Lode wind farm

construction in the parishes of Lode and Ipiķi in Valmiera municipality

Environmental impact assessment report version for public consultation

Riga, July 2024

INSPIRING ENVIRONMENT

Estonian, Latvian & Lithuanian Environment, SIA

Lode wind farm construction in the parishes of Lode and Ipiķi in Valmiera municipality

Environmental impact assessment report version for public consultation

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A. Kāla

Member of the board of directors of Estonian, Latvian & Lithuanian Environment, SIA

Riga, July 2024

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Acronyms

RES	Renewable energy sources
UN	United Nations
CSB	Central Statistical Bureau
NDMS	Natural Data Management System
DMRB Guidelines	Sustainability & Environment Appraisal, LA 105, Air quality
ECMWF	European Centre for Medium-Range Weather Forecasts
ERA5	Fifth Generation Atmospheric Reanalysis of the Global Climate dataset
EU	European Union
EUMETNET	Network of European Meteorological Services
EUROCONTROL	European Organisation for the Safety of Air Navigation
IAQM guidelines	Guidance on the assessment of dust from demolition and construction
SPA	Special protection area
SCC	Species of conservation concern
SAC	Special areas of conservation
ICAO	International Civil Aviation Organisation
IEA Wind TCP	International Energy Agency Wind Technology Collaboration Programme
IPCC	Intergovernmental Panel on Climate Change
EIA	Environmental impact assessment
LNVM	Latvian National History Museum
LNVM AD CVVM	Documents and antiquities collection of the Department of Archaeology of the Latvian National Museum of History
LVGMC	Latvian Environment, Geology and Meteorology Centre
LVRTC	Latvian State Radio and Television Centre
NKMP	National Heritage Board
NKMP DC	National Heritage Board Documentation Centre, Archaeology and History Department
PSR	Primary surveillance radar
GHG	Greenhouse gases
SSR	Secondary surveillance radar
TII Guidelines	Guidelines for the treatment of air quality during the planning and construction of national road schemes

WTG	Wind turbine generator
VOR	VHF Omnidirectional Radio Range
ESB	Environment State Bureau
WMO	World Meteorological Organisation
ZBR	North Vidzeme biosphere reserve
ZIZIMM	Land use, land use change and forestry sector

1 INTRODUCTION

An environmental impact assessment has been drawn up for the proposed activity – construction of a wind farm in the parishes of Lode and Ipiķi in Valmiera municipality. Construction of 19 new high capacity wind turbines (WTG) is planned for the wind farm with the total capacity of up to 136 MW. The planned activity is proposed by Utilitas Wind, SIA, registration no. 40203411869, registered office Malduguņu 2, Marupe, LV-2167.

Decision of the state bureau for the environment (VPVB) no. 5-02-1/21/2023 on application of the environmental impact assessment procedure and application of the transboundary environmental impact assessment procedure to the proposed activity, i.e. the construction of Lode wind farm in the parishes of Lode and Ipiķi, in Valmiera municipality, was adopted on 18 August 2023. Environmental impact assessment programme no. 5-03/15/2023 was issued on 14 September 2023 and decision no. 5-02-1/35/2024 on amendments to programme no. 5-03/15/2023 of 14 September 2023 for the assessment of environmental impact of the construction of the Lode wind farm and related infrastructure in the parishes of Lode and Ipiķi in Valmiera municipality was issued on 26 June 2024 (see Annex 1).

The construction of Lode wind farm is planned in the northeastern part of Valmiera municipality. By the time the application for the proposed activity was drawn up, Utilitas Wind, SIA had identified the survey area for Lode wind farm by analysing various possible locations and limiting factors. The total area of the wind farm survey area is 12.34 km^2. Most of the land included in the wind farm survey area is currently used for forestry while a relatively small part of the area is agricultural land. The EIA involved an extensive analysis ans assessment of 19 WTG construction sites.

Given the rapid development of the wind industry and the lengthy period from planning to construction, the EIA process did not cover just a single specific Lode wind farm model. Several WTG models were compared by analysing their characteristics relevant in the context of the environmental impact of the proposed activity, such as sound power, rotor diameter and turbine height. The final decision regarding the choice of the model will be made during the development of the technical design, taking into account the operational conditions defined by the EIA process and the costs associated with the construction and operation of Lode wind farm, including the long-term electricity generation potential.

The EIA report has been drawn up by SIA Estonian, Latvian & Lithuanian Environment in accordance with the programme issued by the Environment State Bureau involving experts from various fields. The report provides detailed information on the proposed activity, the wind farm planning criteria and alternative solutions as well as information on the existing environmental status and natural assets in and around the area of the proposed activity. In accordance with the programme issued by the state bureau of the environment, the report provides information on the expected impact, including in the transboundary context, as well as proposals for impact mitigation or prevention, and proposals for future monitoring of Lode wind farm.

2 GENERAL DESCRIPTION OF THE PROPOSED ACTIVITY SITE AND SITE SELECTION JUSTIFICATION

2.1 The proposed activity site and the surrounding area description

The Lode wind farm is planned in the northern part of Valmiera municipality and in Lode parish with the survey area bordering Mulgi parish in the county of Viljandi in Estonia. The populated locality (village) nearest to the proposed wind farm survey area border is Arakste, which is approximately 0.3 km away. On the Estonian side, the nearest populated localities are the villages of Laatre, Saate and Penuja. A separate assessment will be carried out for the proposed construction of the cable line in Estonia in accordance with the current regulations in Estonia.

The following roads are situated in the vicinity of the proposed Lode wind farm and are planned to be used during the construction and operation of the WTGs (see also Figure 3.5.1):

- state local road V176 Sili – Estonian border;
- state local road V177 Ķoņi – Lode - Arakste;
- municipal road Arakste – Bērzi;
- VAS Latvijas Valsts Meži roads (Palejas road and Lapegļu clearance).

On the Estonian side, the nearest roads planned to be used during the construction and operation of the WTGs:

- National main road 6 Valga – Uulu;
- local road 24201 Abja – Paluoja – Latvian border;
- local road 24203 Veelikse – Laatre – Latvian border

Several farmsteads are situated in the immediate vicinity of the planned Lode wind farm (see Figure 2.1.2). Although the EIA programme[1] indicates that there are four buildings registered as residential buildings in the cadastre information system in the survey area, there are no residential or public buildings in the Lode wind farm survey area[2.] According to the statutory regulations, wind turbines must be situated at least 800 m from any residential or public building.

According to the information in the register of contaminated and potentially contaminated sites maintained by the Latvian environmental, geological and meteorological centre[3], the Lode wind farm survey area does not include any contaminated or potentially contaminated sites, but it is adjacent to a potentially contaminated site, i.e. a former municipal waste dump (registration number 96688/2143). There are two potentially contaminated sites situated approximately 1 km from the survey area border, i.e. the former fertiliser warehouse Arakste (registration number 96688/2146) and Ezermalas (registration number 96688/2145) (see Figure 2.1.2).

[1] See Annex 1, paragraph 5.4

[2] Kadasts.lv data (retrieved on 13 February 2024)

[3] LVGMC – map of contaminated and potentially contaminated sites, retrieved on 15 February 2024.

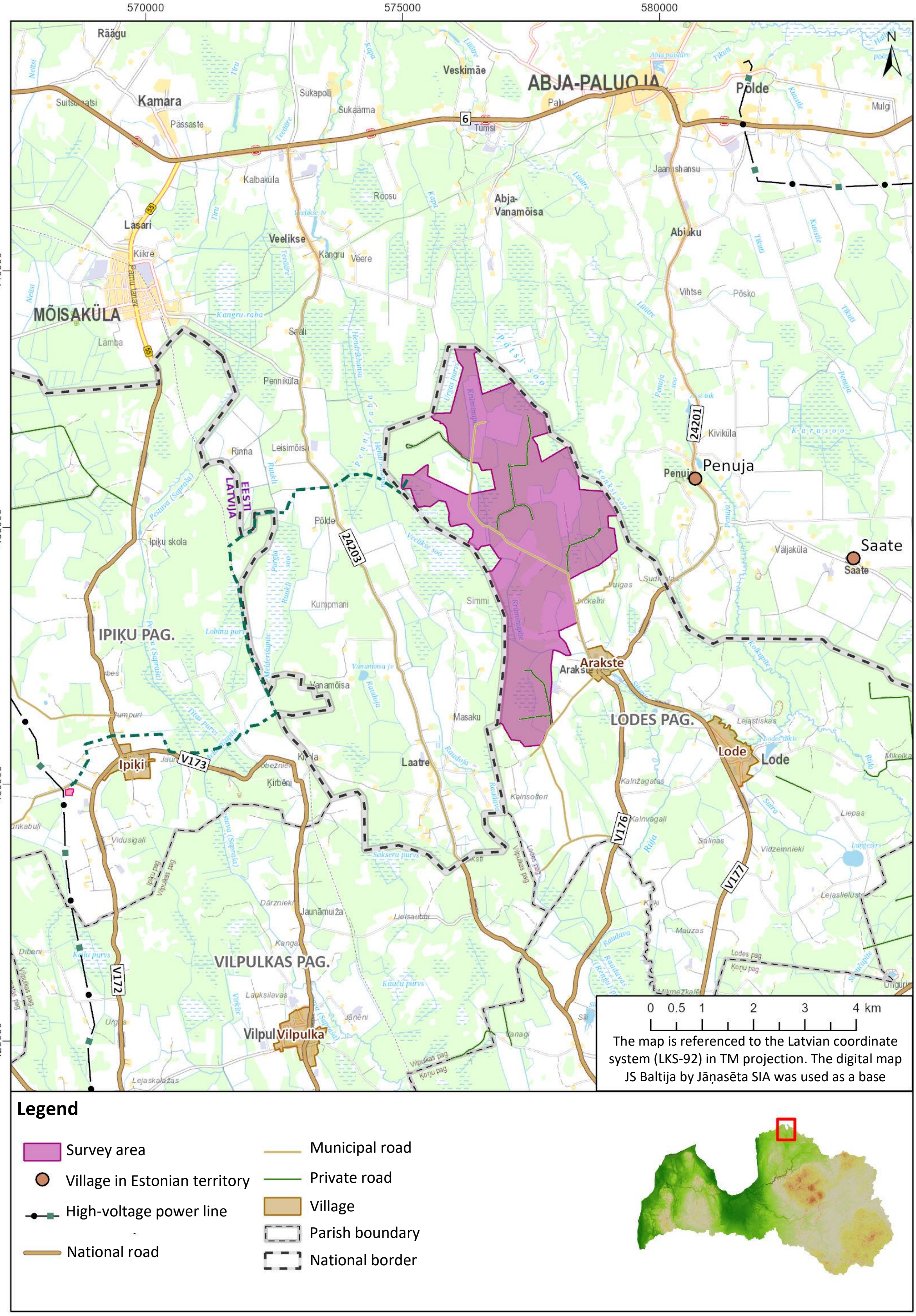


Figure 2.1.1. Location of the planned Lode wind farm.

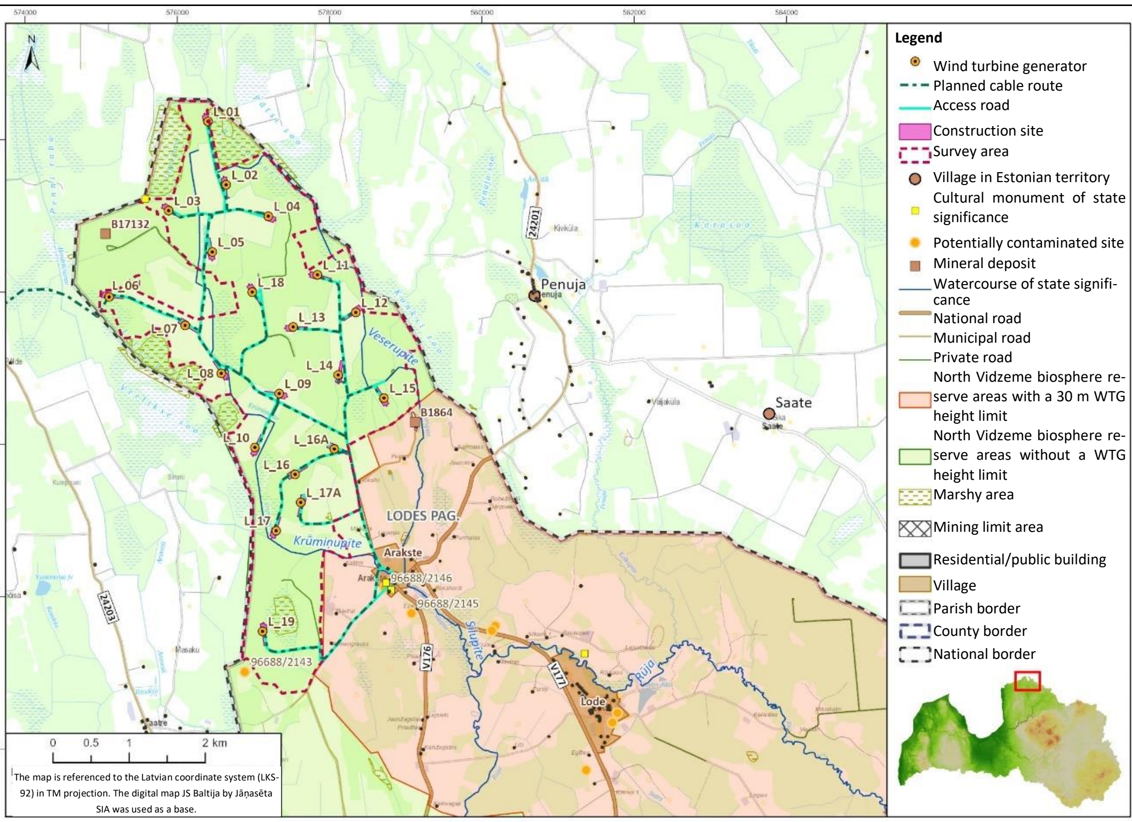


Figure 2.1.2. Description of the proposed Lode wind farm surroundings in Lode parish.

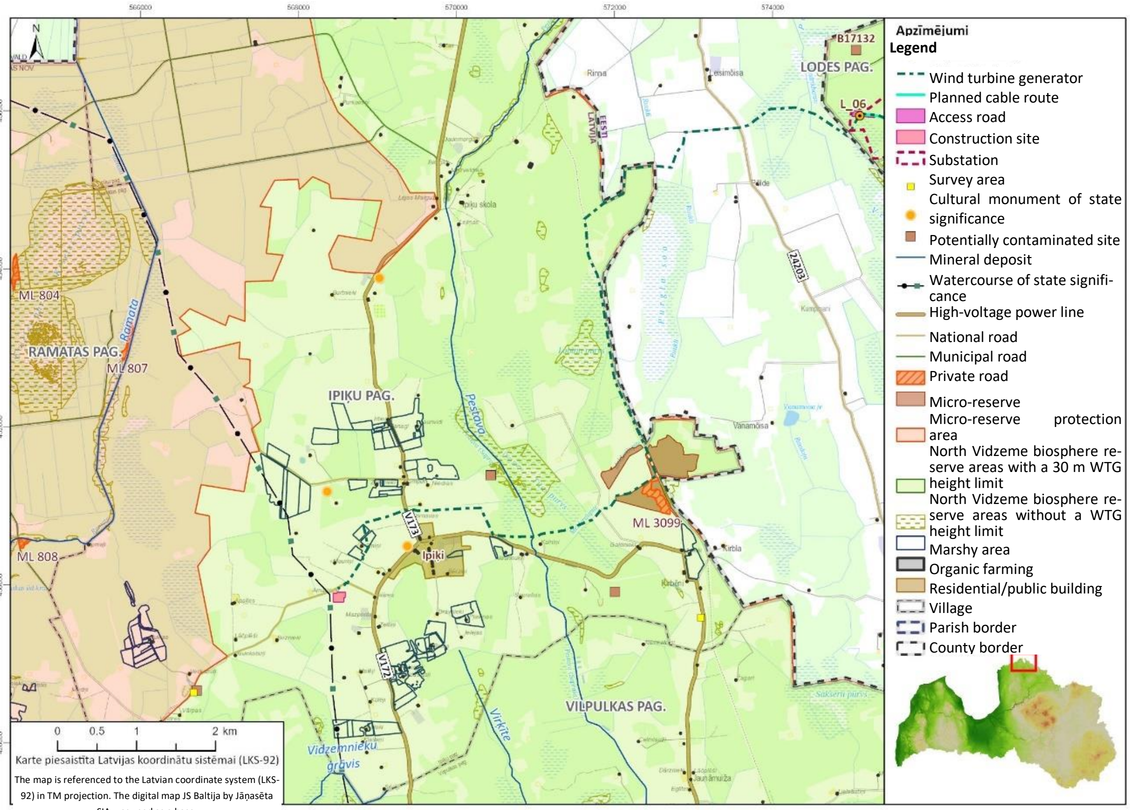


Figure 2.1.3. Description of the proposed Lode wind farm related infrastructure surroundings in Lode parish.

According to the information available in the LVGMC subsoil information system[4], there are no subsoil resource extraction deposits or prospective subsoil resource areas in the area of the planned exploration. To the south, the wind farm survey area borders the sand and gravel deposit Arakste (deposit no. B1864), which has no valid deposit passport, allocated limits or permits for mineral extraction have been issued. To the northwest, 0.6 km from the survey area border, the sand inferred resource area Ūskalns (B17132) (see Figure 2.1.2) is situated.

The survey area of Lode wind farm is adjacent to the state-protected cultural monument no. 2458, Urgu Swedish stone with inscriptions and signs, which is a cultural archaeological monument of regional significance. There are two listed cultural monuments in Arakste village, i.e. Arakstes Manor stables (6905) and Arakstes Manor barn (no. 6904). A cultural monument of state significance closest to the planned 330 kV cable line is Ķirbeles medieval cemetery (no. 2436), while the new substation will be 2.1 km from Veckābuļu medieval cemetery (no. 2437) (see Figure 2.1.2).

The area of the proposed activity is situated in the river Salaca drainage basin. The largest watercourses crossing the Lode wind farm construction site are the Krūmiņupīte (reclamation cadastral number 5452982:01) and Veserupīte (reclamation cadastral number 5452984:01), which are mostly regulated in the area of the proposed activity. The area of the proposed activity includes both reclaimed farmland and reclaimed forest land. The planned cable line will cross the watercourse of state significance Pestava (reclamation cadastral number 54526:01).

The proposed activity site is situated in the special protection area of the North Vidzeme biosphere reserve[5] and falls within the area where the construction of wind turbines is allowed without any height restrictions[6] (see Figure 2.1.2), but there is a restriction that wind turbines should be placed in groups of not more than 20 wind turbines, minimising the distance between adjacent wind turbines as much as possible.

