 330kV and introducing it to the public electricity network.

Systems of connections in the switching stations and the station's equipment are considered to be the main source of magnetic fields at the high voltage transformer stations. The analyses of the impact of planned stations is based on a comparison with measurements conducted at already existing similar investments. In the vicinity of the high voltage station, the highest magnetic field intensity is observed next to overhead power lines, entering the station’s area, which is a result of smaller distance from the test meter probe of the power lines than from the current circuits. It should be emphasized that magnetic fields intensity are much lower than 30A/m, even in the case of the station of the highest voltage. In other places magnetic field intensity are small, from non-measurable to a few A/m.

In accordance with the calculation of electric field strength (bis. M2300-ЭС.PP), the value of electric field strength is 4.75 kV/m at a distance of 20 m from the fencing of the transformer yard, which corresponds to the requirements specified in par. 2.3 of DSN 239-96 “State Sanitary Norms and Regulations of Residents’ Protection from the Influence of Electromagnetic Emissions” (the maximum permissible value is 5 kV/m).

It should be stressed that main transformer station will not be a source of electric or magnetic field, whose level outside the station's area would pose a risk to the environment. The highest levels of electric and magnetic fields will be observed at the station's area, where people do not have access. Electromagnetic fields levels, outside the installation borders, are considered safe and they do not pose a hazard to human health.

6.4.5.5 330kV Power Line Impact – External Connection

Regarding the generation of electromagnetic field in the surroundings, the area protecting human health against the effect of electric field generated by high voltage transmission lines is regulated in Ukraine by state sanitary norms and regulations for human health protection from the effects of electromagnetic radiation, approved by the Ministry of health protection of Ukraine on the 1 of august of 1996. These norms established the following maximum permissible levels of electric field intensity for 330 kV transmission lines:

- 0.5 kV/m inside residential buildings;
- 1 kV/m in areas designated for residential buildings;
- 5 kV/m in populated areas outside residential zones;
- 10 kV/m in OHL sections crossing automobile ways of I-IV categories;
- 15 kV/m in unpopulated areas;
  - 20 kV/m in areas of difficult access (not accessible for vehicles and agricultural machines).

The planned wind farm will be connected to the electricity network via an overhead power transmission line of 330kV.

From the point of view of emissions and radiation of the electromagnetic fields it is crucial to keep a proper distance between the line and the residential areas. Such a distance results from the range of the impact of lines with respect to the magnetic fields emission and it is observed within a few to several dozen metres from the axis of the line. In this case its width is equal to 56,4 m (on both sides of the axis). The key elements are: construction of the supporting piles and their height, and the minimum distance from the wires to the ground, typically present in the central part of span. All subject variants of the line guarantee proper distance from the residential areas, and therefore the final route of line should be prepared taking into account possible reduction of impacts on the nature as these impacts are crucial in such case.

Conclusion

Completion of the investment will not cause any hazard to the environment with respect to electromagnetic field emission and radiation. Wind turbines and MV network infrastructure do not generate electromagnetic fields posing risk to the environment. The most significant source of electromagnetic field is the transformer station and the 330kV PTL. In the case of the transformer station, situating them outside the residential areas and fencing of the station will guarantee that proper electromagnetic conditions are kept outside the station. In the case of overhead power line, it is crucial to conduct detailed measurements depending on the construction of the supporting piles and to set up on this basis a minimum distance from the line to residential areas (this distance should be determined based on the Ukrainian electrical code and will be between a few and several dozens meters).

In the variant chosen for realization, the investment will cause the constant emission of electromagnetic field and radiation. Nevertheless, its impact will be marginal in nature and will not exceed the applicable norms. The specificity of operation of the wind farm with regard to electromagnetic field and radiation should be therefore considered to be minimal. The exploitation of the farm in the alternative variant (222 turbines) would be connected (due to the bigger scale of the undertaking) with stronger electromagnetic impact, which would still not exceed the set thresholds.

6.4.6 The Social Impacts

The potential impact on the quality of life and health of citizens living in a close proximity to the investment may be those identified in terms of: noise emission, electromagnetic fields and radiation, vibrations, and the so-called shadow flickering. The focus should be also put on the range of ice particles dispersion by rotor blades and – in extreme cases – on the disconnection of blade elements. These phenomenas are discussed in more details further in this section.

The potentially important social issue is use of agricultural land for industrial purposes. The Company leases or holds servitude rights to approximately 325-350 (180 for phases 1A and 1B) land plots of a total area of 230 ha (190.4 for phases 1A and 1B) out of a total of apporx 318 ha needed for the entire Project. Given the area of the affected village councils exceeds 36 thousand hectares, the land used for development of the wind farm constitutes less than 1% of the total area. Specific land use is as following (detailed list of land plots for phases 1A and 1 B is provided in the Appendix 10):

- Land designated for WTGs location, which is almost exclusively agricultural hedgerows, which have been re-zoned from agricultural land (for non-agricultural use) to industrial use for the wind farm. The area of this land amounts approx. 209 ha, which is more than 90% of the land used for the wind farm. It is noteworthy that a typical agricultural hedgerow has a configuration of approximately 500 meters x 20 meters. Even though the project developer only requires a wind turbine operations zone length of approximately 65 meters, a strategic decision was taken to lease out the entire agricultural hedgerow in each and every case where a wind turbine was proposed for placement into a hedgerow. Such approach generate additional income to the village council where the hedgerow is located, as 100% of land rent in Ukraine remains within the local jurisdiction. It should be also noted, that the hedgerows do not have a commercial value and serve as a barrier against erosion of arable fields by wind.
- About 10 ha of land has been allocated for the wind park sub-station and administrative complex. This land plot is located outside the boundaries of Nadeshdine village council and was previously unused, so its development will not have a negative economic impact.
- Less than 5 ha of land has been secured via servitude agreements to install 330 kV PTL and pylons. It is noteworthy that Ukrainian law does not require servitude rights to be secured below overhead power transmission lines. To avoid the possibility of future conflict, however, the Company secured third party land rights to all 109 proposed PTL pylons as well as the vast majority of land underneath the entire 23 kilometer distance of the PTL —in a corridor with a width of 20 meters.
- About 19 kilometers of access road rights have been secured to-date for the first phases of the wind farm development, and approx. 72 kilometers of access road rights will be secured for Phase II. Accesss road rights will give the project developer the right to reconstruct existing field roads with 5-meter widths. Agricultural access roads that are currently dirt, will be reconstructed with sand, gravel, geo-textile and then a covering layer to keep the road in-place. Existing intra-village roads will be re-paved entirely.
- About 9 kilometers of land have currently been secured to-date for placement of 35 kV medium voltage cables and approx. 60 kilometers of land rights for 35 kV line will be secured for Phase II. It is noteworthy that in Ukraine the legislation does not require acquisiton of third party legal rights to install medium-voltage cables. To avoid even the possibility of potential conflict, the Company voluntarily approached land plot owners to agree servitude rights to install, operate and maintain the medium voltage cable lines. These servitudes give the project developer the right to install the 35 kV medium voltage cables and create a legal compensation mechanism to compensate local land plot owners for potential disruptions to their farming operations. Please note, however, that the underground power transmission lines will be installed at depths 1.0-1.5 m, i.e. below the typical depth of agricultural land cultivation.
- Less than 5 hectares of land is called 'additional foundation plot' land. This land is usually quite small (up to 125 m^2) and was needed for acquisition when the wind turbine foundation fell outside the width of the allocated agricultural hedgerow. These land plots have almost entirely

been allocated to the Company. The process of allocation of approx. four remaining plots is undergoing and is expected to be finished prior to project financing.

In two village councils, given the comprehensive nature of the main farmer holdings in these village councils, the wind farm developer took a strategic decision to constructively engage with these main farmers. Cooperation agreements were signed with each main farmer. Under the agreements, all parties are to strive not to disrupt the others business operations and to mutually support each other as relevant.

Operation of the wind farm will not require any economical or physical displacement. The land allocated for the wind farm infrastructure has been (and will be in the next development phases) acquired on fair basis and its use will generate no negative impact on local economy/individual wellness but will rather be a source of additional income for the communities and individuals. Further, the Company also intends to utilize local work force as far as possible. During wind park operation, required skill-sets will also range from highly skilled (electrical engineers, wind turbine maintenance workers to skilled (accountants, administrators, project manager, facilities management) to lower skilled (security, cleaning). Lower skill labourers are readily available locally. The challenge will be identifying and hiring higher skilled laborers like electrical engineers.

The work of the wind farm personnel shall be conducted in compliance with requirements of the safety and occupational safety rules designed for work at electric power generating units, requirements of the sanitary legislation as to the normative levels of industrial noise, ultrasound, infrasound, protection against the electromagnetic radiation. All of the WTGs will be equipped with warning lights. The wind farm objects are located outside of the aerodrome environs that belong to Zaporizhia Airport, therefore they require no approval from the airport authorities (Letter # 676 dated September 10, 2014).

The sanitary classification for enterprises, manufacturing facilities, buildings are provided in the State Sanitary Rules for the Design and Development of Populated Settlements. The State Sanitary Rule DSP # 173-96 provide no definition for the size of the sanitary protective zone for the wind power industry objects [5].

Noise

The exploitation of the wind farm may be a nuisance for the locals, especially when it comes to noise emission. The issue in question has been analyzed within the scope of the acoustic analysis-oriented report (Appendix 8), which is summed up in chapters 6.3.1 and 6.4.1. Noise related to transport of the facility personnel or maintenance materials is not considered an issue of concern, as related traffic is not expected to be significant.

It has been stated that the noise generated by the farm, both in investment-related (167 turbines) and rational alternative variant (222 turbines) will not exceed noise thresholds set for protected areas (the steady, acceptable level has been even maintained during the night in the performer simulations).

Therefore, noise level-related troublesomeness of the investment should be considered to be insignificant.

Electromagnetic field and radiation:

The planned undertaking will be situated approximately 807 m (in the case of the investment-related variant) from the closest inhabited buildings. Nearby there lie single provincial towns and places like Devninskoe, Nechkine, Dunaivka, Viktorivka, Girsivka, Mordvinivka, Dobrovka, Nadeshdine, Novopokrovka and Volna.

Scientific examinations carried out to date on the negative impact on electromagnetic waves of the frequency of 50 Hz on human health, and especially – on the risk of cancer development – have not confirmed the detrimental interference of the said waves with human body (Australian

Greenhouse Office, Australian Wind Energy Association, 2004). What is more, examinations on live, isolated cells also have not shown electromagnetic field to cause any changes in their structure. Surveys on humans that have been widely discussed in the literature of the subject have shown none or only a marginal impact of electromagnetic waves on human health (BBC, Ofcome, The Impact of Large Buildings and Structures, including wind farms, on Terrestrial Television Reception, 2009). Even though the examinations were carried out in 2001 for the National Radiological Protection Board of Great Britain and showed that there may be a correlation between a long- term exposition to high-frequency electromagnetic waves and a slight increase of the risk of leukemia development in children (Sustainable Development Commission, Wind Power in the UK. A guide to the key issues surrounding onshore wind power development in the UK, 2005), no similar effects were shown for animals and isolated cells (Australian Greenhouse Office, Australian Wind Energy Association, 2004, 2004).

With regard to the analyzed wind farm, in both variants (167 turbines in the investment-related variant and 222 turbines in the rational alternative variant), electromagnetic radiation measured at the height of 1.8 meters above the ground level will not exceed the value of electromagnetic fields occurring naturally, there are no reasons to state that the aforementioned turbines may in any way or form negatively affect the health of people living nearby. Yet another important factor is that the investment will be realized within an agricultural area, far from built-in spots.

While taking into account the 330kV PTL, a technological path along the planned line has been specified. Its width is equal to 56,4 m (on both sides of the line axis). Within the specified area, there may be excessive electromagnetic field and radiation emissions. The planned line is situated outside of built-in areas, so it will not pose a threat to the local inhabitants.

The impact of electromagnetic fields in the investor's variant (167 turbines) and the rational alternative variant (222 turbines) will not exceed the applicable norms and will not endanger the health of local citizens.

Vibrations

The exploitation of the wind farm will be the source of vibrations caused by the generator, the rotor, and tower angling caused by strong gusts of wind, combined with the gyroscope effect being the result of the constantly operating rotor. Vibrations characterized by very low frequencies that are connected with the rotating motion of turbine blades, may be transferred into the ground and propagated further. However, it has to be stated at this point that modern designs of wind turbines incorporate professional compensating modules the incorporation of which result in the minimal amount of vibrations being transferred to the ground. What is more, the location of the wind farm in a significant distance from built-up areas (approximately 807 m – Volna) will ensure that the generated vibrations will not be felt by the locals and will not in any way endanger people or buildings.

According to the examinations carried out to date (Boczar T., 2007) the effective value of vibration acceleration of the body of wind turbine oscillates around 12.136 cm/s^2 to 23.363cm/s^2. Additionally, vibration tests for the foundation of a wind turbine showed the presence of vibrations ranging from 5.377cm/s^2 to 10.815cm/s^2. As specified in the literature of the subject, the impact of vibrations on people and buildings is strictly connected with their amplitude. It is assumed that:

- Vibrations of the amplitude up to 3.6cm/s^2 have no impact on the structure of buildings,
- Vibrations of the amplitude up to 5.0cm/s^2 are not noticed by and not harmful to humans.

In the case of building, the decisive impact on the structure can be ascribed to horizontal vibrations. The available measurement-related data show that in a close proximity to wind farms, vibrations of the frequency lower than 600 Hz and a negligible amplitude are typically identified. Additionally, it has to be mentioned that the amplitude of vibrations in question that is transferred by the ground to the nearby buildings will not exceed the lower threshold of vibrations that may impact the structure of buildings. What is more, there are also no scientific data proving that vibrations caused by wind farms can be hazardous for people.

While taking into account a remarkable distance between wind turbines and built-up areas, it has to be pointed out that the latter will have no noticeable impact either on the structure of the neighboring buildings on the health of their inhabitants. Vibration propagation in the ground is to a notable extent suppressed and their amplitude significantly lowers with distance. Yet another aspect strongly affecting the decrease in vibration amplitude is an interfacial passage between the foundation of turbines and the ground proper.

Vibrations caused by the operation of wind turbines and transferred via soil to the nearby buildings will be virtually impossible to measure by means of currently available devices.

Therefore, it can be assumed that vibrations generated in the course of operation of turbines will not negatively impact the health of local citizens.

Shadow flicker
On sunny days the periodical disruption of the sun ray by the rotating blades of an operating wind turbine causes an effect called shadow flicker. Especially in rooms which are lit by day light, shadow flicker can lead to a pulsating light level with a frequency of three times the rotor speed. Modern wind turbines (600 – 3.000 kW) are typically three-bladed machines that rotate at rates of 26 – 16 revolutions per minute (RPM). Thus, if for example sunlight passes through the rotor of a three-bladed wind turbine rotating at 20 RPM then the light will flicker at a rate of 3x20=60 shadows per minute, i.e. 1 per second or 1 Hertz (Hz). Such low frequencies are harmless in terms of health and safety but under certain circumstances can be annoying. Another effect, the so-called "disco effect", where flashes of light are caused by periodic reflection of the sun's rays on the rotor blades can be minimized by optimizing the rotor blade surface smoothness as well as by minimizing the reflection properties of the paint used on the blades and is not investigated here. Shadow flicker, however, cannot be avoided.

While there is no Ukraine standard regulating, in Germany the tolerable impact of shadow flicker was set to 30 minutes per day or 30 hours per year. These threshold values are adopted by other countries such as Poland, Great Britain or Ireland.

Calculations (Appendix 7) are carried out using the worst case (WC) method. The WC method assumes the sun is shining all the time, the turbines are running permanently and the rotor swept area of the turbines is perpendicular to the examined dwellings. The threshold value is 30 hours/year and 30 min/day of shadow impact at each dwelling. At the dwelling AZ (0:34 h/day; 36:25h/year) and Vol_01 (0:39 h/day; 74:19 h/year) these demands are exceeded. The causing turbines are 138a and 93a. These WTGs will be equipped with the Vestas Shadow Detection System to control the turbine operation. The sytem stops the turbine if the yearly/daily shadow contingent is reached, i.e. in case of these WTGs 30 h/year. It can be assumed, that the calculation of the real-world values will reduce the shadow flicker impact to approximately one-third of the maximum value.

Scatter of ice shards
The phenomenon of icing of rotor blades is dependent on local climate conditions. Conditions favoring possible icing of the propeller elements occur during days with frost and shawls (temperature below 0 ° C, cloud height below 200 m, visibility below 300 m).

The icing of the propellers begins with zero speed, which means that most of the ice shells fall at a relatively short distance from the wind turbine because of the low rotational speed of the rotor. The scattering range covers the area on both sides of the wind direction and the leeward side of the wind turbine. The direction and speed of the falling ice are determined by the direction and velocity of the rotor blade. The scattering of ice shards from the rotor occurs in a circle-shaped area.

The blade de-icing system will depend on the turbine manufacturer and, at this stage, it is not possible to provide technical details of the turbines as the investor intends to use the most up-to-date solutions. At this stage, we can confirm that this system will be in accordance with the recommendations of the turbine manufacturer and it will be brand new. In addition, it will have to meet the requirements of national regulations. The system will ensure efficient de-icing of rotor blades.

In order to calculate the maximum range of ice shedding around a wind turbine it was assumed that the wind could blow from every direction with the same probability.

A simplified empirical equation has been introduced in representing such a "risk circle" without detailed calculations (Seifert H. et al, 2003).

$$d=(D+H) \times 1.5$$

d = maximum throwing distance in m
D = rotor diameter in m
H = hub height in m

While taking into account the designed wind farm, the maximum height of a tower is equal to 117 m and the diameter of a rotor is 126 m. The calculated maximum ice particle dispersion coefficient is therefore equal to 364.5 m.

Areas located inside the circle of the radius of 364.5 m from a tower are considered to be situated in a danger zone.

The ice particles spread protection zone for the wind farm in Pryazovske and Melitopol Districts of Zaporizhia Region is established at 600 m from the WTG axis [5].

It has to be indicated at this point that wind turbines to be implemented will be equipped with de-icing system, which will almost nullify the risk of icing phenomenon occurrence.

In order to protect individuals within the area of the farm against negative effects of ice particles dispersion, informational boards should be utilized, warning unauthorized individuals and wind farm maintenance personnel about the closeness of a danger zone. Additional pieces of information should provide them with more data on possible dangers. When there are weather conditions that may promote the icing phenomenon, individuals within the wind farm should be wearing helmets and protective glasses. It has to be highlighted, however that the risk of ice particles dispersion is purely theoretical, as if turbines are covered with an excessive amount of ice, they are automatically stopped. Turbine restarting procedure is made in an automatic manner and in a controlled way after turbine condition has been verified by technical staff.

The operation of the wind farm will not have a notable negative impact of the quality of life and health of the locals. When it comes to norms on noise levels and electromagnetic field emission, set thresholds will be kept even for individuals constantly staying in a close proximity to the farm. While combined with the modernization of road infrastructure and the improvement of the sanitary condition of the land, it can be even stated that the quality of life of the inhabitants of the area will notably improve. It is also assumed that the planned undertaking will result in the decrease of global emission of harmful substances to the atmosphere and therefore will become an element limiting the problem of energetic devices interfering with people's lives. It may even have an indirect impact on the decrease in civilization diseases incidence that is connected with the air pollution and environment contamination alike.

To sum up, the realization of the investment in the investor's variant will have a negligible negative impact on overall well-being and heath of the inhabitants of nearby areas. The effect of the exploitation state on the quality of life and health would be much more negative while opting for the alternative variant. Worse shadow flickering analysis outcomes and noise level examination results would be probable, as well as a higher intensity of vibrations.

6.4.7 Water and Wastewater

During operation of the wind farm water will be used at the MTS for drinking and sanitary purposes as well as for irrigation of green areas only. Water will be supplied from a groundwater abstraction well which will be developed at the site. Final expected water consumption is up to 12.3 m^3/day, inclusive of 4 m^3/day assumed for irrigation purposes.

The treatment of sanitary wastewater and rainfall runoff on the ground of the administrative and on-site facility was considered in detail by Diproprom. For treatment, the sanitary wastewater will be drained to local Biotal-10-br2r treatment facility, which will provide full cycle of biological treatment, stabilization and dehydration of excess sludge as well as neutralization of treated wastewater and excess sludge.

Rainfall runoff will be treated at the local treatment facilities consisting of a sand-, gasoline- and oil-separator and a sorption filter with settler compartments.

The treatment quality of sanitary wastewater and rainfall runoff makes it possible to discharge it via a pipeline to the Dzhekelnia River. The quality of discharged efluents shall meet national quality standards as per CMU Resolution # 465 On Approval of the Rules for Protection of Surface Waters against Pollution with Wastewater (as amended by CMU Resolution # 748 (748-2013-п) dated 07.08.2013):

- biochemical oxygen demand (BOD5) – not more than 15 mg/l;
- chemical oxygen demand – not more than 80 mg/l;
- suspended matter – not more than 15 mg/l.

However, for the subject facility more restrictive limits have been established by the State Expert Review:

- biochemical oxygen demand (BOD5) – up to 7 mg/l;
- chemical oxygen demand – up to 50 mg/l;
- suspended matter – up to 8 mg/l.

The standards for maximum permissible discharge of other pollutants to water bodies shall be established by the agencies authorized to issue a permit for special water use, provided that this will not worsen the achieved category of water quality (subpar. 5 of par. 19 as amended by CMU Resolution # 748 (748-2013-п) dated 07.08.2013). The Company will need to obtain the respective permit.

While it is accumulated, the waste sludge is planned to be removed by tank truck to sludge draining beds of Vodocanal Utility Company under a separate contract.

6.4.8 The Impact on Fauna

6.4.8.1 Impact of Ornithofauna

The operation stage of the wind farm can include the following impact:

- Collision mortality: direct mortality due to collision with WTGs;
- Habitat change or habitat loss: birds lose breeding and feeding grounds, due to direct taking over of the area by the wind farm infrastructure.
- Birds displacement due to disturbance: birds change or abandon areas used as feeding, breeding or roosting grounds as a result of new, unknown elements in their environment;
- The barrier effect: birds significantly modify their passage route as a result of WTGs presence.

The following describes the possibility of each of the above-described effects. The first two types of situations: mortality due to collisions and habitat loss, are of primary importance due to possible negative impacts on bird populations.

The impact on bird populations varies widely and depends primarily on the location of wind farms - from practically zero or negligible from the point of view of the impact on the viability of the bird population, to significant effects in the case of great loss of habitat and high mortality due to collisions.

The type and magnitude of the impact is also affected by the type of wind turbine used in the project (tower height, rotor diameter, lighting, linear velocity of the apex of the propellers), the number of turbines within the park and area occupied by the project, turbine location within the project (in relation to each other and environmental elements), or the presence in the vicinity of other wind parks (cumulative impacts). This latter element will gain meaning with the densification of wind farm locations.

In general, the risk of negative impact on birds is higher when the wind turbines are located in areas frequently used by birds. Investments in such areas have a greater potential for negative impact than projects undertaken in locations with low levels of airspace used by birds. Conversely, areas with a low-level of displacement are characterized by a lower risk of negative impact.

However, it is also worth observing the way airspace is used by birds (flight ceilings, time and form of use of land, eg, accommodation, feeding grounds, nesting grounds) and the species composition of birds occurring in the location (studies show that the risk of collision with wind farms differ among species) (Polish Association of Wind Energy, 2008).

The possibility of each of the above-described effects is described below. The impact of all the aforementioned was considered direct, but, as described below, none of these effects were considered significant and cannot significantly worsen the state of the ornithofauna in the vicinity of the planned investment.

Impact of accompanying infrastructure

During the operation of the wind farm, the impact of accompanying infrastructure on the ornithofauna is practically negligible. The cable line will be located at a depth of at least 1 m below the ground and its operation will have no direct impact on the local avifauna. In the case of the transformer station, its influence will not be greater than another type of building. Also the use of access roads will have minimal impact on the local ornithofauna. Eventual disturbances of birds may be associated with noise emission during the occasional journeys of technical service vehicles (which, however, result in less noise than those produced by farmers performing agrotechnical treatments). The vegetation developing in the roadside area may have an indirect beneficial effect on the local ornithofauna due to the emergence of new habitats and feeding grounds.

The planned 330 kV power line is related to the emission of electric field, magnetic field and noise. However, in the case of ornithofauna, the primary risk is collision with cables from the above-mentioned liens, which will be described in more detail below.

Impact of the wind farm

Mortality as a result of a collision with WTGs

Bird collisions with wind turbine constructions are a manifestation of a wider phenomenon which includes the collision of birds with all the high objects present in the air. Birds also collapse into buildings, monuments, bridge structures, overhead transmission lines, lighthouses or relay towers (Drewitt A.L., Langston R. W. H., 2008). (Table 31).

Table 31. Harm caused to animals and bird[20]

Reasons of bird kill (at the rate of 10,000)	Birds
Wind turbines	<1
Television towers	250
Pesticides	700
Machinery	700
Electric power lines	880
Other reasons	1000
Cats	1000
Houses/ windows	5500

It is estimated that, in the United States, from 500 million to 1 billion birds die within a year. This mortality is caused by the following anthropogenic factors (Their percentage is given in parentheses): collisions with buildings (58.2%), with power lines (13.7%), cats (10.6%), vehicle collisions (8.5%), pesticides (7.1%), relay towers (0.5%) and wind turbines (<0.01%) (Erickson W. P., Johnson G. D., Young Jr D. P., 2005). As can be seen above, the construction of tall buildings, especially glazed, is the main cause of bird death, while collisions with wind turbines are a relatively minor danger in relation to other factors threatening the avifauna. The collision of birds with wind turbines is a common phenomenon, noted in about 90% of the farms taken into account (Chylarecki P. et al, 2011).

Study Guidelines for Impact Assessment of wind farms on Birds - PROJECT (Chylarecki P. et al, 2011) gives the average annual number of collisions (old and now unrealistic data from wind farms from North America and Europe): 6.75 cases per turbine. The influence of wind farms on bird mortality include injuries and fatalities mostly due to collisions with rotors or other components of the accompanying infrastructure, such as overhead power lines. Although there is increasing evidence that the risk of collisions is in most cases relatively low, there are exceptions to be taken into account, especially for rare species such as large predatory birds. They are already considered an endangered species, for which an additional factor of their mortality can be wind farms (European Commission, 2010).

The significant threat of collision mortality is primarily related to the topography of the area in the so-called bottlenecks, where migratory or local bird populations fly in a relatively limited or “tight" space, eg. mountain passes or narrow passages (narrow strips of land between waterways). Other sensitive locations are slopes with rising currents used by migratory birds, wetlands and shallow seas, which attract large numbers of foraging and resting birds. Corridors of migration between feeding grounds, places of residence and breeding grounds are also considered to be particularly susceptible to such impacts (European Commission, 2010).

Mortality rates may be seasonal, for example during spring and autumn migrations, bird density is significantly increased. They may also be higher during pre-spring flights, while defending breeding territory or seeking food for chicks. Other factors that may affect the risk of collision include: Flight height of a given species, type of flight (migration or local flights to and from places of feeding by the wind farm), behavior, weather conditions, topography and wind turbine scale and design. However, the potential increase in the risk of collisions, such as poor visibility, fog or rain, may be partially offset by lower flight activity under such conditions (Drewitt A.L., Langston R. W. H., 2008). Some species are more vulnerable than others, which may have additional consequences: an increase in the overall mortality, or substitutive consequences: the replacement of other causes of mortality (Sæther i Bakke, 2000). lthough more direct evidence of such link with wind farms is still scarce, there are indications that predatory birds may be susceptible to additional mortality (Hunt i Hunt, 2006, Carrete i in., 2009) (European Commission, 2010).

Special attention should also be paid to populations of rare and endangered species due to other anthropogenic factors such as loss of habitat (Drewitt A.L., Langston R. W. H., 2008). This applies

[20] http://www.dzienwiatru.eu/o-energetyce-wiatrowej.html

to birds of prey and marine life. There are also concerns regarding sparrows that migrate at night (although there is no evidence to support this hypothesis until now) (Sterner D., Orloff S., Spiegel L, 2007), (Drewitt A.L., Langston R. W. H., 2008), (European Commission, 2010).