According to the information published by the Nature Conservation Agency in the Ozols natural data management system, there are no other special areas of conservation, micro-reserves or their buffer zones, or specially protected trees in the Lode wind farm survey area.

Consideration for micro-reserve no. 3099 was made in the design of the cable line within Ipiķi parish the cable along the border of the micro-reserve in its buffer zone. The special area of conservation in Latvia in the vicinity of Lode wind farm are shown on the map in Figures 2.1.2 and 2.1.3.

To ensure transmission of the electricity generated by WTGs to the grid, construction of a new substation is planned in Ipiķi parish in Valmiera municipality, on plots of land with cadastral numbers 96560030325 and 96560030141. Detailed information on the possible solutions for the transmission to the grid is provided in Chapter 3.4 of the EIA report. The details of the cable route within Ipiķi parish to connect the Lode wind farm to the substation are shown in Figures 2.1.2 to 2.1.3, and further information is provided in Chapter 3.5.2 of the EIA report.

[4] https://videscentrs.lvgmc.lv/iebuvets/zemes-dzilu-informacijas-sistema
[5] In accordance with the act on the Northern Vidzeme biosphere reserve (adopted on 11 December 1997, with amendments up to 6 March 2019), it has been created to promote the balanced and sustainable development of the populated localities within the biosphere reserve
[6] Cabinet regulation no. 303, special rules for the protection and use of the North Vidzeme biosphere reserve

There are no sites in or near the survey area of the planned Lode wind farm that are classified as high-risk sites in accordance with cabinet regulation no. 46 of 21 January 2021, a list of high-risk sites. The nearest ones are in Valmiera about 50 km away.

According to the 2023 data on field clusters or registered farmland, there are no organic farming field clusters in the survey area of the planned Lode wind farm in Lode parish (see Figure 2.1.2). There are several such field clusters in Ipiķi parish, where a cable line has been planned (see Figure 2.1.3).

2.2 Compliance of the proposed activity with the spatial plan and property encumbrances

According to Valmiera municipality sustainable development strategy [7]until 2038, one of the circular economy sectors in the economic specialisation of the Valmiera municipality is energy production. The strategy identifies the resources for the development of this priority sector in Valmiera municipality prioritising energy production using water, sun, wind, ground heat, waste, biomass or peat.

The Vidzeme planning region energy vision (published on 18 May 2018) set a target for reducing CO_2 emissions by 2050: heat and electricity production should be powered almost entirely by renewable energy sources. The Valmiera municipal sustainable energy climate action plan for 2030 stipulates that for the protection of the landscape in the municipality, solar and wind farms cannot be developed in the landscape protection areas of Valmiera municipality special area of conservation, as well as sites designated as cultural landscape areas, including in areas with scenic value of state significance. In other locations, the landscape vulnerability should be considered to minimise conflict situations that may arise from landscape deterioration in close proximity to populated localities. In conclusion, the proposed development is consistent with the objectives of the policy planning documents and the current planning conditions.

According to section 17 of the act on administrative territories and populated localities, the municipal council elected in the 2021 municipal elections will evaluate the binding regulations adopted by the former municipalities forming the municipality and adopt new municipal binding regulations. The previous binding regulations of local authorities in the municipality remain in force until the effective date of the binding regulations of the municipality, but until 1 June 2022 at the latest, with the exception of the binding regulations on spatial planning, which must be drawn up by 31 December 2025. Thus, the permitted (planned) land use in the survey area of the wind farm is determined by the spatial plan of Rūjiena municipality for the 2012–2024 period (approved by binding regulation no. 9 of the Rūjiena municipal council on 19 July 2012, on the Rūjiena municipal spatial plan for the 2012–2024 period)[8].

According to the Rūjiena municipal spatial plan for the 2012–2024 period, the wind farm survey area includes land units or parts thereof whose planned (permitted) use is basically defined as forest and agricultural (including reclaimed agricultural) land (see Figures 2.2.1 and 2.2.2). Neither agricultural, reclaimed agricultural nor forest areas are intended for the construction of energy production plants or facilities as their permitted use.

[7] https://www.valmierasnovads.lv/content/uploads/2022/08/2red-Valm_nov_ilgtsp_att_strategija-precizets.pdf

[8] Spatial plan for Rūjiena municipality for the 2012–2024 period. Available at: [Geolatvija.lv – Latvian Geoportal]

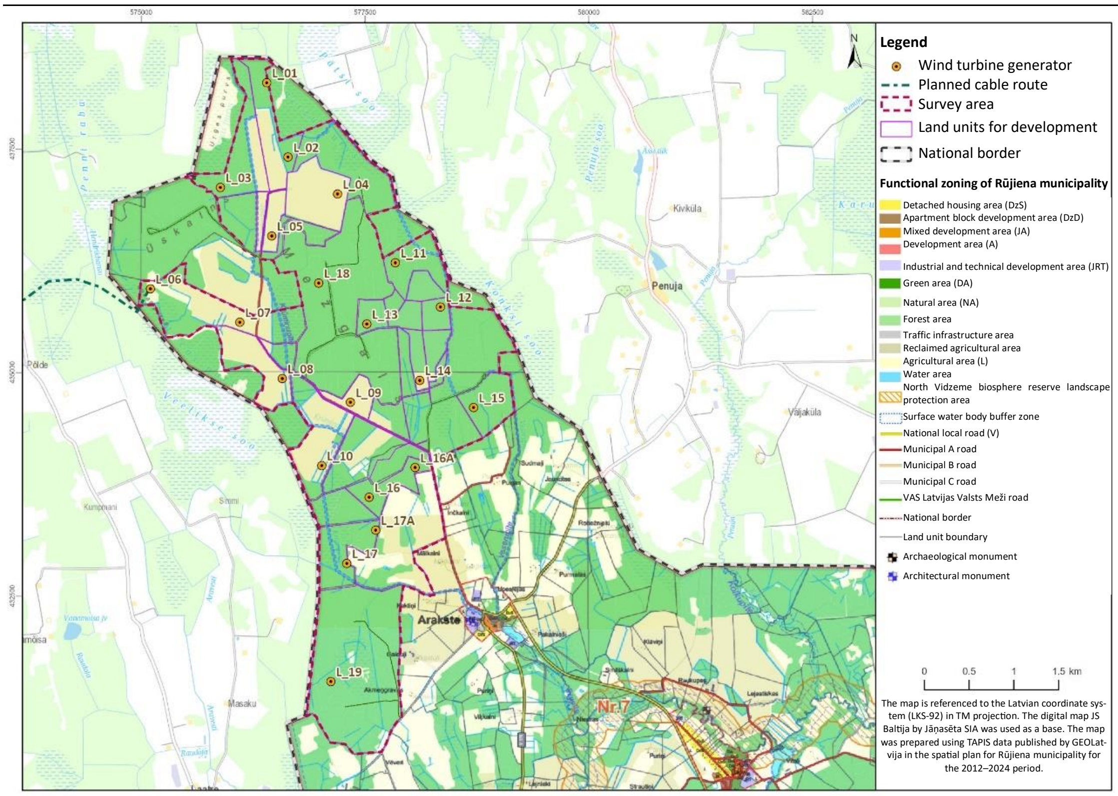


Figure 2.2.1. Functional zoning and buffer zones of Valmiera municipality in the survey area of the planned Lode wind farm and its vicinity in Lode parish.

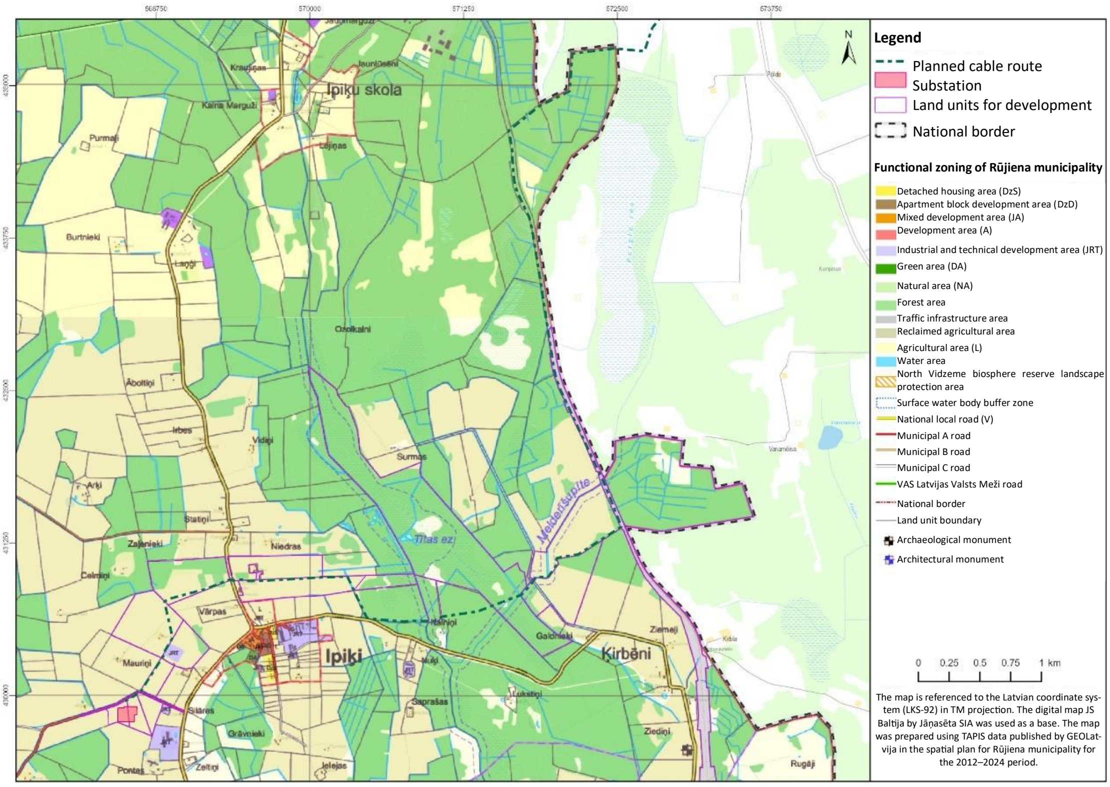


Figure 2.2.2. Functional zoning and buffer zones of Valmiera municipality in the infrastructure area of the planned Lode wind farm and its vicinity in Ipiķi parish.

Pursuant to paragraph 25.1.3 of the use and development regulations set out in the spatial plan for Rūjiena municipality for the 2012–2024 period, free-standing installations, such as wind turbines, must be situated on a plot of land so that the distance to the plot boundary is at least the maximum height of the installation, but pursuant to paragraph 25.1.4, wind turbines over 20 kW may be situated in the industrial and technical development areas (R), and in agricultural areas also if local planning is created.

Regarding the distance of the VES from the boundaries of the land plots, it is concluded that it is currently in contradiction with paragraph 25.1.3 of the land use and development regulation, i.e, a free-standing installation, such as a wind generator, must be located on a land plot so that the distance to the boundary of the land plot is not less than the maximum height of the installation. Consequently, the construction of the planned Lode wind farm required development of a local plan and new territory use and development regulations for the local plan area, which would change the permitted land use to one that allows the construction of wind turbines, as well as cancel or change the conditions regarding the stipulated distances to the plot boundary (in compliance with cabinet regulation no. 240 of 30 April 2013, on general regulations for territory planning, use and development).

According to the above information, the construction of the planned Lode wind farm required development of a local plan and new territory use and development regulations for the local plan area, which would change the permitted land use to one that allows the construction of wind turbines, as well as cancel or change the conditions regarding the stipulated distances to the plot boundary. On 31 August 2023, Valmiera municipal council adopted decision no. 430[9], on the commencement of development of the local plan for the Lode wind farm in Lode parish, Valmiera municipality, to amend the spatial plan for the 2012–2024 period for Rūjiena, which launched the development of the local plan for the Lode wind farm on 22 land plots within the municipality.

Spatial plan for Rūjiena municipality for the 2012–2024 period, Annex 5, regulations on the use and development of the land, specifies the zones where the construction of wind turbines is allowed without any height restrictions. In the rest of Rūjiena municipality, pursuant to cabinet regulation no. 303 of 19 April 2011, on special rules for the protection and use of the north vidzeme biosphere reserve, wind turbines up to 30 m high may be built. The Lode wind farm survey area falls within the area without wind turbine height restrictions (see Figure 2.1.2).

[9] https://www.valmierasnovads.lv/attistiba/teritorijas-planosanas-dokumenti/lokalplanojumi/pazinojums-par-lokalplanojuma-kas-groza-rujienas-novada-teritorijas-planojumu-2012-2024-gadam-veja-parks-lode-lodes-pagasta-valmieras-novada-izstrades-uzsaksanu/

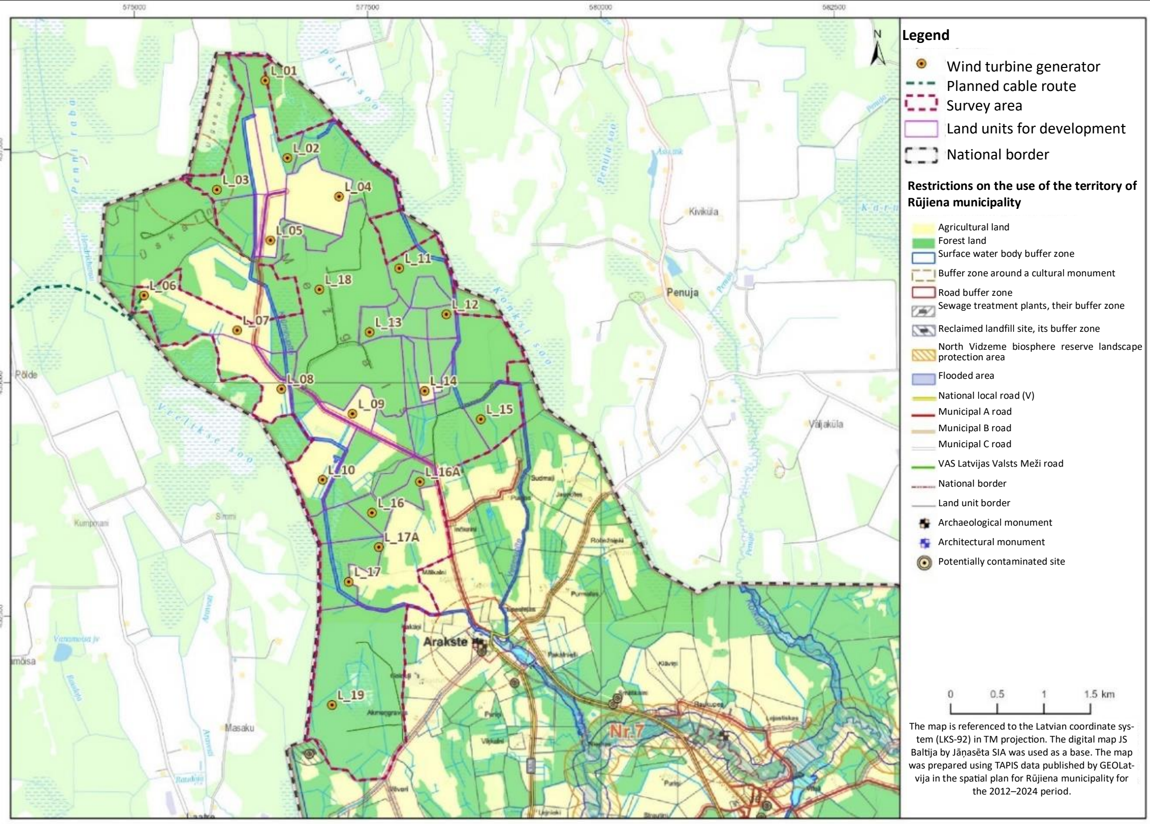


Figure 2.2.3. Use of territory in Valmiera municipality in the survey area of the planned Lode wind farm and its vicinity in Lode parish.

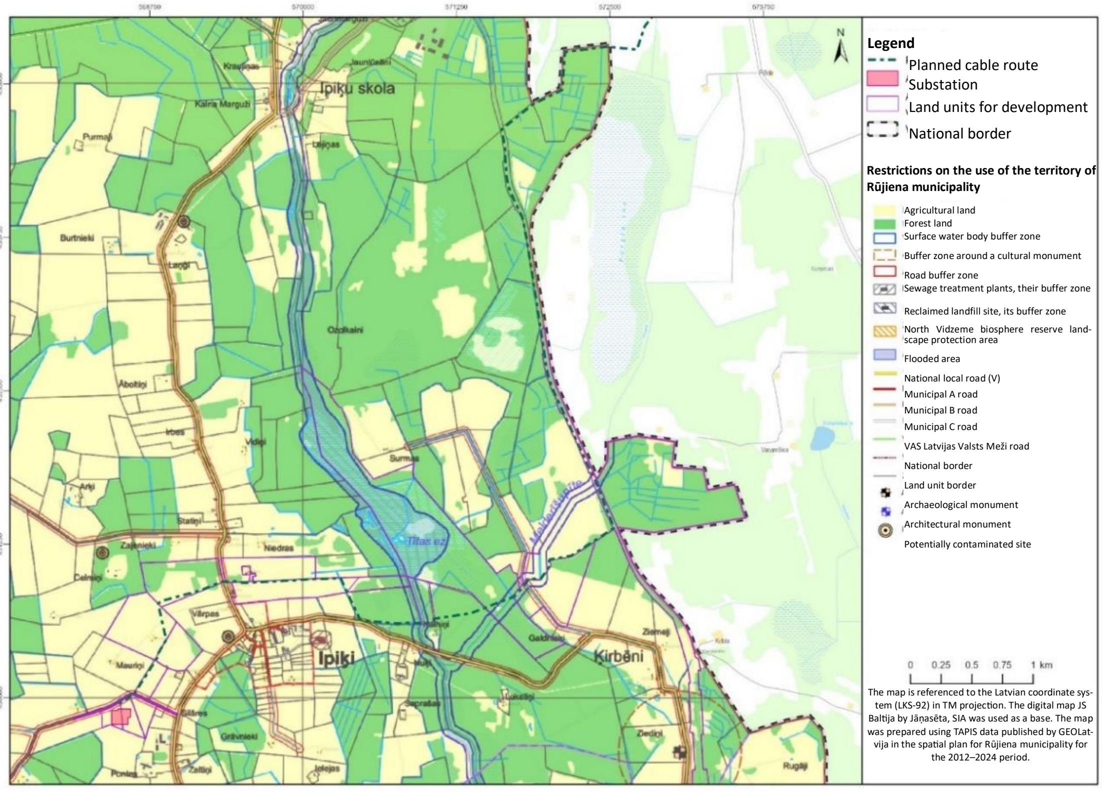


Figure 2.2.4. Land use in Valmiera municipality in the area of infrastructure related to the planned Lode wind farm and its vicinity in Ipiķi parish.

According to the existing spatial plan, the survey area of the planned Lode wind farm affects the buffer zones along national and local roads, cultural monuments, surface water bodies, polluted and potentially polluted sites. Information on the land use restrictions is summarised in Figures 2.2.3 and 2.2.4. Potentially, the location of the WTGs or associated infrastructure may be restricted by the buffer zone around the Urgu Swedish Stones, which is an archaeological cultural monument of regional significance. However, special conditions for any construction and/or work in the buffer zones along roads, cemeteries, surface water bodies, reclamation structures or installations do not restrict the choice of location for WTG construction. Detailed information on the restrictions associated with these buffer zones is provided in Chapters 4.7 and 4.10 of the EIA report.

Pursuant to Article 13 of the act on buffer zones, in rural areas a 30 m wide buffer zone from the road axis to each side is established along national local and municipal roads. The restrictions set out in the act on buffer zones include, inter alia, the condition that any construction work, excavation or earth moving work are prohibited without the permission of the owner of the road, with the exception of the work necessary for agricultural purposes[10.]

Pursuant to the building regulations of the existing spatial plan and cabinet regulation no. 306 of 2 May 2012, on regulations concerning the methodology for determining the using buffer zones around reclamation structures and installations on agricultural land and forest land for watercourses (regulated sections of watercourses and specially-dug beds), as well as for hydrotechnical structures and devices on them, the boundary of the buffer zone is determined:

- for watercourses (regulated or artificial) on agricultural land, 10 m from the watercourse crest on both sides of the watercourse;
- for regulated watercourses (main canals) on forest land, 10 m from the watercourse crest on the dumping side;
- around large-diameter collectors (30 cm or more), 8 m on each side of the collector centre line.

Any construction and reconstruction of structures and utility services, and extraction of minerals and forestation on reclaimed land, in the working buffer zones around reclamation structures and installations or in places where it may affect the work of the reclamation system, require technical regulations issued by VSIA Zemkopības Ministrijas Nekustamie Īpašumi.

According to the current Valmiera municipal spatial plan, the survey area of the planned Lode wind farm is affected by the buffer zones of surface water bodies around:

- the Krūminupīte and Veserupīte rivers – 10 m wide;
- a water body or watercourse with floodland: the entire floodland area in accordance with the graphical part of the spatial plan.

The act on buffer zones, article 37, part 1, paragraph 4, subparagraph b, prohibits construction or erection of any buildings or structures, including fences, within the 10 metre zone. Pursuant to the act on buffer zones, in the buffer zone of surface water bodies, the WTG construction is

[10] Act on buffer zones, article 42, part 1, paragraph 1, subparagraph c.

allowed within a 10 m zone from the water body, while construction of energy transmission and distribution structures is allowed in the 10 m zone and on floodland[11].

Pursuant to the spatial plan for Rūjiena municipality for the 2012–2024 period[12], the minimum width of the buffer zones around swamps with an area from 10 to 100 ha is 20 m. In the survey area, these are the Lucas swamp (34 ha), the Akmeņgravas swamp (35 ha) and the Ērču swamp (38 ha). Cabinet regulation no. 936[13] of 18 December 2012, on nature conservation regulations in forest management, stipulate that forest managers must:

- comply with restrictions on tree felling set out in the legislation on felling trees in forests;
- not create new reclamation ditches unless they are necessary for the management of swamps or other types of land (outside forests);
- not perform any tree felling, soil preparation or reforestation work with motorised machinery during the breeding season from 1 April to 30 June to avoid disturbance to animals.

2.3 Description of wind conditions

One of the determining factors taken into account in the selection of the suitable wind turbine generator models for the construction of the Lode wild farm is the wind conditions in the area of the proposed activity. Data from the European Centre for Medium-Range Weather Forecasts' (ECMWF) fifth-generation global climate weather reanalysis model dataset (ERA5[14]) for the period from 1 January 2014 to 31 December 2023 were used to describe wind conditions in the area of the proposed activity and the assessment of wind-dependent impact.

The ERA5 model is calibrated using the real-time meteorological observation data from meteorological network stations, including those in Latvia. ERA5 model data integration into WindPRO software developed by EMD International AS provides calibrated long-term observational data on wind conditions at different altitudes over a given area. The EIA process uses data on wind conditions in the area of the proposed activity at 200 m above the ground surface.

According to the information on average wind speed from the ERA5 database (see Figures 2.3.1-2.3.3) over the last 10 years, it has been determined that:

- the average wind speed in the area of the proposed activity is 8 m/s;
- the lowest average wind speed was recorded in 2018 at 7.6 m/s and the highest in 2020 at 8.7 m/s (see Figure 2.3.1);
- wind speed in the area of the proposed activity vary throughout the year, with the highest average wind speed occurring in the cold months of December and January and the lowest in the summer (see Figure 2.3.2);

[11] Act on buffer zones, article 37, paragraph 4, subparagraph d, paragraph 5, subparagraph b
[12] Spatial plan for Rūjiena municipality for the 2012–2024 period, Annex 1. Buffer zones and other restrictions in the municipality
[13] https://likumi.lv/ta/id/253758-dabas-aizsardzibas-noteikumi-meza-apsaimniekos; paragraphs 3, 7 and 10
[14] https://climate.copernicus.eu/climate-reanalysis

- approximately 0.2% of the total annual time in the area of the proposed operation is characterised by windless conditions with wind speed under 0.5 m/s.

The results of the wind conditions analysis indicate that the area of the proposed operation is suitable for installing WTGs that comply with the international standard IEC 61400-1 for wind turbines. Part 1: Design requirements for class III and S (designed for areas with lower wind speed). Class III and S WTGs are suitable for installation in areas where the average wind speed at mast height reaches of at least 6 m/s.

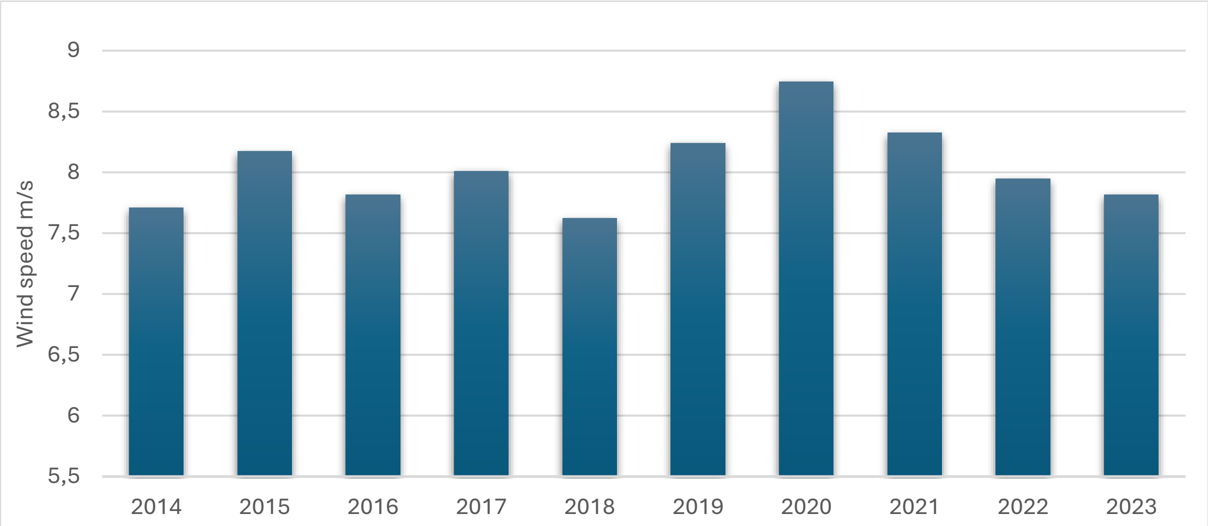


Figure 2.3.1. Annual average wind speed in the area of the proposed activity (at 200 m high)

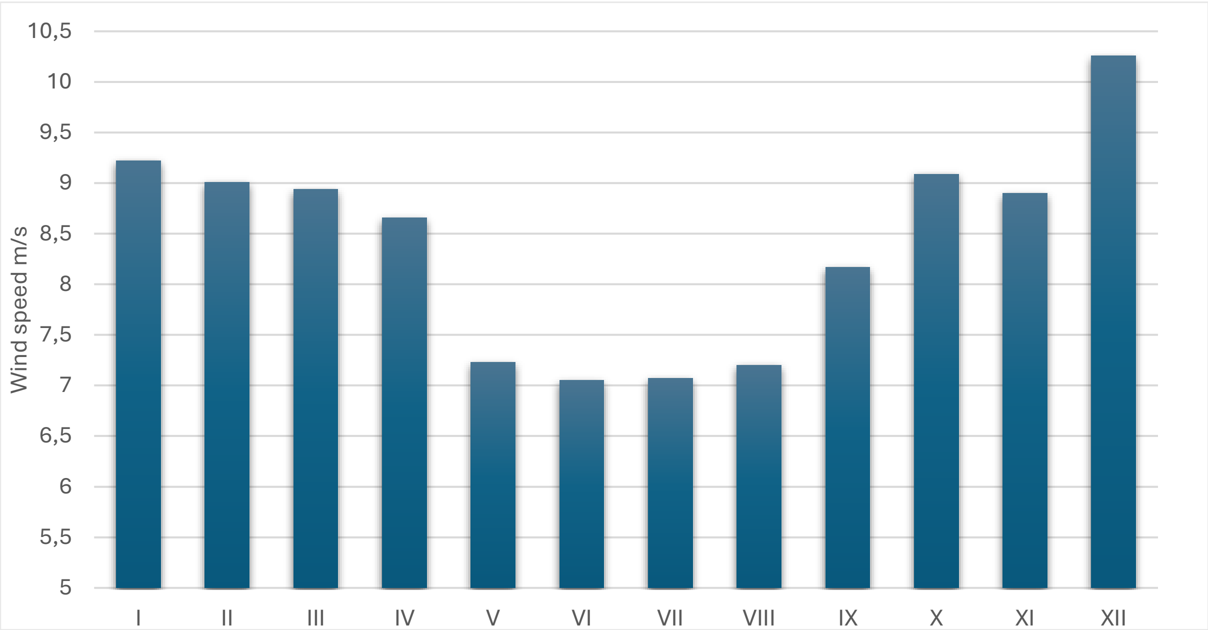


Figure 2.3.2. Average monthly wind speed in the area of the proposed activity (at 200 m high)

Most WTGs start operating when wind speed reaches 3 m/s and are shut down when the wind speed starts to exceed 23 to 25 m/s. An assessment of the ERA5 model developed by the European Centre for Medium-Range Weather Forecasts determined that on an average of 8% of the time, the Lode wind farm will not generate electricity due to insufficient or excessive wind speed (assuming that the WTG is shut down at a wind speed of 25 m/s).

Another important factor to consider when planning the construction of a WTG in a certain area and selecting a WTG model in addition to the average wind speed is the maximum wind speed, as specific WTG classes are designed to withstand certain wind force. According to the information gathered by LVGMC, the nearest national meteorological network station Rūjiena recorded wind gusts of 20–24.6 m/s in the period from the beginning of 2014 to the end of 2023[15]. Based on the average wind speed in the area of the proposed activity, the site was found to be suitable for the installation of class III and S WTG, which are designed and manufactured to withstand wind gusts of 52.5 m/s in accordance with the international standard IEC 61400-1.

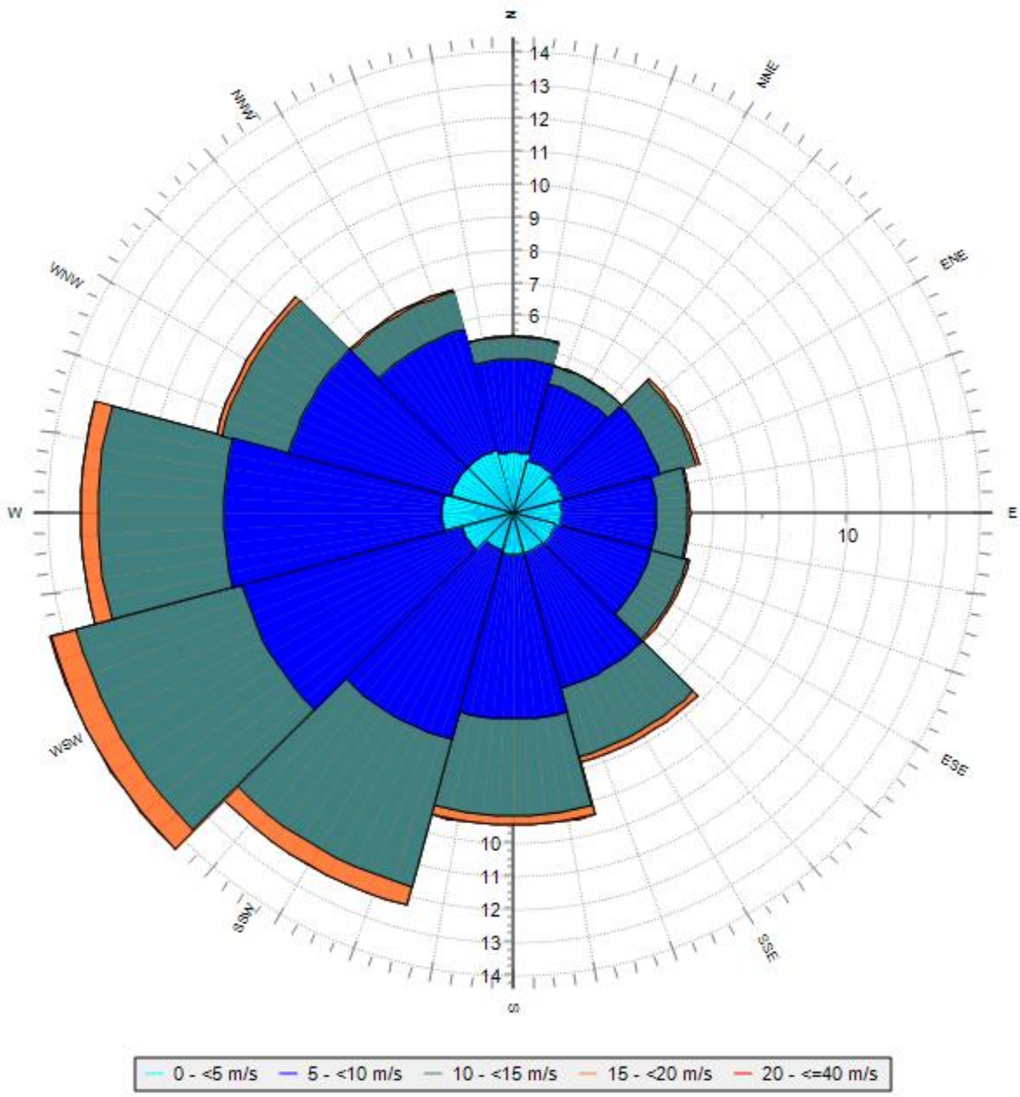


Figure 2.3.3. The wind rose at 200 m high

[15] Available at: https://videscentrs.lvgmc.lv/noverojumu-arhivs/meteo/30100/active/4218/2023-01-01/2023-12-31

3 DESCRIPTION OF THE PROPOSED ACTIVITY

3.1 Planned locations of wind turbines

Within the scope of the proposed activity, it is planned to build the Lode wind farm in the parishes of Lode and Ipiķi, in Valmiera municipality. Wind turbines would be situated in Lode parish and connected to the electricity grid in Ipiķi parish. In total, the survey area of the proposed Lode wind farm includes 45 land parcels or parts of land parcels with a total area of 12.3 km^2. During the environmental impact assessment, a number of potential sites for wind turbines were considered, taking into account the potential environmental and economic impact of construction. Based on assessments by the experts, the EIA process has identified the most suitable sites for the development.

The planned Lode wind farm could include 19 large capacity new generation wind turbines with the rated generation capacity over 6 MW per turbine. Information on the land parcels where the construction of the WTGs is planned is summarised in Table 3.1.1 and the full list of the land parcels included in the survey area is provided in Annex 2 to the report.

The site selection limitations described in Chapter 2.2 have been taken into account in determining the possible turbine locations within the defined survey area.

Potential locations for the construction of the WTGs and associated infrastructure (see Figures 3.1.2 and 3.1.3) are indicative based on currently available information and are subject to revisions within the borders of the property. In such event, the proponent should ensure that the changes meet the location restrictions described in Chapter 2.2, do not affect the natural assets identified in the EIA, and, where any chosen solution differs from the one assessed in this report, reassess the impact of the aspects that depend on the change of location, such as calculations of the flicker effect time, identification of affected development areas and creation of the turbine shutdown regimes.

Table 3.1.1. Potential WTG construction locations

WTG no.	Cadastral number	Cadastral designation of the land unit	Property name	Permitted use according to the spatial plan
L_01; L_02	96680010010	96680010010	Ķeizari	forest area
L_03	96680010035	96680010035	Kalnurgas	forest area, agricultural area
L_04	96680010036	96680010118	Bērzi	agricultural area
L_05	96680020011	96680010078	Vēveri	agricultural area
L_06; L_07	96680010001	96680010001	Rapas	forest area, agricultural area
L_08	96680030035	96680010041	Lucas	agricultural area
L_09	96680010002	96680010043	Zīļi	agricultural area
L_10	96680020077	96680010042	Pupuķi	forest area, agricultural area
L_11	96680040021	96680010002	Mežāres	forest area

WTG no.	Cadastral number	Cadastral designation of the land unit	Property name	Permitted use according to the spatial plan
L_12	96680010085	96680010085	Dūči	forest area
L_13	96680010098	96680010098	Rauķupes 2	forest area
L_14	96680010003	96680010097	Ansētas	forest area, agricultural area
L_15	96680010034	96680010034	Puigas - 1	forest area
L_16 or L_16A	96680010007	96680010006	Robežnieki	forest area
L_17 or L_17A	96680010004	96680010004	Meževidi	forest area
L_18	96680010071	96680010071	Lapegļu forest	forest area
L_19	96680010075	96680010075	Akmeņgravas forest	forest area

According to cabinet regulation no. 240 of 30 April 2013, on general regulations on spatial planning, use and construction, the construction of wind turbines is not allowed within 800 m of any residential or public buildings. The EIA programme indicates that there are four residential buildings in the survey area of the proposed Lode wind farm. The inspection was carried out on 13 February 2024 and it was established that according to the state cadastre information system data on the main use of the building, there are no public or residential buildings in the survey area. Figure 3.1.1 summarises information on residential and public buildings and the buffer zone around them.