Collision mortality is usually determined on the basis of dead body search, which may lead to underestimation of results, especially when it comes to small birds, due to their low detection rates and the rapid action of scavengers. Using mathematical models may help to obtain more accurate estimates, although they are highly dependent on reliable field data and correct assessments of bird collision avoidance skills (Band W. et al, 2007), (Chamberlain D. et al, 2006). Recently, the coefficient of collision on wind turbines has been proposed as a collision index. Due to the increasing size of wind turbines, this may be an important and useful collision measurer (Drewitt A.L., Langston R. W. H., 2008), (European Commission, 2010).

The assessment of the possibility that birds collide with wind turbines is extremely difficult. Despite many studies conducted at various wind farms around the world, no universal models have been developed that would clearly identify such hazards. This is due to the fact that the number of birds perishing on individual wind farms depends on many factors. The most important are:

- Location of the wind farm in relation to areas with particularly frequent and numerous occurrences of birds.
- The nature of the occurrence of birds in a given area - hatcheries, feeding grounds, resting places, seasonal or permanent migration routes.
- The size of the wind farm, the number of windmills, the distance between individual turbines, the way turbines are arranged in space.
- The type of wind turbines used - tower height, tower type (tabular, latticed), rotor diameter, speed and rotation rate.
- Weather, time of day, visibility.
- Bird species.
- Way of lighting of the farm and its surroundings.

In the last 10 years almost all major wind farms built around the world were monitored for bird mortality. Still, it is very difficult to gather complete data to establish reliable criteria for assessing the risk of bird mortality. This is due to the fragmented data collected in the field from very diverse locations, with different methods and with varying intensity (Hötker, H. et al, 2006). The results obtained in many published and unpublished analyzes are very diverse. Below are some of them:

- 73 turbines on a farm in the USA, Minnesota (set every 90-180 m) - 2 years of observation - 11 dead birds (Higgins K.F., Osborn R.G., Naugle D. E. , 2007).
- 4724 turbines on 18 different farms (Sterner D., Orloff S., Spiegel L, 2007) – data from 14 publications of various authors from different countries): annual collision of birds of prey in one turbin- on 9 farms: 0,00 (zero) and in the remaining: 0.012 - 0.036 - 0.050 - 0.007 - (0.050 and 0.023 are the famous Altamon Pass) - 0.1 - 0.176 – 0.048.
- Poland - a farm of 9 turbines not far from, and partly, in the seafront (daily checks) - 2 seasons of walking (spring and autumn), about 4 months altogether - no collision (3 dead birds from a previous period, not certain how long - skeletons) (Busse P., 2010).
- Poland - a farm of 24 turbines - from March to December - one domestic dove, a farm of about 20 turbines - three years of observation - less than 10 birds (Busse P., 2010).

As of today, there is no reliable, accepted by the whole ornithological environment, method of estimating the collision of birds on wind farms. This constitutes a major impediment in the assessment of the impact on individual bird populations. This evaluation can only be used as an indicative example of the collision of birds on existing wind farms as described in the publications cited above. It must be borne in mind that only a threat of significant impact causing a loss of the proper conservation status of a given population in the area of investment or its neighboring IBA may provide a basis for not approving the implementation of the project because of the threat to the IBA.

Despite many years of monitoring studies on various existing farms, we have not seen collective results and bird collision analysis. This may be because the results of such tests are not generally available. The authors of the EIA report have been able to reach the data collected in post-monitoring. In Report on monitoring of the wind farm near Gnieżdżewo impact on birds (Zieliński P et al, 2010) The results of the 2007-2011 mortality study show that 38 dead birds were found around 11 turbines (which results in an annual mortality per turbine of 0.7 birds). Despite the distance between the investment area and the existing wind farm in Poland, a similarity in these areas can be observed. Both areas are located by the sea. Therefore, the following calculations are based on the aforementioned data.

The most reliable method for calculating the potential mortality rate of birds at the site is based on local (national) data. Accordingly, the calculations were carried out primarily on the basis of the data presented above from the post-monitoring of a wind farm in Gnieżdżewo (method I), taking into account the planned investment. The bird mortality rate was set at 0.7 birds / turbine. The following results were obtained:

- For investment variant: 167 wind turbines * 0.7 birds / turbine / year = 116,9 birds / year (about 117 birds / year).
- For a rational alternative investment: 222 wind turbines * 0.7 birds / turbine / year = 155.4 birds / year (about 155 birds / year).

For comparison, the calculation of the potential mortality rate of birds at the site is presented below, based on the coefficient adopted for the analyzed wind farms in North America and Europe, at a level of 6.75 annual deaths per wind turbine (II method).
Using this method, the following results were obtained:

- For selected investment variant: 167 wind turbines * 6.75 birds / turbine / year = 1127.25 birds / year (about 1128 birds/ year).
- For a rational alternative investment: 222 wind turbines * 6.75 birds / turbine / year = 1498.5 individuals / year (about 1499 birds/ year).

The values obtained are, by order of magnitude, higher than the values derived from the index calculated on the wind farm in Gnieżdżewo (a mortality of the order of 0.7 birds per turbine) and are presented for illustrative purposes only. Under Ukraine's natural conditions, such a high mortality rate is quite unlikely and should not be taken into consideration in the analysis of the impact of the planned investment on the avifauna. The above coefficient applies to completely different geographical locations, different bird species composition and completely different flight frequencies.

With these calculations, the most unfavorable turbine parameters were taken into account. It should also be stressed that the above calculations are of a theoretical nature only, indicating the maximum mortality rate of birds and not the actual level of collision.

Change of land use patterns due to presence of the wind farm

The deterrence of birds, leading to the displacement or exclusion of local populations from areas occupied by a wind farm and thus the loss of habitat use, may also be relevant for wind farms. Such sublethal effects may lead to a decrease in the condition of the population, which in some respects is more treacherous than direct mortality, as the detection of any impact on the state of the population may be delayed (Langston & Pullan, 2003) (European Commission, 2010).

Disturbance can be caused by the sight, noise and vibration generated by wind turbines and / or by farm maintenance activities requiring the use of motor vehicles. Accompanying road infrastructure may also facilitate access to the site, which in turn may affect the overall increase in deterrence. Breeding populations are considered less susceptible to this effect than populations that prey or rest on the area (Band W. et al, 2005) (Chamberlain D. et al, 2006). Although recent studies indicate that this is not always the case (Drewitt A.L., Langston R. W. H., 2008).). An example are some some wading birds, which are strongly linked to their place of occurrence, suggesting that their attachment to a location may outweigh their repulsion. The real effect may be invisible until the young birds replace the old ones (Desholm M.et al, 2006). Initial screening studies show that local populations of certain species (such as waterfowl and marmosets in resting and wintering areas) show no signs of habitat (Stewart et al, 2004) (Hötker, H. et al, 2006). Whereas recently published long-term studies have shown that different species can become accustomed to the presence of wind farms (Petersen K. et al, 2006).

Wind turbines can reduce the intensity of use by birds in adjacent areas. This type of deterrent effect takes place during the breeding and after-breeding periods. It should also be noted that in some of the wind farms no impact has been shown Anseriformes and Charadriiformes birds respond most strongly to the presence of turbines (Chylarecki P. et al, 2011).

Based on the current state of knowledge, it is obvious that the effects of the deterrence of birds leading to their displacement from investment sites, depending on species and location, should be taken into account in wind farm impact assessments. It should also be borne in mind that even if the range of impact of a single wind farm may be small in relation to the overall availability of habitat for breeding, foraging, resting or wintering, the cumulative effect of a few wind farms may be significant (European Commission, 2010).

Regarding the cumulative impact of several nearby wind farms, it is important to note that potential turbine systems, by their effect of deterrence, could modify the feeding behavior and layout of breeding areas of two-biotope species, eg, birds of prey. Notwithstanding, in the vicinity of the planned wind farm there are no other investments of this type.

Barrier effect caused by the wind farm

There is a potential risk that wind turbines located along migration routes or long-distance migrations, or along regular pathways between feeding grounds and places of rest or nesting at local level, may be a barrier to the movement of bird species (European Commission, 2010).

To evaluate the real threat of the barrier factor to migratory birds, it is worthwhile analyzing the results of a study carried out on the offshore wind farm of Nysted, off the coast of Denmark, concerning geese migrating in its area. Flight routes in the area of the farm are monitored by radar method since 2005. Annually 200,000 - 300,000 geese migrate in the autumn and spring season to the farmland (Kahlert J et al., 2005), (Petersen K. et al, 2006). The research was started before the implementation of the project and is being continued for many years of its operation. The results show that birds avoid the wind turbines, thus adding about 500 meters to their original route. Considering that the migration route is over 1400 km, this is an additional but insignificant energy effort for the birds, irrelevant to their fitness. Only the necessity of avoiding around 100 similar objects could produce a noticeable loss of bird mass, although it would be only of 1% (Masden E et al, 2009).

As shown in the two drawings below, the wind farm is recognized and avoided by birds (Figure 15 and Figure 16).

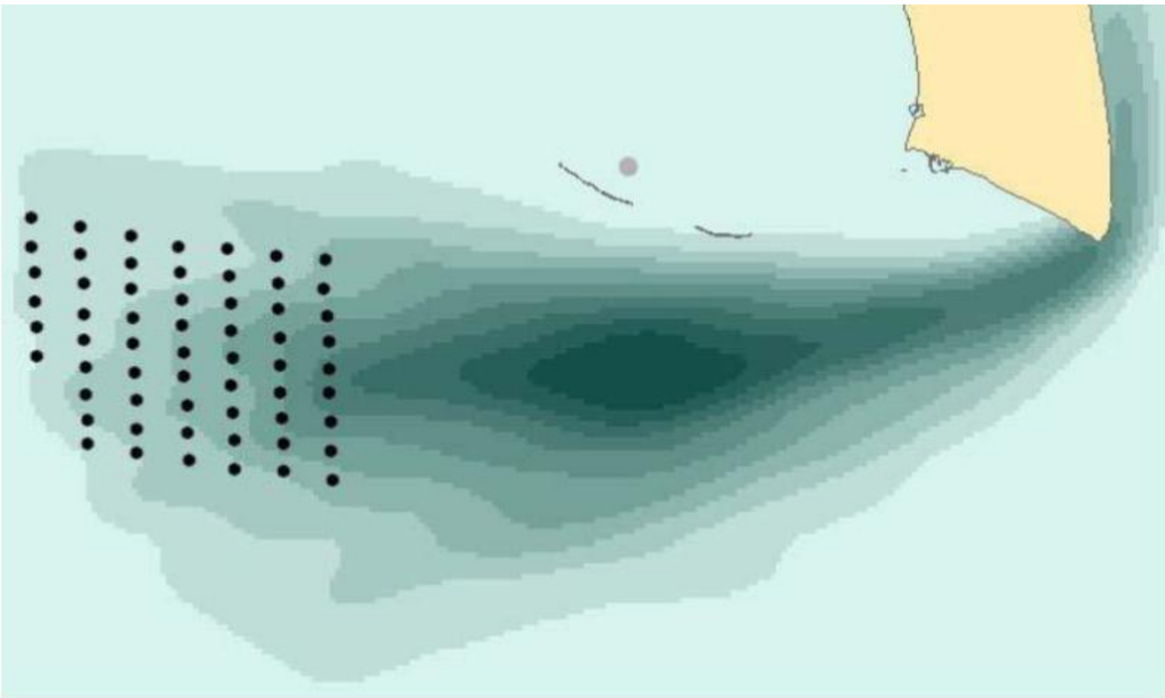

Figure 15. A flux of migratory birds in the Nysted farm, Denmark, during the pre-implementation period. Black dots indicate the planned location of WTGs, radar locations in gray.

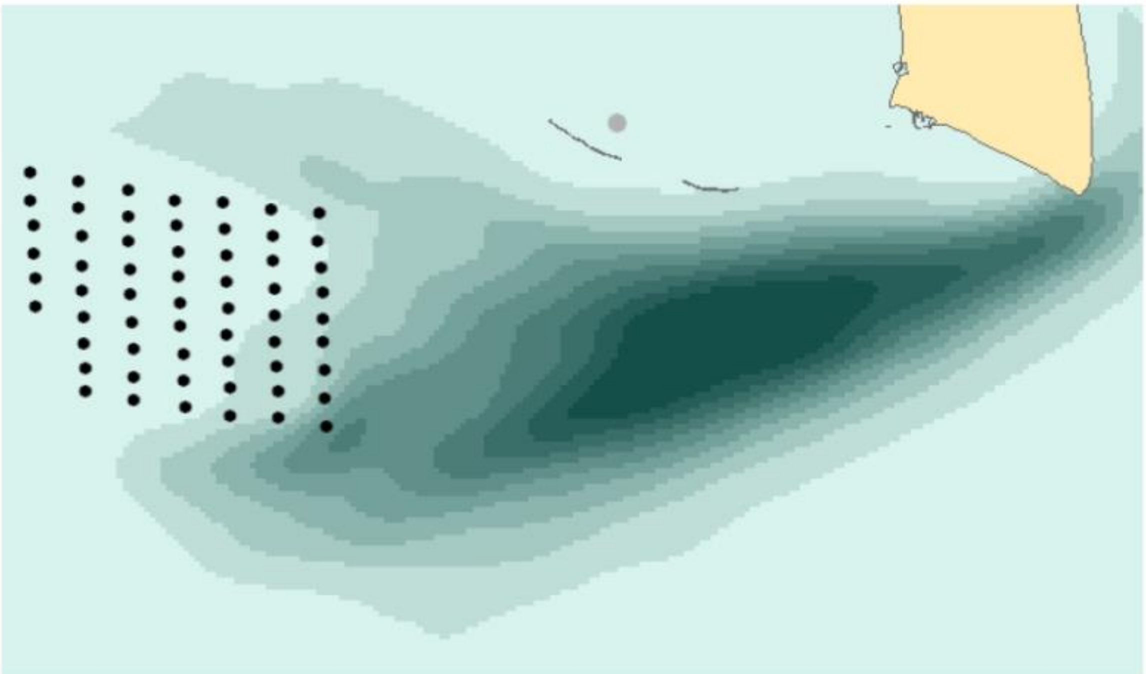

Figure 16. A flux of migratory birds in the Nysted farm in Denmark during farm operation. Black dots indicate the locations of WTGs, radar locations in gray.

The above results indicate that a barrier effect that could be considered as having a significant impact on birds caused by wind farms may occur only in the case of local migrations or in relation to a huge scale of wind farms or groups of large farms located on a large area, which is the route of seasonal migration.

Many bird species, especially waterfowl and sparrows, have been documented to avoid wind farms. These behaviors are very species-specific. During the day birds can keep distance from the wind farm in the range of 100-3000 m, whereas at night these distances may be smaller (Petersen I. K., & Fox A. D., 2007), (Madsen J., Boertman D, 2008). Although the short-term benefits of avoiding mechanisms are obvious, due to the elimination of the risk of bodily injury or death from collision, such changes to the flight route may involve increased energy and time expenditures that may theoretically, in the long term, affect the condition with which parameters such as survival and reproductive capabilities are related.

From a review of available literature, the barrier effect has no significant effect on the condition of the bird population (Drewitt A.L., Langston R. W. H., 2008), although the potential cumulative effects (such as that of several wind farms along the migration route) must not be neglected (Madsen J., Boertman D, 2008). The risk of the barrier effect can be influenced by the proper design of the wind farm – eg. by the size and / or turbine spacing. A change in the project can therefore be considered as an important mitigating measure (European Commission, 2010).

Birds flying at turbine height can change the direction or the flight ceiling, thus avoiding places where they are exposed to collisions. The cost of avoiding a single turbine on the migration route is generally insignificant as the lengthening of the route represents usually 5-10% of the original course. On the overall migration route scale, which as a rule counts with more than a thousand kilometers, such an additional outlay is imperceptible and comparable with the effects of side wind drift (Chylarecki P. et al, 2011).

During the ornithological monitoring at the Project site, a barrier impact and obstacles to flight were analyzed in the wind farm area:

a) Birds, which use the wind park site as the feeding territories, generally move at the altitudes under 50 m, negative impact shall be estimated as low, and for the majority of species it is absent.
b) Technical characteristics of the wind turbines create a threat for migrating birds that fly within the interval of 50 - 170 m owing to rotor motion.

According to the results of investigations in spring 2016, the major part of migrating birds (1 540 specimens, or 86.9% of the total number of migrants) flew at the altitudes up to 50 m. Also, certain part of migrants (231 specimens, 13.1%) was recorded at the altitudes over 200 m (generally, at the altitude of 300 - 400 m). There has not been registered any flock in the altitude interval of 50 - 170 m, which may be dangerous for flights, over the period of observations within the wind park and in the buffer zones in spring 2016.

On the basis of summary analysis of bird migration altitudes at the Projet site, it may be stated that they are not threatening and influence of the wind park on birds shall be estimated as low.

During nesting period, when there is no a task to pass long distances and birds go into a state of increased caution, the altitudes of passages become lesser and are characterized by the interval up to 15 m. Species composition of birds, which breed within the wind park sites or visit them for feeding during nesting period, is lesser than in the course of migrations. Designed distance between the wind turbines (500 - 800 m and more) is enough to do not create linear barriers. Local birds get accustomed quickly to the existing structures, therefore the negative impact on birds is low, and for the majority of nesting species it is absent.

Technical characteristics of the wind turbines create a threat for migrating birds that fly within the interval of 50 - 170 m owing to rotor motion. According to the results of investigations in autumn 2016 all migrating birds (3 054 specimens, or 100% of the total number of migrants) flew at the altitudes up to 50 m. There has not been registered any flock in the altitude interval of 50 – 170 m, which may be dangerous for flights, over the period of observations within the wind park and in the buffer zones in autumn 2016.
On the basis of summary analysis of bird migration altitudes, it may be stated that they are not threatening for birds and influence of the wind park on them shall be estimated as low.

Direct loss, fragmentation and habitat transformation due to the wind farm presence
The loss or destruction of bird habitats is dependent on local conditions and the amount of land occupied by the wind farm and associated infrastructure. An inappropriately located wind farm

causes direct loss of nesting habitats and feeding grounds for some species of birds, which may be an additional factor for their displacement (Pearce-Higgins, J., Stephen, L., Douse, A. i Langston, R. H. W., 2012). Some studies show the benefits of avoiding location of investment items in buffer zones around eg. nesting, resting and feeding areas (Bright i in. 2006, 2009, LAG-VSW, 2007). Although these data are often an estimate, they may be of interest to developers and others, regarding special attention which needs to be paid to certain areas when creating a development plan or for an Environmental Impact Assessment (European Commission, 2010).

From the current studies on the influence of wind farms on bird habitat loss, the presence of wind turbines can result in:

- "Repulsive" effect, already visible at a distance of 250 m from the turbine. The nesting density of sparrows diminishes from 200 m from the turbine, and in nests in the 40 m zone, there is over 4 times less birds than in areas more than 200 m away from the turbine.
- The deterrent effect of the turbine on birds feeding and resting in open areas, mainly birds of prey, ducks and geese, is noticeably more pronounced compared to breeding avifauna, usually between 200 m and 500 m.
- Birds flying through areas on which wind farms are located avoid the turbines by changing flight direction in the horizontal or vertical plane. This behavior, in turn, is a factor that reduces the risk of collisions and reduces the mortality rate of birds using space in the wind farm.

One of the wind farms in Denmark tried to observe the behavior of the birds there, using lures that were located in various places in the farm. Observations have shown that birds did not want to cross the limit of 100 m from the furthest outposts. On the one hand, the main conclusion from the study was that birds kept a safe distance from wind farms and, on the other hand, were not afraid of working turbines.

Research conducted to develop further wind power policies in the UK, whose aim was to identify the actual impact of turbines on birds, has shown that:

- Birds near turbines live in small flocks - the cause of such phenomena may be the avoidance of areas that are adjacent to the turbines.
- Birds stay safe from turbines.

It has also been observed that this is not the effect of turbine setting, nor is the amount and size of the turbines influential in the size of the populations of birds in their immediate vicinity, but this is rather dependent on the vicinity of vegetation and crops that are their living environment. Proof of this can also be the presence of several hatchlings in the gondolas of wind turbines in Denmark.

However, there are also well documented examples of situations in which the presence of wind turbines does not mean that birds will abandon these areas as foraging or resting places. The study was conducted at the Wyboldumer Polder / Larrelter Polder / Windmill Park, located in the Emden area, directly adjacent to Dollart Bay. There are 54 different types of wind turbines across the region. The wind park extends about 7 km perpendicular to the bay. The height of most objects is about 120 m. Single new objects have 150 m or more.

In the vicinity of the wind farm zone in the Ems to Dollart estuary there are European bird conservation areas 'Krummhörn' (DE-2508-401), 'Emsmarsch' (DE-2609-40) and 'Fehntjer Tief' (DE-2611-401). The area of the Dollart Bay is part of the Niedersächsisches Wattenmeer (DE-2210-401) bird protection zone. In the period from December to March, between 5 and 10% of the total population of white-headed geese (*Anser albifrons*) from the North Sea and the Baltic flocks in. Taking into account the exchange of birds during transit, approximately 20% of the winter population of north-western Europe may be dependent on Dollart as an important resting area (GERDES 2000). The annual maximum population of the species in the Dollart basin is over 50 000. In the case of cereal geese (*Anser fabalis*) the maximum number is about 30 000 individuals (D + NL), Anser anser – 6 000 individuals. The grassland adjoining Dollart regularly hosts a maximum of 35 000-40 000 Barnacle goose (*Branta leucopsis*).

After the completion of the draft of the Wybolsumer Polder wind farm in the years 1999-2004, a large-scale study was carried out, performed among others by FROELICH & SPORBECK Environmental Design Office (2004). The study considered the wind park and neighboring areas as a refuge for host birds and the behavior of flying birds. As part of a study carried out by the Environmental Design Office, prof. Dr. Sporbeck also assessed the risk of collision. Reichert's (2003) descriptions indicate that the wind park areas are used as resting and feeding grounds even after the installation of wind farm facilities, and that the wind park is located directly in the exchange area between Dollart and the northern resting and feeding areas of Rysumer and Loquader Hammrich.

In autumn 2003 and spring 2004 FROELICH & SPORBECK (2004) prepared the Wybelsumer Polder monitoring. In general, there were 23,124 specimens of the 53 species of birds in the farm. According to the results of the study, Barnacle geese (about 10 800 birds) accounted for almost half of all birds surveyed. The second most common species was the wild goose - 5 600 individuals. Exact flight records have been documented, with flight altitude. In addition to daytime observations, there were observation at dusk and at night made on a thermal camera.

In the spring of 2004, the area of the Wybelsumer Polder wind farm with its ponds and direct surroundings served as a place for sleep, rest and forage for, among others, Barnacle geese and wild goose. The ponds are adjacent directly to the wind power plant. Around 1 000 geese were observed on ponds and adjacent grassland ponds and, at night, up to 1 800 individuals in ponds (mostly Barnacle geese).

Birds that approached wind power plants at a distance of up to 50 m changed the place from individual grasslands and fields or ponds without irritation. Also during the night and at dusk, geese flickered between wind turbines' individual objects without omitting or correcting their flight path. The closest distances from these objects were 20-50 m.

For the planned wind farm, a loss of breeding areas for different phenological seasons was analyzed. The analysis concluded that:

- Negative impact of loss of breeding places is absent in winter period.
- Negative impact on transit spring migrating birds is absent, and on feeding migrants it is low. For that species, which remain within wind farm for nesting on completion of the migration, the loss of breeding places is not significant. Low density of birds nesting, small species composition makes possible to select nesting places without obstacles. Slight loss of nesting places, owing to the wind farm construction, will have not continuous, but mosaic pattern, leaving the major part of the wind farm territory for free selection of nesting places. Besides, the majority of species recorded in the course of nesting are common and widely distributed in the region, with their high quantity. Negative impact of this factor shall be estimated as low
- For bird species, which nest within the wind farm sites, loss of breeding places is not significant. Small species composition and their small quantity will enable to select without obstacles nesting places at the wind farm sites. Approximate percentage of occupation by the equipment will be small. Slight loss of nesting places owing to the wind farm construction will have not continuous, but extremely mosaic pattern, leaving the major part of the wind farm territory for free selection of nesting places. Besides, the majority of species recorded in the course of nesting is common and widely distributed in the region. Negative impact of this factor shall be estimated as low
- Negative impact on autumn migrating birds is absent. For that species, which remain for wintering within wind farm on completion of the migration, the loss of breeding places is not significant. Low density of birds nesting, small species composition makes possible to select nesting places without obstacles. Slight loss of nesting places, owing to the wind farm construction, will have not continuous, but mosaic pattern, leaving the major part of the wind farm territory for free selection of nesting places. Besides, the majority of species recorded in the course of nesting are common and widely distributed in the region, with their high quantity. Negative impact of this factor shall be estimated as low.

The loss of habitat for ornithofauna is marginal, even if the potential for deterrence, ie. diminishing nesting density in the vicinity of turbines, is taken into account. On the other hand, the base of the windmill, where low spontaneous vegetation of the nature of xerotherm and weeds develops, is a favorable condition to feed many species of birds, especially grainivorous.

In the case of crop fields in the planned wind farm, we are not dealing with the fragmentation of habitats in the ecological sense of the term, as the agricultural fields themselves are artificial ecosystems, and the emergence of turbines is even the creation of new microbiods (Tryjanowski P. et al, 2009). Transformation of fields related to the construction of wind farms, the emergence of access roads and maneuvering yards, may have an effect on the presence of dry-kinned species of birds which like elements of a rudimentary character in the landscape, such as stonechat, crested lark or corn bunting. The presence of increased numbers of these species was demonstrated in other wind farms operating in Poland.

The following information was collected from Appendix 4 on the impact of equipment and exploitation phase of the wind farm on birds.