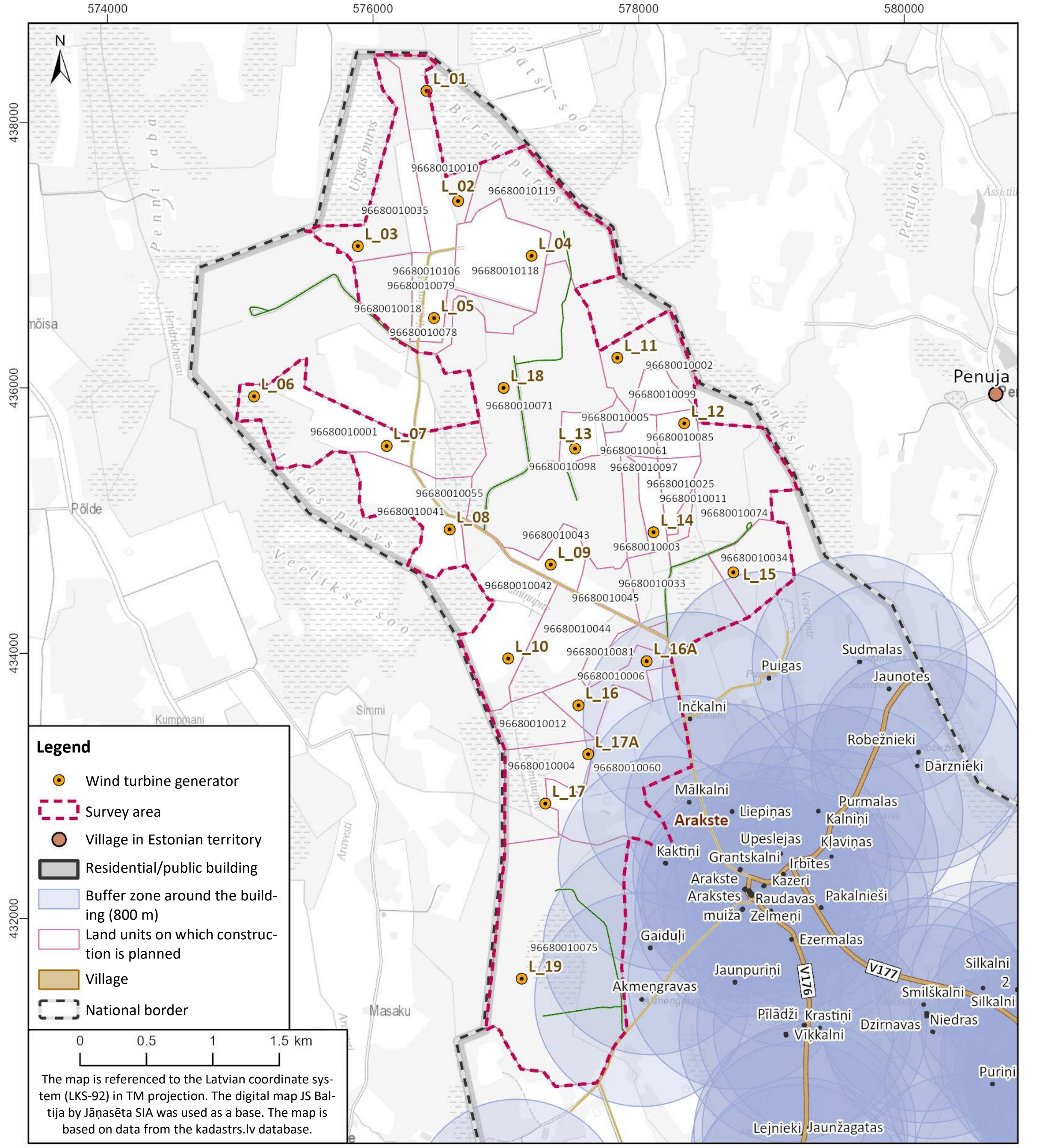


Figure 3.1.1. Public and residential buildings in the vicinity of the planned Lode wind farm in Lode parish.

Details of the proximity of residential properties in the vicinity of the proposed Lode wind farm to the proposed WTG sites are summarised in Table 3.1.2, and their locations are shown in Figure 3.1.1.

Table 3.2.1. Distance from the residential buildings[16] in the vicinity of the planned Lode wind farm to the potential WTG construction sites

No.	Cadastral designation of residential building	Residential building name	Nearest WTG	Distance to the nearest WTG, m
1	96680010049001	Akmeņgravas	L_19	911
2	96680010032001	Arakste	L_17	1626
			L_17A	1550
3	96680010066001	Arakstes Manor	L_17	1662
			L_17A	1660
4	96680010026001	Gaiduļi	L_19	989
5	96680010022001	Grantskalni	L_17	1543
			L_17A	1436
6	96680010088001	Inčkalni	L_16	841
7	96680010101001	Irbītes	L_17	1864
			L_17A	1725
8	96680010029001	Jaunotes	L_15	1461
9	96680010092001	Jaunpuriņi	L_19	1601
10	96680020015001	Kalnsolteri	L_19	1710
11	96680010090001	Kazeri	L_17	1751
			L_17A	1648
12	96680010056001	Liepiņas	L_16	1400
			L_16A	1300
			L_17A	1160
13	96680010047001	Mālkalni	L_17	1079
			L_17A	833
14	96680010057001	Puigas	L_15	833
15	96680010103001	Raudavas	L_17	1876
			L_17A	1812
16	96680010007001	Robežnieki	L_15	1937
17	96680010058001	Sudmalas	L_15	1157
18	96680010065001	Upeslejas	L_17	1807
			L_17A	1621
19	96680020047001	Vīķkalni	L_19	2026
20	96680010083001	Zelmeņi	L_17	1676
			L_17A	1642

[16] According to the data in the state cadastre information system about the main use of the building. Retrieved on 13 February 2024.

The construction of Lode wind farm involves not only the construction of the WTGs, but also the development of the associated infrastructure, i.e. access roads and electricity transmission infrastructure. More information on the construction of related infrastructure is provided in Chapter 3.4 of the report.

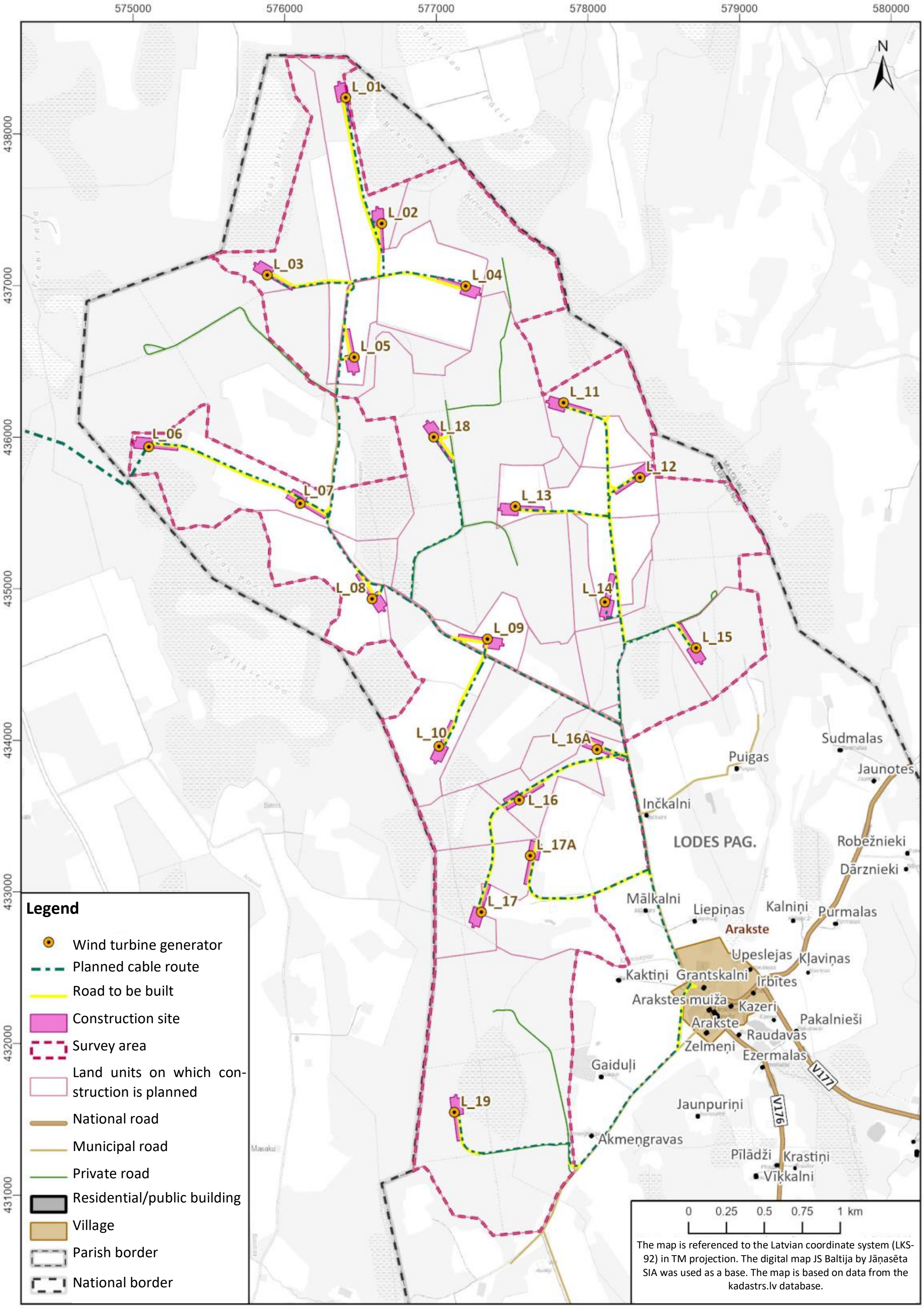


Figure 3.1.2. WTG sites in the planned Lode wind farm in Lode parish

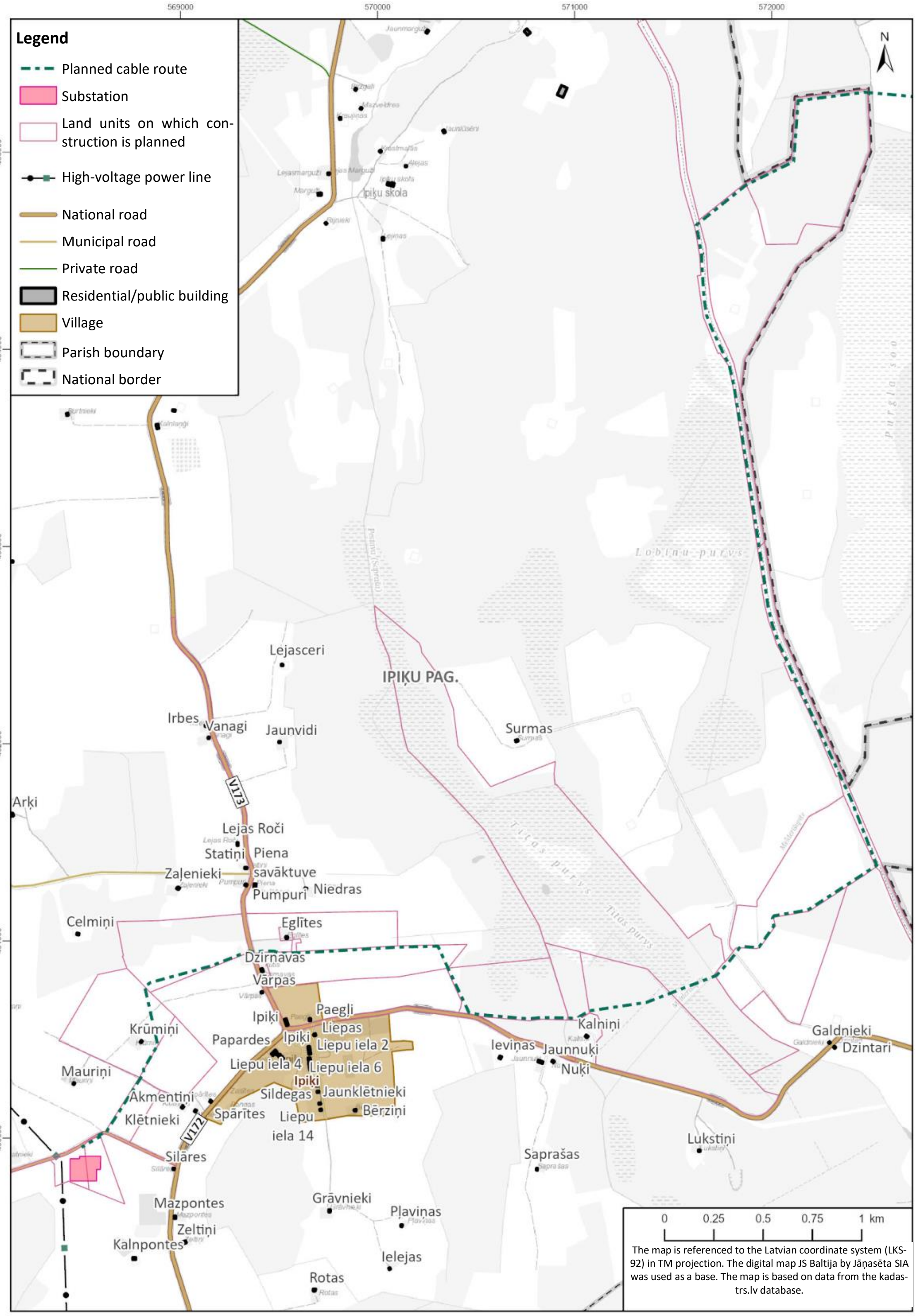


Figure 3.1.3. Lode wind farm-related infrastructure construction sites in Ipiķi parish

3.2 Description of the planned wind turbine generators

In order to increase the amount of energy produced in the long term, plans have been made to build the next-generation high-capacity WTGs in the Lode wind farm, each with a rated generation capacity of over 6 MW. These stations are suitable for areas with lower wind speed, which complies with the international standard IEC 61400-1 on wind turbines. Part 1: Design requirements as defined for Class III and S.

Considering the rapid development of the wind industry in recent years and the lead time between the planning and the construction of the wind farm, the EIA did not focus on a specific turbine model. Multiple WTG models are compared in terms of their parameters, such as plant height, rotor diameter and sound power output, which are relevant for assessing the environmental impact of the proposed activity.

It is expected that the final decision on the choice of a specific model will be taken shortly before the beginning of the technical design phase based on the operational conditions defined during the EIA process and the assessment of the costs associated with the construction and operation of the Lode wind farm, including the potential amount of electricity to be generated over the long term.

Information on the WTG models that may be installed in the Lode wind farm is summarised in Table 3.2.1. However, the proponent does not exclude the possibility that newer-generation WTGs with equivalent or better characteristics and higher generation capacity could also be installed in the Lode wind farm.

Table 3.1.2. WTG models assessed in the EIA

Manufacturer	Model	Rated generation capacity (MW)	Planned mast height (m)	Rotor diameter (m)	Total WTG height (m)	Wind speed (m/s) at which the WTG is:	
						started	stopped
Vestas	V162-6.2	6.2	166	162	≤ 247	3	25
Vestas	V172-7.2	7.2	166	172	≤ 252	3	25
Nordex	N163-5.7	5.7	164	163	≤ 246	3	26
Siemens Gamesa	SG6.6-170	6.6	165	170	≤ 250	3	26

All the WTG models assessed are technologically similar: the masts are assembled from steel sections; the rotors have three fibreglass composite blades with adjustable pitch angle; each nacelle incorporates a generator, transformers, brakes, power transmission equipment and devices for monitoring and controlling the operation of the WTGs. For Nordex turbines, combined masts can be built where the lower part of the mast is made of a monolithic concrete structure and the upper part is made of steel sections. Composite masts are usually built when the larger diameter steel mast sections cannot be delivered to a wind farm, but solutions where a large diameter section is divided into several individual segments to be assembled on site are now being increasingly used.

For all the WTG models assessed as part of the EIA process, manufacturers have integrated environmental mitigation technologies. Based on the results of the assessment, specific operating modes to reduce noise emissions, flicker effect and bat impact (bat mode), as well as equipment e.g. to identify and reduce the impact of icing are to be provided where necessary.

The WTG models assessed in the EIA differ in terms of their rated generation capacity. Figure 3.2.1 summarises the power generation potential of each WTG model at specific wind speed while Table 3.2.2 provides information on the WTG manufacturers' projection of the power generation potential of each turbine, taking into account information on wind conditions in the vicinity of the proposed operation at 200 m above the ground. According to the calculations (taking into account the average wind speed over a 10-year period), a single WTG installed in the Lode wind farm could generate up to 31.2 GWh of electricity annually. At the same time, the total energy output of 19 WTGs in the Lode wind farm could range from 375 to 594 GWh per year (not taking into account process breaks or production drops due to forced shutdowns for impact reduction).

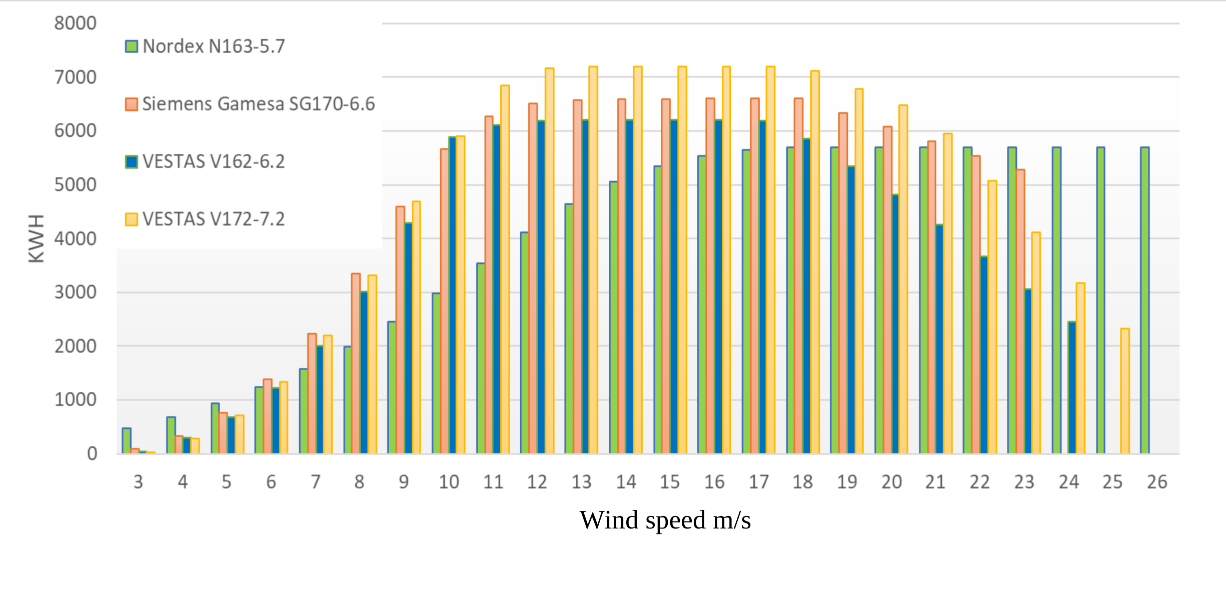


Figure 3.2.1. Electricity generation potential (kWh) at specific wind speed

Table 3.2.2. Electricity generation potential of one WTG (GWh/year)

Parameter	**Vestas V162-6.2**	**Vestas V172-7.2**	**Siemens Gamesa SG170-6.6**	**Nordex N163-5.7**
Energy generation potential calculated based on wind speed data in the area of the proposed activity	28.25	31.26	29.75	19.71

In the context of environmental impact, an important aspect is the noise level generated by the WTG, which is directly related to the wind speed, i.e. the noise level of the WTGs increases with increasing wind speed. Considering that noise pollution is one of the most important aspects analysed when assessing the impact of WTGs on public health, not only in Latvia but also in other countries, in recent years WTG manufacturers have been able to find solutions to avoid increase or even reduce noise emissions, while increasing the nominal generation capacity of the turbines. This is largely achieved by improving the aerodynamic performance of the WTG blades and reducing rotation speed of the rotor.

Information on the noise levels of the WTG, depending on wind speed, is provided in Chapter 4.1.5 of the report and summarised in Tables 4.1.4 to 4.1.6. The information in the tables was provided by the WTG manufacturers and is based on noise measurements according to the requirements of the international standard IEC 61400-11 (noise level determined at wind speed 10 m above ground) or noise level predictions based on measurements from similar turbines. As can be seen, the noise emissions of all WTGs increase as wind speed increases, but do not increase any further once the rotor reaches its rated speed.

3.3 Description of alternatives and justification for the choice of alternative

The EIA process assessed both the location of the proposed activity, i.e. WTG installation site, and the technical alternatives, i.e. WTG models. The alternatives for the location of the WTGs include different options for the turbine locations, which have been assessed in the EIA to arrive at the most optimal solution to balance different nature and environmental interests. The alternatives for the WTG locations assessed during the EIA process are shown in Figure 3.1. In the assessment of location alternatives, the report retains 2 alternative sites for turbines L_16 and L_16A, L_17 and L_17A, as alternatives L_16A and L_17A are only feasible if an agreement to demolish the Inčukalni residential property is reached.

The technical alternatives assessed in this report are described in Chapter 3.2.

For each aspect of the impact, the location and/or technical alternative is assessed with the relevant information, assessment and conclusions presented in a specific chapter of the EIA report (summarised in Table 3.1).

Potential locations for the construction of WTGs are indicative based on currently available information and are subject to revisions within the borders of the property. In such an event, at the technical design phase is should be ensured that the changes do not affect the natural assets, and, where any chosen solution differs from the one assessed in this report, reassess the impact of the aspects that depend on the change of location, such as calculations of the flicker effect time, identification of affected development areas and creation of the turbine shutdown regimes.

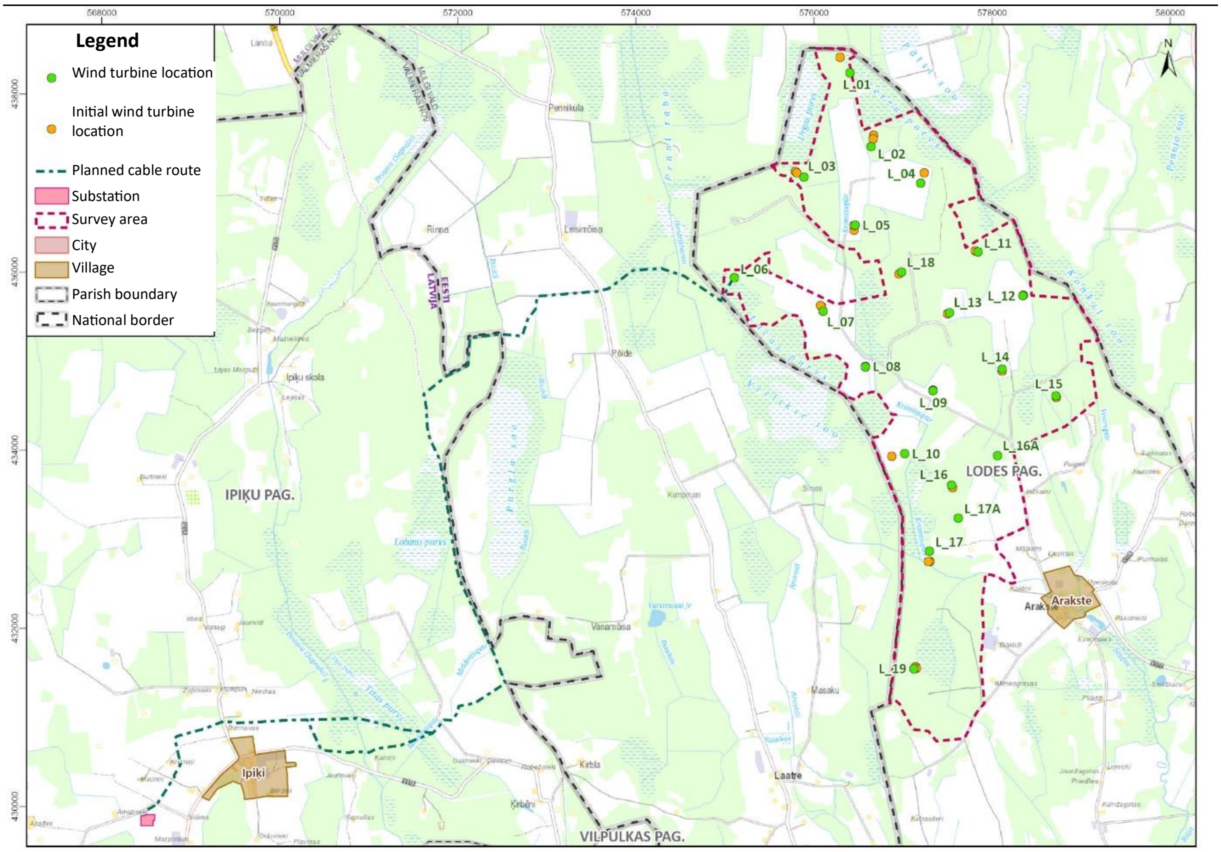


Figure 3.1. Alternatives locations for the proposed activity assessed during the EIA process

Table 3.3.1 summarises the aspects assessed in the EIA report, which have been assessed in the context of both main WTG alternative locations and other WTG alternative locations and in the context of technological alternatives.

Table 3.1.3. Alternatives assessed in the EIA report

Aspect	EIA report section	WTG location alternatives	Technological alternatives
Environmental noise	4.1.	-	x
Low-frequency noise	4.1.	-	x
Flicker	4.2.	-	x
Biodiversity – plants and habitats	4.3.	x	-
Biodiversity – bats	4.4.	x	x
Biodiversity – ornithofauna	4.5.	x	x
Landscape and visual impact	4.6.	x	x
Cultural heritage	4.7.	x	-
Air quality	4.8.	x	-
Climate	4.9.	x	x
Geology	4.10.	x	-
Hydrology	4.10.	x	-
Waste management	4.11.	-	-
Environmental risks and emergency situations	4.12.	x	x
Communication systems	4.13.	x	-
Vibrations	4.15.1	-	-

Exposure to electromagnetic fields	4.15.2	-	x

As mentioned above, the WTG locations are based on the assessment of the impact of the WTGs during the construction and operation done by a habitat expert, an ornithologist and a bat expert. The following is a justification of the assessment of the alternatives in the context of each of the aspects assessed in the EIA:

- Ambient and low-frequency noise:
  - The noise levels from WTGs are different for different WTG models and the EIA assesses the main WTG location alternatives and technological alternatives;
- Flicker:
  - The WTG flicker effect is different for different WTG models and the EIA assesses the main WTG location alternatives and technological alternatives;
- Biodiversity – plants and habitats:
  - Construction of WTGs and associated infrastructure may affect special protected species or habitats, and the EIA assesses a number of WTG location alternatives;
- Biodiversity – bats:
  - WTG operation can potentially affect bat populations, and the EIA assesses the initial and main WTG location alternatives taking into account the expert opinion on the areas where the WTG construction is not desirable during the survey;
- Biodiversity – ornithofauna:
  - WTG operation can potentially affect bird populations, but the magnitude of the impact is largely not dependent on the WTG locations, but on the overall suitability of the site for certain bird species. The EIA assesses the initial and main WTG location alternatives taking into account the opinions of experts on the areas where the WTG construction is not desirable during the survey;
- Landscape and visual impact:
  - WTG operation will lead to changes in the landscape and the EIA assesses the main WTG location alternative and technological alternatives (worst-case scenario);
- Cultural heritage:
  - The WTG construction and operation can potentially affect various heritage assets and the EIA assesses the main WTG alternative;
- Air quality:
  - Significant emissions of air pollutants are attributable to the processes planned for the construction phase of the farm, but no significant emission sources are identifiable during the period of operation; the main WTG alternative has been assessed in the EIA;
- Climate:
  - The potential GHG emission reductions are linked to the area of land to be transformed and the potential for electricity generation, and the EIA assesses the main WTG location alternative and technological alternatives;
- Geology and hydrology:

  - The WTG construction locations affect geological, engineering geological and hydrological conditions of the site and the buffer zones around surface water bodies, and the EIA assesses the main WTG alternative;
- Waste management:
  - The WTG models for waste management are described as equivalent, the EIA assesses the overall conditions for waste management regardless of the technological or location option chosen.
- Environmental risks and emergency situations:
  - The risks associated with the operation of WTG are influenced by the technical characteristics of the WTG models, the EIA assesses the main WTG location alternative and the technological alternatives;
- Communication systems:
  - The operation of the WTG can potentially affect the operation of communication systems, the EIA assesses the main alternative and technological alternatives (consultations with AS Latvijas Gaisa Satiksme);
- Socioeconomic aspects:
  - The construction and operation of WTGs can potentially affect various socioeconomic aspects (e.g. tourism, property value, etc.), the EIA analyses various studies;
- Vibrations:
  - WTG operation generates vibrations. The EIA assesses whether provisions are needed to mitigate vibration, regardless of the technological or location solution chosen.
- Exposure to electromagnetic fields:
  - WTG operation and cable routes generate electromagnetic fields, and the EIA assesses technological and cable route alternatives.

3.4 Area of land required for the wind farm

The total area of the Lode wind farm survey area identified by the planning process is 12.34 km². However, only a fraction of this area will be needed for the construction of WTGs and related infrastructure. Some of these areas will be used during both the construction and operation of the farm, and some only during the construction phase.

The land required for the farm can be divided into three groups as shown in Table 3.4.1:

- long-term built-up areas;
- areas occupied only during the construction process;
- areas where overgrowth height restrictions must be put in place for the transportation of equipment.

Certain areas are also required for the construction of electricity transmission infrastructure. Considering that the proposed activity is to construct electricity transmission cable lines, which will allow the area above the routes to be used for its existing purposes after the cables are laid, the area required for the electricity transmission infrastructure has not been analysed in detail.

During the construction, areas adjacent to the aforementioned structure construction locations may be temporarily disturbed by the placement of materials, such as topsoil and soil, removed from the area intended for the construction of the road or platforms. The area of potentially temporarily constrained sites cannot be determined at this stage, as it is directly dependent on the solutions and construction technology used during the construction.

Based on the technical specifications of the WTG manufacturers, Table 3.4.1 summarises the information on the area of land required for the construction of the planned wind farm[17]. According to the calculations, the construction of 19 WTGs will require about 63 ha, of which 17 ha are for long-term development. Of this area, about one third will be used to operate the WTGs after the construction process is completed. It is expected that no restrictions on economic activities will be imposed in the remaining area.

Table 3.1.4. Land required for the wind farm construction

Site	**Area required (ha)**	
	Main alternative	**With WTGs L_16A and L-17A**
Long-term built-up areas		
Construction of new access roads	11.44	0.81
WTG foundation area	1.9	0.2
Main crane working platform	1.9	0.2
Substation area	1.76	
Areas occupied by structures only during the construction		
Temporarily used parts of the construction site	45.32	2.82
Deforestation areas		
Installation sites	15.05	2.88
For the construction of new access roads and the improvement of municipal roads	2.25	0.08

WTG construction

According to the Nordex N163 technical specifications, the construction of one assembly site requires an area of approximately 1 ha. Overgrowth clearing and ground surface levelling will be required in the area. Once the construction of a WTG is completed, about 0.6 ha of the assembly site will be available for further business activities. The assembly site layout elements which were taken into account for the further detailing and environmental impact assessment are provided in Figure 3.5.2 of the report. It should be noted, however, that the configuration of the assembly site may change based on the WTG installation site conditions and technical specifications of the different manufacturers.

The information on the area required for the construction of the assembly site for one WTG (unit area) and 19 stations (total area) based on the Nordex N163 model construction specification is summarised in Table 3.4.2.

[17] Nordex N163 model construction specification, in which the manufacturer has laid down conditions for the construction of access roads and assembly sites, was used as a basis.

***Table 3.4.2.* Approximate land area required for the wind farm construction**

WTG no.	Land use on the assembly site where transformation would be required (incl. assembly site access road), ha						Defor-estation area, ha
	Agricultural land and other vegetated sur-faces	Forest, by forest type					
		Dry mineral soils	Wet mineral soils	Wet or-ganic soils	Drained mineral soils	Drained or-ganic soils	
L_01	0.01	0.27	0.14	-	-	1.09	1.51
L_02	0.11	0.80	-	-	-	0.60	1.40
L_03	-	0.01	0.05	1.15	0.31	-	1.51
L_04	1.51	-	-	-	-	-	-
L_05	1.51	-	-	-	-	-	-
L_06	-	0.87	-	0.64	-	-	1.51
L_07	1.51	-	-	-	-	-	-
L_08	1.51	-	-	-	-	-	-
L_09	1.51	-	-	-	-	-	-
L_10	1.25	-	-	-	0.26	-	0.26
L_11	-	0.89	0.62	-	-	-	1.51
L_12	1.51	-	-	-	-	-	-
L_13	1.47	0.05	-	-	-	-	0.05
L_14	1.51	-	-	-	-	-	-
L_15	-	0.44	-	0.65	0.38	0.04	1.51
L_16	-	1.51	-	-	-	-	1.51
L_16A	0.14	1.17	0.19				
L_17	0.25	1.21	0.02	-	0.03	-	1.26
L_17A		1.51					
L_18	-	1.51	-	-	-	-	1.51
L_19	-	1.06	-	-	-	0.46	1.51
Total	13.82	11.31	1.02	2.43	0.97	2.19	15.05

Table 3.4.3 summarises the area requiring transformation during the installation of each tur-bine.

Table 3.4.3. Areas of land to be transformed for assembly sites

Purpose of the site	WTG unit construction area, ha	Total area required for construction, ha	
		Main alternative	With WTG L_16A and L_17A
WTG foundation area	0.1	1.9	0.2
Part of the WTG assembly site for main crane operation	0.1	1.9	0.2
Only assembly site elements necessary for the construction process	0.6	11.4	1.2
Access road to the installation site	~0,2	3.8	0.4

Table 3.4.4. Approximate area of land to be transformed for new access roads

Agricultural land and other vegetated surface area, ha	Forest, by forest type, ha				Deforestation area, ha
	Dry mineral soils	Wet mineral soils	Drained mineral soils	Drained organic soils	
16.17	1.35	0.39	0.28	0.32	2.25

3.5 Wind farm construction process

While the most significant environmental impact in the context of wind farms are related to their period of operation, the construction of a wind farm itself can cause irreversible and significant changes to the environment if the factors and actions affecting the environment are not timely identified and appropriately managed. A detailed plan for the construction process of the proposed wind farm will be developed after the of the EIA process. However, in preparation of this report, the most significant factors and actions associated with the construction of the wind farm that may have a negative impact on the environment have been identified.

The information on the construction process of the Lode wind farm in the EIA report is based on the information provided by the proponent and in the WTG manufacturers' construction specifications. The main stages of the construction process:

1. Document preparation and approval: This stage involves drawing up the documentation, which includes technical designs, obtaining permits and the necessary regulatory approvals.
2. Construction work:
   - Site preparation: Topsoil removal and levelling to prepare the construction site.
   - Construction of access roads and areas: Construction of roads and areas both for the delivery and installation of the turbines and for the access infrastructure.
   - Rearrangement of reclamation systems: Where necessary, improvement of water drainage systems and ensuring better site drainage.
   - Construction of utilities: Construction of power supply and communication systems necessary to run the turbines.

- WTG foundation construction: Construction of sturdy foundations to support the wind turbines.
- WTG delivery and installation: Installation of wind turbines and connection to the grid.
- Site recultivation: After construction is completed, restoration of the natural environment and appearance of the site.

3. Wind farm commissioning.

The exact construction plan for the Lode wind farm will be developed as a part of the construction design, once the specific WTG model selected for construction is known and the logistics matters for the delivery the materials, equipment and machinery needed for construction are arranged. The construction of Lode wind farm and related infrastructure may begin in 2025, and is scheduled for completion in 2027. The wind farm is expected to be built in one phase within about two years.

The wind farm construction also involves transporting significant amounts of materials and equipment. According to the specifications provided by the WTG manufacturers:

- construction of new access roads – up to 30 lorries per 100 m of new road;
- construction of installation sites – up to 140 lorries per site;
- WTG construction – up to 280 lorries per WTG;
- main crane assembly – up to 55 lorries per WTG.

Consequently, the average number of lorry trips over the 2-year period of the construction of 19 WTGs could be around 34 lorries per day (round trip) or 3 lorries per hour (during the day). Further details on the expected noise increase in the vicinity of the roads are provided in Chapter 4.1.4.

3.5.1 Site preparation work

The wind farm construction will begin with site preparation work, which will include the removal of topsoil and subsoil in the areas where new roads and WTGs will be built, the construction of assembly sites and excavation of construction pits for the WTG foundations.

It is expected that a dedicated area will be created to store the necessary construction materials, except the WTG components and the large machinery which will be assembled at each WTG construction site. The area of one assembly site could be around 1 ha. The base will be made of gravel and crushed stone ensuring load-bearing capacity of at least 200 kN/m^2. The exact site locations and area will be determined during the design phase. It will be planned outside special protected habitats and protected species sites.

In areas where new roads and assembly sites are planned, as well as in areas where WTG foundations are to be built, topsoil will be removed before beginning the construction work. The removed topsoil will be temporarily placed along the construction site border. Detailed engineering geological survey at the WTG construction sites will be initiated after the EIA process is completed. During this survey, the bearing capacity of the soil will be assessed for each WTG site. It is expected that the topsoil removed will be used for site recultivation during the final phase of the construction process.