Table 32. Assessment of impacts on birds caused by the equipment and operation of the designed territory of the wind farm in the winter period, during spring migration, the nesting period, during autumn migration of 2016

wind farm	Winter period 2016	Spring migration 2016	Nesting period 2016	Autumn migration 2016
Impacts caused by equipment				
long-time territory occupation and change of environment characteristics	As the territory of the wind farm site is represented almost exclusively by anthropogenic types of biotopes (agricultural areas, agricultural hedgerows), the creation of infrastructure of the wind farm sites will not be threatening for movement of birds in winter period. In accordance with plan structure of the wind farm placement, considerable changes in the dominant biotopes are not predicted. Impact shall be estimated as low.	As the territory of the wind farm sites is represented for the most part by the anthropogenic types of biotopes (agricultural areas, agricultural hedgerows), then the creation of small (by the area) infrastructure will not be threatening for gatherings and feeding movements of birds, as the major part of the territory will remain without changes. Analysis of field researches indicates small migration gatherings of birds and migration stops within the wind farm sites. In regard to feeding migrants, recorded species are characterized by their wide distribution and the ability to manoeuvre easily throughout the territory. Negative impact on migrating birds is low.	As the territory of the sites of the designed wind park is represented exclusively by anthropogenic types of biotopes (agricultural areas, agricultural hedgerows), creation of the infrastructure of the wind park sites is not threatening for nesting of birds and feeding movements. Machinery and personnel, which will work at the construction for a certain period, have an inessential anthropogenic load on birds and their nesting places. Significant changes in dominant nesting biotopes (agricultural hedgerows) are not planned due to planning structure of the wind farm location. The impact shall be estimated as negligible.	As the territory of the wind farm sites is represented for the most part by the anthropogenic types of biotopes (agricultural lands, agricultural hedgerows), then the creation of small (by the area) infrastructure will not be threatening for gatherings and feeding movements of birds, as the major part of the territory will remain without changes. Analysis of field researches indicates small migration gatherings of birds and migration stops within the wind farm sites. In regard to the feeding migrants, recorded species are characterized by their wide distribution and the ability to manoeuvre easily throughout the territory. Negative impact on migrating birds is low.
deterring by mast vertical structures	This factor is not threatening for small quantity of birds that occur in winter period and use the altitude corridor of 5 - 10 m during the flights (technical characteristics of the wind turbines might potentially create a threat for birds that fly at the altitudes of 50 - 170 m owing to rotor motion, but in winter 2016 birds have not been recorded at these altitudes). Birds get accustomed quickly to the existing structures, therefore the negative impact on birds is low, and for the majority of species it is absent.	Vertical structures are the signal for short-term change of the course for migratory birds, at that the large area of the wind farm enable to do it easily. Besides, slight density of the placement of equipment will not obstruct feeding flights of birds, due to large total area of the wind farm and considerable distances between the wind turbines. High-power electric network lines pass near the sites. Special observations have not revealed negative impact on migrating birds of both vertical structures (towers) and horizontal ones (electric wires). Negative impact on migrating birds shall be estimated as low.	Vertical structures are the signal for nesting birds to select other place for nesting, and large area of the wind farm enables to do it without obstacles. Besides, high-voltage line of electric networks passes near the sites. Special observations have not revealed negative impact on birds of both vertical structures (towers) and horizontal ones (electric wires). Negative impact on birds during nesting period is low.	Vertical structures are the signal for short-term change of the course for migratory birds, at that the large area of the wind farm enable to do it easily. Besides, the slight density of the placement of equipment will not obstruct the feeding flights of birds, due to large total area of the wind farm and considerable distances between the wind turbines. High-power electric network lines pass near the sites. Special observations have not revealed the negative impact on the migrating birds of both vertical structures (towers) and horizontal ones (electric wires). Negative impact on migrating birds shall be estimated as low.
barrier impact and obstacles for flight.	Birds, which use the wind farm site as the feeding territories, generally move at the altitudes under 50 m, negative impact shall be estimated as low, and for the majority of species it is absent.	Technical characteristics of the wind turbines create a threat for migrating birds that fly within the interval of 50 - 170 m owing to rotor motion. According to the results of investigations in spring 2016, the major part of migrating birds (1 540 specimens, or 86.9% of the total number of migrants) flew at the altitudes up to 50 m. Also, certain part of migrants (231 specimens, 13.1%) was recorded at the altitudes over 200 m (generally, at the altitude of 300 - 400 m). There has not been registered any flock in the altitude interval of 50 - 170 m, which may be dangerous for flights, over the period of observations within the wind farm and in the buffer zones in spring 2016. On the basis of summary analysis of bird migration altitudes, it may be stated that they are not threatening and influence of the wind farm on birds shall be estimated as low.	During nesting period, when there is no a task to pass long distances and birds go into a state of increased caution, the altitudes of passages become lesser and are characterized by the interval up to 15 m. Species composition of birds, which breed within the wind farm sites or visit them for feeding during nesting period, is lesser than in the course of migrations. Designed distance between the wind turbines (500 - 800 m and more) is enough to do not create linear barriers. Local birds get accustomed quickly to the existing structures, therefore the negative impact on birds is low, and for the majority of nesting species it is absent.	Technical characteristics of the wind turbines create a threat for migrating birds that fly within the interval of 50 - 170 m owing to rotor motion. According to the results of investigations in autumn 2016 all migrating birds (3 054 specimens, or 100% of the total number of migrants) flew at the altitudes up to 50 m. There has not been registered any flock in the altitude interval of 50 - 170 m, which may be dangerous for flights, over the period of observations within the wind farm and in the buffer zones in autumn 2016. On the basis of summary analysis of bird migration altitudes, it may be stated that they are not threatening for birds and influence of the wind farm on them shall be estimated as low.
Impacts caused by the wind farm operation				

wind farm	Winter period 2016	Spring migration 2016	Nesting period 2016	Autumn migration 2016
deterring caused by rotor motion, shadows flicker, light gleams	Negative impacts owing to rotor motion, shadow flicker and light gleams shall be estimated as low, and for the majority of birds, which stay in the feeding territories at wind farm sites in winter, they are absent.	Technical characteristics of the wind turbines may potentially create a threat for migratory birds that fly at the altitudes of 50 - 170 m owing to rotor motion. Analysis of researches shows that this altitude interval has not been used within the designed sites of the wind farm. According to our observations at already operating wind parks, the impact of this factor on birds during the period of migrations has not been revealed. So, negative impacts caused by rotor motion, shadows flicker and light gleams shall be estimated as low, and for the majority of birds that stay at the wind farm sites they are absent.	Technical characteristics of the wind turbines create a threat for migrating birds that fly at the altitudes of 50 - 170 m owing to rotor motion. Analysis of researches during nesting period of birds shows that birds do not use this altitude interval within the wind park site. According to our observations at already operating wind farm, the impact of this factor on birds' nesting complexes has not been revealed. So, negative impacts caused by rotor motion, shadows flicker and light gleams shall be estimated as low, and for the majority of birds, which are in the course of nesting or in the feeding territories at the sites of wind farm, they are absent.	Technical characteristics of the wind turbines may potentially create a threat for migratory birds that fly at the altitudes of 50 - 170 m owing to rotor motion. Analysis of researches shows that this altitude interval almost is not used within the designed sites of the wind park. According to our observations at already operating wind parks, the impact of this factor on birds during the period of migrations has not been revealed. So, negative impacts caused by rotor motion, shadows flicker and light gleams shall be estimated as low, and for the majority of birds that stay at the wind farm sites they are absent.
additional territory development	Owing to extremely low attractivity of feeding territories and lack of safety ground biotopes for roosting time, this factor will not have an effect on wintering birds and shall be characterized as low.	Effect of this factor is possible for birds, which are nesting within the sites. Negative impact on migratory birds is absent. It shall be considered that in comparison with the impacts of wind parks, the influence of agricultural works in the course of year is much higher.	As significant changes of dominant landscapes in the course of the wind farm construction will not take place, then the nesting capacity of biotopes will not change. Reduction or increase of bird quantity during nesting period mostly depends on population waves and anthropogenic factor of permanent agricultural works in the course of year, which are in large excess over the level of influence in comparison with the wind farm.	Effect of this factor is possible for birds, which are nesting within the sites. Negative impact on the migratory birds is absent. It shall be considered that in comparison with the impacts of wind parks, the influence of agricultural works in the course of year is much higher.
disturbing owing to night-time illumination	Impact of this factor shall be estimated as very low.	Percentage of birds, which migrate at night, is small. And small by the quantity and species diversity transit migrants will not sense the night-time illumination within the sites due to illumination of adjacent residential settlements. Parallel researches of bats' activity during night time in the territory of the wind farm enabled to carry out observation of night ornithological situation. As a result of carried out works, we have not revealed any case of creation of hazardous situation owing to nocturnal migrations of birds. Impact of this factor shall be estimated as very low.	Bird activity at night ceases in nesting period. Observations of bird nests near to illuminated buildings have not revealed negative effect of light on the breeding success. Negative impact of birds disturbing within wind farm owing to night-time illumination is absent.	Percentage of birds, which migrate at night, is small. And small by the quantity and species diversity transit migrants will not sense the night-time illumination within the sites due to illumination of adjacent residential settlements. Parallel researches of bats' activity during night time in the territory of the wind farm enabled to carry out observation of night ornithological situation. As a result of carried out works, we have not revealed any case of creation of hazardous situation owing to nocturnal migrations of birds. Impact of this factor shall be estimated as very low.
collisions with the wind turbine generators	Small quantity of birds at the wind farm sites in winter period and absence of considerable feeding gatherings and roosts enable to predict that negative impact on birds will be very low.	When evaluating the observation data of the migration in spring 2016, namely such important aspects as the total quantity of birds, dynamics of the passage intensity, description of the altitude and directions of the migration, diurnal activity, we shall state that the negative impact on migrants was low.	When estimating the data of observations of birds' behaviour near to the high-voltage line of electric networks, we shall state their unobstructed movement over this continuous linear barrier. Special researches in the territory of already constructed wind parks also indicate that for the majority of birds operating wind turbine is not an obstacle. Negative impact is low.	When evaluating the observation data of the migration in autumn 2016, namely such important aspects as the total quantity of birds, dynamics of passage intensity, description of the altitude and directions of the migration, diurnal activity, we shall state that the negative impact on migrants was low.

Summary

The implementation of a wind farm in the investor's variant will not have a significant negative impact on the avifauna. In the case of the rational alternative, the impact on the local ornithofauna will be slightly higher, which manifests itself, among others, in higher results of potential mortality of birds. The impact of the investment in question should be regarded as moderately negative.

Impact of the Power Transmission Line

Another negative impact of the project on ornithofauna is the operation of the 330 kV power line, which may include:

- Mortality due to collision.
- Deterrence - impact of the presence of the object on behavior and flight changes.
- Interaction of the electromagnetic field.
- Fragmentation and destruction of habitats as a result of the construction of lines.
- Accumulation of overhead lines.

Collisions

Birds colliding with power lines are a well-known phenomenon and has been documented in 14 countries around the world and in 28 US states for almost 350 species representing 15 orders, 35 families and sub-families (Huntig K., 2002), (Manville A.M, 1999).

Mortality due to a collision is a real threat of population decline, especially for rare species (López-López et al, 2011), (Kustusch K et al, 2013). The mortality of different bird species is varied, and the factors that have a significant influence can be divided into two groups (López-López et al, 2011): (1) landscape factors: vegetation structure and composition, terrain topography, resting places, (2) individual factors: construction of the top of the pole, distance between the individual elements, morphology and behavior of the species.

Depending on the combination of these factors, the collision frequency ranges from 0.1 to 500 events / year / km on average (Jenkins, A. R. et al, 2010), (Kustusch K et al, 2013). The risk of collision with the power lines is high in open areas and it rises in bad weather. However, it is believed that the body morphology, flight and behavior of the species are of the utmost importance.

According to Expert Opinion and Scientific Report (Appendix 3) and literature sources we established that birds in the Project area can be divided into the following ecological groups with respect to the infastructure of the overhead power transmission line:

- species which do not use overhead lines at all (a group of waterfowl which in their life cycle almost always remain in the surface area of water bodies: grebes, cormorants, herons, and terns);
- species which usually don’t use overhead lines but sometimes can stay in the area of wire line run (some species of ducks, swans, herons, harriers, pied avocet, pied stilt, waders etc.);
- species for which horizontal structures of the power poles and available cavities serve as a nest arrangement place (hooded crow, jackdaw, common rave, sparrows, tits, certain species of falcons);
- species for which PTL poles and wires serve as a roost (almost all species of passeriformes, small falcons, pigeons etc.);
- species which during their seasonal migrations use overhead lines for mass stops and rest (swallows, European starling, European goldfinch, pigeons).

The greatest threat from the subject overhead power line is the risk of collisions between large birds and the lightning conductor because it is clearly less visible than the transmission lines. Studies have shown that the most common bird collisions are with the lightning conductor. This is because birds are able to quickly notice the transmission lines (thicker and better visible wires) and try to avoid them from above. At the same time, they approach dangerously close to the huge conductor, which is thinner and less visible.

Man-induced alteration of the landscape causes alteration of the bird existence conditions (number of places suitable for nesting, diversity, quantity and availability of food, availability and quality of protective conditions etc.), and, respectively, behavioral peculiarities of the birds. Species, whose behavioral strategies vary within a wide range, successfully adapt to existence under new conditions and even extend their home ranges, while the birds with a limited set of behavioral strategies - vice versa - go down in number down to complete extinction. For instance, in the south of Ukraine at apparent threat of birds collision with PTLs or in case of effect of the electrical current on them, quite many species obtained certain benefits using PTL wires and poles in their living activity, especially under conditions of the dominating open terrains. Exactly due to it, in parallel with monitoring of the PTL impact on birds, it is also necessary to study ways of usage and avoidance by them of the overhead power transmission lines. Preliminary studies allow to claim about positive meaning of overhead transmission lines for many rare species, first of all - for carnivorous birds especially as artificial analogues of the tree vegetation on open terrains prevailing in southern Ukraine. Most often, and sometimes massively, PTL is used by the Corvidae family birds, first of all jackdaw (*Corvus monedula*): wires are used as roosts and hollow-type poles are used as a nesting place. For this species, like for ravens (*Corvus corax*), OLT poles here serve as the main nesting place. Quite often power transmission lines are also used by small passeriformes, especially common rook (*Sturnus vulgaris*) - as roost and nesting place, and corn bunting (*Emberiza calandra*) - as roosts.

That is why during the census of the birds and searches for died specimens along the PTL, it is also necessary to record cases when the poles and wires are used for nesting or as roosts (for rest, hunting, display etc.). Special attention shall be paid to the peculiarities of that how birds from different systematic groups react to the PTL. For identifying species most vulnerable to the PTL, it is necessary to record strategies of avoidance by the birds of collisions with wires and poles.

Quantitative characteristic built upon results of the studies performed in 2016 is shown in Table 33.

Table 33. Characteristics of the ornithological complex by its distribution into ecological groups

Item #	Ecological group	Number			
		species		birds	
		abs.	%*	abs.	%*
1	Not using PTL at all	24	34.3	983	8.9
2	Usually don't use PTL	6	8.6	834	7.6
3	May nest on PTL	10	14.3	1276	11.6
4	Use PTL as roost	41	58.6	9208	83.5
5	Use PTL in mass	12	17.1	8238	74.7
	Total**	**70**		**11,025**	

Notes: * - percent of the total number of species or birds; ** some species fell within 2 categories (for example, they may use PTL as a nesting place, and as a roost), and due to this there's no digit in %

Analyzing Table 33 we see that of the entire ornithological complex which counted 70 species, 41 species (or 58.6%), which number made 83.5% of the total number of birds, use overhead power transmission lines as their roosting place. Such picture can be explained by the dominance of open terrains (mainly farmed ecosystems) with the lack of tree plantation, and due to this birds have to use man-made structures for roosting. The birds may experience negative impact of such behavior only in case of electrical shock which usually happens to large specimens - eagles, buzzards, cranes, herons, which are used to land onto most dangerous sections of overhead power transmission lines. There's no such threat for small passeriformes.

Quite large part of the birds (24 species or 34.3%) doesn't use overhead power lines at all. If we add to this group species which usually avoid territories with power transmission lines (6 species or 8.6%), then almost a half of the entire ornithological complex is outside the risk zone with respect to collision with overhead line poles and wires.

We also have to mention that 12 species are referred to a group of birds which during their seasonal migrations form mass gatherings and may use power line wires for roosting (rest). This group includes European starling, bank swallow, fieldfare, piegeons, European goldfinch, linnet, Eurasian tree sparrow etc. We are not aware of the cases of bird deaths due to their rest on the wires, but such behavior requires some management of hazing actions.

And finally, at least 10 bird species nest on PTL poles, using horizontal structures and cavities of vertical masts. Such species include common raven, hooded crow, jackdaw, common kestrel, European tree sparrow, great tit etc. In most cases the nesting is successful but the scheduled maintenance works on overhead power lines require the personnel to remove bird nests from the PTL structures.

To prevent birds dying from contacts with the reference PTLs, such PTLs shall be equipped with the hazing means on their most dangerous sections. Moreover, prevention of the bird deaths can be facilitated by installing on the PTL artificial nests of some carnivorous birds which apt to oust large birds from their nesting territory, which will scare away most small birds which are potential trophy. Moreover, this will also facilitate recovery of home areas of these species which are listed in the Red Book of Ukraine (2009) and a number of International Conventions on Nature Conservation, and through this - creation of the positive image of the energy production industry, aimed at the greening (environmentalization) of its activity.

For example, considering the fact that according to the results of inspection of the reference PTL at Syvash conducted in 2013-2014, 75.8% of the dead birds died at 2 sections, a proposal was made to equip wires at these 2 sections with bird-scaring devices with movable and shining elements which would intensively move, shine and produce noise thus scaring the birds away. Moreover, the proposal was made to install, on the anchor line support, an artificial nest for saker falcon to scare other birds away from most bird-vulnerable sections of the overhead power transmission line.

Required type of bird-scaring means, schemes and methods of their installation shall be determined individually for each separate bird-vulnerable section of the power line (with consideration of local terrain peculiarities, vegetation, buildings/structures, nature of the economic use of the territories etc.) and with the participation of experts experienced in conducting such actions and measures. It is desirable, during performance of such works, to conduct trainings for local experts (engineers, ecologists, ornithologists) to allow them gain their own experience in this area of nature conservation activity.

Deterrence effect

In fact, little research has involved the impact of the emergence of power lines in the landscape on the behavior of birds (Raab R. et al, 2010) showed that the presence of the line affected the direction of flight in the Otis tarda, and the range was 800 m. Rayaner (1988) observed a variation in the response of ducks approaching the transmission lines - they lowered or increased the flight ceiling and interrupted the work of their wings while trying to avoid the line.

Enforcing changes in the direction or the flight ceiling must have as consequence increased energy expenditure, which is undoubtedly unfavorable to birds. In the case of predatory birds, the deterring effect of high artificial landscape elements is rather poorly understood. The results of many studies indicate that, in this group of birds, this effect is poorly marked, which in turn leads to more frequent collisions with masts and poles than others (Huntig K., 2002), (Wuczyński, A., 2009).

Impact of electromagnetic fields

The intensity of the electric field and the magnetic field is high on transmission lines and decreases with the increase of distance from the line. Hence, birds using poles for nesting and chatting are particularly vulnerable to the negative influence of the electromagnetic field. Studies from other authors show that this effect may be associated with adverse physiological changes (dysfunction of the immune system, disruption of embryogenesis, developmental and behavioral anomalies - mainly changes in bird activity) (Fernie K. et al, 2005). Both levels of influence may lead to changes in the reproductive success of birds, but the results of the various studies are divergent - some show an increase in reproductive success and others a decrease (eg, (Fernie, K. J., and Bird, D. M., 2000) (Fernie K. et al, 2005). A small number of scientific papers on the subject and discrepancies in the results do not allow for a clear assessment of whether the electromagnetic field in the case of the project under consideration will have a significant negative impact on bird populations.

Birds sitting on poles or power cables will die if some maneuver results in a short-circuit or earth fault. The losses caused by electric shocks are almost exclusively observed in the case of malfunctioning posts in the medium voltage grid, which relate to bird species that use such posts for resting, nesting or accommodation. In regions and countries where poorly designed and constructed pillars are still in widespread use, very large losses are recorded in populations of the most impressive birds of large species: storks, eagles, vultures and other clawed birds, as well as crows and owls. In the case of high voltage lines used in their construction long, suspended insulators, the risk of electric shock is high.

In the case of high voltage lines which use in their construction long, suspended insulators, the risk of electric shock is low. Cases of death due to paralysis are recorded sporadically. With high air humidity, small flocks of birds flying by can cause arcing. This discharge may also occur as a result of fecal clogging by a large bird sitting on a crossbar beyond the insulators. This latter possibility can be avoided by placing repellents in appropriate places above the insulators.

Fragmentation and habitat destruction:

330 kV PTL route does not fall within the natural reserve fund lands and has no impact on biodiversity of this category, to include the natural reserve fund (NRF) territories on adjacent lands. This is confirmed by the following.

1. The 330 kV PTL route is located primarily on anthropogenic landscape complexes (agricultural hedgerows and agricultural lands, man-made forest plantations) and partially on areas with natural vegetation (flood plain of the Molochna River).
2. Distance from the 330 kV PTL route to the NRF territories is safe for natural components.
3. In the Molochny Estuary Wetland about 95% of the birds population belong to semi-aquatic group, and their seasonal distribution is practically connected to the water territories, therefore this facility (330 kV PTL) will have minimum impact on the birds as only insignificant number of them visits these territories.
4. Most transit and feeding migrations within the project territory are characterized by safe altitudes of the birds' passage.
5. Local importance wildlife preserves located on the territories adjacent to the 330 kV PTL route are all - without any exclusion - botanical. Technological infrastructure of the 330 kV PTL route at construction and operation is located outside the NRF territories

Table 34 shows Assessment of impacts of 330 kV PTL on birds caused by the equipment and operation in the winter period, during spring migration, the nesting period, during autumn migration of 2016.

Table 34. Assessment of impacts on birds caused by the equipment and operation of the designed territory of the 330 kV PTL in the winter period, during spring migration, the nesting period, during autumn migration of 2016

330 kV PTL	Winter period 2016	Spring migration 2016	Nesting period 2016	Autumn migration 2016
Equipment-conditioned impacts				
lasting occupation of the territory and alteration of the environment characteristics	Since the project territory is represented almost exclusively by man-made types of biotopes (agricultural lands, hedgerows, man-planted forest, and garden), creation of the wind farm site infrasturcture won't become dangerous for birds passages in the winter period. No significant changes in the dominant biotopes are forecasted. The impact is evaluated as low.	Since the project area is represented primarily by man-made types of biotopes (arable lands, hedgerows), creation of insignificant by area infrastructure will not become dangerous for gatherings of the transit and feeding passages of the birds, as the larger part of the territory will remain unchanged. Analysis of the field studies points at the absence of migratory gatherings of the birds within 330 kV PTL. Our observations of seasonal migrations in the area of already existing PTLs show quite high maneuvering skills of the larger part of the birds which freely pass the overhead lines by. Increased risk of birds collision with 330 kV PTL poles and wires exists only during short periods with bad weather conditions (fog and strong wind). Negative impact on migratory birds is average.	Since the project area is represented exclusively by man-made types of biotopes (arable lands, hedgerows), creation of the 330 kV PTL infrastructure will not become dangerous for nesting and feeding passages of the birds. Machinery and personnel which will operate at the construction during a certain period of time will create insignificant man-induced load on the birds and their nesting places. No significant changes in the dominant nesting biotopes (hedgerows) are forecasted. The impact is evaluated as insignificant.	Since the project area is represented primarily by man-made types of biotopes (arable lands, hedgerows), creation of insignificant by area infrastructure will not become dangerous for gatherings of the transit and feeding passages of the birds, as the larger part of the territory will remain unchanged. Analysis of the field studies points at the absence of autumn migratory gatherings of the birds within 330 kV PTL. Our observations of seasonal migrations in the area of already existing PTLs show quite high maneuvering skills of the larger part of the birds which freely pass the overhead lines by. Increased risk of birds collision with 330 kV PTL poles and wires exists only during short periods with bad weather conditions (fog and strong wind). Negative impact on migratory birds is average.
hazing by vertical mast structures	For insignificant number of birds found in the winter period and use 5-10 altitude corridor during their passages this factor is not dangerous (technical characteristics of the wind turbines may pose potential threat due to the rotor motion for birds flying at the height of 50-170 m, but no birds were found at these heights in the winter 2016. Birds quickly get used to the existing structures, therefore negative impact on birds is low, and is absent for most bird species.	For the migratory birds vertical structures are a signal for a short-time change of the route, and the large area of territories adjacent to 330 kV PTL will allow to make it without any obstacles. Moreover, insignificant density of equipment placement will not obstruct feeding passages of the birds because of significant distances between the power poles. Powerful power transmission lines pass near the project territory. Special observations revealed no negative effect on the migratory birds both from the side of vertical structures (towers/poles) and horizontal structures (electrical wires). Negative impact on migratory birds is estimated as low.	For the nesting birds vertical structures are a signal to choose other place for nesting, and large area of alternative plots allows to make it freely. Moreover, there is a high-voltage power transmission line nearby. Special observations revealed no negative effect on the birds both from the side of vertical structures (towers/poles) and horizontal structures (electrical wires). Negative impact on the birds during the nesting period is low.	For the migratory birds vertical structures are a signal for a short-time change of the route, and the large area of territories adjacent to 330 kV PTL will allow to make it without any obstacles. Moreover, insignificant density of equipment placement will not obstruct feeding passages of the birds because of significant distances between the power poles. Powerful power transmission lines pass near the project territory. Special observations revealed no negative effect on the migratory birds both from the side of vertical structures (towers/poles) and horizontal structures (electrical wires). Negative impact on migratory birds is estimated as low.
barrier impact and obstacles for passage	Birds, which use the wind farm site as their fodder territories, travel primarily at the heights under 50 m, so the negative impact on them is estimated as low, and for most species there is no such impact.	According to spring 2016 observations results, 48% of birds migrating within 330 kV PTL area and in the buffer zone (500 m) use height ranges from 0 to 25 m, which is a safe height. Approximately other 7% are flying at heights over 200 m (transit migrants). Therefore, a group of birds which received no negative effect at all makes up 55%. For other bird species in the project territory there are no factors which would condition birds passages along fixed routes, so they use alternative spaces to freely pass by the obstacles and avoid the barrier impact. Based on the summarized analysis of potential threats, we need to state that the barrier impact for migratory birds is low.	During the nesting period when there is no task to travel large distances and the birds switch to enhanced precautiousness, passage heights go down and are characterized by the range 0-15 m. Species composition of the birds which replicate during the nesting period within the project territory or visit it for feeding is lower than during the migrations. The design distance between the power poles is sufficient not to create linear barriers. Local birds quickly get used to the existing structures, therefore negative impact on the birds is low, and is absent for most nesting bird species.	The majority of the registered birds (5355 sp., 98.7% of the total number of birds) which were recorded in the territory of the designed 330 kV PTL, within buffer zones and adjacent territories were observed in the flight at the height of up to 50 m. However, the number of birds registered in the direct vicinity of the 330 kV PTL planned for construction is extremely low. Observations of the birds behavior revealed trends when passage heights depend from the visual openness of the space. Hence, larger part of the birds in the open spaces used significantly lower heights than near hedgerows, standalone trees, buildings, motor roads and existing overhead transmission line, at approaching to which birds tend to gain height. This behavior is explained by the flight safety what will also have positive effect on overcoming of possible barrier impact of 330 kV PTL. For other bird species in the project territory there are no factors which would condition birds passages along fixed routes, so they use alternative spaces to freely pass by the obstacles and avoid the barrier impact. Based on the summarized analysis of potential threats, we need to state that the barrier impact for migratory birds is low.

330 kV PTL	Winter period 2016	Spring migration 2016	Nesting period 2016	Autumn migration 2016
Impacts conditioned by the operation of the overhead power transmission line.				
additional development of the territories.	Due to extremely low attractiveness of the fedding territories and absence of safe onshore habitats for roosting, this factor will not affect the wintering birds and is characterized as low.	Negative impact is low for migratory birds.	Since there will be no significant alterations to the dominating landscapes during the construction, nesting capacity of the biotopes will remain unchanged. Increase or decrease in the number of birds during the nesting period to a great extent depends on the population waves and man-induced factor from the side of permanent agricultural works during the year, which are several times higher than the degree of the wind farm impact.	Negative impact is low for migratory birds.
annoyance due to night illumination.	There is no lighting along the bigger section of the overhead line. Power substations are illuminated during a lasting time but we are not aware about cases of the birds deaths due to it. Moreover, illumination in settlements and on motor roads is significantly larger in terms of scale. Impact of this factor within the 330 kV PTL territories is estimated as very low.	A percentage of birds migrating within the 330 kV PTL in the night is insignificant. And small by the number and species diversity transit migrants will not sense night illumination within the sites thanking to illumination of the adjacent settlements. Parallel studies of the activity of bats in the dark time in the project territory made it possible to observe the night ornithological situation. As a result of the performed work we found no cases of creation of dangerous situation due to night migrations of birds. Negative impact of this factor is estimated as very low.	Majority of the birds stop their activity for the night hours during the nesting period. Observations of the bird nests near the illuminated buildings revealed no negative effect of the light on success of replication. There is no negative effect from the annoyance of birds due to the night illumination.	Percentage of birds which migrate within 330 kV PTL at night is some larger than that of the spring period, but almost all night migrants belong to the transit ones which use heights over 200 m. Transit migrants will not sense the night illumination within 330 kV PTL route due to illumination of the adjacent settlements. Parallel studies of the activity of bats in the dark time in the project territory made it possible to observe the night ornithological situation. As a result of the performed work we found no cases of creation of dangerous situation due to night migrations of birds. Negative impact of this factor is estimated as very low.
collisions with the 330 kV PTL infrastructure elements	Insignificant number of birds in the winter period on the wind farm sites and abscence of feeding gatherings and roosts enables to forecast that negative impact on birds will be very low. For preventing collisions of birds with horizontal elements (traverses, wires) and poles, it is necessary to utilize birdscaring methods in potentially dangerous places. Such place is a run of the Molochna River on the southern edge of Sadove village, across which the PTL route passes. According to our recommendations, 500-meter run of the 330 kV PTL is subject to ornithological management.	Estimating the data from observations of the migration in the spring 2016, in particular such important aspects as total number of birds, dynamics of the passage intensity, characteristic of the migration height and directions, daily activity, we may tell that negative impact on the migrants was low. We recorded no cases of collisions on the existing power networks. Potential threat for birds is present in the periods of bad weather and climate conditions (fog, strong wind). For minimizing this effect it is necessary to make a provision in the design of the power transmission line poles for ornitho-protective gear to disable bird deaths from electrical shock, as well as for visual hazing devices at certain sections of 330 kV PTL (southern outskirts of Sadove Village).	Upon evaluating the data of observations over the birds behavior near the high-voltage power transmission line, we can confirm their free passage through this uninterrupted linear barrier. Special studies also show that infrastructural elements of 330 kV PTL are not considered as obstacles for the majority of the birds. The negative impact is low.	Estimating the data from observations of the migration in the autumn 2016, in particular such important aspects as total number of birds, dynamics of the passage intensity, characteristic of the migration height and directions, daily activity, we may tell that negative impact on the migrants was low. We recorded no cases of collisions on the existing power networks. Potential threat for birds is present in the periods of bad weather and climate conditions (fog, strong wind). For minimizing this effect it is necessary to make a provision in the design of the power transmission line poles for ornitho-protective gear to disable bird deaths from electrical shock, as well as for visual hazing devices at certain sections of 330 kV PTL (southern outskirts of Sadove Village).