3.5.2 Construction of utilities

Lode wind farm will have cable connection to a substation planned west of Ipiķi providing a link to the third Estonian-Latvian 330 kV interconnector. The new cable line to connect the wind farm to the substation will start at the WTG L_06, cross the Latvian-Estonian border in about 250 m and continue along the Estonian territory for about 3 km. The cable line continues along the Latvian border to the narrow-gauge railway Rūjiena-Ipiķi-Pärnu embankment. This section is approximately 1.3 km long. The cable line is planned to run for ~3.5 km along the narrow-gauge railway Rūjiena-Ipiķi-Pärnu embankment to the micro-reserve ML 3099, then turning west, crossing the micro-reserve buffer zone and continuing through the forest and farmland to the substation for approximately 5.2 km. The layout of the cable route is shown in Figure 3.1. In Lode parish, the cable route will cross land units with the following cadastral designations: 96680010001 and 96680010072, in Ipiķi parish – 96560020002, 96560020054, 96560020060, 96560040036, 96560040040, 96560040057, 96560040008, 96560040027001, 96560040024, 96560040029, 96560040034, 96560030122, 96560030319, 96560030011, 96560030054, 96560030300, 96560030094, 96560030129, 96560030067, 96560030158 and 96560030141. The substation is planned on land parcels with the cadastral designations 96560030141 and 96560030325.

According to the territorial use and building regulations of the spatial plan of Rūjiena municipality for the 2012–2024 period, construction of engineering communications and engineering networks is allowed in all territories, in accordance with the statutory regulations.

A separate assessment will be carried out for the cable route in Estonia in line with the applicable the statutory regulations.

Although the construction of overhead lines is a cheaper option, the proponent of the proposed activity intends to install underground cable lines for the transmission of electricity to the substation, thus reducing both the environmental impact of the proposed activity and the land use potential of the transmission line routes.

Cable lines will be installed in the road right-of-way whenever possible. The expected area required for the substation is up to 1 ha. It should be noted that during the construction, the communication networks necessary for the control and monitoring of the WTGs will also be built. It is expected that the networks to be constructed (fibre optic and low-current cable lines) will be installed next to the electricity transmission networks and that the utilities will be installed together with the construction of the access roads.

Information on potential locations for the construction of electricity transmission infrastructure, as well as planned locations for the construction of cable lines, is provided in Figure 3.5.1.

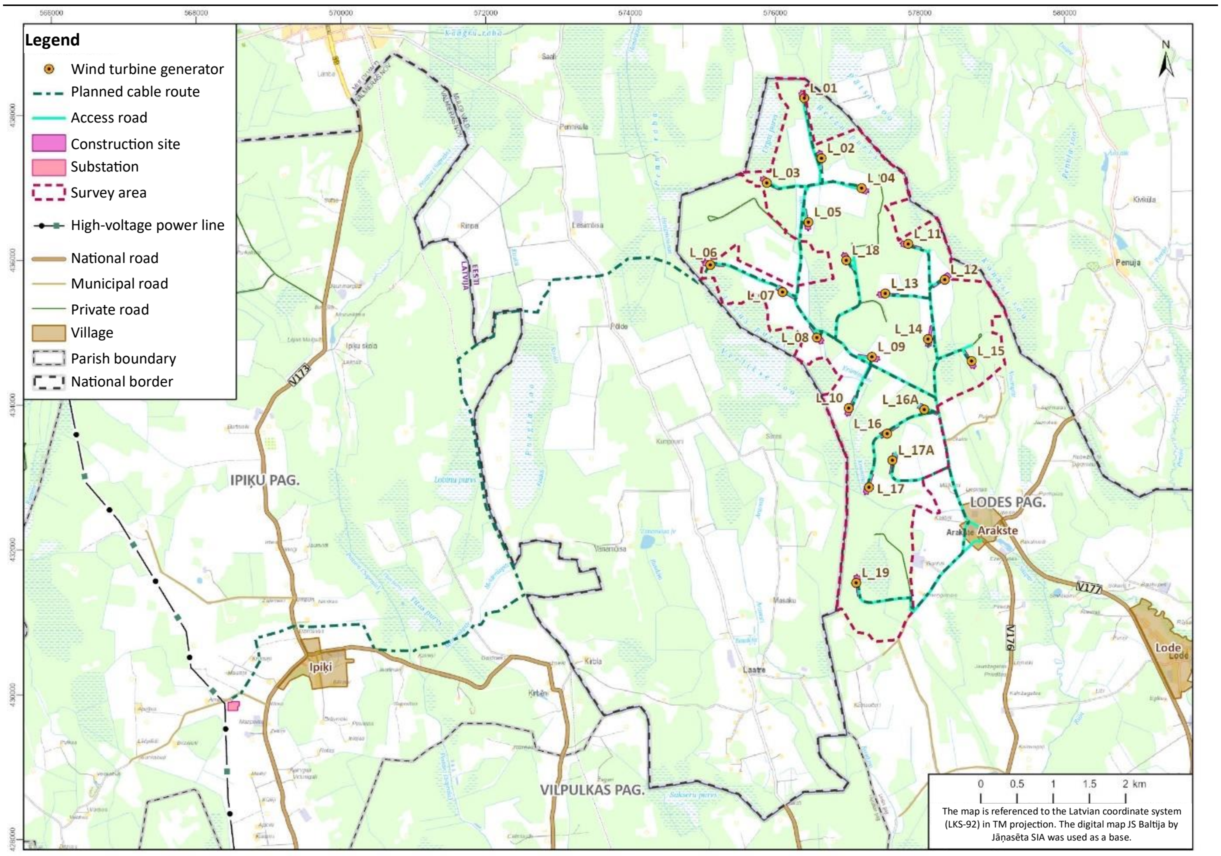


Figure 3.5.1. Planned power supply infrastructure

3.5.3 WTG foundation construction

It is expected that the WTGs in the planned wind farm will be installed on a monolithic reinforced concrete foundation in accordance with the technical specifications of the manufacturers and taking into account the bearing capacity of the soil on the proposed activity site. The size of the WTG foundation structure depends on the WTG model to be installed, the height of the mast, the bearing capacity of the soil and other factors.

Detailed engineering geological survey of all WTG sites will be performed by the proponent after the completion of the EIA process. The engineering geological survey will assess the bearing capacity of the soil on each WTG site. If the engineering geological survey identifies areas where the soil bearing capacity is insufficient for the construction of the selected WTG, the foundation structure will be built on piles in those locations. Whether the piles will be required and the technological solution for the construction thereof will be determined during the construction design phase.

3.5.4 Construction of access roads and areas

To ensure access to the WTG construction sites during the construction and operation of the wind farm, access roads and assembly sites should to be constructed and, where necessary, existing roads need to be adapted.

Access to the planned Lode wind farm during the construction and operation is planned via the national local roads V176 Sīļi-Estonian border and V177 Ķoņi-Lode-Arakste, as well as the municipal road Arakste-Bērzi and the roads of VAS Latvijas Valsts Meži roads (Palejas road and Lapegļu clearance) (see Figure 3.5.2). It is expected that access could also be provided via

Estonian roads and roads owned by others, which are currently used for access to farmland clusters and forest areas.

During the development of the construction project for the planned wind farm, the suitability of national and local roads for transporting construction materials and components of the WTGs will be assessed, including, if necessary, adapting all or part of the necessary road section to improve load-bearing conditions. The need for and the way of adaptation of any municipal or national roads will be arranged with the owner of the road concerned. The total length of potential municipal roads under access roads is 8.11 km.

As mentioned above, the existing access road network is not sufficient for the construction of the proposed wind farm, and the new access roads are planned as part of the implementation of the proposed activity. New roads are planned close to the boundaries of field clusters or parcels, where possible, thus reducing farmland fragmentation. The location of access roads will be agreed with the property owners and their comments will be taken into account with roads being situated to minimise their impact on the use of agricultural and forest land. The total length of prospective roads is about 11.66 km. The locations of the access roads to the proposed Lode wind farm are shown in Figure 3.5.2.

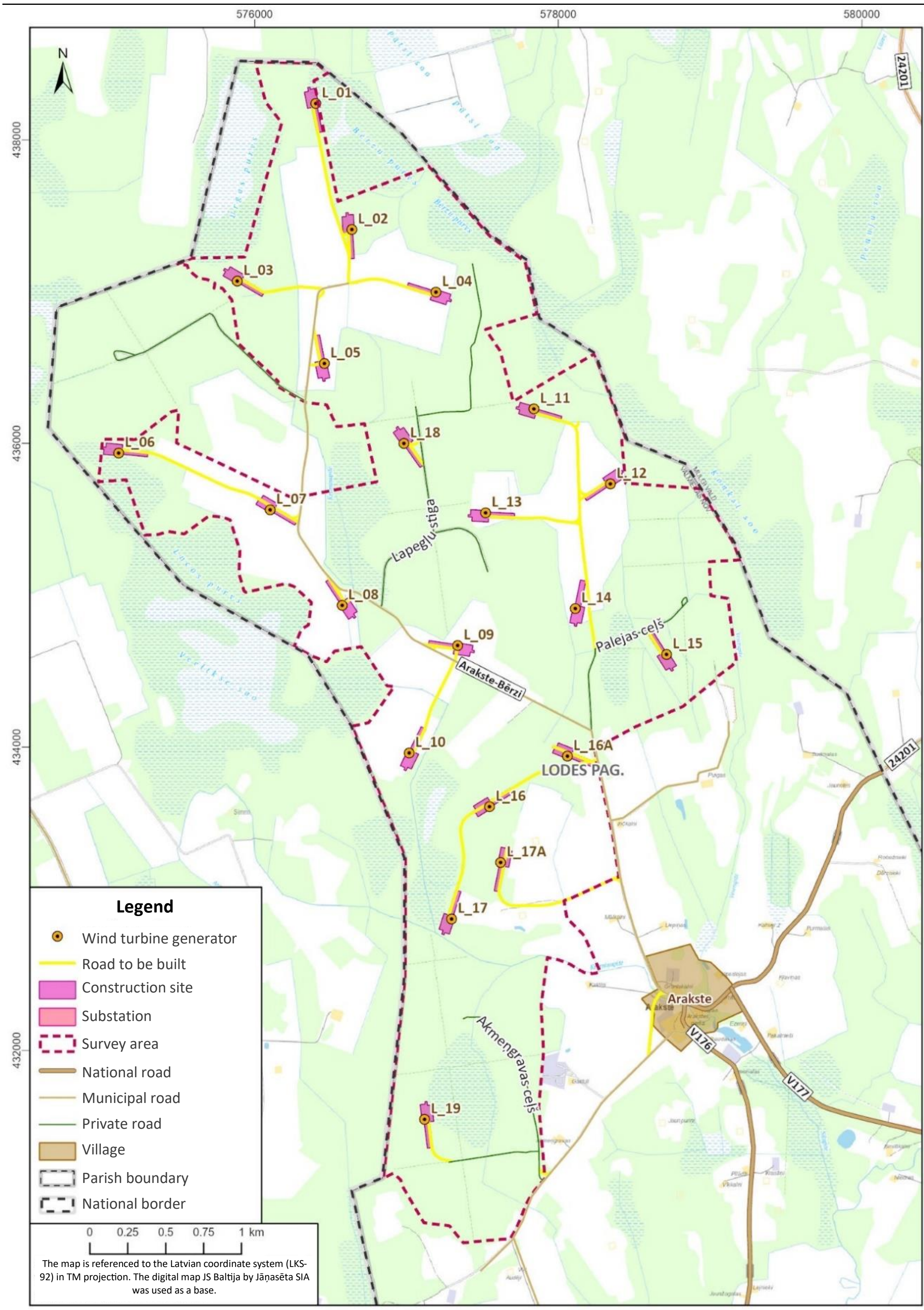


Figure 3.5.2. Road network used for the construction of the Lode wind farm

Pursuant to requirements of the WTG manufacturers, all access roads must be at least 6 m wide (at least 4.5 m over straight, flat sections) and have load capacity over 250 kN/m^2. Existing roads less than 6 metres wide would be widened. New roads will be gravel and crushed stone with adequate bearing capacity. The specific technical solutions and scope of work will be determined by assessing the technical condition and load-bearing capacity of each road section during the construction design phase.

New roads to be built are planned in the vicinity of the existing reclamation ditches whenever possible, thus reducing the need for new drainage infrastructure. It is expected that sections of existing roads that currently have roadside ditches to direct rainwater away from the road will be maintained, with cleaning and profiling where necessary. For the adaptation of existing roads that do not currently have roadside ditches for storm water drainage, as well as for the construction of new roads, the need for ditches will be assessed and they will only be installed if natural drainage conditions are insufficient to drain storm water from the road. As part of the construction project for the planned wind farm, solutions will be developed and implemented during the construction to ensure that the existing reclamation and drainage system will continue to function after the planned wind farm is built.

An assembly site is planned by each WTG to be built. The size and configuration of the assembly site depends on the model of the WTG, machinery used for the assembly, location of the site, changes in ground surface elevation, logistics solutions, rotor assembly solutions and other process limiting elements such as the location of stand-alone trees to be preserved, etc. The configuration of each assembly site will be designed in cooperation with the selected WTG manufacturer or its authorised construction company.

A illustrative example of an assembly site is shown in Figure 3.5.3. The elements of the assembly site, such as access roads, main crane working area and the hard surfaced areas (hard surfacing: compacted gravel material providing the specified load bearing capacity) and the WTG foundation area, will be created during the construction process and maintained during the lifetime of the wind farm. The elements of the assembly site for the blade and mast elements will be created during the construction and dismantled after the construction of the WTG. The elements of the assembly site, such as access roads and the main crane working area, will be made of gravel and crushed stone material and must have load-bearing capacity over 250 kN/m^2.

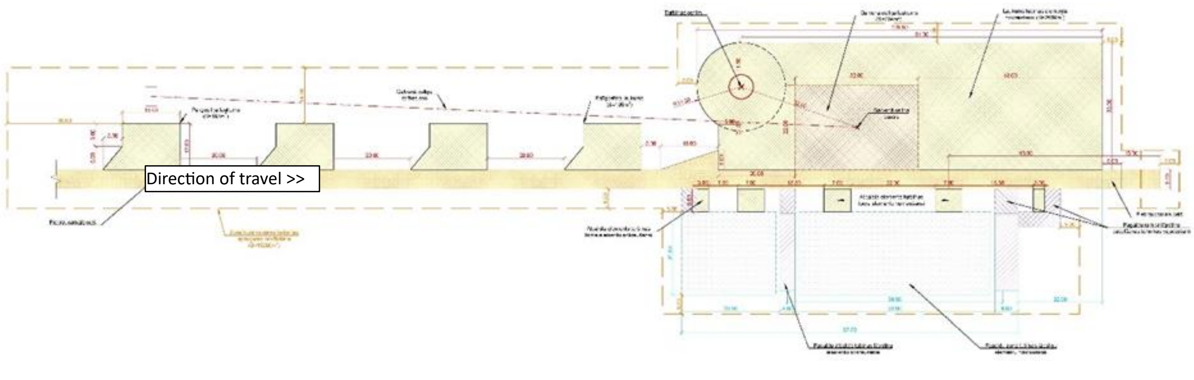


Figure 3.5.3. Example of an assembly site.

3.5.5 WTG delivery and installation

During the development of the construction design, the transport routes will be assessed in detail and a transport plan for the WTGs will be developed in cooperation with the performer of the proposed activity and the manufacturer of the selected WTG model. The WTG component size and weight, road capacity and other restricting factors, such as location of bridges, viaducts and other facilities along the transport route or close to roads will be taken into account when developing the delivery plan. Where necessary, the road will be adapted, carrying capacity improved or the road configuration modified to ensure that the constructed road surface is suitable for the manoeuvring of oversized cargo vehicles.

It is expected that the WTGs could be delivered from their place of manufacture to the port of Paldiski, from where they could be transported by road along the E67 or E263 to Valga-Uulu and then to the planned wind farm site.

The planned Lode wind farm will have a direct impact on the landscape during its construction.

Given the overall dimensions of the wind turbines and the experience of other countries in transporting turbines to their installation site, it is known that the turbines will be transported in parts as oversize cargo. This requires a thorough preliminary survey to determine the best transport corridors, identify conflict points and define the necessary measures to clear the route. According to the EIA developer, three routes are being studied. All routes start from the Valga-Uulu (Estonian territory) motorway 6 and go from Arakste to the proposed activity site with only the middle portion of the route changing (see Figure 3.5.4).

When assessing the work required to clear transport routes for the transport of turbine parts, it was established that in Estonia the work mainly involves relocation or temporary dismantling of overhead power lines below and the temporary dismantling of existing road infrastructure such as lanterns or road signs. In Latvia, however, most of the work involves cutting or trimming roadside vegetation, i.e. trees, shrubs, bushes, etc., to provide wide enough corridors or adequate radii on bends and curves.

The WTG component delivery to the proposed activity site will be done by the manufacturer of the WTG or its authorised carrier using specially designed and equipped vehicles. Considering that transportation of WTG components may interfere with movement of other vehicles along the transport route, it is expected that the deliveries of WTG components could also take place at night when traffic is lower. Oversize cargo delivery routes will be coordinated in accordance with the statutory regulations governing the carriage of oversized and heavy goods.

The delivered WTG components will be stored either at the WTG assembly site or in dedicated areas for temporary storage of machinery, equipment and materials. The WTG installation in the Lode wind farm will be carried out by the manufacturer of the selected WTG model or its authorised construction company. During the construction design phase, a detailed plan for the WTG installation will be drawn up in cooperation between the proponent of the proposed activity and the WTG manufacturer and/or a contractor authorised by the manufacturer. Installation of a single WTG typically requires 5 to 7 days, but in the event of high very strong wind which make safe WTG installation impossible, the estimated installation time may be longer. Assembly takes place at wind speed of up to 10 m/s.