Cumulative impact

A few other high-voltage overhead lines are located a few kilometers north and northwest of the proposed PTL 330 kV. In the case of birds, the cumulative effect of the simultaneous operation of a high voltage line may be related to the so-called barrier effect. For birds, both lines will most likely be seen as one whole (single barrier) or two successive obstacles.

Positive Impacts:

Among the predominantly negative impacts, the infrastructure of power lines sometimes affects the bird populations. Power poles serve some species for chatting, as place for singing to males and as nesting place to such birds as corvids (ravens, gray crows), and as secondary use of their nests by small falcons (kestrels, hobbies) (Tryjanowski et al., 2013) have shown positive influence of poles and lines of the highest tensions on diverse species of birds in the agricultural landscape in Poland. Both the number of species and the observed specimens was significantly higher in fields under poles and power lines than in open fields devoid of power lines. This phenomenon was caused primarily by the presence of shrubs growing under the pillars. Local geobiocenoses and ecosystems of grasslands and pastures, as well as foliage and bushes that were removed during the power line, have long since undergone subsequent succession in areas immediately adjacent to the foot of the pillars. In addition, animals, birds and bats in the area have become accustomed to living in the vicinity of the power line.

6.4.8.2 Impact on Bats

The large number of scientific publications on the impact of wind farms on chiropterofauna indicates the different types of impacts of this type of investment. Their types are presented in Table 35.

Table 35. Potential impacts of wind farms on chiropterofauna during operation.

Potential impacts on bats on a working wind farm		
Activities	Summer term	Migration period
Ultrasonication	Probably limited impact	Probably limited impact
Loss of feeding sites due to bats being disturbed by turbines	medium to high	Probably less impact during spring, mid to high in the fall and during hibernation
Loss or displacement of the air corridors	Medium	Low
Collision	Low to high depending on the species	High to very high

The environmental impact of wind turbines on the chiropterofauna can be:

- mortality due to collision with a power plant or pressure injury
- loss or alteration of flight route
- loss of feeding places
- destruction of hiding places
- cumulative impacts

The loss or degradation of habitats suitable for feeding bats may occur in the vicinity of groves of forests frequented bats, but also in open areas if previously used by bats. It is not appropriate to create new linear elements in the landscape (eg, groves along roads) that could be used by the animals during the migration so as not to attract them to working turbines.

The results of long-term observations have shown that wind farms can have varying degrees of impact on bats depending on the species. According to Bach and Rahmel (Bach, L., 2001) some species of bats whose feeding grounds are occupied by wind farms are disturbed by the movement and turbulence of rotors, thus leaving their hunting grounds. An example is the Serotine bat (*Eptesicus serotinus*), which, after the start of the wind farm, has begun to avoid the area around the turbines and then the site of the whole project. On the other hand, the common pipistrelle

(*Pipistrellus pipistrellus*) in the same area not only did not give up feeding but even increased its activity (Bach L. Rachela, 2011).

The most serious threat to the chiropterofauna is the risk of collisions with turbines (Kunz T. H, Arnett E. B., Cooper B. M. Erickson W.P. Larkin R.P., Maybee T., Morrison M. L., Strickland M. D., Szewczak J. M., 2007). Some species of bats can rise to significant altitudes - there have also been recorded collisions of these mammals with airplanes, at an altitude of about 300 m (Peurach S. C., dove C. J., Stepko L., 2009) up to 2500 m (Peurach S. C., 2003). According to Collins and Jones (Collins J., Jones G., 2009), the activity of bats of the genus *Nyctalu*s and *Eptesicus*, recorded in the UK at 30 m, was not significantly different from that recorded at ground level. Only the activity of the Pipistrellus (terrestrial) species at terrestrial level was significantly higher. In turn, according to the authors of other studies conducted in France, the pipistrelle were recorded at a height of 150 m, the serotine bat (*Eptesicus serotinus*) at 90 m, and the mouse-eared bat *(Myotis sp*.) at 30 m above the ground. The study in Sweden (Ahlen L.en al, 2009) revealed the Common noctule (*Nyctalus noctula*) at 1200 m.

The increase in bat mortality can be compounded by their attraction towards turbines. It has been observed that bats fly up to moving propellers (Horn J. W., Arnett E. B., Jensen M., Kunz T. H., 2008), and some are try to sit on the turbine cover (Ahlen L.en al, 2009). There are various hypotheses trying to explain why wind turbines attract bats. The most popular explanation for this is the idea that wind turbines can attract insects that feed on bats (Ahlen L.en al, 2009).

Some animals die from mechanical injuries such as fractures or open wounds (Durr v. T 2002) (Seiche K., Endl P., Lein M., 2008) partly due to pressure shock and pulmonary vesicle rupture, called barotrauma. According to Baerwald (Baerwald E. F., D'Amorus G., H., klug B., J., Barclay R. M. R., 2008) bats killed in this way can account for up to half of all bats killed on a wind farm. Thus, even in locations in which during the pre-implementation monitoring the activity of bats was assessed as low, after the implementation of the project, the number of mammals in the wind farm may increase. Therefore, the standard practice recommended for the implementation of this type of undertaking is the implementation of several years of post-monitoring.

The rate of bat deaths on individual wind farms depends on many different factors and it is very difficult to compare them. Apart from issues related to habitat conditions, the main reason is the use of different coefficient for the dead-body finds. For example, the probability of victims increases about twice if dogs are used for hunting (Arnett E. B., Huso m. M. P., Schirmacher M. R. Hayes J. P., 2010). Some publications indicate that bat mortality in wind farms is in some cases significantly higher than bird mortality (Kunz T. H, Arnett E. B., Cooper B. M. Erickson W.P. Larkin R.P., Maybee T., Morrison M. L., Strickland M. D., Szewczak J. M., 2007).

The greatest amounts of collision are characteristic of species such as: common noctule (*Nyctalus noctula*), giant noctule (*Nyctalus lasiopterus*), lesser noctule (*Nyctalus leisleri*), parti-colored bat (*Vespertilio murinus*), common pipistrelle (*Pipistrellus pipistrellus*), soprano pipistrelle (*Pipistrellus pygmaeus*), Nathusius's pipistrelle (*Pipistrellus nathusii*) (Kepel et al., 2011).

The main factor affecting the degree of collision of species is their flight style, feeding tactics and migration habits with respect to turbine heights and to a lesser extent the actual abundance and frequency of neighboring habitats (Barclay R., M., R., Baerwald E. F., Gruver J. C., 2007).

The most conflicting species, eg. common noctule and Nathusius's pipistrelle, belong to species that travel long distances (Niethammenr J., Krapp F, 2004). Bats usually follow established paths, which run mainly along tree trunks, watercourses, linear trees, mountain passes. The migratory corridors of these mammals can be detected in acoustic monitoring (Baerwald E., F., Barclay R., M., R., 2009) which may be helpful in locating wind turbines at safe distances from these corridors.

In the chiropterological report (Appendix 6) it was found that: small quantity of bats of local aggregation, slight (by quantity and intensity) feeding movements in the territory of the wind park sites, lack of intensive transit migration routes give grounds for estimation of the collisions with the wind turbine generators as low. But monitoring observations at already operating wind park site are necessary for confirmation of the estimation of this factor effect.

Thus, preliminary studies of living conditions of chiropterans within wind farm do not give grounds for conclusion that the placement of wind turbine generators here will have negative influence on their populations. Negative impact on migrating bats is low.

The operation of overhead PTL can pose a potential threat to bat populations, but such impact is so far underrepresented. There are no studies that would define and estimate the scale of this type of interaction. Mostly we deal with individual observations, but there are no detailed studies or research. Certainly bats use linear elements of the landscape as a way to move between the feeding grounds and the hiding places of the day. It can be assumed that high suspended cables will not be an attractive bat travel route compared to low-hanging lines. We may expect a weak barrier effect. It is possible that electromagnetic fields generated near the line may discourage bats from feeding in their neighborhood. However, there are known cases of flying bats in the immediate vicinity of power lines or even using energy poles as resting places (own data). Therefore, it is not possible to treat the power line as a barrier that is not crossed by bats.

There is also no documented evidence of the negative impact of electric power investments on the mortality of these animals. The degree of collision of bats with such objects is not recognized. One can only suppose that such obstacles may occasionally cause accidental collisions, eg. in the case of very numerous flights at the height of electric traction lines. Such situations may occur in flight routes which include migration and feeding grounds. It should be noted that migrating bats often fly at high altitudes - above the height of the wires. On the other hand, bats hunting over waters or in forests usually move low - below the height of the wires - often directly above the water itself or below the crown of trees in the woods. Bats foraging massively in open areas are rare. Such use of space during seasonal flights or hunting significantly reduces the likelihood of collisions with overhead high voltage lines.

High-voltage lines of electric networks pass in the north and northern east of the wind farm sites and buffer zones. Special observations have not revealed the negative impact on migrating bats of both vertical structures (towers) and horizontal ones (electric wires). Impact of dense electric network lines also has not been noted in human settlements, which are the main habitats of bats. There is quite enough space at the wind farm sites and in the buffer zones for animals to fly past obstacles. Negative impact on migrating bats is absent.

Cumulative impact

As regards the cumulative effect of the simultaneous influence of two overhead lines in possible bat collisions, it will not occur. With the proposed arrangement of wires and the distance between them, there is no possibility of electric shock. There are not either reports of bat deaths on lines, from which it can be concluded that these structures are visible to bats. With the proposed arrangement of wires and the distance between them there is no possibility of electric shock. The variant chosen from the point of view of the abundance and abundance of bats selected is the most beneficial. There are also no reports with high bat mortality on the lines, suggesting that these structures are visible to bats.

The operation of the farm in the variant chosen for implementation will not have a significant negative impact on the bats. The variant chosen from the point of view of the frequency and quantity of the bats selected is the most beneficial one. This is due to the location of turbines in the air places less used by bats. This variant is characterized by the lowest potential collision and the smallest impact on bat feeding in the analyzed area. The potential impact on the chiropterofauna implied by the alternative variant would be slightly higher compared to the investor’s variant. This is due to the greater number of wind turbines, which translates into a higher probability of bat collisions with working rotors.

6.4.9 The Impact on Flora

Wind and its associated infrastructure can affect plant species and their habitat, if particular components of a project are located in these habitats or their implementation may cause permanent damage or degradation to such habitats. The destruction of habitats is harmful not only because of the flora present, but also because of the fauna that inhabits or uses it. Particular attention should also be paid to potential impacts on migratory corridors or local protected species. Impacts that can lead to permanent habitat destruction include, for example, water disturbance, which is extremely dangerous for particularly sensitive habitats such as peat bogs, marshes, sand dunes, and lagoons. Changes in water relations can affect not only the habitats within the boundaries of the investment area, but also other associated habitats, such as streams or other waterways located below the devastated area.

The literature describes an exemplary situation in which a project had significant impact on the habitat. It took place in Ireland (European Commission, 2010) where a wind farm on a peat bog was located. As a result of the incorrect location of two wind turbines and the inadequate proportions of the road (which is the accompanying infrastructure of the farm), the hydrological system of this habitat was destabilized, which led to a peat bog landslide.

Due to the fact that the land is currently being used as agricultural land, the impact of the stage of exploitation of the investment on plant species and their habitat is not expected. The influence of the stage of exploitation of the investor’s option and the alternative to the planned project in the flora will not take place (neutral impact).

6.4.10 The Impact on Landscape and Cultural Landscape

In order to reduce the adverse psychological effect on the population caused by the landscape changes due to the wind farm construction, the intension is to use modern imported WTGs that are constructively and by virtue of their color promote the object’s disguising reducing the disharmony effect. The landscape of the wind farm site is a plain surface with arable lands separated by wind-breaking agricultural hedgerows and dirt roads. The WTGs installed in the agricultural hedgerows will visually liven the perception of the landscape. The color tones used for the towers, the nacelles and the blades that range from white to grayish-light-blue which were tested in Europe and are unoppressive visually shall serve to facilitate this goal[5].

In general, as a result of the realization of the planned investment, there are two levels of landscape impact: environmental and cultural ones. The former relates to the transformation of characteristic environmental features connected with landform. The wind farm will be located in the area that is exploited agriculturally.

The site terrain is natural, smooth, undulating plain, with a mild slope to the south-west in the direction of the Molochnyi Estuary.

While taking into account the second level, it relates to a wider scope of aspects incorporating the implementation of new anthropogenic elements into a harmonic landscape. They may interfere with the already existing exposition and the perception of the landscape due to height and acreage-related changes.

The determining element of the interference assessment of the investment is a topologic analysis of the environment accounting for the geomorphological specificity of the land together with the local flora and the nature of the area to be exploited. Height differences of a given area are beneficial when it comes to turbine hiding. What is more, the investment should not impact the exposition and the valuable cultural aspects of the land in a negative manner. Furthermore, the identified forest density and the closeness of built-up areas make it possible to hide the investment to some extent. The dominant covering forms that can be taken advantage of in the case of the discussed land are:

1. Hedgerows
2. Rural built-up areas

At the investment site there are no protected cultural objects. Such elements of the landscape are not present due to the fact that the wind farm will neighbor with external parts of rural areas. There are no culturally important objects nearby, so the investment will not impact the local landscape in a negative manner.

While seen from a short distance, wind turbines can be considered to be an „alien" element of the landscape due to the unequivocally anthropogenic character. However, with the increase of the distance, the landscape-specific dissonance decreases. The said state of affairs is strictly connected with the specificity of turbines to be installed – thanks to their streamlined design and bright colors, they become hardly visible from the distance of approximately 9 to 15 kilometers. Some turbine elements may be seen from 20 kilometers if the observer focuses on the area where they are and the overall visibility is above-average.

The following visibility levels of wind turbines can be specified by taking advantage of the simplified scheme below:
1.Very high turbine visibility level – up to 3 km from the investment location,
2. High turbine visibility level - from 3 to 6 km from the investment location,
3. Moderate turbine visibility level - from 6 to 9 km from the investment location,
4. Low turbine visibility level - from 9 to 15 km from the investment location
5. Marginal turbine visibility level - from 15 to 20 km from the investment location

It has been specified that the wind farm in question is situated in the first area, where the level of turbine visibility is very high. The investment can be seen from various routes and distances due to its localization. Therefore, it has to be considered to be a dominant element of the local landscape. The movement of rotors is clearly visible and is visible to the human eye.

The construction of the wind farm will cause notable landscape changes, mainly due to the introduction of new, fixed elements to it, namely - 167 wind turbines. Nevertheless, the impact of the said structures cannot be assessed as negative, neutral, or positive, as their reception is highly subjective in nature and depends on the preferences of an observer.

The creation of a farm in the rational alternative variant (222 turbines) would cause even greater impact on the landscape, mainly due to the scale of the undertaking.

6.4.11 The Impact of Cultural Goods and Historic Monuments

Due to the fact that the planned development will be located in a close proximity to agricultural lands in Zaporizhia Region, in Priazovsk and Melitopol Districts, in the village councils of Devninskoe, Dobrivka, Dunaevka, Girsivka, Mordvinivka and Nadeshdine, and there are no protected cultural monuments in the area (Chapter 3.11) – the direct impact on cultural assets will not be identifiable.

In the case of realization of the rational alternative variant of the undertaking (222 turbines), the impact on cultural monument would probably be greater. It would be caused by a bigger scale of the investment, the higher number of turbines, as well as the location of some parts of the wind farm closer to local monuments.

6.4.12 The Impact on Material Goods

With regard to the development of wind-based energy generation, the impact on material asset may be related to:

- Development of energy-related infrastructure in the area,
- Increased lease income for individuals leasing land for the construction of wind farms and auxiliary infrastructure,
- Economic advantages connected with the increased income generated from property tax,
- Limited land development options caused by the realization of the investment,
- Decrease of the value of lands located in a close proximity to the realized investment.

The impact on material assets will mainly concern the management of lands affected acoustically by the installed wind turbines.

The decrease of value of properties situated in a close vicinity to the wind farm is a frequent reason of local societies voicing their opinions against the realization of the project on the areas they inhabit. However, outcomes of surveys carried out for areas where wind farms have been built have not proved the validity of the said correlation.

Wind farms are often localized in agricultural areas which are additionally protected due to the needs of the national food industry. It has to be pointed out that a properly functioning farm does not limit the possibility of agriculturally exploiting the land, aside from some small plots of land that are taken directly by wind farm-related installations. Therefore, one cannot make an assumption that the creation of a farm would translate into the decrease of the price of the land. What is more, the self-government of the area will be granted economic benefits in the form of increased property tax-related incomes.

The exploitation of the investment will be also connected with the development of the local energetic infrastructure, which will positively impact the investment-related value of the nearby lands and the increase in the energetic safety of the commune.

It has to be indicated at this point that there is no risk of a negative impact of the investment on material assets, including the decrease of the value of nearby lands in connection with the realization of the undertaking. The way of its exploitation will not change, aside from small plots of land that will be excluded from agricultural production.

Additionally, there will also be a direct positive impact of the realization of the investment (330 kV electric grid). The value of both public and private assets will undoubtedly increase.

The impact of the variant chosen for realization on material assets should be therefore considered to be moderately positive in all of the analyzed aspects. The construction of a farm in the aforementioned alternative variant could increase the desired impact to even a greater degree (due to the bigger scale of the undertaking).

6.5 Impact at the Stage of Liquidation

The expected lifespan of a wind farm is 25-30 years. After this time may be liquidation of wind farm (eg. as a result of technical progress and will be used other energy sources). A more likely scenario, however, is rebuilding the wind farm and installation of newer WTG's generation and more effective energy production.

Please note that the necessity of eliminating wind farm or individual turbines may occur earlier, eg. as a result of the construction disaster or when post-construction monitoring shows that operating wind turbines have a significant negative impact on birds or bats, or exceed the standards of sound.

It also has to be pointed out that the possible liquidation of the investment would be probably limited to the disassembly of particular elements of the wind farm. The removal of foundations, as well as cable and road infrastructure is less likely (but still possible).

A very likely scenario is the one assuming the disassembly of properly operating wind turbines and their sale for further use. The existing devices would be then replaced by new ones, characterized by higher efficiency.

Typical contaminants that may occur during decommissioning of the wind farm (or single turbines), include:

- contamination of surface and groundwater (in emergency situations, eg. oil spill from construction machinery),
- wastes from dismantling of parts of wind turbines,
- air pollution from transportation and construction machines and equipment.

Liquidation of the wind farm will have the following environmental effects:

1. Immediate return the landscape to the initial state (unless significant change in the physiognomy of environment will not occur),
2. A negligible impact on birds,
3. Creation of waste from scrapping the construction of turbines and associated infrastructure elements and in the case a good technical condition of the turbines they can be sold to another entity,
4. Reclamation of land to its previous state (filling sand, clay, replenish soil substrate, the introduction of vegetation).

In the case of planned cessation of wind farm operation, the liquidation process will be carried out in compliance with the applicable law regulations and in cooperation with proper organs and institutions, which will be also prior informed about the cessation of wind farm exploitation.

The owner of the installation will be obliged to re-cultivate the land after the liquidation of the wind farm and the auxiliary infrastructure. The investment area will be restored to the condition before the wind farm construction commencement.

The impact of the liquidation procedure on individual components of environment, material assets, and individuals living nearby the farm is going to be discussed below.

6.5.1 The Impact on the Acoustic Climate

The impact on the acoustic climate in the liquidation phase will be similar as during the construction. During demolition works a source of noise will come from means of transportation and construction machinery (or example, excavators, cranes, bulldozers and others). Demolition works will be connected with the highest noise emission. Despite the fact that the liquidation stage is characteristic of relatively high noise emission, it should be remembered that is of an episodic character, and after their completion the acoustic climate condition is restored to its original condition. Demolition works should be conducted only during the day.

Impact on the acoustic climate during decommissioning will be similar in the investor's variant and an alternative variant possible to realize (will be applied identical hardware, and depending on the variant in question can only occur differences in the number of hours of work of individual machines and equipment). An environmental impact of the investment variant or the alternative variant, possible to be realized, should be considered as moderately negative.

6.5.2 The Impact on Soil Surface

During dismantling of the wind farm the following wastes are expected to be generated:

- Group 13: Waste oils and wastes of liquid fuels
  - 13 01 05* - non-chlorinated emulisons - approximately 150 tons/year;
  - 13 02 05* - mineral-based non-chlorinated engine, gear and lubricating oils - approximately 150 tons/year;
- Group 15: Waste Packaging; Absorbents, Wiping Cloths, Filter Materials and Protective Clothing not otherwise specified:
  - 15 01 10* - Packaging containing residues of dangerous substances or contaminated by hazardous substances – approximately 2.8 tons/year;
  - 15 02 02* - absorbents, filter materials (including oil filters not otherwise specified), wiping cloths, protective clothing contaminated with hazardous substances – approximately 71 tons/year;
  - 15 02 03 - absorbents, filter materials, wiping cloths and protective clothing other than those mentioned in 15 02 02 – approximately 71 tons/year;

- Group 16: Wastes not otherwise specified in the list:
  - 16 02 09* - Transformers and capacitors containing PCBs – approximately 14 tons/year;
  - Kod 16 02 10* - discarded equipment containing or contaminated by PCBs other than those mentioned in 16 02 09 – approximately 14 tons/year;
  - 16 02 13* - Discarded equipment containing hazardous components other than those mentioned in 16 02 09 to 16 02 12 – approximately 14 tons/year;
  - 16 02 14 - discarded equipment other than those mentioned in 16 02 09 to 16 02 13 - approximately 3.0 tons/year;
  - 16 02 15* hazardous components removed from discarded equipment – approximately 6.0 tons/year
  - 16 02 16 - components removed from discarded equipment other than those mentioned in 16 02 15 - approximately 15 tons/year;
- Group No. 17: construction and demolition wastes (including excavated soil from contaminated sites):
  - 17 01 01 concrete - approximately 326 408 tons/year
  - 17 01 03 tiles and ceramics - approximately 347 tons/year;
  - 17 01 06* mixtures of, or separate fractions of concrete, bricks, tiles and ceramics containing dangerous substances - approximately 7735 tons/year
  - 17 01 07 mixtures of concrete, bricks, tiles and ceramics other than those mentioned in 17 01 06 - approximately 7590 tons/year;
  - 17 02 03 plastics - approximately 0.02 tons/year;
  - 17 04 01 copper, bronze, brass – approximately 5000 tons/year;
  - 17 04 05 iron and steel - approximately 19 506 tons/year;
  - 17 04 11 cables other than those mentioned in 17 04 10 - approximately 6.0 tons/year;
  - 17 06 04 insulation materials other than those mentioned in 17 06 01 and 17 06 03 - approximately 6.0 tons/year;
  - 17 09 04 mixed construction and demolition wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03 – approximately 8000 tons/year

These wastes should be transferred off the site by certified companies for final treatment.

In the case of implementation of a rational alternative variant (222 turbines) the amount of waste from each group would be approx. 15% higher than the amount indicated above.

Upon the completion of works the area should be cleaned and restored to the pre-disassembly condition. The works contractor will need to ensure safe removal of the turbines. This work should be performed using specialized equipment.

Waste will be protected against adverse weather conditions, leaching and dismantle.
All actions necessary to carry out the stage of the liquidation should take place without a risk to the environment including health and safety, excluding the threat to life and human health.

The obligation to land reclamation of the liquidated wind farm and accompanying technical infrastructure will rest with the owner of the installation. The project site will be restored to the state before its implementation.

The impact of the liquidation phase on the surface of the earth will have a similar character in analyzed variants (for variant consisting of 222 turbines scale of impacts would be greater). The impact is rated as moderately negative.

6.5.3 The Impact on Surface and Ground Waters

Demolition works may have a negative impact on surface and ground waters only in case of failure leakages from construction machines and equipment used during the liquidation of the plant. Fuels, lubricants and gasoline are sources of petroleum pollution. That must be eliminated by the proper job organization and service of construction machines, and also by using equipment in a good technical condition. Construction sites should be provided with an appropriate quantity of sorbents. It will be also necessary to take care of a safe disassembly of wind turbines and technical infrastructure. Those works will be conducted with particular caution in the way that will not cause a threat to environment taking into account safety and health at work by using specialist equipment.

Impact on surface and underground variant of the investment project at the stage of liquidation of the wind farm is estimated as insignificant negative due to the short-lived nature of the work, the scale of the impact would be greater for a wind farm consisting of 222 turbines.

6.5.4 The Impact on Air Quality

During the demolition of the investment there will take place an unorganized emission of exhaust fumes and dusts from means of transportation and machines used for the infrastructure disassembly (for example, excavators, cranes, bulldozers and others). Most likely, however, possible liquidation will be limited to the dismantling of WTGs (without foundations, access roads and cables), the transformer station and route PTL.

The nuisance decrease will first of all rely on working out a demolition works timetable so as to limit to a maximum a quantity of courses of transportation vehicles. The proper protection of the resulting rubble so as to prevent the recurring emission of dust pollutants into the environment. The systematical cleaning of the demolition area will be essential too.

Because of a short-lasting and local character of those emissions no essential impact on the ambient air is predicted. With due diligence while conducting demolition works, this phase will not pose a threat to the ambient air and will be a small nuisance to local residents.

Impact on the air during decommissioning will be similar in the investor’s variant and an alternative variant possible to realize (will be applied identical hardware, and depending on the variant in question can only occur differences in the number of hours of work of individual machines and equipment). It is estimated as moderate negative.

6.5.5 The Impact on Electromagnetic Field

At the stage of liquidation of the investment excludes occurrence of interaction of electromagnetic fields in the investor’s variant and an alternative variant possible to realize.

6.5.6 The Impact on People’s Health and Living Conditions

During the project liquidation stage the site will face insignificant, changeable in time and space, noise emissions, air pollution and vibrations. Those emissions are not expected to be essentially a nuisance to people who live nearby. Greater hardship for the people of the liquidation elements farm can provide transportation of large amounts of waste, which will take place in large part on public roads.

There will also be a threat to human health with regard to the ongoing disassembly works as well as vehicle movement and operation. Proper organization of work, marking areas for work, adherence to safety rules and rules of the road will minimize the risk of occurrence of adverse effects to human health and life.

The impact of the liquidation of the investment phase of the variant selected for implementation on the living conditions and health of people rated as not significantly negative. It will have a similar character in the variant consisting in the construction of 222 turbines where scale of impacts would be greater.

6.5.7 The Impact on Flora and Fauna

The impact on flora and fauna at the phase of liquidation will be of short-term and reversible character and will be related mainto to operations of machines and the movement of heavy vehicles. In this phase local destruction of vegetation, deterioration of land adjacent to the demolition work due to the emission of pollutants (air, noise) disturbance of animals with adjacent areas or small animal falling into the excavation may occur.

Plants after demolition is completed will be in a few months restored to its previous state. Disturbance of animals will be of short duration, and after completion of the work should be returning the animals to the breeding grounds.

The impact of the liquidation stage of the investment variant on flora and fauna has been assessed as not significantly negative. However, in a rational alternative variant possible magnitude of impacts would be the greater.

6.5.8 The impact on Landscape, Cultural Landscape and Monuments

Liquidation of a wind farm and associated infrastructure should not directly affect in a negative way neither the landscape nor cultoral landscape and monuments (no impact).

The dismantling of wind turbines and associated infrastructure over a longer period of time will have a positive impact on the landscape, including cultural landscape, due to the removal of alien elements which interfere visually with the surroundings.

It is estimated that at the stage of liquidation of the investor’s variant impact on the landscape and cultural landscape will be moderately positive. It will have a similar character in the alternative variant possible.

6.5.9 The Impact on Material Goods

Liquidation of the project may have an indirect negative impact on material goods through the loss of influence of the community on account of property taxes. Impact phase of liquidation on material goods will have a similar character in the investor’s and alternative variant. It is estimated as moderate negative.

6.6 The Impact of IBA Sites

IBA bird sanctuaries are distinctive places in the environment in which there are particularly valuable birds, or in which there are great populations of birds. In particular, bird sanctuaries are areas where there are:

- Rare, endangered species of birds.
- Range-restricted species or species specific to natural biomass.
- High concentrations of migratory and wintering birds.

IBA bird sanctuaries are based on a set of strict criteria developed by BirdLife International. These criteria are based on scientific basis and applied in the same standardized way in all countries of the world. Bird sanctuaries show where there are key places for the protection of birds. To determine an IBA bird sanctuary is therefore necessary to specify in a reference list: where we must act first to effectively protect birds, and which areas should be protected under the existing forms of area protection. Owing to the identification of IBA bird sanctuaries, effective protection of bird populations and their habitats is possible and, in broader terms, all biodiversity may be protected.

6.6.1 Description of Potential Impacts of the Project on IBA Areas

The potential impacts of wind farms and PTL on avian species occurring in the IBA area may occur during the construction, operation and liquidation phases of the project.

These will primarily affect the particularly valuable birds of the IBA bird sanctuary. At the construction stage of the project, there may be increased impacts on birds in construction sites and neighboring areas, including habitat types. These impacts can be related to heavy traffic, construction works, and therefore increased noise, as well as the presence of high lifting equipment - lifts. The latter may also cause collision hazards, but not to a higher degree than the collision estimation described below for the operation stage. In addition, there will be loss of a certain surface area of potential feeding grounds occupied by installed structures and access roads - long-term effect, and by the arrangement of roads and yards and maneuvering - short-term effect, during the construction process lasting several months.

Analogous phenomena will take place at the stage of the liquidation of both the wind farm and auxiliary infrastructure. The impact of the phase of exploitation of the investment discussed therein on birds and legally protected bat species inhabiting IBA areas will be analogous to the one touched upon in sections 6.4.8.1 and 6.4.8.2 of this document. The realization of wind farm-oriented developent may result with:

- Increased mortality of birds caused by collisions with operating turbines and/or auxiliary infrastructure elements, especially – overhead power lines;
- Decrease in birth quantity due to the loss and fragmentation of habitats as a result of scaring off animals from the areas located in a close proximity to the farm and/or due to the extension of communication-oriented and energy-related infrastructure required to properly manage wind turbines;
- Interferences with population functioning, with the major focus being put on short- and long-term migrations of birds (the so-called barrier effect) and the alteration of land utilization paradigm.

The impact on protected bats, aside from the risk of collision, may be based on the destruction of winter havens and reproduction colonies (as well as on notable interferences with them), crossing their flight paths (including those migratory ones), and the construction of investment-related structures in animals' hunting areas, therefore making it impossible for them to gather food. The discussed wind farm may impact chiropterofauna not only at the stage of exploitation but also – at the construction phase. The intensity of the said interferences to a significant extent depends on investment location, bat species, and other variables (including local ones).

Wind farms and their auxiliary infrastructure may impact areas being IBA protected areas, mainly if the localization of some elements of the investment or their placement causes damage or irreversible degradation of such habitats. The destruction of the aforementioned spots is detrimental in character, not only due to the presence of flora, but also – fauna inhabiting or taking advantage of the areas in question. The extent of habitat changes is strongly correlated with its susceptibility, size, specificity, investment location, connection-oriented infrastructure, as well as with the effectiveness of utilized protective and mitigating measures.

6.6.2 Ornithofauna

The planned development will not be situated in any of IBA areas. Due to the said fact, there will be no direct impact of the investment on IBAs. The possible interference of the investment with the aforementioned spots will be only indirect in character. To dispel any doubts relating to the assessment of the impact of the wind farm on legally protected birds inhabiting IBAs, all the habitats located within 30 kilometers from the area of the planned investment have been taken into account at the initial stage, that is:

- **UA071 Molochnyj Liman (or Molochnyi Estuary):**
    - 4.2 kilometers from the wind farm site,
    - 4.7 kilometers from the main transformer station,
    - 2.0 kilometers from the overhead power transmission line.
- **UA072 Molochna River Valley:**
    - 2.6 kilometers from the wind farm site,
    - 5.5 kilometers from the main transformer station,
    - Through to the overhead power transmission line.
- **UA070 Utlyuk Lyman:**
    - 19.7 kilometers from the wind farm site,
    - 28 kilometers from the main transformer station,
    - 27.5 kilometers from the overhead power transmission line.

During the site monitoring-related works, the presence of 110 species of birds in the area of the planned development have been identified, as well as of 72 species in spots where 330 kV power lines are to be built. Their list in Table 36 has been additionally juxtaposed with the index of species inhabiting IBA areas. Some species identified during supervisory proceedings have been found to inhabit at least one IBA area. They have been highlighted in grey in the attached tables. From the point of view of the investment safety assessment, the most important species are those, which have been identified during the monitoring phase and are also listed in: the protected status of European Red List, Protected status of the Red Data Book of Ukraine and the List of the International Union for Conservation of Nature (IUCN). Species meeting this criterion have been highlighted in red.

Table 36. Species of birds inhabiting IBA areas identified during monitoring-oriented undertakings together with their respective protective statuses

No.	English name	Latin name	Molochnyj Liman UA071	Molochna river valley UA072	Utlyuk lyman UA070	wind farm	330kV PTL	Status	ERL	RDB	IUCN	BERN	BONN	CITES
1	African stonechat	*Saxicola torquata*				x	x	m, n				2	2	
2	Athene noctua	*Athene noctua*				x		m, w, n				2		2
3	Bank swallow	*Riparia riparia*				x	x	m, n				2		
4	Barn swallow	*Hirundo rustica*				x	x	m, n				2		
5	Barred warbler	*Sylvia nisoria*				x	x	m, n				2		
6	Bittern	*Botaurus stellaris*		x				m, w, n				2	2	
7	Black redstart	*Phoenicurus ochruros*				x		m, n				2	2	
8	Black tern	*Chlidonias niger*				x	x	m,				2	2	
9	Blackbird	*Turdus merula*				x	x	m, w, n				3	2	
10	Black-headed gull	*Chroicocephalus ridibundus*				x	x	m, w, n				3		
11	Black-necked Grebe	*Podiceps nigricollis*	x											
12	Black-winged Stilt	*Himantopus himantopus*		x		x		m, n		VU	LC	2	2	
13	Brambling	*Fringilla montifringilla*				x		m, w				2		
14	Calidris spp.	*Scolopacidae*				x								
15	Caspian Gull	*Larus cachinnans*	x		x			m, w, n				-	-	-
16	Chaffinch	*Fringilla coelebs*				x	x	m, w, n				3		
17	Collared flycatcher	*Ficedula albicollis*				x		m,				2		
18	Collared Pratincole	*Glareola pratincola*	x	x				m, n		RA	NT	2	2	
19	Common buzzard	*Buteo buteo*				x	x	m, w, n				2	1,2	2
20	Common gull	*Larus canus*				x	x	m, w				3		
21	Common kestrel	*Falco tinnunculus*				x	x	m, w, n				2	2	2
22	Common pochard	*Aythya ferina*				x		m, w, n				3	1,2	
23	Common quail	*Coturnix coturnix*				x	x	m, w, n				3	2	
24	Common raven	*Corvus corax*				x	x	m, w, n				3		
25	Common Redshank	*Tringa tetanus*		x		x		m, n				3	1,2	
26	Common redstart	*Phoenicurus phoenicurus*				x	x	m, n				2	2	
27	Common scops	*Otus scops*				x		m, n		RA	LC	2		2
28	Common shelduck	*Tadorna tadorna*				x		m, w, n				2	1,2	
29	Common swift	*Apus apus*				x		m, n				3		
30	Common tern	*Sterna hirundo*				x		m, n				2	2	
31	Common whitethroat	*Sylvia communis*				x	x	m, n				2		
32	Cormorant	*Phalacrocorax carbo*				x		m, w, n				3		
33	Corn bunting	*Emberiza calandra*				x	x	m, w, n				3		
34	Crested lark	*Galerida cristata*				x		m, w, n				3		
35	Domestic pigeon	*Columba livia*				x		m, n				3		
36	Ducks	*Anas spp.*				x	x							
37	Dunlin	*Calidris alpine*				x		m,				2	1,2	
38	Eurasian collared dove	*Streptopelia decaocto*				x	x	m, w, n				3		
39	Eurasian coot	*Fulica atra*				x	x	m, w, n				3	2	
40	Eurasian curlew	*Numenius arquata*				x	x	m, w		EN	NT	3	1,2	
41	Eurasian jay	*Garrulus glandarius*				x	x	m, w, n				2		

No.	English name	Latin name	Molochnyj Liman UA071	Molochna river valley UA072	Utlyuk lyman UA070	wind farm	330kV PTL	Status	ERL	RDB	IUCN	BERN	BONN	CITES
42	Eurasian oystercatcher	*Haematopus ostralegus*				x		m, n		VU	LC	3		
43	Eurasian sparrowhawk	*Accipiter nisus*				x		m, w				2	1,2	2
44	Eurasian tree sparrow	*Passer montanus*				x	x	m, w, n				3		
45	European bee-eater	*Merops apiaster*				x		m, n				2	2	
46	European goldfinch	*Carduelis carduelis*				x	x	m, w, n				2		
47	European greenfinch	*Chloris chloris*				x	x	m, w, n				2		
48	European magpie	*Pica pica*				x	x	m, w, n				2		
49	European pied flycatcher	*Ficedula hypoleuca*				x		m,				2		
50	European robin	*Erithacus rubecula*				x		m, n						
51	European roller	*Coracias garrulous*				x		m, n	VU	EN	NT	2	2	
52	European starling	*Sturnus vulgaris*				x	x	m, w, n				2		
53	Fieldfare	*Turdus pilaris*				x	x	m, w				3	2	
54	Garden warbler	*Sylvia borin*				x	x	m, n				2		
55	Garganey	*Anas querquedula*				x	x	m, w				3	1,2	
56	Glossy ibis	*Plegadis falcinellus*				x		m,		VU	LC	2	2	
57	Golden oriole	*Oriolus oriolus*				x	x	m, n				2		
58	Goshawk	*Accipiter gentilis*					x	m, w				2	1.2	2
59	Great Cormorant	*Phalacrocorax carbo*	x					m, w, n				3		
60	Great Crested Grebe	*Podiceps cristatus*	x			x	x	m, w, n				3		
61	Great egret	*Egretta alba*				x	x	m, w, n				2	2	
62	Great tit	*Parus major*				x	x	m, w, n				2		
63	Great White Egret	*Ardea alba*	x					m, w, n				2	2	
64	Greater white-fronted goose	*Anser albifrons*				x	x	m, w				3	1,2	
65	Grey Heron	*Ardea cinerea*	x				x	m, w, n				3		
66	Grey partridge	*Perdix perdix*				x	x	m, w, n	VU			3		
67	Grey plover	*Pluvialis squatarola*				x		m				3	2	
68	Greylag Goose	*Anser anser*	x		x			m, w, n				3	1,2	
69	Gulls	*Larus spp.*				x								
70	Hen harrier	*Circus cyaneus*				x		m, w		RA	LC	2	1,2	2
71	Hooded crow	*Corvus cornix*				x	x	m, w, n				2		
72	Hoopoe	*Upupa epops*				x	x	m, n				2		
73	House sparrow	*Passer domesticus*				x	x	m, w, n				2		
74	Jackdaw	*Corvus monedula*				x		m, w, n				2		
75	Leaf warbler	*Phylloscopus sp.*				x								
76	Lesser grey shrike	*Lanius minor*				x	x	m, n				2		
77	Linnet	*Linaria cannabina*				x	x	m, w, n				2		
78	Little Bittern	*Ixobrychus minutus*		x				m, n				2	2	
79	Little egret	*Egretta garzetta*				x		m, n				2		
80	Little gull	*Hydrocoloeus minutus*				x		m, n				2		
81	Little owl	*Athene noctua*				x	x	m, w, n				2		2
82	Long-eared owl	*Asio otus*				x	x	m, w, n				2		2
83	Long-legged buzzard	*Buteo rufinus*				x	x	m, w, n	VU	RA	LC	2	1,2	2

No.	English name	Latin name	Molochnyj Liman UA071	Molochna river valley UA072	Utlyuk lyman UA070	wind farm	330kV PTL	Status	ERL	RDB	IUCN	BERN	BONN	CITES
84	Mallard	*Anas platyrhynchos*	x			x	x	m, w, n				3	1,2	
85	Mediterranean gull	*Larus melanocephalus*				x	x	m,				2	2	
86	Merlin	*Falco columbarius*				x		m, w				2	2	2
87	Mute Swan	*Cygnus olor*	x		x	x		m, w, n				3	1,2	
88	Northern lapwing	*Vanellus vanellus*				x	x	m, w, n	VU			3	2	
89	Northern pintail	*Anas acuta*				x	x	m, w				3	1,2	
90	Northern wheatear	*Oenanthe oenanthe*				x	x	m, n				2		
91	Pied Avocet	*Recurvirostra avosetta*	x			x	x	m, n		RA	LC	2	2	
92	Purple Heron	*Ardea purpurea*	x					m, n				2	2	
93	Red-backed shrike	*Lanius collurio*				x	x	m, n				2		
94	Red-footed falcon	*Falco vespertinus*				x		m, n	VU			2	2	2
95	Ring-necked pheasant	*Phasianus colchicus*				x		m, w, n				3		
96	Rook	*Corvus frugilegus*				x	x	m, w, n				2		
97	Rough-legged buzzard	*Buteo lagopus*				x	x	m, w				2	1,2	2
98	Ruddy turnstone	*Arenaria interpres*				x		m				2	2	
99	Ruff	*Philomachus pugnax*				x	x	m,				3	1,2	
100	Sandwich tern	*Thalasseus sandvicensis*				x		m, n				2	2	
101	Savi's Warbler	*Locustella luscinioides*		x				m, n				2		
102	Scaup	*Aythya marila*	x		x	x	x							
103	Skylark	*Alauda arvensis*				x	x	m, w, n				3		
104	Slender-billed gull	*Chroicocephalus genei*				x		m, n				2	2	
105	Small passerine birds	*Passer spp.*				x	x							
106	Smew	*Mergellus albellus*	x											
107	Species group - waterbirds	*Species group - waterbirds*	x		x									
108	Stock pigeon	*Columba oenas*				x	x	m, w, n		VU	LC	3		
109	Syrian woodpecker	*Dendrocopos syriacus*				x	x	m, n				2		
110	Tawny pipit	*Anthus campestris*				x	x	m, n				2		
111	Terns	*Chlidonias spp.*				x								
112	Thrush nightingale	*Luscinia luscinia*				x	x	m,				2	2	
113	Turtle dove	*Streptopelia turtur*				x	x	m, n				3		
114	Western marsh-harrier	*Circus aeruginosus*				x	x	m, w, n				2	1,2	2
115	Whinchat	*Saxicola rubetra*		x				m, n				2	2	
116	Whiskered tern	*Chlidonias hybrida*				x		m,				2		
117	White wagtail	*Motacilla alba*				x	x	m, w, n				2		
118	White-fronted Goose	*Anser albifrons*	x		x			m, w				3	1,2	
119	White-tailed eagle	*Haliaeetus albicilla*				x	x	m, w, n		RA	LC	2	1,2	1
120	Whooper swan	*Cygnus cygnus*				x	x	m, w				2	1,2	
121	Winter wren	*Troglodytes troglodytes*				x	x	m, w, n				2		
122	Woodpigeon	*Columba palumbus*				x	x	m, w, n						
123	Yellow wagtail	*Motacilla flava*				x	x	m, n				2		
124	Yellowhammer	*Emberiza citrinella*				x		m, w, n				2		
125	Yellow-legged gull	*Larus michahellis*				x	x	m, w, n				-	-	-

Notes: Status: m - the species occur during seasonal migrations; w - the species occur during the winter period; n - the species occur during the nesting period.

ERL - the protected status of European Red List: VU - (Vulnerable) vulnerable, the species that may in the near future be classified as "endangered" if there continues the performance of the factors that affect their condition; EN - (Endangered) endangered, the species that are threatened with extinction; their conservation is unlikely, their regeneration is impossible without special measures.

RDB - Protected status of the Red Data Book of Ukraine: EN - endangered; VU - vulnerable; RA - rare; IN - invaluable.

IUCN - the protected status of the International Union for Conservation of Nature: LC - least risk.

BERNE - Berne Convention or the Convention on the protection of wild flora and fauna and natural habitats in Europe, includes four annexes: Annex II (2) - the list of species of fauna subject to special protection; Annex III (3) - the species of fauna subject to protection.

BONN - Bonn Convention Annex II (2) include the species whose state is unfavorable, the conservation and management of which requires international agreements as well as those species whose state could be significantly improved as the result of the international cooperation that can be done on the basis of international agreements.

CITES - Washington Convention on International Trade in Endangered Species of Wild Fauna and Flora, endangered species (CITES), includes three annexes: Annex II (2) includes: "(a) all species which although not necessarily now threatened with extinction may become so unless trade in specimens of such species is subject to strict regulation in order to avoid utilization incompatible with their survival; and (b) other species which must be subject to regulation in order that trade in specimens of certain species referred to in sub-paragraph (a) of this paragraph may be brought under effective control."

As part of the preliminary assessment found the potential to adversely impact the Wind Farm and its associated infrastructure on a site near the farm areas IBA and the most important species, by acting on the following bird species:

1. Black-winged Stilt *Himantopus himantopus*
2. Common Redshank *Tringa totanus*
3. Common scops *Otus scops*
4. Eurasian curlew *Numenius arquata*
5. Eurasian oystercatcher *Haematopus ostralegus*
6. European roller *Coracias garrulous*
7. Glossy ibis *Plegadis falcinellus*
8. Great Crested Grebe *Podiceps cristatus*
9. Grey Heron *Ardea cinerea*
10. Grey partridge *Perdix perdix*
11. Hen harrier *Circus cyaneus*
12. Long-legged buzzard *Buteo rufinus*
13. Mallard *Anas platyrhynchos*
14. Mute Swan *Cygnus olor*
15. Northern lapwing *Vanellus vanellus*
16. Pied Avocet *Recurvirostra avosetta*
17. Red-footed falcon *Falco vespertinus*
18. Scaup *Aythya marila*
19. Stock pigeon *Columba oenas*
20. White-tailed eagle *Haliaeetus albicilla*

6.6.3 Assessment of the Impact of the Investment on Rare Bird Species Inhabiting IBAs and the Most Important Species

Predictive assessment of the wind farm impact on birds, which shall be used for the expert appraisal, has been developed on the basis of generally accepted guidelines of BirdLife International reflected in the directive document - Windfarms and Birds: An Analysis of the Effects of Windfarms on Birds, and Guidance on Environmental Assessment Criteria and Site Selection Issues.

Additionally, the recommendations included in the „Development of Energy Production-related Branch of Industry versus Nature 2000" guidebook issued by the European Union have been followed.

In Annex II of the said guidebook, there is the list of birds considered by European Union experts to be to a significant extent susceptible to the impact of wind farms. Three major types of negative interference have been taken into account, namely:

- habitat loss,
- mortality caused by collisions with turbines,
- carrier effect occurrence

The recommended risk assessment scale is as follows: notable, moderate, potential, and marginal.

6.6.3.1 Birds

Black-winged Stilt *Himantopus himantopus*

IBA, where the species is the subject of protection: UA072 Molochna river valley – Population estimate 120-200 breeding pairs

According to the Recommendations of the European Commission, the species is not classified as remarkably susceptible to the operation of wind farms.

Justification of Red List category[21]

[21] http://datazone.birdlife.org/species/factsheet/black-winged-stilt-himantopus-himantopus

This species has an extremely large range, and hence does not approach the thresholds for Vulnerable under the range size criterion (Extent of Occurrence <20 000 km^2 combined with a declining or fluctuating range size, habitat extent/quality, or population size and a small number of locations or severe fragmentation). The population trend is unclear but it is not thought to approach the thresholds for Vulnerable under the population trend criterion (>30% decline over ten years or three generations). The population size is very large, and hence does not approach the thresholds for Vulnerable under the population size criterion (<10 000 mature individuals with a continuing decline estimated to be >10% in ten years or three generations, or with a specified population structure). For these reasons the species is evaluated as Least Concern according to Global IUCN Red List Category.

Population justification
The global population is estimated to number c. 450 000 - 780 000 individuals (Wetlands International 2015). The European population is estimated at 53 900 – 75 700 pairs, which equates to 108 000 - 151 000 mature individuals.

Trend justification
The overall population trend is unclear, some populations may be stable, increasing or have unknown trends (Wetlands International, 2015). The European population is estimated to be stable (BirdLife International, 2015).

Observations in the course of pre-investment monitoring and assessment: (data taken from Appendix 4):

Black-winged stilt - *Himantopus himantopus* listed in the Red Data Book of Ukraine and valuated as least risk (LC). During summer 2016 (specifically: on 7th August 2016), the quantity of Black-winged Stilt was equal to 18 birds, all of which inhabited area located in a close proximity to the planned wind farm. Experts were unable to identify the height of flight paths of the said species.
Due to the sighting of the "Black-winged Stilt" in neighboring areas, there is no significant negative impact of the wind farm on the "Black-winged Stilt" that is the subject of IBA protection UA072 Molochna river valley.

Common Redshank *Tringa totanus*
IBA, where the species is the subject of protection: UA072 Molochna river valley – Population estimate 275-315 breeding pairs

According to the Recommendations of the European Commission, the species is not classified as remarkably susceptible to the operation of wind farms.

Justification of Red List Category[22]
This species has an extremely large range, and hence does not approach the thresholds for Vulnerable under the range size criterion (Extent of Occurrence <20 000 km^2 combined with a declining or fluctuating range size, habitat extent/quality, or population size and a small number of locations or severe fragmentation). The population trend is not known, but the population is not believed to be decreasing sufficiently rapidly to approach the thresholds under the population trend criterion (>30% decline over ten years or three generations). The population size is very large, and hence does not approach the thresholds for Vulnerable under the population size criterion (<10 000 mature individuals with a continuing decline estimated to be >10% in ten years or three generations, or with a specified population structure). For these reasons the species is evaluated as Least Concern according to Global IUCN Red List Category.

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[22] http://datazone.birdlife.org/species/factsheet/22693211

Population justification
The global population is estimated to number c. 1 300 000 – 3 100 000 individuals (Wetlands International, 2015). The European population is estimated at 340 000 - 484 000 pairs, which equates to 680 000 – 968 000 mature individuals (BirdLife International, 2015). National population estimates include: < c.10 000 individuals on migration and c. 1 000 - 10 000 wintering individuals in China; c.1 000 - 10 000 individuals on migration and c. 1 000 - 10 000 wintering individuals in Taiwan; c.50 - 10 000 wintering individuals in Korea; c.100-10 000 breeding pairs and c.50-1 000 individuals on migration and c.1 000-10 000 wintering individuals in Japan and c.100-10 000 breeding pairs and c.50-1 000 individuals on migration in Russia (Brazil 2009). The population is therefore placed in the band 1 000 000 - 3 499 999 individuals.

Trend justification
The overall population trend is uncertain, as some populations are decreasing, while others are stable, increasing or have unknown trends (Wetlands International, 2015). In Europe, trends between 1980 and 2013 show that populations have undergone a moderate decline ($p<0.01$) (EBCC, 2015).

Observations in the course of pre-investment monitoring and assessment (data taken from Appendix 4):

During examinations carried out in 2016, Common Redshank was noticed 17 times. All birds were identified on Adjacent territories. In August, two birds were identified on water area of the middle part of the Molochnyi Estuary near to Viktorivka Village. Two next were seenin the pond in Oleksandrivka Village. Experts were unable to identify the height of flight paths of the said species. Therefore, there is no expected interference of the wind farm to be built with the local population of Common Redshank, being a protected species in IBA UA072 Molochna river valley.

Common scops *Otus scops*
The scale of impact of the wind farm on a given species in accordance with the Recommendations of European Commission of 2010.
According to the Recommendations of the European Commission, the species is not classified as remarkably susceptible to the operation of wind farms.

Justification of Red List Category[23]
This species has an extremely large range, and hence does not approach the thresholds for Vulnerable under the range size criterion (extent of occurrence <20,000 km^2 combined with a declining or fluctuating range size, habitat extent/quality, or population size and a small number of locations or severe fragmentation). Despite the fact that the population trend appears to be decreasing, the decline is not believed to be sufficiently rapid to approach the thresholds for Vulnerable under the population trend criterion (>30% decline over ten years or three generations). The population size is extremely large, and hence does not approach the thresholds for Vulnerable under the population size criterion (<10,000 mature individuals with a continuing decline estimated to be >10% in ten years or three generations, or with a specified population structure). For these reasons the species is evaluated as Least Concern.

Population justification
The European population is estimated at 232,000-393,000 pairs, which equates to 463,000-785,000 mature individuals (BirdLife International 2015). Europe forms approximately 57% of the global range, so a very preliminary estimate of the global population size is 812,000-1,380,000 mature individuals, although further validation of this estimate is needed. It is placed in the band 800,000-1,400,000 mature individuals.

[23] http://datazone.birdlife.org/species/factsheet/eurasian-scops-owl-otus-scops

Trend justification
The population is suspected to be in decline owing to ongoing habitat destruction. In Europe the population size trend is unknown (BirdLife International 2015).

Based on the observations in the course of pre-investment monitoring (Appendix 4), there is no expected interference of the wind farm on that sepcies because only one nesting couple has been observed near the site of the planed wind farm.

Eurasian curlew *Numenius arquata*

According to the Recommendations of the European Commission:

Disturbance displacement	Collision	Barrier to movement	Direct habitat loss/damage
XX		X	

XXX = Evidence of significant impact,

XX = proof or indiciations posini a siginificant threat,

X = potential threats

x = minor or insignificant threat

Justification of Red List Category[24]
This widespread species remains common in many parts of its range, and determining population trends is problematic. Nevertheless, declines have been recorded in several key populations and overall a moderately rapid global decline is estimated. As a result, the species has been uplisted to Near Threatened.

Population justification
The global population is estimated to number c.835,000-1,310,000 individuals (Wetlands International 2016). The European population is estimated at 212,000-292,000 pairs, which equates to 425,000-584,000 mature individuals (BirdLife International 2015).

Trend justification
Data from 2007 return estimated three-generation declines of 26.1-34.1%. However, owing to the uncertainty over whether declines in southern populations have been compensated for by increases in northern populations, the global trend is suspected to fall within the band 20-30% in the past 15 years (three generations). The European population is estimated to be decreasing by 30-49% in 31.2 years (three generations) (BirdLife International 2015).

Based on the observations in the course of the pre-investment monitoring (see Appendix 3 and Appendix 4) in Spring Migration of 2016, only 14 individuals were found but outside of the investment site and 2 individuals outside the planned PTL. Therefore a risk of significant negative impact of the Project on Eurasian curlew is low.

Eurasian oystercatcher *Haematopus ostralegus*
The scale of impact of the farm on a given species in accordance with the Recommendations of European Commission of 2010.

According to the Recommendations of the European Commission, the specie is not classified as remarkably susceptible to the operation of wind farms.

Justification of Red List Category[25]
This species has been uplisted to Near Threatened. It has an extremely large range and population size, and the largest flyway population increased strongly between the 1960s and 1990s but subsequently declined moderately rapidly. The recent decline may be part of a longer-term

[24] http://datazone.birdlife.org/species/factsheet/eurasian-curlew-numenius-arquata/text

[25] http://datazone.birdlife.org/species/factsheet/eurasian-oystercatcher-haematopus-ostralegus/text

fluctuation and the population should be monitored carefully to ascertain whether it shows signs of stabilising. None of the remaining flyway populations have increased. Should new information suggest declines are continuing or that actions to benefit the species, such as limiting mechanical shellfishery operations, are not leading to population recoveries, the species would merit uplisting to a higher threat category.