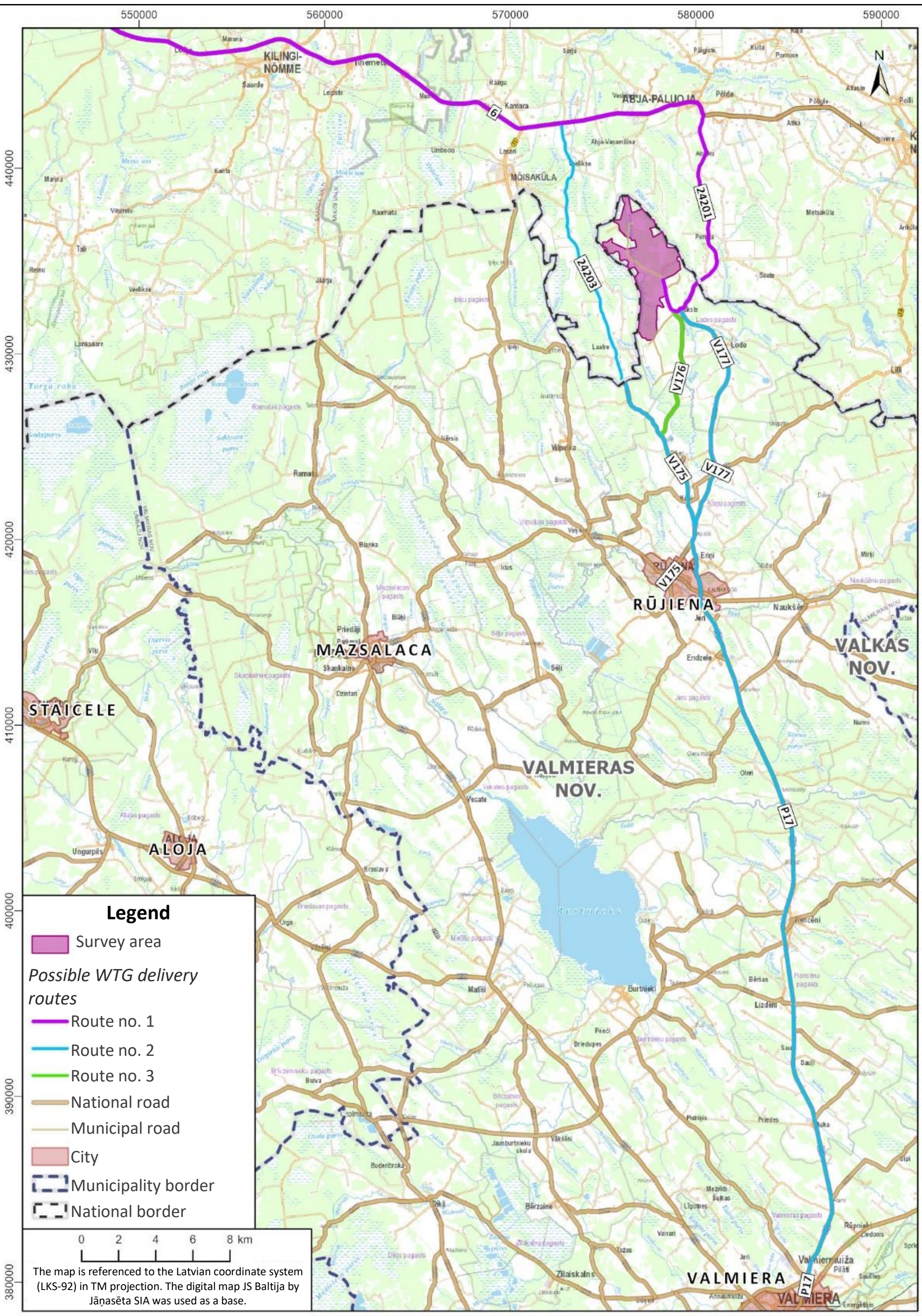


Figure 3.5.4. Possible WTG delivery routes

3.5.6 Site recultivation

After the construction is completed, the areas built for the temporary storage of machinery, equipment and materials, and the WTG assembly site elements for placing the blades and mast sections, will be dismantled. Considering that all areas will be used for parking and operation of machinery during the construction, if any contamination is visually established, soil contamination tests will be done to assess the removed soil use options before further any use of the soil removed from the areas being dismantled. Considering that all sites will be made of gravel and crushed stone, it is expected that the soil from the reclamation will be used to repair the access roads.

Topsoil will be restored in the recultivated areas using soil removed from the construction sites during site preparation. It is expected that once the recultivation work is completed, the areas used during the construction process that are no longer necessary for the WTG operation can be used for future agricultural or forestry activities.

3.6 Site containment, monitoring and control during the construction and operation

No access restrictions to Lode wind farm sites are planned during the construction or operation, except specific parts of the site during construction.

Construction companies with relevant experience will be contracted for site preparation, construction of access roads and areas, rearrangement of reclamation systems, construction of utilities, construction of the WTG foundations, WTG delivery and installation and recultivation of the construction site. They will ensure the containment, monitoring and control of the site, taking into account the requirements of Latvian legislation, such as cabinet regulation no. 500, on general construction regulations. Permanent physical security will be provided at construction sites where construction materials and equipment are stored.

Detailed information on the organisation of the construction work and restrictions during the construction will be included in the construction organisation plan, which is an integral part of the technical design and binding on the contractors.

When the wind farm is put into operation, information signs will be installed on the roads crossing the wind farm site to inform about the recommended safety precautions and emergency response. During the operation of the wind farm, the WTG will be monitored and controlled remotely 24 hours a day, every day. During maintenance or in emergency situations, the WTG will be monitored and controlled and, if necessary, access will be restricted by trained personnel on site. During the operation of the wind farm, economic activities outside the WTG sites will not be restricted, so it is expected that property managers will be able to use the adjacent areas for agriculture or forestry even after the WTGs are built. If necessary, the performer of the proposed activity will inform the agricultural or forestry operators of safety measures and emergency actions.

3.7 Proposed activity implementation sequence and planned deadlines

The EIA process for the planned Lode wind farm is currently underway. The EIA process is expected to be completed in 2024. Once the EIA process is completed and the approval is received, the construction design phase of the wind farm will begin, including the final selection of a specific WTG model. Once the design has been drawn up and approved, construction work will begin and is expected to be completed within about two years from the start of the construction.

The expected WTG lifetime is 25 to 30 years. If the benefits of selling the energy generated by the plant outweigh the costs of maintenance and upgrading, well-maintained WTGs can have longer lifetime. Experience from other countries shows that the actual lifetime of a wind farm can also be affected by technological developments and industry policy. At the end of their lifetime, wind farms are dismantled or repowered. Currently, it is not possible to predict which of these options will be used at the end of lifetime of the planned wind farm. During the dismantling, WTGs and their foundations are completely disassembled, while repowering means that old turbines are mostly replaced by new ones.

According to information provided by the WTG manufacturers, 85–95% of the materials used to build the plants are reusable and only a small portion of the materials are currently not recycled and are incinerated in special plants. Currently it is difficult to predict what share of the materials used to build the turbines will be suitable for recycling. It is likely that the share of recyclable materials will increase as turbines reach the end of their lifetime, as the number of material types suitable for recycling increases and technological solutions for recycling improve.

3.8 Wind turbine related utility buffer zones

Pursuant to the amendments to the act on buffer zones adopted on 6 October 2022, there are no safety buffer zones around wind turbines. During the construction of the planned wind farm, buffer zones will be established around the constructed infrastructure of the power transmission systems, i.e. transformer substations, electrical and electronic communications networks.

According to the act on buffer zones, the following buffer zones should be established around the aforementioned infrastructure objects:

- 1 m wide buffer zone around transformer substations;
- 1 m wide buffer zone along electricity cable lines:
    - 1.5 m wide buffer zone if the cable crosses a forest area;
    - if a cable is closer than 1 m to a building or structure, the buffer zone on that side of the cable is limited to the foundations of the building or structure;
    - a 1 m wide buffer zone along the underground lines of electronic communications networks:
        - if the line is within the road right-of-way and closer than 1 m from the edge of the road right-of-way, the buffer zone on that side of the electronic communications network line is up to the border of the road right-of-way;
        - if the line is closer than 1 m to a building or structure, the buffer zone on that side of the electronic communications network line is up to the foundation of the building or structure;
        - if the line is within the red line of a road, street or access road (including utility corridors) and closer than 1 metre both from the building line and the foundation of a building or structure, the buffer zone on that side of the electronic communications network line is up to the building line or the foundation of the building or structure (whichever is the closest).

4 DESCRIPTION OF THE ENVIRONMENTAL SITUATION AND ASSESSMENT OF THE ENVIRONMENTAL IMPACT OF THE PROPOSED ACTIVITY

4.1 Noise

This chapter of the EIA report assesses the potential impact of the proposed Lode wind farm on noise levels in the vicinity of the proposed activity. The assessment covers the ambient noise from the operation of the WTGs. The chapter is supplemented by input data for the environmental noise calculation model generated by the noise software attached in Annex E.1.

WTGs generate noise not only in the range of frequencies audible to humans, but also very low-frequency sound, infrasound, and high-frequency sound or ultrasound. Infrasound is sound below 20 Hz beyond the human hearing range, low-frequency sound is sound between 10 and 160 Hz and ultrasound is sound above 20 kHz beyond the human hearing range. Information in various publications and websites related to potential negative impact of WTGs on society, relatively frequently mention the low-frequency sounds produced by WTGs, their prevalence and negative impact. An assessment of low-frequency noise from the proposed wind farm and the results of the low-frequency noise calculation attached in Annex E.2 are added to the chapter on noise impact.

4.1.1 Legislative framework

Environmental noise – Latvia

Environmental noise indicators, their application and assessment methods are determined by cabinet regulation no. 16 of 7 January 2014, on noise assessment and management. In accordance with Annex 1 to the regulations, the calculation methods set out in Annex 5, section 2.1 (general – traffic, railway track and industrial noise) and section 2.4 industrial noise, section 2.5 (calculation: noise propagation from traffic, railway tracks and industrial sources) should be used for forecasting environmental noise generated by the planned sites. Annex 2 to the aforementioned cabinet regulation sets out the environmental noise limit values applicable depending on the main types of land use established in the municipality's spatial plan and taking into account areas which include residential buildings registered in the state cadastre information system as development land or land under residential courtyards. Under the regulations, the ambient noise limit values are set for annual average noise levels during the day, evening and night.

The environmental noise limit values applicable to the construction areas in the vicinity of the planned wind farm have been determined on the basis of the existing Rūjiena municipal spatial plan for the 2012–2024[18] period, and taking into account the information on the location of residential buildings and the main use of the buildings included in the state cadastre information system. According to the existing spatial plan, the proposed activity site and its surroundings include farmsteads built on rural land and the village of Arakste, which is divided into detached houses (DzS), apartment blocks (DzD) and mixed development (JA) areas. Taking into account that according to the current Rūjiena municipal regulations on territory use and building, detached houses (DzS), apartment blocks (DzD) and mixed development (JA) can be built in the detached house territories, the noise limit values applicable to the territories of

[18] Available at: https://geolatvija.lv/geo/tapis#document_70

individual (detached, low-rise or farmstead) residential houses, children's institutions, medical, health and social care institutions are applied to the aforementioned territories. Information on the classification of the use functions of the development areas is summarised in Table 4.1.1.

According to the amendments to cabinet regulation no. 16 of 7 January 2014 Noise Assessment and Management effective as of 3 November 2023, different noise limit values are applied to noise from traffic and industrial sources. Considering that WTGs are classified as industrial sites, the environmental noise limit values applicable to industrial sites were used in the noise assessment . Information on the noise limit values applied is summarised in Table 4.1.2.

Table 4.1.1. Classifications of the functions of use of the built-up areas

Function of the built-up area use (cabinet regulation no. 16, on noise assessment and management (07 January 2014))	Rūjienas municipality territory use and development regulations (TIAN)
Private (detached, low-rise or farmstead) residential house, children's facility, medical, health and social care facility development site	Detached housing areas (DzS) Apartment block areas (DzD) Mixed development areas (JA)

Table 4.1.2. Applicable noise limit values in Latvia: noise from industrial sources

Land use function	Noise limit values		
	L_{day} (dB(A))	$L_{evening}$ (dB(A))	L_{night} (dB(A))
Private (detached, low-rise or farmstead) residential house, children's facility, medical, health and social care facility development site	55	50	45

Pursuant to paragraph 2.8 of cabinet regulation no. 16 of 7 January 2014, on noise assessment and management, construction work that have been approved by the local municipality is not subject to the environmental noise limit values set out in the regulations, and therefore the impact of construction work on noise levels in the vicinity of the proposed activity area is not quantified in this noise assessment.

Environmental noise – Estonia

The environmental noise indicators, their application and the assessment methods are determined by Estonian cabinet regulation no. 71 of 21 December 2016, on ambient noise limits, methods of measurement, determination and assessment of noise levels (orig. *Välisõhus leviva müra normtasemed ja mürataseme mõõtmise, määramise ja hindamise meetodid)*[19]. *Estonia, like Latvia, applies different noise limit values to noise from traffic and industrial sources. However, pursuant to the current laws on environmental noise, the following applies:*

[19] Available at: https://www.riigiteataja.ee/akt/121122016027

- Ambient noise limits – the *maximum permissible sound level above which significant harm to the environment is likely to result and, if exceeded, appropriate noise abatement measures must be taken* – applies to existing residential areas;
- Ambient noise objectives – *maximum permissible noise levels in areas with new buildings* - applies to the planned residential development areas.

According to these regulations, the environmental noise limit values should be applied in accordance with the main land use designations in the spatial plan of the municipality and taking into account areas with residential development. After assessment of the available information, it can be concluded that in the proposed activity area there are farmsteads built on rural land and there are no separate areas earmarked for residential development in the municipal spatial plan.

In accordance with those regulations, the residential areas surrounding the proposed activity site have industrial noise limits applicable to Category II development areas, such as educational establishments, healthcare and social welfare establishments, residential areas and green spaces. The residential development area is determined based on the topographic information available from the Estonian Land Service (Maa-Amet) geoportal[20].

Information on the applicable industrial noise limit values is summarised in Table 4.1.3.

Table 4.1.3. Applicable noise limit values in Estonia: industrial noise

Land use function	Noise limit values		Noise target values	
	L_{day} (dB(A))	L_{night} (dB(A))	L_{day} (dB(A))	L_{night} (dB(A))
Category II – educational establishments, healthcare and social welfare establishments, residential areas, green areas	60	45	50	40

Pursuant to Estonian cabinet regulation no. 71 of 21 December 2016, on ambient noise limits, methods of measurement, determination and evaluation of noise levels, construction work is subject to the ambient noise limit values during the hours from 9 pm to 7 am.

Considering that, according to the information provided by the proponent, the construction work will take place mainly during daytime hours, the impact of the construction work on the noise levels in the vicinity of the proposed activity site has not been quantified in this noise assessment.

The environmental noise limit values set in Latvia and Estonia apply to all sources of industrial noise, regardless of the nature of their activities. Although a similar approach is used in most other European countries, the impact of noise on public health may depend not only on the quantitative values of the noise, i.e. decibels, but also on the type of noise source. The World Health Organization has developed guidelines recommending a limit value of 45 dB(A) L_{dvn} for noise from WTGs[21]. Although the WHO-recommended limit values are only a guideline, the

[20] Available at: https://geoportaal.maaamet.ee/eng/Spatial-Data/Estonian-Topographic-Database-p305.html
[21] Available at: https://cdn.who.int/media/docs/default-source/who-compendium-on-health-and-environment/who_compendium_noise_01042022.pdf?sfvrsn=bc371498_3

recommended limit value was also used to assess the impact of the proposed wind farm when working on this assessment.

Low-frequency noise

Latvia and Estonia have not adopted legislation stipulating specific limits and assessment procedures for low-frequency noise which can be used to identify a sufficiently safe distance from residential buildings at which a WTG installation would be permissible without causing harm to public health, and therefore the EIA process looked at the experience of other countries in the matter. In recent years, published assessments of the impact of WTGs have focused more on low-frequency noise, but in most cases the calculated values are compared with audibility thresholds or limit values for low-frequency noise in the working environment, because in most European countries, as in Latvia, low-frequency noise from WTGs is not yet limited by regulations setting out limit values.

Looking at the experience of other European countries, specific limits for indoor low-frequency noise from WTGs have been set only in Denmark (Danish ministry of the environment and food order no. 1736 of 21 December 2015), where both a procedure for assessing low-frequency sound and a limit value binding on all wind farm developers have been established. The order stipulates that the cumulative low-frequency (10-160 Hz) noise level from WTGs in residential buildings cannot exceed 20 dB at wind speed of 6 m/s and 8 m/s (10 m above the ground). Compliance of any existing or planned activity with the indoor noise limit value is determined by calculations because measurements are significantly affected by low-frequency noise from natural and other anthropogenic noise sources. On 7 February 2019, the Danish Ministry of the Environment and Food issued an order, order no. 135, to supplement the previous regulation. Order no. 135 additionally includes sound insulation corrections for summer house or cottage type buildings, which are characterised by significantly lower sound insulation levels than permanently occupied buildings.

4.1.2 Impact assessment approach

Both the forecasted ambient noise and low-frequency noise pollution levels have been calculated for the EIA report.

Environmental noise

The environmental noise calculations were done using IMMI 2023 software (developed by Wölfel Engineering GmbH & Co. KG) (licence no. S001/00757), where the methods set out in regulation no. 16 of the cabinet of ministers of Latvia of 7 January 2014, on noise assessment and management, and regulation no. 71 of the cabinet of ministers of Estonia of 21 December 2016, on ambient noise limits, noise level measurement, determination and assessment methods were used for the calculations.

Pursuant to Annex 1, paragraph 5 of the regulations of the cabinet of ministers of Latvia, the input data for the calculation models generated by the noise calculation software are attached as Annex E.1 (in electronic format) to the EIA report.

The following noise indicators were applied to assess environmental noise in Latvia:

- Daytime noise score L_{day} indicating discomfort during the day. This is the A-weighted long-term average sound level (dB(A)), which represents the annual average daytime noise level. Determined taking into account all days (as a portion of 24 h) in a year.

- Evening Noise Indicator - L_{vakars} indicating discomfort in the evening. This is the weighted long-term average sound level (dB(A)) taken over all evenings (as part of the day) during one year.
- Night noise score L_{night} indicating sleep disturbance caused by noise. This is the weighted long-term average sound level (dB(A)) determined taking into account all nights (as a portion of 24h) in a year.
- 24h noise score L_{24h} indicating the overall discomfort caused by environmental noise.

Pursuant to Annex 1, paragraph 1.2, of the regulations, the assessment and modelling of noise performance assumed that daytime hours are from 7 am to 7 pm, evening hours are from 7 pm to 11 pm, and nighttime hours are from 11 pm to 7 am. Noise was assessed at 4 m above the ground.

Noise was assessed at 4 m above the ground. In accordance with the regulations, the limit values for ambient noise are set for annual average noise levels.

The following noise indicators were applied to assess environmental noise in Estonia:

- Daytime noise score L_{day} indicating discomfort during the day. This is the A-weighted long-term average sound level (dB(A)), which represents the annual average daytime noise level. Determined taking into account all days (as a portion of 24 h) in a year.
- Night noise score L_{night} indicating sleep disturbance caused by noise. This is the weighted long-term average sound level (dB(A)) determined taking into account all nights (as a portion of 24h) in a year.
- 24h noise score L_{24h} indicating the overall discomfort caused by environmental noise.

Pursuant to Annex 1 of the regulations, the assessment and modelling of noise performance assumed that daytime hours are from 7 am to 11 pm and nighttime hours are from 11 pm to 7 am.

Noise was assessed at 2 m above the ground. In accordance with the regulations, the limit values for ambient noise are set for annual average noise levels.

The noise values are plotted in increments of 5 dB(A).