Population justification
The global population is estimated to number c. 1,004,000-1,160,000 individuals (Wetlands International 2012). The European population is estimated at 284,000-354,000 pairs, which equates to 568,000-708,000 mature individuals (BirdLife International 2015).

Trend justification
The overall population trend is decreasing. The ostralegus and finschi populations are reported to be declining (Wetlands International 2012, Nagy et al. 2014, Sagar and Veitch 2014, van de Pol et al. 2014, van Roomen et al. 2014a, BirdLife International 2015). The population of ostralegus increased strongly between the 1960s and the 1990s (van de Pol et al. 2014), but has subsequently declined significantly, at a rate exceeding 40% over three generations. The longipes population is reported to be stable (Sarychev and Mischenko 2014, van Roomen et al. 2014b) and the trend for the osculans population is unknown (Melville et al. 2014). Recent declines in the H. o. ostralegus population may however be part of a longer-term fluctuation. Mechanical shellfisheries operations have been severely restricted in the Netherlands and the species's population there may be expected to increase in the future (van de Pol et al. 2014). Further information is needed to confirm whether the population reaches stability or if it continues to decline. Because of this uncertainty, the rate of decline is currently placed in the band 20-29% in three generations although the current rate appears to be higher.

Based on the observations in the course of the pre-investment monitoring (see Appendix 3 and Appendix 4) in Spring Migration of 2016, only 4 individuals were found but outside of the investment site. Therefore a risk of significant negative impact of the Project on Eurasian oystercatcher is low.

European roller Coracias garrulous
The scale of impact of the farm on a given species in accordance with the Recommendations of European Commission of 2010.

According to the Recommendations of the European Commission, the species is not classified as remarkably susceptible to the operation of wind farms.

Justification of Red List Category[26]
This species has been downlisted to Least Concern. Although the population is still thought to be declining, the declines are not thought to be sufficiently rapid to warrant listing as Near Threatened. The European population is still thought to be declining but at a less severe rate and the Central Asian population is not thought to be declining significantly. Conservation actions in several countries have contributed to national recoveries.

Population justification
In Europe, the breeding population is estimated to number 75,000-158,000 mature individuals (BirdLife International 2015). The European population is thought to hold around 40% of the global breeding range therefore a very approximate estimate of the global population is 188,000-395,000 mature individuals or 282,000-593,000 individuals. Here placed in the band 100,000-499,999 mature individuals and 200,000-600,000 individuals.

[26] http://datazone.birdlife.org/species/factsheet/european-roller-coracias-garrulus/text

Trend justification

The species was previously thought to be undergoing sharp declines in Europe, however new data compiled for the 2015 European Red List of Birds suggests that the population is declining at a less severe rate, with the breeding population decreasing by c. 5-20% over three generations (16.8 years) (however many national populations in central and eastern Europe are still declining) (BirdLife International 2015). Negative trends are still reported for northern European populations such as Lithuania as well as Latvia, Poland, Belarus and Estonia (L. Raudonikis in litt. 2015). Some southern European populations have also declined: in the past century, the species has gone extinct in Germany, Denmark, Sweden (Snow & Perrins, 1998) and Finland (Avilés et al. 1999), possibly due to habitat loss as a result of agricultural intensification (Snow & Perrins 1998). In Central Europe, extinctions occurred in some areas around 25 years ago with no evidence of recolonization (M. Vogrin in litt. 2015).

It is thought to be relatively common in Tajikistan (D. Ewbank in litt. 2015) and in Central Asia (Afghanistan, Kazakhstan, Krygystan, Tajikistan, Turkmenistan and Uzbekistan) an analysis of observations of this species suggests that a strong or moderate decline is unlikely whilst a weaker decline cannot be excluded due to limitations in the data (R. Ayé in litt. 2015). The species is considered common in Uzbekistan by ornithologists however significant habitat loss has occurred suggesting the species may be declining (R. Kashkarov in litt. 2015). Populations in the Middle East have not apparently exhibited declines. Europe holds approximately 40% of the global breeding range, considering new information from Central Asia which suggests the species has not declined significantly and assuming that populations in the Middle East and north-west Africa have also not declined significantly since they were last assessed, the population is not thought to be undergoing significant declines.

Based on the observations in the course of the pre-investment monitoring (see Appendix 3 and Appendix 4) in Autumn Migration of 2016, only 2 individuals were found inside the investment site. Therefore a risk of significant negative impact of the Project on European roller is low.

Glossy ibis Plegadis falcinellus

The scale of impact of the farm on a given species in accordance with the Recommendations of European Commission of 2010.

According to the Recommendations of the European Commission, the species is not classified as remarkably susceptible to the operation of wind farms.

Justification of Red List Category[27]

This species has an extremely large range, and hence does not approach the thresholds for Vulnerable under the range size criterion (Extent of Occurrence <20,000 km2 combined with a declining or fluctuating range size, habitat extent/quality, or population size and a small number of locations or severe fragmentation). Despite the fact that the population trend appears to be decreasing, the decline is not believed to be sufficiently rapid to approach the thresholds for Vulnerable under the population trend criterion (>30% decline over ten years or three generations). The population size is extremely large, and hence does not approach the thresholds for Vulnerable under the population size criterion (<10,000 mature individuals with a continuing decline estimated to be >10% in ten years or three generations, or with a specified population structure). For these reasons the species is evaluated as Least Concern.

Population justification

The global population is estimated at 230,000-2,220,000 individuals (Wetlands International 2015). The European population is estimated at 28,300-37,700 pairs, which equates to 56,500-75,400 mature individuals (BirdLife International 2015). The population is therefore placed in the band 200,000-2,300,000 individuals.

[27] http://datazone.birdlife.org/species/factsheet/glossy-ibis-plegadis-falcinellus/text

Trend justification

The overall population trend is decreasing, although some populations have stable trends (Wetlands International 2015). This species has undergone a large and statistically significant increase over the last 40 years in North America (3,800% increase over 40 years, equating to a 150% increase per decade; data from Breeding Bird Survey and/or Christmas Bird Count: Butcher and Niven 2007) Note, however, that these surveys cover less than 50% of the species's range in North America. In Europe the population size is estimated to be increasing (BirdLife International 2015).

Based on the observations in the course of the pre-investment monitoring (see Appendix 3 and Appendix 4) in 2016 only 8 individuals were found but outside of the investment site. Therefore a risk of significant negative impact of the Project on Glossy ibis is low.

Great Crested Grebe *Podiceps cristatus*

IBA, where the species is the subject of protection: UA071 Molochnyj Liman – Population estimate 5 000-12 000 individuals

According to the Recommendations of the European Commission, the species is not classified as remarkably susceptible to the operation of wind farms.

Justification of Red List Category[28]

This species has an extremely large range, and hence does not approach the thresholds for Vulnerable under the range size criterion (Extent of Occurrence <20 000 km^2 combined with a declining or fluctuating range size, habitat extent/quality, or population size and a small number of locations or severe fragmentation). The population trend is not known, but the population is not believed to be decreasing sufficiently rapidly to approach the thresholds under the population trend criterion (>30% decline over ten years or three generations). The population size is very large, and hence does not approach the thresholds for Vulnerable under the population size criterion (<10 000 mature individuals with a continuing decline estimated to be >10% in ten years or three generations, or with a specified population structure). For these reasons the species is evaluated as Least Concern according to Global IUCN Red List Category.

Population justification

The global population is estimated to number c. 915 000 – 1 400 000 individuals (Wetlands International 2015). The European population is estimated at 330 000 - 498 000 pairs, which equates to 660 000 - 997 000 mature individuals (BirdLife International, 2015).

Trend justification

The overall population trend is uncertain, as some populations are decreasing, while others are increasing or have unknown trends (Wetlands International 2015). In Europe the population is estimated to be declining moderately rapidly (BirdLife International, 2015), (EBCC, 2015).

Observations in the course of pre-investment monitoring and assessment (data taken from Appendix 3 and Appendix 4):

In the course of monitoring-oriented undertakings carried out in 2016, 5 birds of the said species were seen during their spring migration. During autumn, 30 of them were identified. All of the representatives of the species in question were seen outside of the area of the planned wind farm. In August, 17 Great Crested Grebes were seen on water area of the upper part of the Molochnyi Estuary near to Girsivka Village. In the case of some of them, their flight height was identified – Great Credtes Grebes travelled from 0 to 10 m from the ground and were heading south.

[28] http://www.birdlife.org/datazone/species/factsheet/22696602

Monitoring undertakings assessing the possibility of 330kV power line construction proved that all the Great Crested Grebes were seen in adjacent territories. In spring, there were 5 of them, 17 in summer, and 5 in autumn.
While taking into account the flight path height and travelling outside the area of the wind farm, it is not expected that the wind farm and 330 kV would endanger the well-being of Great Crested Grebes, being a protected species in IBA UA071 Molochnyj Liman.

Grey Heron Ardea cinerea
IBA, where the species is the subject of protection:
- UA071 Molochnyj Liman – Population estimate 4 500 - 6 000 individuals

The scale of impact of the farm on a given species in accordance with the Recommendations of European Commission of 2010.

According to the Recommendations of the European Commission, the species is not classified as remarkably susceptible to the operation of wind farms.

Justification of Red List Category[29]
This species has an extremely large range, and hence does not approach the thresholds for Vulnerable under the range size criterion (Extent of Occurrence <20,000 km2 combined with a declining or fluctuating range size, habitat extent/quality, or population size and a small number of locations or severe fragmentation). The population trend is not known, but the population is not believed to be decreasing sufficiently rapidly to approach the thresholds under the population trend criterion (>30% decline over ten years or three generations). The population size is very large, and hence does not approach the thresholds for Vulnerable under the population size criterion (<10,000 mature individuals with a continuing decline estimated to be >10% in ten years or three generations, or with a specified population structure). For these reasons the species is evaluated as Least Concern.

Population justification
The global population is estimated to number c.790,000-3,700,000 individuals (Wetlands International 2015). The European population is estimated at 223,000-391,000 pairs, which equates to 447,000-782,000 mature individuals (BirdLife International 2015). National population estimates include: c.100,000-1 million breeding pairs and >c.10,000 individuals on migration in China; c.100-10,000 breeding pairs and c.1,000-10,000 wintering individuals in Korea; c.100,000-1 million breeding pairs and >c.10,000 wintering individuals in Japan and c.100,000-1 million breeding pairs and >c.10,000 individuals on migration in Russia (Brazil 2009).

Trend justification
The overall population trend is uncertain, as some populations are decreasing, while others are stable, increasing or have unknown trends (Wetlands International 2015). A moderate increase between 1980 and 2013 has been estimated for the European population (EBCC 2015). However the European breeding population is thought to have undergone a short-term decline between 2000 and 2012 (BirdLife International 2015).

Based on the observations in the course of the pre-investment monitoring (see Appendix 3 and Appendix 4) in nesting period of 2016 only 3 individuals were found but outside of the investment site. Therefore a risk of significant negative impact of the Project on Grey heron is low.

Grey partridge *Perdix perdix*
The scale of impact of the farm on a given species in accordance with the Recommendations of European Commission of 2010.

[29] http://datazone.birdlife.org/species/factsheet/grey-heron-ardea-cinerea/text

According to the Recommendations of the European Commission, the species is not classified as remarkably susceptible to the operation of wind farms.

Justification of Red List Category[30]
This species has an extremely large range, and hence does not approach the thresholds for Vulnerable under the range size criterion (extent of occurrence <20,000 km2 combined with a declining or fluctuating range size, habitat extent/quality, or population size and a small number of locations or severe fragmentation). Despite the fact that the population trend appears to be decreasing, the decline is not believed to be sufficiently rapid to approach the thresholds for Vulnerable under the population trend criterion (>30% decline over ten years or three generations). The population size is extremely large, and hence does not approach the thresholds for Vulnerable under the population size criterion (<10,000 mature individuals with a continuing decline estimated to be >10% in ten years or three generations, or with a specified population structure). For these reasons the species is evaluated as Least Concern.

Population justification
The European population is estimated at 1,380,000-2,670,000 pairs, which equates to 2,750,000-5,340,000 mature individuals (BirdLife International 2015). Europe forms approximately 70% of the global range, so a revised estimate of the global population size is 3,900,000-7,600,000 individuals, although further validation of this estimate is needed.

Trend justification
The population is estimated to be in overall decline. It has suffered marked declines in all parts of its native range owing to habitat loss and degradation caused by agricultural intensification and loss of insect prey caused by pesticides (McGowan and Kirwan 2013). This corresponds well with the strong long-term (1980-2013) decline reported for the European population by the Pan-European Common Bird Monitoring Scheme (EBCC 2015) and the <25% decline in the European population over three generations (11.7 years) reported by the 2015 European Red List of Birds (BirdLife International 2015).

Based on the observations in the course of the pre-investment monitoring (see Appendix 3 and Appendix 4) in 2016 numerous individuals were found at the Project site but almost all of them were staying on the ground. Therefore a risk of significant negative impact of the Project on Grey partridge is low.

Hen harrier Circus cyaneus
According to the Recommendations of the European Commission:

Disturbance displacement	Collision	Barrier to movement	Direct habitat loss/damage
XX	X	x	

XXX = Evidence of significant impact,

XX = proof or indiciations posing a siginificant threat,

X = potential threats

x = minor or insignificant threat

Justification of Red List Category[31]
This species has an extremely large range, and hence does not approach the thresholds for Vulnerable under the range size criterion (extent of occurrence <20,000 km2 combined with a declining or fluctuating range size, habitat extent/quality, or population size and a small number of locations or severe fragmentation). The population size has not been quantified, but it is not believed to approach the thresholds for Vulnerable under the population size criterion (<10,000 mature individuals with a continuing decline estimated to be >10% in ten years or three generations, or with a specified population structure). The population trend is not known, but the

[30] http://datazone.birdlife.org/species/factsheet/grey-partridge-perdix-perdix/text
[31] http://datazone.birdlife.org/species/factsheet/hen-harrier-circus-cyaneus/text

population is not believed to be decreasing sufficiently rapidly to approach the thresholds under the population trend criterion (>30% decline over ten years or three generations). For these reasons the species is evaluated as Least Concern.

Population justification
The European population is estimated at 30,000-54,400 breeding females, which equates to 60,000-109,000 mature individuals (BirdLife International 2015). Europe forms approximately 34% of the global range, so a very preliminary estimate of the global population size is 176,000-321,000 mature individuals, although further validation of this estimate is needed. It is placed in the band 100,000 to 499,999 mature individuals.

Trend justification
The population trend is difficult to determine because of uncertainty over the impacts of habitat modification on population sizes. However in Europe the population size is estimated and projected to be decreasing at a rate approaching 30% over the period from 2000, when the decline is estimated to have started in Russia, which holds 70% of the European population, to 2024 (three generations) (BirdLife International 2015).

Based on the observations in the course of the pre-investment monitoring (see Appendix 3 and Appendix 4), one individual was registered at a territory adjacent to the Project site in thw einter period of 2016. Possibility of this specie migrations to the wind farm territory is extremely low due to unsatisfactory state of forage resources for birds of prey. Negative impact of the wind farm shall be characterized as low.

Long-legged buzzard Buteo rufinus
According to the Recommendations of the European Commission (data used for Buteo buteo):

Disturbance displacement	Collision	Barrier to movement	Direct habitat loss/damage
x	XX	x	

XXX = Evidence of significant impact,
XX = proof or indiciations posing a siginificant threat,
X = potential threats
x = minor or insignificant threat

Justification of Red List Category[32]
This species has an extremely large range, and hence does not approach the thresholds for Vulnerable under the range size criterion (extent of occurrence <20,000 km2 combined with a declining or fluctuating range size, habitat extent/quality, or population size and a small number of locations or severe fragmentation). The population trend appears to be fluctuating, and hence the species does not approach the thresholds for Vulnerable under the population trend criterion (>30% decline over ten years or three generations). The population size has not been quantified, but it is not believed to approach the thresholds for Vulnerable under the population size criterion (<10,000 mature individuals with a continuing decline estimated to be >10% in ten years or three generations, or with a specified population structure). For these reasons the species is evaluated as Least Concern.

Population justification
The European population is estimated at 11,800-19,200 pairs, which equates to 23,700-38,400 mature individuals (BirdLife International 2015). Europe forms approximately 17% of the global range, so a very preliminary estimate of the global population size is 139,000-226,000 mature individuals, although further validation of this estimate is needed. It is placed in the band 100,000 to 499,999 mature individuals.

Trend justification

[32] http://datazone.birdlife.org/species/factsheet/long-legged-buzzard-buteo-rufinus/text

The population is suspected to fluctuate in response to vole populations (Ferguson-Lees and Christie 2001). The European trend is currently estimated to be increasing (BirdLife International 2015) however accounting for fluctuations the global population trend for this species is estimated to be stable.

Based on the observations in the course of pre-investment monitoring and assessment (see Appendix 3 and Appendix 4), Long-legged buzzard was registered but has not nested at the Project site. A risk for this specie is assessed as low.

Mallard *Anas platyrhynchos*
IBA, where the species is the subject of protection: UA071 Molochnyj Liman – Population estimate 25 000-30 000 individuals

According to the Recommendations of the European Commission, the species is not classified as remarkably susceptible to the operation of wind farms.

Justification of Red List Category[33]
This species has an extremely large range, and hence does not approach the thresholds for Vulnerable under the range size criterion (Extent of Occurrence <20 000 km^2 combined with a declining or fluctuating range size, habitat extent/quality, or population size and a small number of locations or severe fragmentation). The population trend appears to be increasing, hence the species is not thought to approach the thresholds for Vulnerable under the population trend criterion (>30% decline over ten years or three generations). The population size is extremely large, and hence does not approach the thresholds for Vulnerable under the population size criterion (<10 000 mature individuals with a continuing decline estimated to be >10% in ten years or three generations, or with a specified population structure). For these reasons the species is evaluated as Least Concern according to Global IUCN Red List Category.

Population justification
The global population is estimated to number > c.19 000 000 individuals (Wetlands International, 2015). The European population is estimated at 2 850 000 - 4 610 000 pairs, which equates to 5 700 000 – 9 220 000 mature individuals (BirdLife International, 2015).

Trend justification
The overall population trend is increasing, although some populations may be stable, fluctuating, decreasing, and others have unknown trends (Wetlands International, 2015). This species has undergone a large and statistically significant increase over the last 40 years in North America (99.3% increase over 40 years, equating to a 18.8% increase per decade; data from Breeding Bird Survey and/or Christmas Bird Count: [Butcher and Niven 2007]) and in 2015 the species's abundance was 51% above the long-term average for the period 1955-2014 (Zimpfer, N.L., Rhodes, W.E., Silverman, E.D., Zimmerman, G.S. and Richkus, K.D., 2015). In Europe the population size is estimated to be stable (Wetlands International, 2015).

Observations in the course of pre-investment monitoring and assessment (data taken from Appendix 4):

In January and from March to April 2016, there were 51 Mallards seen in the adjacent areas. What is more, in summer, there were Mallards (8 birds) outside the area of the planned wind farm (on the pond in Oleksandrivka Village). In autumn, 157 birds were seen in the adjacent areas. Mallards were seen flying at the height of 0 to 50 meters in the buffer area, heading north.
In view of the height in the buffer area, there is no possibility of significant adverse effects of the wind farm on protected Mallards in IBA UA071 Molochnyj Liman.

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[33] http://www.birdlife.org/datazone/species/factsheet/22680186

Mute Swan *Cygnus olor*

IBA, where the species is the subject of protection:

- UA071 Molochnyj Liman – Population estimate 2 000-5 000 individuals,
- UA070 Utlyuk lyman – Population estimate 11 000-16 000 individuals.

According to the Recommendations of the European Commission, the species is not classified as remarkably susceptible to the operation of wind farms.

Justification of Red List Category[34]

This species has an extremely large range, and hence does not approach the thresholds for Vulnerable under the range size criterion (Extent of Occurrence <20 000 km^2 combined with a declining or fluctuating range size, habitat extent/quality, or population size and a small number of locations or severe fragmentation). The population trend appears to be increasing, and hence the species does not approach the thresholds for Vulnerable under the population trend criterion (>30% decline over ten years or three generations). The population size is very large, and hence does not approach the thresholds for Vulnerable under the population size criterion (<10 000 mature individuals with a continuing decline estimated to be >10% in ten years or three generations, or with a specified population structure). For these reasons the species is evaluated as Least Concern according to Global IUCN Red List Category.

Population justification

The global population is estimated to number approximately c. 598 000 – 615 000 individuals (Wetlands International 2015). The European population is estimated at 83 400 – 116 000 pairs, which equates to 167 000 – 231 000 mature individuals (BirdLife International, 2015).

Trend justification

The overall population trend is increasing, although some populations have unknown trends (Wetlands International 2015). The European population is estimated to be increasing (BirdLife International, 2015), (EBCC, 2015).

Observations during the pre-investment monitoring and evaluation (data taken from Appendix 3 and Appendix 4):

13 species were found in the spring 2016 outside the area of the planned farm. In July, the 4 mute swans have been observed on the lower part of the Molochnyi Estuary and offshore strip of the Sea of Azov. The flight altitudes for 5 species have been established. The mute swan usually flew at height of 25-50 m above the ground and kept going west.
In January 27 in adjacent areas to the planned 330 kV line were found 51 species, 27 i in spring and 150 in autumn.
Therefore, there is no expected interference of the wind farm and 330kV line to be built with the mute swan, being a protected species in IBA UA072 Molochna Liman oraz IBA UA070 Utlyuk lyman.

Northern lapwing *Vanellus vanellus*

According to the Recommendations of the European Commission:

Disturbance displacement	Collision	Barrier to movement	Direct habitat loss/damage
XX	X	x	

XXX = Evidence of significant impact,

XX = proof or indiciations posing a siginificant threat,

X = potential threats

x = minor or insignificant threat

[34] http://www.birdlife.org/datazone/species/factsheet/22679839

Justification of Red List Category
This species is suspected to be decreasing at a moderately rapid rate. It is therefore classified as Near Threatened. Should new information suggest these declines are occurring more rapidly it would warrant uplisting; it almost meets the requirements for listing as threatened under criteria A2abce+3bce+4abce.

Population justification
The global population is estimated to number c. 5,600,000-10,500,000 individuals (Wetlands International 2012). The European population is estimated at 1,590,000-2,580,000 pairs, which equates to 3,190,000-5,170,000 mature individuals (BirdLife International 2015).

Trend justification
The overall population trend is decreasing, although some populations have unknown trends (Wetlands International 2015). In Europe, trends since 1980 show that populations have undergone a moderate decline ($p<0.01$), based on provisional data for 21 countries from the Pan-European Common Bird Monitoring Scheme (EBCC/RSPB/BirdLife/Statistics Netherlands; P. Vorisek in litt. 2008); this is supported by recent data from Europe, suggesting the European population is decreasing by 30-49% in 27 years (three generations) (BirdLife International 2015). A strong decline is also reported for the European and western Asian population between 1988 and 2012, based on annual mid-winter counts (Nagy et al. 2014). No recent trend data is available for the two other flyway populations (breeding in southern Russia, Kazakhstan, Mongolia and northern China and wintering in southern and eastern Asia [Wetlands International 2015]).

During the pre-investment monitoring in 2016 (see Appendix 3 and Appendix 4) Northern lapwing buzzard was registered but did not nest at the Project site of Wind Park. A risk posed by the Project to this specie is evaluated as low.

Pied Avocet *Recurvirostra avosetta*
IBA, where the species is the subject of protection: UA071 Molochnyj Liman – Population estimate 50-250 breeding pairs,
According to the Recommendations of the European Commission, the species is not classified as remarkably susceptible to the operation of wind farms.

Justification of Red List Category[35]
This species has an extremely large range, and hence does not approach the thresholds for Vulnerable under the range size criterion (Extent of Occurrence <20 000 km^2 combined with a declining or fluctuating range size, habitat extent/quality, or population size and a small number of locations or severe fragmentation). The population trend is not known, but the population is not believed to be decreasing sufficiently rapidly to approach the thresholds under the population trend criterion (>30% decline over ten years or three generations). The population size is very large, and hence does not approach the thresholds for Vulnerable under the population size criterion (<10 000 mature individuals with a continuing decline estimated to be >10% in ten years or three generations, or with a specified population structure). For these reasons the species is evaluated as Least Concern according to Global IUCN Red List Category.

Population justification
The global population is estimated to number c. 280 000 - 470 000 individuals (Wetlands International 2015). The European population is estimated at 58 400 - 74 300 pairs, which equates to 117 000 - 149 000 mature individuals (BirdLife International, 2015)

[35] http://datazone.birdlife.org/species/factsheet/pied-avocet-recurvirostra-avosetta/text

Trend justification
The overall population trend is uncertain, as some populations are decreasing, while others are increasing, stable, or have unknown trends (Wetlands International, 2015). In Europe the population size is estimated to be fluctuating (BirdLife International, 2015)

Observations during the pre-investment monitoring and evaluation (data taken from Appendix 3 and Appendix 4):

Pied avocet – *Recurvirostra avosetta* listed in the Red Data Book of Ukraine were recorded in the researched territory. Specie found in spring 28 times. All birds are out of the investment area. 10 individuals flew at a height of 0-10 m. 80% of individuals flew north and 20% west.
In the spring of 2016, 7 individuals were observed in the adjacent territories of 330 kV line.
Therefore, there is no expected interference of the wind farm and 330kV line to be built with the pied avocet being a protected species in IBA UA071 Molochnyj Liman.

Red-footed falcon *Falco vespertinus*
The scale of impact of the farm on a given species in accordance with the Recommendations of European Commission of 2010.

According to the Recommendations of the European Commission, the species is not classified as remarkably susceptible to the operation of wind farms.

Justification of Red List Category[36]
This species is listed as Near Threatened because it is experiencing a moderately rapid population decline, owing to habitat loss and degradation. This species would qualify for uplisting to a higher threat category if evidence suggests a rapid population decline.

Population justification
The global population is estimated to number 300,000-800,000 individuals, with 30,000-64,000 pairs in Europe (BirdLife International 2015).

Trend justification
The population is suspected to be in decline owing to ongoing habitat destruction. The European population (forming c.40% of the global population) is estimated to be decreasing at a rate approaching 30% in 17.1 years (three generations) (BirdLife International 2015).

During observations of 2016 monitorig (see Appendix 3 and Appendix 4) only one nesting couple was observed at the Project site. A risk posed by the Project to this specie is assessed as low as all individuals were recorded flying maximum 50 m above ground.

Scaup *Aythya marila*
IBA, where the species is the subject of protection:
- UA071 Molochnyj Liman – Population estimate 80 000-100 000 individuals,
- UA070 Utlyuk lyman – Population estimate 2 000-3 000 individuals.

Justification of Red List Category[37]
This species has an extremely large range, and hence does not approach the thresholds for Vulnerable under the range size criterion (Extent of Occurrence <20 000 km^2 combined with a declining or fluctuating range size, habitat extent/quality, or population size and a small number of locations or severe fragmentation). Although the population may be decreasing, the decline is not believed to be sufficiently rapid to approach the thresholds for Vulnerable under the population trend criterion (>30% decline over ten years or three generations). The population size is

[36] http://datazone.birdlife.org/species/factsheet/red-footed-falcon-falco-vespertinus/text
[37] http://www.birdlife.org/datazone/species/factsheet/22680398

extremely large, and hence does not approach the thresholds for Vulnerable under the population size criterion (<10 000 mature individuals with a continuing decline estimated to be >10% in ten years or three generations, or with a specified population structure). For these reasons the species is evaluated as Least Concern according to Global IUCN Red List Category.

Population justification
The global population is estimated to number c. 4 920 000 – 5 130 000 individuals (Wetlands International 2016). The breeding population in Europe is estimated at 134 000 – 178 000 pairs, which equates to 269 000 – 355 000 mature individuals (BirdLife International, 2015).

Trend justification
The overall population trend is decreasing, although some populations may be stable or have unknown trends (Wetlands International, 2015). This species underwent a significant population increase between 1974 and 2011 in North America (Zimpfer 2011, T. McCoy in litt. 2012). In Europe the breeding population size is estimated to be decreasing by less than 25% in 24.6 years (three grenerations) (BirdLife International, 2015).

Observations during the pre-investment monitoring and evaluation (data taken from Appendix 3 and Appendix 4):
In January, 2016 we found 20 individuals outside an investment wind farm and the same individuals outside the planned line of 330 kV, and therefore it does not provide for the possibility of significant negative impact of the wind farm and power line 330 kV Scaup, which is the subject of protection of the IBA Molochnyj Liman UA071 and UA070 IBA Utlyuk Lyman.

Stock pigeon *Columba oenas*
The scale of impact of the farm on a given species in accordance with the Recommendations of European Commission of 2010.
According to the Recommendations of the European Commission, the species is not classified as remarkably susceptible to the operation of wind farms.

Justification of Red List Category[38]
This species has an extremely large range, and hence does not approach the thresholds for Vulnerable under the range size criterion (Extent of Occurrence <20,000 km2 combined with a declining or fluctuating range size, habitat extent/quality, or population size and a small number of locations or severe fragmentation). The population trend appears to be increasing, and hence the species does not approach the thresholds for Vulnerable under the population trend criterion (>30% decline over ten years or three generations). The population size is extremely large, and hence does not approach the thresholds for Vulnerable under the population size criterion (<10,000 mature individuals with a continuing decline estimated to be >10% in ten years or three generations, or with a specified population structure). For these reasons the species is evaluated as Least Concern.

Population justification
The European population is estimated at 561,000-1,040,000 pairs, which equates to 1,120,000-2,070,000 mature individuals (BirdLife International 2015). Europe forms c.80% of the global range, so a very preliminary estimate of the global population size is 1,400,000-2,600,000 mature individuals, although further validation of this estimate is needed.

Trend justification
In Europe the overall trend from 1980-2013 shows a moderate increase (EBCC 2015).

Observations during the pre-investment monitoring and evaluation (data taken from Appendix 3 and Appendix 4):

[38] http://datazone.birdlife.org/species/factsheet/stock-dove-columba-oenas/text

The species was register in Autumn migration 2016. The possibility of loss of certain protected species, which is caused by the Wind Park construction, is extremely low. All individuals was recorded flying maximum 50 m above ground.

White-tailed eagle Haliaeetus albicilla

According to the Recommendations of the European Commission:

Disturbance displacement	Collision	Barrier to movement	Direct habitat loss/damage
XXX	XXX		

XXX = Evidence of significant impact,

XX = proof or indiciations posing a siginificant threat,

X = potential threats

x = minor or insignificant threat

Justification of Red List Category[39]

This species has an extremely large range, and hence does not approach the thresholds for Vulnerable under the range size criterion (extent of occurrence <20,000 km2 combined with a declining or fluctuating range size, habitat extent/quality, or population size and a small number of locations or severe fragmentation). The population trend appears to be increasing, and hence the species does not approach the thresholds for Vulnerable under the population trend criterion (>30% decline over 10 years or three generations). The population size may be moderately small to large, but it is not believed to approach the thresholds for Vulnerable under the population size criterion (<10,000 mature individuals with a continuing decline estimated to be >10% in 10 years or three generations, or with a specified population structure). For these reasons the species is evaluated as Least Concern.

Population justification

In Europe, the breeding population is estimated to number 9,000-12,300 breeding pairs, equating to 17,900-24,500 mature individuals (BirdLife International 2015). Europe forms 50-74% of the global range, so a very preliminary estimate of the global population size is 24,200-49,000 mature individuals, although further validation of this estimate is needed. It is placed in the band 20,000-49,999 mature individuals.

Trend justification

The population is increasing locally owing to conservation measures such as protecting eyries, providing safe (non-poisoned) food and re-introductions to certain areas such as Bavaria (Ferguson-Lees and Christie 2001). The European population is increasing (BirdLife International 2015).

According to the observations in the course of pre-investment monitoring (see Appendix 3 and Appendix 4), one indywidual was registered within the territories adjacent to the wind park site and one was registered within the territories adjacent to the PTL in the winter period of 2016. Possibility of their feeding migrations to the wind park territory is extremely low due to unsatisfactory state of forage resources for birds of prey. Negative impact of the wind park shall be characterized as low.

6.6.3.2 Bats

In the vicinity of the planned wind farm and overhead power line there are no areas where bats are the subject of protection.

12 bat species, which may occur within the sites of the wind farm, buffer zones and in the adjacent territories according to results of preliminary researches, observations in August - September 2016, as well as according to literature data, are included in Table 37. Seven species out of twelve ones were identified by the voices and had been found in the course of investigations in 2016.

[39] http://datazone.birdlife.org/species/factsheet/white-tailed-sea-eagle-haliaeetus-albicilla/text

Only giant noctule (Nyctalus lasiopterus) out of the list of the species of the north-western Azov Sea region is listed in the international Red Lists, which has not been registered according to results of researches in August - September 2016. In accordance with the European Red List there is not enough information about distribution and biology of this species (DD category – data deficient).

All 12 species are listed in the Bern Convention (on the Conservation of European Wild Flora and Fauna and Natural Habitats) and in the Bonn Convention (on the Conservation of Migratory Species of Wild Animals). Almost all of them, according to Annex 2 of the Bern Convention are subject to special protection, and in accordance with Annex 2 of the Bonn Convention their state is estimated as unfavourable, preservation and regulation of using which needs international agreements.

Among 7 bat species, which have been registered in August - October 2016, 5 species pertain to vulnerable category, and status of Nathusius' pipistrelle and pygmy pipistrelle is unrated owing to lack of information (Table 37).

Table 37. Bats of the North-Western Azov Sea Region in the Conservation Lists of National and International Level*

No.	Species	Categories					
		RDBU	IUCN	ERL	BC	BO	WA
1	Whiskered bat *Myotis mystacinus* Kuhl, 1817	VU	–	–	2	2	–
2	Common long-eared bat *Plecotus auritus* Linnaeus, 1758	VU	–	–	2	2	–
3	Grey long-eared bat *Plecotus austriacus* Fischer, 1829	RARE	–	–	2	2	–
4	Lesser noctule *Nyctalus leisleri* Kuhl, 1817	RARE	–	–	2	2	–
5	Giant noctule *Nyctalus lasiopterus* Schreber, 1780	EN	NT	DD	2	2	–
6	Common noctule *Nyctalus noctula* Schreber, 1774	VU	–	–	2	2	–
7	Kuhl's pipistrelle *Pipistrellus kuhlii* Kuhl, 1817	VU	–	–	2	2	–
8	Nathusius' pipistrelle *Pipistrellus nathusii* Keyserling et Blasius, 1839	UR	–	–	2	2	–
9	Pygmy pipistrelle *Pipistrellus pygmaeus* Leach, 1825	UR			2	2	–
10	Common pipistrelle *Pipistrellus pipistrellus* Schreber, 1774	VU	–	–	3	2	–
11	Parti-coloured bat *Vespertilio murinus* Linnaeus, 1758	VU	–	–	2	2	–
12	Serotine bat *Eptesicus serotinus* Schreber, 1774	VU	–	–	2	2	–

Notes: [light blue box] – potential species that may be found in the region; [pink box] – species identified in the course of researches; **RDBU** – the Red Data Book of Ukraine [8]: **VU** – vulnerable; **EN** – endangered; **RARE** – rare; **UR** – unrated; **IUCN** – the Red List of the International Union for Conservation of Nature [9]: **NT** – near threatened; **ERL** – the European Red List: **DD** – data deficient [10]; **BC** – the Bern Convention 1979 [11]; Annex 2 includes species that are subject to special protection, 3 – subject to protection; **BO** – the Bonn Convention on the Conservation of Migratory Species of Wild Animals 1979 [12]: Annex 2 includes species, state of which is unfavourable, preservation and regulation of using which needs international agreements, as well as that species, state of which might be considerably improved as a result of international cooperation on the basis of international agreements; **WA** – the Washington Convention, **CITES** [13]; " – " – a species is not listed in the list.

Species composition of bats of the north-western Azov Sea region, in comparison with other natural zones, is the poorest one. Analysis of literature data and identification of sounds by means of ultrasonic detectors enables to assume that pipistrelles dominate in species composition of migrants, in particular, Kuhl's pipistrelles.

Species range is represented by taxons widely distributed in Ukraine. Lack of natural and artificial hiding places for troglophil group eliminates potential negative impact of construction and operation of the wind farm on species of endangered category.

Spatial distribution of migrants over the wind farm is uneven. Bats fly sparsely in a wide front. The highest intensity of passage has been recorded since the middle of August and till the middle of

September. We have revealed migration corridor, which pass over the water area of the Molochnyi Estuary and along the coast of the Sea of Azov.

We have not observed mass seasonal migrations, when bats fly in flock, like birds.

6.6.3.3 Habitats

The IBA areas closest to the Project are listed in chapter 6.6.2.
In the area of investment there no species and natural habitats protected by law were observed and therefore, there will be no impact on the protected subject of abovementioned IBA areas.

6.7 The Impact of the Project on Interrelationship of Environmental Components

The estimation of the impact of the investment on mutual relations between individual elements of environment is troublesome. The exploitation of the investment will not cause the pollution of atmosphere, which could lead to acid rains and result in environment condition deterioration. What is more, there are no interferences with the state of nearby water reservoirs which could pose a significant risk to animal habitats and water and mud reservoirs state. Therefore, it can be assumed that the realization of the undertaking will not remarkably affect relations between individual elements of the local environment.

While analyzing the impact of the investment on the local area, one can only identify short-term, reversible interferences of low intensity, especially at the stage of investment realization, which may modify relations between individual environmental features. The emission of dust-based pollution during groundwork execution may negatively influence the quality of air, which may in turn translate into a lower possibilities of vegetation development in nearby areas (stoma clogging that may decrease the effectiveness of photosynthesis).

Water excess removal may be connected with a temporal lowering of surface waterbed, which may in turn result in soil drying and vegetation condition decrease. The aforementioned process may also take place in a reverse order: the exposition of the outer layer of soil may cause its physical and chemical state deterioration, resulting in soil erosion process initiation or acceleration.

Yet another negative factor strictly connected with construction works is noise emission that may lower the overall acoustic climate, which may lead to an undesirable changes in habitation conditions. Animals may be scared off and indirectly forced to move somewhere else in search for calmer and more favorable areas, which would in turn decrease their local population.
It cannot be neglected that the construction of the wind farm in question will also be correlated with mechanical removal of vegetation which will be the result of the operation of heavy machinery and trucks movement. Cutting down trees located in the area is also possible. The degradation of the condition of vegetation may lead to the destruction of animal homes, as well as reproduction and hunting spots and therefore decrease the overall population of wild animals in the close vicinity of the farm.

Mutual relations between individual elements of the local environment may be also disturbed by an uncontrolled leaking of hazardous substances and their absorption by the soil, which could be a result of a machinery malfunction. The absorption of oil-related substances leaking from improperly operating construction machines would be highly troublesome. The migration of pollutants in the environment may cause soil condition deterioration, as well as the decrease in quality of both surface and underground waters. Such problems may also negatively affect people, animals, and vegetation.

Wind-based power generation is specific due to the mutual nullification of both positive and negative factors and their impact on the local environment.
Negative factors are as follows:

- Interference with the local landscape due to the introduction of new dominant elements in the form of wind turbines, which may cause a negative reaction of citizens living nearby;
- Potential negative impact on bats and birds;

- Emission of pollutants to the atmosphere during construction, exploitation, and liquidation phases; it may result in:
- temporal (construction phase) scaring off of animals from their habitats and hunting spots located nearby the wind farm construction site;
- temporal (construction phase) destruction of vegetation on the construction site (being an agricultural area as of now);
- short- and long-term nuisances (noise, dust generation during the construction phases) for nearby citizens.

Positive factors are as follows:

- Production of energy by means of utilization of a renewable source of energy (wind), being an alternative to conventional power plants emitting air polluting substances (including carbon dioxide, being one of most hazardous greenhouse gases). Greenhouse effect minimization and atmosphere protection.
- Long-term production of clean wind energy (for 25 to 30 years) which will translate into significant savings of fossil fuels and the limitation of atmosphere pollution resulting from fossil fuels excavation and exploitation;
- Investment will not result in the emission of pollutants to nearby water reservoirs and to the air, in the exploitation phase, the amount of waste generated will be marginal, especially while juxtaposing it with the amount generated by conventional power plants. Therefore, the investment will positively impact both biotic and abiotic elements of the environment.

The analysis of the scale of possible interferences and effects has shown that the overall outcome of the investment for the individual elements of the local environment will be positive (juxtaposition can be found in Chapter 6).

6.8 The Analysis of a Possible Serious Failure and its Impact on Environment

The impact of the investment on the environment discussed in the earlier part of Chapter 6 assumes the normal mode of operation of the wind farm. Within this section, the authors analyze the impact of possible malfunctions of turbines or the auxiliary infrastructure on the environment.

The aforementioned malfunctions should be understood mainly as emissions, fires, or explosions occurring during farm exploitation, material storage, or transportation, during which there is a direct emission of substances that may pose immediate threat to health and lives of nearby citizens or to the condition of the local environment.

The protection of the local environment against a serious malfunction should be predominantly oriented towards controlling aspects that may lead to it and towards the possible limitation of malfunction outcomes and their impact on people and environment. A serious malfunction may negatively interfere with: soil, surface waters, underground waters, air, and the health and lives of nearby citizens. The prevention of malfunction should be based on the protection of underground waters, water collection spots, and areas alike, mainly by isolating the designed objects from the ground, creating an effective and safe precipitation water removal system, as well as proper planning aiming at the prevention of emergency events. The latter should take place at all level of governmental and self-governmental administration.

The inevitability of natural disasters, as well as malfunctions of technical devices, installations, and means of transportation requires proper bodies to adopt protective measures aiming at the protection of the environment and people against their occurrence. The said fact should be also connected with more sensible and planned utilization of resources the aim of which is to prevent negative outcomes of malfunctions and disasters. Each industrial malfunction has its own, unique course and is characterized by a myriad of causes and effects. Events of the said type are often sudden and difficult to predict. Therefore, they should be to the greatest extent possible identified and accounted for at the stage of investment planning.

Stages of construction and liquidation

The main threat for the immediate surroundings and people living in areas neighboring with the investment will be the contamination of soil and underground waters with oil-like substances leaking from utilized machinery and vehicles. In order to prevent such leaks and minimize their possible negative impact, the following actions should be undertaken:

- Site welfare facilities should be located in enforced area that are additionally protected against soil and underground water contamination by oil-related substances,
- All possible works should be executed and managed by authorized individuals having a certificate confirming their qualifications,
- Only attested materials should be used to build the discussed objects and create auxiliary facilities,
- Construction and maintenance teams should be equipped with substances neutralizing oil-related substances. Construction workers should be obliged to fix all the identified leaks as soon as possible.

Exploitation stage

The local environment may be affected negatively at the stage of farm exploitation as a result of a fire, or an electric or mechanic malfunction of the WTG. Such occurrences may result in an uncontrolled emission of pollutants to soil, water, and air. Only an immediate and effective intervention can limit the scope of damages. Such unfavorable events can be prevented or to a greater extent controlled by means of:

- Maintaining devices and installations in a satisfactory condition,
- Performing systematic technical checks.

In an emergency situation (construction-related disaster) the construction of wind turbines may be destroyed (they may, for example, fall down). Such an event is, however, extremely unlikely, as the design of the turbines complies with all the durability and load-related norms. What is more, within the wind farm, only brand-new turbines will be installed and will be regularly monitored and maintained. A construction-related disaster may result in soil, as well as surface and underground waters contamination as a result of lubricant and oil leaks. It has to be pointed out that thanks to the properly designed servicing procedures, the aforementioned event is highly unlikely.

Due to their remarkable height, wind turbines may be struck by lightings. The edges of rotor blades are especially vulnerable. Generally, blades are very delicate and vulnerable, so in order for them to be utilized in an optimal manner, they have to be equipped with an anti-lighting installation. Otherwise, they can be easily destroyed, posing threat to environment and nearby citizens. Wind turbines installed within the scope of the investment will be equipped with such a system, which will protect all of the turbine, starting from foundations, up to rotor blade edges. The system will ensure that lightings are diverted from susceptible turbine elements and safely guided to the ground.

Wind-based power plants may also pose a threat to immediate surroundings (including citizens living nearby) due to the risk of occurrence of a mechanical malfunction of its structural elements. Therefore, a number of protective mechanisms will be introduced in the planned wind turbines in order to minimize the risk of the occurrence of such unfavorable events. One of the most important protective measures will be maintaining an optimal distance between wind turbines and built-up areas, as well as public roads. It has to be mentioned at this points that malfunctions in the form of bending or damaging of turbine elements are very unlikely and may happen only in the case of extreme weather conditions.

While introducing all of the aforementioned protective measures, the undertaking will not pose any threat to people and the local environment, as well as will not be dangerous for the immediate surrounding as all the fire and work safety principles will be followed by the employees trained to comply with them.

6.9 The Analysis of a Possible Transboundary Environmental Impact

While taking into account the specificity of the analyzed deelopment, namely the construction of the „wind farm" (incorporating 167 wind turbines of power of 3.45MW each) together with auxiliary infrastructure in the form of access road, land enforcement, transformer grid, and 330 kV overhead PTL in Zaporizhia Region, Priazovsk and Melitopol Districts, Zaporizhia Region, in Priazovsk and Melitopol Districts, in the village councils of Devninskoe, Dobrivka, Dunaevka, Girsivka, Mordvinivka and Nadeshdine, south-eastern Ukraine, the trans-border impact of the said undertaking on the environment will not be identified.

The minimal distance of the development from the closest borders (with Russia) is equal to 180 km. While taking into account the localization of the project and its maximal scope, it has been specified that the undertaking in question will affect nearby areas only and its possible interferences will not exceed the borders of Ukraine. What is more, the investment will not interfere with migration trails of birds.

7. THE DESCRIPTION OF PREDICTED MAJOR ENVIRONMENTAL IMPACTS OF THE UNDERTAKING INCLUDING DIRECT, INDIRECT, SECONDARY, CUMULATED, SHORT-, MID- AND LONG-TERM, PERMANENT AND MOMENTARY IMPACTS

The description of predicted environmental impacts is presented in Table 38 below.

Table 38. Classification of environmental impacts of the planned undertaking, including potentially major

Component	wind farm, MTS									Overhead Power Transmission Line 330 kV								
	IMPACT									IMPACT								
	direct	indirect	secondary	Short-term	Mid-term	Long-term	momentary	periodic	permanent	direct	indirect	secondary	Short-term	Mid-term	Long-term	momentary	periodic	permanent
THE STAGE OF CONSTRUCTION/LIQUIDATION																		
IBA sites	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fauna and flora	X	X		X				X		X	X		X				X	
People	X			X			X			X			X			X		
Surface waters and groundwater	X			X				X		X			X				X	
Air	X			X				X		X			X				X	
Acoustic climate	X			X				X		X			X				X	
Generation of electromagnetic fields	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soil surface	X			X					X	X			X					X
Landscape	X				X		X			X				X		X		
Cultural goods and historic monuments	X					X			X	X					X			X
Material goods	X			X					X	X			X					X
THE STAGE OF EXPLOITATION																		
IBA sites	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fauna and flora	X	X				X		X		X	X				X		X	
People		X				X			X		X				X			X
Surface waters and groundwater		X				X			X		X				X			X
Air		X				X			X		X				X			X

	wind farm, MTS									Overhead Power Transmission Line 330 kV								
Component	IMPACT									IMPACT								
	direct	indirect	secondary	Short-term	Mid-term	Long-term	momentary	periodic	permanent	direct	indirect	secondary	Short-term	Mid-term	Long-term	momentary	periodic	permanent
Acoustic climate	X					X			X	X					X			X
Generation of electromagnetic fields	X					X			X	X					X			X
Soil surface	X			X			X			X			X			X		
Landscape	X					X			X	X					X			X
Cultural goods and historic monuments	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Material goods	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

8. DESCRIPTION OF METHODS OF PREDICTION AND PREDICTED MAJOR ENVIRONMENTAL IMPACTS

No major environmental impacts of the planned development is predicted resulting from: the existence of the development itself, use of environmental resources and emissions.

The environmental impact assessment at particular stages of the project has been conducted on the basis of prediction methods by analogy, expert prediction methods, and cartographic analysis methods. Acoustic and shadow flicker calculations have been conducted with the use of the WindPro program.

In chapter 6 of the report the detailed analysis of the impact of the subject investment (including major impacts) have been presented. The analysis has not shown a negative major impact of the subject development on the environment. Nature examinations conducted for the needs of the report have excluded a possibility of a negative major impact of the wind farm on the environment, providing that preventive measures for reducing a negative impact are applied.

The energy production from wind farms is clear, the so called “zero emission” source of energy generation. This means that no greenhouse gases are produced by the WTGs during energy production, they are generated during combustion of the fossil fuels in conventional sources of energy generation (power plants and heat and power plants).

9. PREDICTED MEASURES FOR PREVENTION, REDUCTION AND NATURE COMPENSATION OF NEGATIVE ENVIRONMENTAL IMPACTS

Description of predicted environmental impacts is provided in chapter 6. Below, the measures for prevention, reduction and nature compensation of negative environmental impacts are summarized..

9.1 The Stage of Realization

At the stage of the realization:

- Construction and assembly work, connected with the realization of the planned undertaking and transportation of construction materials will be conducted mainly during the day, that is between 06:00 and 22:00 hrs excluding periods of construction, which from a technological point of view is required continuity of works and excluding the transport of wind turbines (oversized).
- Exploitation and parking of mechanical equipment indispensable for the realization of the undertaking will be conducted so as to eliminate the possibility of soil pollution and groundwater with petroleum products.
- During the realization of the undertaking, nuisance to people and environment will be reduced by ensuring the efficient traffic organization of transportation vehicles, the right organization of construction sites and by ensuring supervision over the work of construction machines.
- The construction time of particular investment stages will be reduced to an indispensable minimum by the proper planning of construction process.
- Earth masses will be used for organizing the site of wind farm (soil from excavations for foundations, cable ditches and of other construction waste) and next will be transferred for use to natural persons, and only if there is no other possibility, they will be dumped at a landfill.
- Earthworks will be conducted so as to prevent excavations against precipitation water inflow.
- Works will be conducted with construction equipment in a good working condition, the used equipment will undergo regular technical checks, and its technical efficiency will be supervised.
- Construction-assembly materials and prefabricated elements must possess certificates and meet appropriate standards
- The wastes generated at construction-assembly sites during the realization of the undertaking will be managed in accordance with the principles defined in the currently binding law in that scope.
- Construction works will be conducted with taking into account a rational area management, care of preserving its nature values and maintaining the possibility of its former use.
- Works which can change the natural area relief will be reduced to minimum.
- Execution of cable trenches and foundations will be monitored for any archaeological finds.
- The available methods of preventing the irrational use of the earth's surface will be applied, thus the one making changes in the configuration of the terrain has the obligation to carry out reclamation works.
- During conducted construction works all precautions will be taken to prevent pollutants (among others, petroleum compounds) from penetrating soil-water environment. Thus, the assembly and storage areas will be insulated appropriately. Furthermore, in case of harmful substance leakage, the works contractor should possess the proper sorbents to liquidate pollution, especially petroleum pollution (for example, fuel and lubricants) and synthetic pollution (for example, oils).

- Construction-assembly works if well organized and if modern devices are used will be conducted in the shortest possible time so as to reduce to an indispensable minimum the functioning of construction-assembly sites as elements alien to landscape (noise, vibrations, traffic of truck).
- Accompanying facilities will be located as far from built-up areas as possible.
- Towers of wind power plants should be designed and made in order to integrate with the character of the landscape, using appropriate colors and materials, so that the least disturb the harmony of the landscape (slender shape, bright color, in a range of gray, matt paint).
- Humus layer will be stored separately and used again.
- The ground transportation routes excavations for foundations and cable trenches and other construction waste should be taking place in the smallest possible portion of the built-up areas.
- To reduce acoustic noise there will be used equipment in a good working condition
- In the case of crossing watercourses electricity cables and telecommunications will be performed transition by jacking, directional drilling or the casing pipe.
- During construction works drinking water at the construction sites will be provided in containers or bottles. Sanitary needs should be satisfied by means of portable showers and toilets. Generated wastewater from these should be collected by septic vehicles and transported to the nearest WWTP (or wastewater acceptance points) for treatment.
- Principles of material saving will be applied.
- The wastes will be transferred for disposal only to those entities that meet formal and legal requirements as to recovery or disposal and collection and transportation of that type of wastes.
- To reduce threats to people's health in connection with the conducted construction works and earthworks, the proper works organization, the marking of works sites should be applied and rules of safety and health at work should be followed.
- To ensure workers' safety and reduce nuisance connected with the planned construction:
- Workers should use workwear and personal protective equipment while conducting works when they are required,
- Machines, construction equipment and materials during works and breaks should be secured,
- Furthermore, the employees should:
- Possess certificates authorizing them to work at their posts,
- Possess valid certificates of completed basic and periodical trainings in safety and health at work,
- Possess appropriate certificates of qualifications and licenses to operate construction equipment.
- When conducting excavations for the foundations of the turbines must be protected from the area in front of the entry of animals in the area of construction works.
- Roads and cables will be laid in such a way to not interfere with environmentally valuable areas.
- Set borders of assembly and construction sites, as well as leased plots of land will be strictly kept.
- After the realization of the investment, the construction and assembly sites will be removed and the area will should be reorganized and brought into a state allowing natural regeneration of the natural environment..
- Trees that are not to be cut down will be protected against damages. Works in their proximity should be performed carefully, preferably – in a manual manner. Additional protective layers and fences may also be used.
- All installation works, in particular the clearance and forming of vegetation should be conducted outside the breeding period for birds and under an ornithology supervision
- In the case of a collision of cable line with trees that are not to be cut down, the path of the cable should be changed by means of proper construction elements in such a way to avoid interference with said trees.

At the liquidation stage the recommended minimizing recommendations will be the same as at the construction stage.

Resume:
Taking into account a narrow range of low-emission works no additional special means and solutions for environment protection are predicted, except for the duties resulting from regulations and norms of law. It should be emphasized that most of those impacts are of a temporary character and upon the completion of works they will be removed (a temporary assembly yard, wastes). The adopted technological and technical solutions will ensure effective environment protection, will not negatively affect people’s health and considerably reduce a risk of a possible failure. Upon the completion of the planned works, the investment site will be cleaned to enable a natural restoration of nature environment. Furthermore, as far as nuisance is concerned, the planned undertaking will not limit the function of adjoining areas and will not have an impact on third parties’ interests.

9.2 The exploitation stage

Wind turbines are the source of the so-called clean energy. Their utilization is an effective way of ensuring lower emission of CO_2, SO_2, NO_x and dust to atmosphere, which translates into a positive interference with the quality of environment in social (lower air pollution, between air quality for citizens) and global (limitation of climate-related outcomes of greenhouse effect and effects alike) context.

In the course of planning and designing works relating to the construction of the wind farm to date, the following environment protection-oriented measures have been applied:

- Localization of wind turbines:
    - Far from housing units and built-up areas in order to minimize the risk of noise generated by the turbines to affect citizens living nearby;
    - In an agricultural area with no significant ecologic features;
- Application of underground SN cable connections between individual turbines and the transformer station,
- Utilization of a unified, toned color pallet of the turbines aiming at the limitation of the impact of the construction on the local landscape
- Lack of commercial advertisements at the top of the towers in order to maintain landscape-related factors. Only promotional materials that can be placed at the top of the towers can be the name and logo of the producer or investor.
- Notifications and warning signs will be compliant with currently applicable norms. Also, edges of rotor blades will be painted and lamps will be installed at the top of each tower.

At the stage of the investment exploitation:

- Within the wind farm guarantee access to sorbents neutralizing leaks
- Conduct ongoing monitoring of the wind farm and its associated equipment in order to reduce the risk of failure.
- Faulty turbines, which can cause elevated noise levels should be immediately repaired.
- Waste from the operation of the wind farm will be collected and stored within the reach of third parties.
- In the event of significant mortality of birds in connection with the operation of the investment we are advised to take appropriate preventive action.

10. THE COMPARISON OF THE PROPOSED TECHNOLOGY WITH THE OTHER TECHNOLOGY

The fight against climate change, caused by the accumulation of greenhouse gases in the atmosphere, has become one of the key doctrines of political and economic European Union. One of the three key elements of climate policy, alongside energy efficiency and reduce CO^2 emissions into the atmosphere, will be a significant increase in the share of energy production from renewable sources. Great importance for the realization of this goal will be the development of emission-free energy generation technologies, especially wind energy, which is the fastest growing energy sector in the world.

Ukraine although it is not a member of the EU, must join in the efforts to stop climate change. To fulfill the EU's objectives for the share of energy from renewable sources is required in the dynamic development of wind energy. However, it must be in accordance with the constitutional principle of sustainable development, and thus with an equal emphasis on economic factors, social and environmental.

The proposed technology of generating electricity by wind farm is commonly used in the world and is becoming increasingly popular in the country. Wind turbines do not pollute the air, soil or water. As described above, the proposed technology is the result of scientific-technical effect.

11. POINTING OUT DIFFICULTIES RESULTING FROM TECHNOLOGICAL SHORTCOMINGS OR GAPS IN CONTEMPORAY KNOWLEDGE ENCOUNTERED WHILE WORKING OUT THE REPORT

The planned wind farm with associated infrastructure will be carried out using conventional materials and devices used in Ukraine and other countries. The authors of the report have not encountered any greater difficulties resulting from technological shortcomings or gaps in contemporary knowledge, in particular related to the assessment of environmental risks in terms of the surface of the earth, plants, animals and landscapes resulting from the impact of the planned project.

Attention should be paid primarily to incomplete knowledge of the actual impact of wind turbines on birds. The consequence of this situation is the need for time-consuming and costly ornithological research, both before the construction investments and after the start of exploitation. Current recommendations and estimations allowing to specify whether the area is suitable for the construction of the wind farm are based on data that often concern other geographical locations, where amount of birds and their flight trails are different, so exceptionally careful (or even pessimistic from the point of view of estimated amount of birds) models assessing the suitability of the land, collision risks, and interference with bird flight trails have been prepared. It is assumed that wind farms have the greatest impact on the quality of life of birds at the stage of exploitation.

As of today, there is no reliable, widely accepted method of assessing the risk of collision for birds flying through wind farms. It is a basic limitation when it comes to the specification of the impact of the investment on various populations of the said animals.
Examination outcomes point to the positive interference of wind farms with such bird species as *Alauda arvensis* (lark), *Anthus pratensis* (meadow pipit), and *Saxicola torquata* (European stonechat). It may be caused by the maintenance of some tall herbs and weeds that grow next to turbines, but are typically eliminated in the course of agricultural exploitation of the land. Data that can be found in older works are rather surprising, but it has to be pointed out that even though hundreds of wind farms have been created, human knowledge on the correlation between birds and wind turbines is far from being comprehensive.

Carried out analyses have not proved that the impact of wind farms on bird populations is dependent on the size of the undertaking that is – the number of installed turbines and their collective power. Taking into account constant technological development, the said correlation may change in the future. As of now, it has not been unequivocally defined and proved. Additionally, monitoring and observation-based examinations are carried out for individual projects only, so they cannot be treated as universal and applicable to every possible undertakings of the discussed type. It seems that the replacement of old turbines with new, more powerful ones does not increase the severity of impact of wind farms on bird populations.

Aside from difficulties connected with the analysis of death rates, risk of collision, and barrier effect, one has to mention a paradox relating to the specification of natural value of the land where a wind farm is to be built. After a year, we receive ornithological materials of higher quality and pointing to the existence of more bird populations than previously thought (the so-called effect of sampling effort – number of species depends not only on the size of land but also – on the amount of time spent on their identification and classification). Therefore, the value of land may be under- or overestimated. The quality of data available at www.birdlife.org – IBA is yet another problem. They have frequently been gathered in an extensive and random manner, not enabling for reliable scientific comparison.

The source of uncertainty is the ongoing evaluation of the accuracy of the calculation model in acoustic modeling, resulting from the assumed simplifications and error method. The lack of certainty with regard to the analysis of acoustic sound propagation shows certain components connected with the utilized calculation methods, parametric representation of noise source, as well as digital modeling of space in which noise is propagated from a reference point to the place where noise emission is assessed.

The handling of the input data is in accordance to the internationally accepted standard for measuring wind turbine sound emissions, the IEC 61400-11. In each case, the data are assumed to have an uncertainty of +/- 2 dB.

Attention should be paid also to the gaps in the present knowledge on the issues related to the formation and propagation of vibrations. The gaps in currently available knowledge relate, among others, to the potential impact of wind farms on soil sterilization. There are no published surveys or examinations that would touch upon the said issue. The problem of soil sterilization as a result of vibrations generated between the surface of foundations and soil can only be considered in hypothetical terms. At the same time, there are no scientific bases allowing for the specification of the extent of the said vibration that should disallow for the construction of a wind farm in a given area.

In the other areas not encountered difficulties in assessing the impact of investment on the environment. Even though some assumptions and conceptual technical solutions have been taken advantage of while making evaluations, it should be assumed that the scale, scope, and type of factors affecting the land have been identified and assessed properly. The lack of detailed schedules and some technical details have not affected assessment quality, as the most unfavorable configuration has been chosen for analysis.

The performance of acoustic analyses basing on digital reference maps almost completely minimizes the uncertainty connected with an improper geometry of the model and the assumed simplifications in land formation or the lack of environmental details (vegetation, small buildings) indicate possible under- or overestimation of the level of noise due to the assumption of an ideal noise propagation model utilization.

In the case of acoustic analyses, it has also been assumed that turbines will work constantly with their nominal power generating maximal level of noise for the entire time. It is an assumption that is far from factual state, but it has been chosen due to the fact that it is the most unfavorable acoustic scenario.

In practice, turbines work with their nominal power only 30 % of total operation time. For the rest of the operational period, they work with lower power and generate less noise. Such a representation may notably lower acoustic uncertainty, but it has to be assumed that the provided reference values are maximal ones.

12. DEVELOPER'S SOCIAL PROGRAM

As presented in section 3.1 above, the site area is situated in the territories of Melitopol and Priazovsk districts, where agricultural production is a dominant business activity, except for Melitopol, which in a regional scale is a significant industrial centre.

Population of Melitopol gradually decreases. Between 1989 and 2012 the population of the city decreased from 173 thousand to 157 thousand inhabitants, to finaly reach 156 thousand in 2015. At the same time, there is a continuous demand for new, well skilled employees, such as electric and gas welders, operators of machine tools with program management, electricians for equipment repair and maintenance (automatic lines and modular machines), turners, millers etc. According to the publicly available sources, the average monthly salary in the city increased by more than 28% between January 2015 and 2016. Compiling these facts one can conclude that the living conditions in the city and likely also a lack of a clear perspectives for personal development are the factors which stimulate people to relocate to more attractive places, like Kiev or highly industrialized region of Donbass.

Ramboll Environ was not able to identify data on change of population in the rural areas of both Districts. However, based on observations collected during area inspection in 2012 the living conditions in the villages around the wind farm area are far below the average for Western Europe and even post-soviet countries of central Europe. As reported by the citizens of local society, the villages in the area suffer outflow of young people to other parts of Ukraine and abroad in search of improvement of their lives.

The Investor is voluntarily implementing a social program aimed at improvement of living conditions in the area and at the same time limitation of potentially negative impact on the local societies. In 2009 the Investor signed an agreement with the Governor of Zaporizhia Region according to which, approx. 1 million USD shall be spent on social infrastructure investments. So far the Investor sponsored among others the following:

- Constructed extension of natural gas pipeline to the village of Nadezdine;
- Built street light installation, renovated school heating system and replaced windows, replaced roof of the Village Community Center in the village of Mordvynivka;
- Reconstructed the Rural Health Post and Village council building, purchased a car for Mordvinivka Village Council;
- Reconstructed the Community Center in the village of Dobrivka;
- Replaced roof and windows in the building of Nadezhdine Village Council
- Purchased numerous laptop computers for village councils;
- Built water tower and repaired or replaced main water pipeline for Divninske, Dunaivka, Gisrsivka and Nadezhdine villages;
- Purchased four ambulances for various village and district hospitals
- Purchased medical equipment for Melitopol District;

and others.

These investment were discussed with the Village Councils to secure the most important needs of the local societies are addressed.

Given the above, the development is expected to create positive social impact by improving living conditions of the local societies. It should be also noted here that the wind farm will create new permanent working places which should be an impulse for the young citizens of the villages to stay at their places.

13. MONITORING OF THE DEVELOPMENT

The report should include a proposal of the monitoring of the impact of the planned undertaking at the construction, exploitation or its use stage on, in particular subject matter of IBA sites. In the case of wind farms it is also required to carry out monitoring of the birds and bats before the start of the investment.

13.1 Pre-investment Monitoring

The realization of the undertaking had been preceded by conducting the following nature analyses:

- Assessment of birds and bats monitorings (Appendix 3, Appendix 4, Appendix 5, Appendix 6),
- Assessment of noise emission into the environment (Appendix 8),
- Assessment of shadow flicker effect (Appendix 7).

At the stage of working out the report, the impact of the subject undertaking on landscape and other natural environment components, IBA areas, material goods and cultural goods have been analyzed.

These studies include research results, conclusions on the implementation of the planned investment and recommendations for the prevention or reduction of its negative impact on the elements of the natural environment. Used in the planning of the project the results of monitoring carried out at the stage of pre-investment allow its implementation in the form described in this report.

13.2 Monitoring at the construction stage

As it may be concluded from the included analyses, the investment construction stage will not cause major nuisance to the environment. Actions resulting from construction works will be of a temporary and short-term character. Thus there is no need to conduct the monitoring of the project at its construction stage. Such monitoring is not also required by law. It should be noted however that in the realization phase of the investment permanent construction supervision is required.
The proper course of construction works and the following of health and safety regulations will be supervised by the Construction Supervision Office. Any irregularities and accidents occurring will be constantly reported and analyzed, and on the basis of the analysis will be introduced appropriate preventive measures.
Tasks of construction manager:

- Monitoring of environmental impacts identified in the report, the impact of the planned project with regard to construction methods.
- Control method of storage and storage of materials and organize storage sites after the completion of the works.
- Control of waste storage for their proper segregation and the proper labeling of containers.
- Control the course of construction works - assembly, in particular with regard to the risks of contamination of soil and surface and groundwater with petroleum substances coming from the machinery, construction equipment and means of transport,
- Control of deep excavations for the release of them falling into animals.
- Control implementation of the relevant security trees and shrubs located in the area of the construction works from destruction.

At the stage of implementation of the proposed project is not expected to carry out a more detailed monitoring of the impact of the planned project, due to the fact that the ongoing work will be minimal and short-lived impact on the environment. The construction phase will take place local nuisance associated with the emission of pollutants into the air from construction machinery and vehicles. The work will be carried out on the basis of the projects according to the project with the guidance of national law, standards and health and safety instructions.

13.3 Monitoring at the Exploitation Stage

Due to the necessity to confirm the correctness of conclusions drawn from the pre-investment monitoring it is recommended to conduct post-construction monitorings of birds and bats, as it was indicated in pre-investments bird and bats reports of individual investments. After the completion of the construction, it is advisable to conduct control measurements of noise levels at the nearest protected areas acoustic accordance.

The monitoring of bats

In the area of investment bat species could potentially be at risk of barotrauma and mechanical collisions (injury, decapitation parts of the body) of the rotors of wind turbines. Therefore, when you start the investment should be carried out monitoring afterinvestment, the examination of the mortality of bats and recording the activity of these animals in the vicinity of the turbines.

It is recommended that the planned monitoring porealizacyjny embraced bat activity conducted using the same method as pre-investment monitoring. Additionally, you should conduct monitoring of mortality of bats, which will be conducted in parallel with the monitoring bird mortality.

If post-construction monitoring reveals high real risk of mortality, post or even during his lifetime it will be necessary to introduce appropriate additional restrictions on the operation of the turbines (both bats and birds).

The monitoring of birds

The ornithological monitoring should be commenced at the time of completing the WTGs construction and PTL lines (prior to the electricity run). Already at this stage collisions may occur, which may require implementation of additional collision mitigation measures.

The proper post realisation monitoring should last 5 years in relation to the cross-country significance of the Molochny Estuary Wetland. The monitoring should cover not only the wind farm area (real collisions) and the PTL route between Nove Village and Mordvynivka, but also include further observation on the areas directly adjacent to the wind farm, in particular the Molochny Estuary. This will enable the assessment of the deterrence effect and a barrier effect related to the location of the wind farm. When presenting the death rates, the presence of night time migrants should also be included in the registry of the collision victims. Upon the findings of more than frequent collisions, particularly with the key bird species should result in recommending temporary shut downs during sensitive periods within the scope set out in the ornithological supervision.

The monitoring of noise

Upon the completion of the construction of the wind farm in Pryazovske and Melitopol Districts of Zaporizhia Region and its putting into operation, it is recommended to organize regular examinations of the sound levels (the sound and infrasound band) at the boundary of the established sanitary protective zone of 800 m and at the boundary of the closest residential development (Volna Village).

14. PROJECT ASSESSMENT VERSUS IFC STANDARDS

14.1 Corporate Environmental, Health and Safety Management

14.1.1 General Description

EuroCape Ukraine I is owned by Longwing Energy S.C.A., a company registered in Luxembourg. The Company was established to develop the subject project. Currently, the company employs approximately 50 full-time and contract staff.

As the Project owner and developer, the Company will not use its own staff at the stage of construction, instead, professional contractors will be assigned to conduct specific design, construction, assembly and start-up works. As far as possible local workforce will be utilized, it is expected that during construction and then exploitation approximately 225 people will be employed. It is understood by Ramboll Environ, that the general civil and electrical engineering balance-of-plant works will be conducted by Ukrainian companies, while the erection of WTGs will be conducted by the equipment supplier staff.

It is also ENVIRON's understanding that during the first phase of the wind farm operation, i.e. during the guarantee period all necessary service and maintenance will be provided by the supplier of the equipment. It is intention of the Company to train local inhabitants to do service and maintenance works after the guarantee period.

14.1.2 Organization of EHS Management

The Company has not implemented any environmental or health and safety management systems yet. At this stage of Project development, the EH&S management of the Company follows requirements of the Ukrainian law and good management practice as far as applicable from the point of view of the size of the Company and undertaken tasks.

In order to fulfill requirements of the IFC PS1 (social and environmental management system) the Company will need to develop and implement an environmental, social and H&S management system. After completion of the project development, i.e. during operation of the wind farm, the formal certification of the system is recommended.

14.1.3 Environmental Permits

The Company at this stage of project development is not in need of any environmental permit. Due to the fact that operation of the wind farm will not be related to any emissions of substances into the environment, a need for such permits in the future appears to be unlikely, however, the Company should monitor national environmental legislation and follow legal requirements.

14.1.4 Staff Training and Supervision

The company will have to develop and implement a codified staff training program appropriate for functions and exposure to hazards by the employees. It is also recommended to develop a policy which would require contractors (and their subcontractors) to provide appropriate training to their employees. The Company should secure in the agreements with the contractors the right to control whether all staff involved in the project development and further wind farm operation passed appropriate H&S training.

14.1.5 Internal and External Stakeholder Dialogue

The internal stakeholder dialogue within the Company bases on day-to-day routine exchange of information between the employees, which, taking into account small size of the Company, appears to be sufficient at this stage of the project development. Moreover, the Company arranges 2-3 times per year a corporate meetings with full staff. In the future, however, more formalized forms of internal dialogue may need to be developed.

The external stakeholder dialogue at this stage of the project development follows the needs of legal requirements (e.g. Public Hearing as part of the Urban Planning Verification) and good practice in building positive relationships with the state, regional, district and village administrations, as well as with the society of the neighboring villages.

In order to meet the best management practice as codified under the IFC PS1, the Company will need to implement certain mechanisms and planning of the dialogue with the external stakeholders, following the SEP (which is presented in a stand alone document).

14.2 Compliance with National Regulations and International Standards

Based on the analysis of presented documents and discussion with the Company representative, the Project at the current stage of development is compliant with the national regulations.

Ukraine as a non-member state of EU is not obliged to follow European regulations and standards as well as any other international ones. However, as a matter of good practice and requirements of the financing institutions, the international standards shall apply to the project development and further operation of the wind farm.

This ESIA is aiming at verification of environmental and social impacts of the project against the good international practice and IFC requirements. Measures necessary to mitigate environmental and social impacts as well as these necessary for the Project to fulfil the IFC Performance Standards are summarized in a stand alone Environmental and Social Management Program.

14.3 Compliance with IFC PS

The assessment of the project against the IFC Performance Standards (2012) and IFC H&S Guidelines for Wind Energy is presented in the table below. The following color coding is used:

- the green color reflects the status of compliance;
- the yellow color reflects the status of partial compliance or likely future compliance;
- the red color reflects the status of non-compliance which cannot be corrected.

Ref No.	Requirement	Status	Reference	Comment/ Gap analysis	Recommendation
1	IFC PS 1: Environmental and Social Assessment and Management System	Partly compliant	None	The Company has already undertaken a lot of preliminary environmental studies and analysis and addresses social aspects of the project development. The Project was subject to environmental impact assessment in line with the national regulations. This report provides additional environmental and social impact assessment in line with international standards. The Company has not developed any formalized Environmental and Social Management System (ESMS) yet.	Actions necessary to mitigate and manage the Project's environmental and social impacts are summarized in a stand alone Environmental and Social Management Plan (ESMP). The Company should follow the ESMP in further phases of the Project development. A need for development a formalized ESMS is addressed in the ESMP.
2	PS1: Policy	Partly compliant	None	Although the Company has no codified E&S Policy, the Project is being developed in full respect to environmental and social international	Development of the Policy is addressed in the ESMP.

Ref No.	Requirement	Status	Reference	Comment/ Gap analysis	Recommendation
				standards. Project has been planned and developed taking into account a need to minimize impacts to the environment, wild nature and society. The social relations with the affected communities have been developed based on the fair and transparent relations with all stakeholders.	
3	IFC PS1: Identyfication of Risks and Impacts	Compliant	This ESIA report , EIA conducted in line with the Ukrainian legislation	All project risks and impacts have been properly identified.	None.
4	IFC PS 1: Management Programs	Compliant	Stand alone ESMP	Actions necessary to address and mitigate environmental and social impacts are summarized in the ESMP	None
5	IFC PS 1: Organizational Capacity and Competency	Partly compliant	None	The Company has already proven that the existing organizational structure is able to successfully develop the Project and properly address environmental and social issues, in line with the national law and international standards. At present, the responsibility for environmental issues is divided among three executives: Director, Project Manager and Regional Representative for Zaporizhia region. Recently, the Company assigned a dedicated person as an Environmental officer. Ramboll Environ confirms competency of the Company management and its capacity to properly address environmental and social issues related with the Project at its further development and operational phases. Ramboll Environ recommends, that within the organizational structure of the Company a clear competency and responsibility should be assigned to the person or personnel responsible for	A need for organizational structure improvement is addressed in the ESMP

Ref No.	Requirement	Status	Reference	Comment/ Gap analysis	Recommendation
				management and supervision of environmental and social performance, implementation of the ESMP and monitoring. Such person/personnel should be properly skilled and educated to perform these tasks. Additional training for the existing personnel should be considered if necessary.	
6	IFC PS 1: Emergency Prepardness and Response	Compliant	This ESIA report	The Project is not considered as the one of a large risk of serious industrial accident. Potentially hazardous situations are identified and mitigation measures are defined.	Protective measures are addressed in the ESMP
7	IFC PS1: Monitoring and Review	To be compliant	None	As part of the ESMS the company should develop a formalized procedures for Project Monitoring and Review. Independent review of the Project is recommended on regular basis, e.g. every 3 years.	A need for monitoring and review is addressed in the ESMP
8	IFC PS 1: Stakeholders Engagement	Compliant	Stendalone SEP	Although not in a formalized and structured way, the Company has developed the Project engaging many various stakeholders. For the next phases of the Project, the Stakeholder Engagement Pland has been prepared and will be implemented.	Follow the SEP
9	IFC PS 1: External Communication and Grievance Mechanism	Compliant	Standalone SEP	External communication and grievance mechanism is addressed in SEP	Follow SEP
10	IFC PS 1: Ongoing Reporting to Affected Communities	Compliant	Standalone SEP Stendalone ESMP	The Company has been in regular contact with the repesentatives of the affected communities since the beginning of Project development. Reporting to affected communities and other stakeholders is addressed in SEP and ESMP	
11	IFC PS2: Working Conditions and Management of	Compliant with room for	None	The Company has no formalized human resources policy, however, in its operations the Company	

Ref No.	Requirement	Status	Reference	Comment/ Gap analysis	Recommendation
	Worker Relationships	improvem ent		follows requirements of the Ukrainian Constitution and other legislative labor and employment Ukrainian requirements as well as good international practice. Working conditions and terms of employment are known to all of the employees and are specified with the individual work contracts. There is no working organization in the Company. The Company follows the European standards of non-discrimination and equal opportunity. The Company due to its size is not obliged to evaluate a retrenchment program and no retrehchment is planned. The grievance mechanism in the Company allows every employee to report his concerns/grievances to his boss.	
12	IFC PS 2: Occupational Health and Safety (OHS)	Compliant	None	The company follows Ukrainian regulations related to OHS.	None.
13	IFC PS 2: Workers Engaged by Third Parties	To be compliant	None	The Company will select contractors and other collaborating companies based on professional criteria.	A need for hiring only companies which represent high-ethical standards is addressed in ESMP
14	IFC PS2: Supply chain	Not applicable	None	The items supplied for the Project are selected based on the quality, reliability and the state-of-the-art level of development.	None
15	IFC PS3: Resource Efficiency	Compliant	None	The project implements the most up-to-date technology. Wind farm utilizes “zero-emission” technology.	None
16	IFC PS 4: Community Health and Safety	Compliant	This ESIA report	The Project has been designed with use of the most up-to-date technology. Elements of the wind farm will be supplied by internationally recognized manufacturers, who follow Good Industry International Practice,	None

Ref No.	Requirement	Status	Reference	Comment/ Gap analysis	Recommendation
				inclusive these applicable to H&S standards. The community will not be exposed to hazardous materials. Land use for the Project will not significantly affect the nature, hence will not impact the nearby communities. The community will not be exposed to any potential diseases due to existence of the Project.	
17	IFC PS 4: Security Personnel	To be compliant	None	According to the Company representatives, the security personnel will be recruited mainly from the local inhabitants. The security personnel will be properly trained to avoid any exposure to H&S risks while at work.	None
18	IFC PS 5: Land Acquisition and Involuntary Resettlement	Compliant	None	Location of the Project was selected in the Village Councils which expressed their interest in having such development at their territories. The infrastructure of the wind farm, MTS and PTL is located out of the settlements. Final selection of the Project site was preceded with extensive engagement of local communities and authorities at various administrative (village, districts and regional) levels. The land for the Project purposes (approximately 350 plots) has been acquired based on agreements for lease with the land owners and users, however such agreements with approximately 4 land users are still ongoing but are expected to be completed before Project financial closure. Land which is expected to be used temporarily during construction only has not been leased by the Company.	None

Ref No.	Requirement	Status	Reference	Comment/ Gap analysis	Recommendation
				Instead, a compensation scheme, currently for the 1st phase of the construction, has been agreed with land users and fair above the potential loses prices for such land use will be paid by the Company. The Project has not required any physical or economical displacement and no such displacement is expected in the future.	
19	IFC PS 6: Protection and Conservation of Biodiversity	Compliant	This ESIA report	The impacts on biodiversity was assessed in this ESIA report. No significant impact on ecosystems, birds and bats was identified.	None
20	IFC PS 6: Management of Ecosystem Services	Not Applicable	None	The Project is unlikely to adversely impact ecosystems.	None
21	IFC PS 6: Sustainable Management of Living Natural Resources	Not applicable	None	No living resources are used by the Project	None
22	IFC PS 6: Supply Chain	Not applicable	None	No purchase of primary production is required for the Project	None
23	IFC PS 7: Indigenous Peoples	Not applicable	None	None	None
24	IFC PS 8: Protection of Cultural Heritage in Project Design and Execution	Compliant	This ESIA report	No adverse impact has been identified.	None
25	IFC EHS[40]: Visual impacts	Compliant	This ESIA report	No adverse impact has been identified	.None
26	IFC EHS: Noise	Compliant	This ESIA report	No adverse impact has been identified	.None
27	IFC EHS: Species Mortality or Injury and Disturbance	Compliant	This ESIA report and annexes.	The Project is not expected to generate a high risk of species mortality or injury	Conduct post-construction monitoring of birds and bats (addressed in the ESMP)

[40] IFC Environmental Health and Safety Guidelines for Wind Energy

Ref No.	Requirement	Status	Reference	Comment/ Gap analysis	Recommendation
28	IFC EHS: Shadow flicker	Compliant	This ESIA report and annexes.	None adverse impact identified	None
29	IFC EHS: Habitats alteration	Compliant	This ESIA report and annexes.	None adverse impact identified	None
30	IFC EHS: Occupational health and safety	Compliant	None	Secure construction and maintenance works to be conducted by reputable companies specialized in that kind of business, define strict H&S requirements in the contracts	Adressed in the ESMP
31	IFC EHS: Aircraft safety	Compliant	None	The Project is being developed out of the airports	None
32	IFC EHS: Blade and ice throw	Compliant	This ESIA report	The turbines are to be located in a safe distance from roads and buildings, safety zones are to be established around each of the WTGs.	Addressed in the ESMP
33	IFC EHS: Electromagnetic Interference	Compliant	None	None	None
34	IFC EHS: Public access	Compliant	None	The turbines are to be located away from the residential areas. Access to the internal part of the towers will be restricted.	None
35	IFC EHS: Environmental Monitoring	To be compliant	None	None	Conduct a post-construction monitoring on noise, bats and birds impact. Action addressed in the ESMP
36	IFC EHS: OHS monitoring	To be compliant	None	None	The company will need to elaborate an OHS monitoring program. Addressed in the ESMP.

15. PROJECT SENSITIVITY TO CLIMATE CHANGES

As presented in section 3.2 the Project is being developed in the area of a mildly continental climate. It features dry, moderately hot summer and relatively cold winter with thin snow cover. The snow cover is not stable. The average temperature of the coldest month (January) is from -5 ^{o}C to +2 ^{o}C, but considerable frost with strong wind also happens. A long-term average temperature (for the years 1901-2015) varies between -4.8 ^{o}C in January and 20.6 ^{o}C in July.

As forecasted for the period 2020-2039 (according to Climate Change Global Portal http://sdwebx.worldbank.org/climateportal/index.cfm?page=country_future_climate&ThisRegion=Europe&ThisCcode=UKR) the average temperature for the region will slightly grow, and will vary between -4.02 ^{o}C in January and 27 ^{o}C in July. The forecast for the years 2040-2059 indicate even stronger growth of temperature: -2.24 ^{o}C in January and 28.32 ^{o}C in July.

The Project due to its nature, i.e. use of wind energy for production of electricity does not appear to be sensitive to other climatic factors than wind speed. The air temperature matters in terms of a potential for ice creation in temperatures below 0 ^{o}C and possible ice throw effect in such conditions. Growth of average temperature through the upcoming years is therefore positive as the number of days with conditions favorable for ice throw effect should decrease. However, modern WTGs are equipped with ice detection systems (or even de-iceing systems) which reduce the risk of ice throw. Hence from this perspective the forecasted climate change will have a small impact on the Project.

The global worming, which is confirmed by the cited above temperature growthis assisted by more and more intense weather phenomena, such as long dry or wet periods, thunderstorms or strong wings. Forecast of such phenomena for the subject region is not available. In Ramboll Environ's opinion, however, Project sensitivity to such phenomena is low, as the WTGs will be equipped with lightning protection and WTGs will be automatically turned off in case of strong wings (i.e. above the upper threshold wind speed), hence will be protected from hazardous situations related to climate.

16. CONCLUSIONS

The analyses conducted in the report have shown that the construction and exploitation of „wind farm with technical infrastructure in Zaporizhia Region, in Priazovsk and Melitopol Districts, in the village councils of Devninskoe, Dobrivka, Dunaevka, Girsivka, Mordvinivka and Nadeshdine, south-eastern Ukraine" will not cause the exceeding of the permissible environmental standards and will not have a negative impact on IBA sites at the construction, exploitation or liquidation stages. Also the expected social impact will have a positive character, as the Investor undertakes infrastructure investments for beneficiary of the neighbouring villages, hence improving standard of living. Therefore there are no contraindications as to its realization in a form and a scope indicated by the investor providing that the recommendations described in Chapter 9 are applied to.

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