Low-frequency noise

For the assessment and modelling of low-frequency noise, the WindPro software (by EMD International), which has been developed for the assessment of impact from WTGs and includes a special module for the calculation of low-frequency noise in accordance with the requirements of order 135 of the Ministry of the Environment and Food. The input and resulting data of the calculation models generated by the software are attached in Annex E.2 of the EIA report.

Pursuant to order 135 of the Danish Ministry of the Environment and Food, the level of low-frequency noise pollution from WTGs should be determined through calculations. The order stipulates that the purpose of the impact assessment is to ascertain and, if necessary, limit the level of low-frequency noise in residential premises, and that the assessment should be based on noise emission data from the WTGs at wind speeds of 6 m/s and 8 m/s at 10 m above the ground.

Order no. 135 of the Danish Ministry of the Environment and Food sets forth sound insulation values for two types of enclosure structures of the building (see Table 4.1.2). The calculations assume that the sound insulation performance of residential buildings in the vicinity of a wind farm is that of a typical residential building. According to order no. 135 of the Danish Ministry of the Environment and Food, the low-frequency noise level for each 1/3 octave band tone in a building is forecast by the following equation:

$$L_{pALF} = L_{WA,ref} - 10 * \log\left(l^2 + h^2\right) - 11\,dB + \Delta L_{gLF} - \Delta L_{\sigma} - \Delta L_{a},$$

where:

L_{pALF} - noise level for a 1/3 octave band tone (dB);
$L_{WA,ref}$ - WTG sound power level (dB);
l - distance from the WTG foundation to the receiving point (m);
h - WTG nacelle height (m);
Δ_{gLF} - adjustment for ground surface;
$\Delta_{L\sigma}$ - adjustment for sound insulation;
Δ_{La} - adjustment for atmospheric absorption ($a_a * \sqrt{l^2 + h^2}$).

Information on the applicable adjustments for ground surface, sound insulation and atmospheric absorption is summarised in Table 4.1.3.

Table 4.1.3. Adjustment for use in low-frequency noise calculations

Adjustments	1/3 octave band frequency, Hz												
	10	**12.5**	**16**	**20**	**25**	**31.5**	**40**	**50**	**63**	**80**	**100**	**125**	**160**
Δ_{gLF}	6.0	6.0	5.8	5.6	5.4	5.2	5.0	4.7	4.3	3.7	3.0	1.8	0.0
ΔL_{σ} typical residential building	4.9	5.9	4.6	6.6	8.4	10.8	11.4	13.0	16.6	19.7	21.2	20.2	21.2
ΔL_{σ} summerhouse	6.8	3.9	0.4	-0.2	4.8	6.2	8.4	10.5	11.9	11.9	16.0	17.5	17.9
a_a (dB/km)	0.0	0.0	0.0	0.0	0.02	0.03	0.05	0.07	0.11	0.17	0.26	0.38	0.55

To estimate the cumulative low-frequency noise level from each source over the entire low-frequency range, the calculated noise level for each 1/3-octave band frequency is summed up using the following equation:

$$L_{pALF,tot} = 10 * log\left(\sum 10^{\frac{L_{pALF,i}}{10}}\right),$$

and the total noise from multiple WTGs is calculated using the following equation:

$$L_{total} = 10 * \log\left(10^{\frac{L_{p1}}{10}} + 10^{\frac{L_{p2}}{10}} + \ldots\right).$$

4.1.3 Description of the existing situation: environmental noise

In order to identify the level of environmental noise pollution from other noise sources unrelated to the proposed activity in and around the area of the proposed activity, information on environmental noise sources in the vicinity of the proposed activity was collected as a part of the noise assessment. Considering that legislation in both Latvia and Estonia stipulates noise limit values applicable to noise from industrial sources, information on industrial noise sources in the vicinity of the proposed Lode wind farm was collected for the noise assessment to assess potential cumulative impact.

According to the available information, there are no industrial noise sources in the vicinity of the proposed wind farm. The most significant noise sources in the vicinity of the proposed wind farm are national roads, which are subject to environmental noise limits for traffic noise under Latvian and Estonian legislation. In view of the above, this noise assessment does not consider traffic noise separately.

4.1.4 Impact during construction of WTGs: environmental noise

The construction of the Lode wind farm is expected to be completed within two years. Considering that the construction of the wind farm will take place in phases, the noise associated with the wind farm construction processes can be described as non-permanent. According to the information provided by the proponent of the proposed activity, to avoid disturbance to residents at night, the construction work in the area of the proposed activity will be carried out mainly during the day and in the evening (the exact construction organisation plan will be approved by the construction board during the development of the construction design). Although most of the construction work is not expected to cause disturbance to the residents at night, it is possible that some short-term activities may be carried out at night. For example, installation of WTGs is only possible in specific wind conditions. Therefore, if the installation of a WTG in suitable meteorological conditions is not possible during the day, it could be performed at night. It should be noted that nighttime construction will be an exceptional activity and not a general practice in the organisation of the wind farm construction work.

According to paragraph 2.8 of Latvian cabinet regulation no. 16, on noise assessment and management, construction work that has been approved by the local municipality is not subject to the environmental noise limit values specified in the regulations. However, according to Estonian cabinet regulation no. 71, of 21 December 2016, on ambient noise limits, methods of measurement, determination and evaluation of noise levels, any construction work is subject to the ambient noise limit values from 9 pm to 7 am. Considering that, according to the information provided by the proponent, the construction work will take place mainly during daytime hours, the impact of the construction work on the noise levels in the vicinity of the proposed activity site has not been quantified in this noise assessment.

The assessment of the construction process of the proposed wind farm has identified the following construction phases that are associated with increased noise:

- site preparation;
- construction of access roads and assembly sites;
- realigning reclamation systems;
- construction of utilities;
- WTG foundation construction;
- WTG delivery;
- WTG installation;
- site recultivation.

The site preparation, reclamation realignment, utilities construction, WTG installation and site reclamation phases mainly involve the operation of certain machinery units at specific construction sites. Construction of access roads and assembly sites, construction of the WTG foundations and delivery of the WTGs are associated with a significant increase in traffic in the vicinity of the proposed activity.

The proponent envisages that the noise emission of the equipment used in the construction work will not exceed the noise emission limit values of the equipment set out in Annex 2 to cabinet regulation no. 163 of 23 April 2002, regulations on noise emission from equipment for use outdoors.

Taking into account the overall planned construction work duration, the major construction work locations in relation to residential areas, construction work timing and the noise emission limits of the machinery used, noise from the construction work or construction activities related to the installation of power transmission lines in the area of the proposed activity is assessed as a temporary or occasional nuisance not likely to have a significant effect on public health.

During the construction of WTGs and related infrastructure, potentially the most significant noise pollution in the wider area will come from transportation of materials and equipment. According to the specifications provided by the WTG manufacturers:

- construction of new access roads – up to 30 lorries per 100 m of new road;
- construction of installation sites – up to 140 lorries per site;
- WTG construction – up to 280 lorries per WTG;
- main crane assembly – up to 55 lorries per WTG.

Based on the above information, the average number of lorry trips over a two-year period in the event of construction of 19 WTGs is expected to be around 34 lorries per day (round trip) or 3 lorries per hour (during the day). Considering that the exact transport route is yet unknown, but assuming that the existing traffic along the proposed route is not high, the noise levels in the vicinity of the roads would be expected to increase by 3 to 5 dB(A). Although such an increase in noise level may appear significant, it is not expected that the noise level in the vicinity of the motorway will exceed the regulatory limits for environmental noise.

Most of the construction materials and equipment are not expected to be transported at night, but the delivery of large components of the WTGs may be done at night when the traffic on the roads is low, thus not causing disruptions for the users of the public road infrastructure.

4.1.5 Impact during the operation of the operation of the Lode wind farm: environmental noise

A number of possible technological alternatives, i.e. different WTG models, are being assessed as a part of the environmental impact assessment. Taking into account that the wind farm design and the choice of the WTG model may differ from the ones assessed in this EIA report, the approach taken in the context of the technological alternatives is to assess the worst-case scenario, i.e. the noisiest turbine, by setting emission limit values, where necessary, that would ensure compliance of the proposed activity with the statutory regulations, regardless of the chosen WTG model. Although all of the WTGs analysed in this assessment also offer special operating modes with lower noise emission values, possibility of use of these modes in the context of environmental noise is not assessed in this assessment, as all the modes offered by the manufacturers are also associated with significantly lower turbine efficiencies.

In order to identify the WTG model with the highest noise pollution, i.e. to identify the potentially most unfavourable situation, the noise emission levels of all WTG models assessed in this assessment were compared with each other during the EIA process. For the comparison of emission values, data provided by the WTG manufacturers based on noise measurements according to IEC 61400-11, as well as data on wind speed, which can have a significant impact on the turbine noise level, were used. Comparison of the noise emission data from different WTG models shows that they are essentially similar: as wind speed increases and the power generation potential of the WTG increases, the noise level of the plant also increases, but once the plant reaches its rated capacity, the noise level of WTGs does not increase any further. Detailed information on the WTG models that may be installed in the Lode wind farm is provided in Chapter 3 of the EIA report, while information on the sound power levels of the WTG models at a given wind speed is summarised in tables 4.1.4 to 4.1.6.

Table 4.1.4. Vestas V162 – 6.2 sound power level power level

Blade type	**Sound power ($L_{W(A)}$) level (dB) at wind speed (m/s)**							
	3	**4**	**5**	**6**	**7**	**8**	**9**	**≥10**
Standard (ST)	96.7	96.9	97.1	99.0	102.0	104.8	107.1	107.6
Enhanced aerodynamics (STE)	93.9	94.1	94.3	96.2	99.2	102.0	104.3	104.8

Table 4.1.5. Vestas V172-7.2 sound power level power level

Blade type	**Sound power ($L_{W(A)}$) level (dB) at wind speed (m/s)**							
	3	**4**	**5**	**6**	**7**	**8**	**9**	**≥ 10**
Standard	97.8	97.8	98.4	101.8	105.4	108.8	110.1	110.1
Enhanced aerodynamics (STE)	94.6	94.6	95.2	98.6	102.2	105.6	106.9	106.9

Table 4.1.6 Sound power level generated by Nordex N163 – 5.7

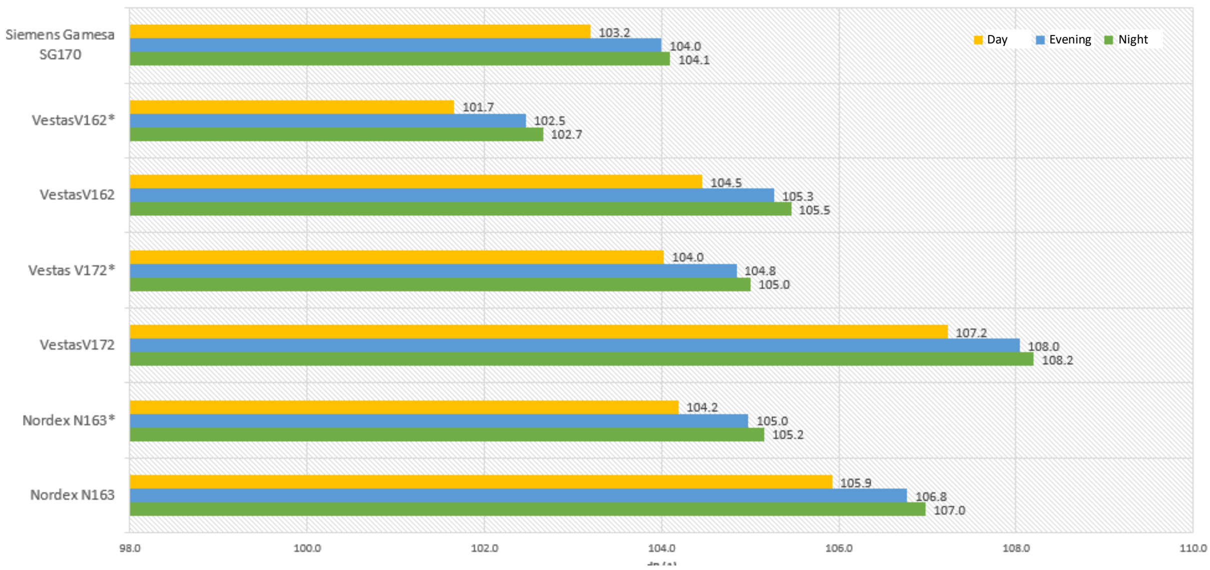
Blade type	**Sound power ($L_{W(A)}$) level (dB) at wind speed (m/s)**							
	3	**4**	**5**	**6**	**7**	**8**	**9**	**≥10**
Standard (ST)	97.5	97.5	97.5	100.8	100.8	105.9	109.2	109.2
Enhanced aerodynamics (STE)	95.5	95.5	95.5	98.8	103.7	103.7	107.2	107.2

Table 4.1.7 Sound power level of Siemens Gamesa SG 470-6.6

Blade type	Sound power level ($LW_{(A)}$) (dB) at wind speed m/s							
	3	4	5	6	7	8	9	≥10
Standard (ST)	92.0	92.0	95.7	99.1	102.5	104.7	106.6	107.0

Not only the sound emission values of the WTGs have significant effect on the long-term noise pollution performance of the WTG, but also the turbine on time at certain emission parameters, i.e. wind speed. To calculate the approximate lifetime of a WTG, the ERA5 model developed by the European Centre for Medium-Range Weather Forecasts (ECMWF) was used to estimate wind speed in the area of the proposed operation for the period from 1 January 2014 to 31 December 2023. Using the detailed wind speed information at 200 m above ground (average over a 10-year period), the potential WTG on time during the day, evening and night was calculated.

The total noise emissions from each of the WTG models assessed in the environmental impact assessment process, according to the collected information on wind speeds in the vicinity of the proposed operation, are provided in Figure 4.1.1. For modelling purposes, the WTG on time does not take into account process brakes in the turbine operation or the need to shut down the WTG in the context of other environmental aspects, such as to reduce the flicker duration or to ensure the protection of bats and birds. Based on the results of the calculations, it was concluded that the highest noise emissions would be generated by the installation of a Vesta V172-7.2 on a 166 m high mast with standard blades, hence this model has been used to estimate the ambient noise level of the WTGs in the vicinity of the planned Lode wind farm.



** improved blade aerodynamics*

Figure 4.1.1. Comparison of noise from the WTG models assessed in the EIA report based on information on wind speed during periods in a day

The ambient noise levels from the WTGs were calculated for 47 residential areas situated up to 2 km from the proposed wind farm. Calculations were carried out for two location alternatives, i.e. the main alternative and the WTGs 16A and 17A alternative location which would be possible if a certificate from the building board that the property does not in fact exist is acquired and the cadastre and land register entries are deleted for the residential building registered within the Inčkalni property.

According to the calculations, the operational noise level of the WTG model Vestas V172-7.2 MW with standard blades does not exceed the environmental noise limit values set by the cabinet of ministers in the nearby residential areas with any of the location alternatives. However, it is expected that some residential areas in the vicinity of the proposed wind farm could have noise levels above the World Health Organization's recommended limit values for WTG noise. The information on the calculated highest noise levels from a WTG is summarised in Tables 4.1.8 and 4.1.9. Environmental noise dispersion maps are provided in Annex 3 of the EIA report, where Figures 1 to 8 show noise dispersion maps prepared in accordance with

Latvian legislation, while Figures 9 to 14 show noise dispersion maps in accordance with Estonian legislation.

As part of the EIA process, one potential substation site is considered for the wind farm connection to the national electricity grid within the properties with the cadastral designations 965600300325 and 96560030141. Considering that the technical design of the substation will be determined during the construction design phase and that the noise emission characteristics of the proposed substation are currently unknown, the permissible noise level at the substation boundary has been calculated using data on the distance to the residential areas and the lower environmental noise limit of 45 dB(A) at night applicable to these residential areas as a part of this environmental impact assessment process.

The nearest residential building, known as Silāres (cadastral designation 96560030109001), is situated 368 m from the potential substation site. *According to the calculations, the noise level at the substation border must not exceed 61 dB(A) to comply with the ambient noise limit value at night at the residential building in question.*

It should be noted, however, that 266 m to the west of the potential substation site there is the building Amatnieki which is not registered as residential property in the state cadastre information system, but is in fact occupied (cadastral designation 96560030015001). If the building is subject to the environmental noise limit values, then according to the calculations, the noise level at the substation border must not exceed 59 dB(A) to comply with the ambient noise limit value at night at the residential building in question.

Table 4.1.8. The highest calculated noise level in residential areas with WTG model Vestas V172-7.2 with standard blades *(in Latvia – calculated at 4 m above ground)*

Cadastral designation of residential building	Cadastral designation of residential building Residential area name AT – noise level measured in the development area F – noise level measured 2 m away from the facade	Noise score, dB(A)										
		Noise limit value			Noise generated by WTG main alternative				Noise generated by WTG with 16A and 17A			
		L_{day}	$L_{evening}$	L_{night}	L_{day}	$L_{evening}$	L_{night}	L_{24h}	L_{day}	$L_{evening}$	L_{night}	L_{24h}
96680010049001	Akmeņgravas (F)	*55*	*50*	*45*	37	38	38	44	36	37	37	44
96680010032001	Arakste (AT)				35	36	36	42	35	36	36	42
96680010066001	Arakstes muiža (AT)				35	36	36	42	35	36	36	42
96680010026001	Gaiduļi (F)				37	38	38	45	37	38	38	44
96680010022001	Grantskalni (F)				35	36	36	42	35	36	36	43
96680010088001	Inčkalni (F)**				41	42	42	48	43	44	44	50
96680010101001	Irbītes (AT)				34	35	35	41	34	35	35	41
96680010029001	Jaunotes (F)				34	35	35	42	35	36	36	42
96680010092001	Jaunpuriņi (F)				33	34	34	40	32	33	33	40
96680010063001	Kaktiņi (F)				38	39	39	46	38	39	39	45
96680010031001	Kalniņi (F)				34	35	35	41	35	35	36	42
96680020015001	Kalnsolteri (F)				29	30	30	37	28	29	29	36
96680010090001	Kazeri (AT)				35	35	36	42	35	36	36	42
96680010056001	Liepiņas (F)				37	38	38	44	38	39	39	45

Cadastral designation of residential building	Cadastral designation of residential building Residential area name AT – noise level measured in the development area F – noise level measured 2 m away from the facade	Noise score, dB(A)										
		Noise limit value			Noise generated by WTG main alternative				Noise generated by WTG with 16A and 17A			
		L_{day}	$L_{evening}$	L_{night}	L_{day}	$L_{evening}$	L_{night}	L_{24h}	L_{day}	$L_{evening}$	L_{night}	L_{24h}
96680010047001	Mālkalni (F)				39	40	40	46	40	40	41	47
96680010057001	Puigas (F)				40	40	41	47	41	42	42	48
96680010103001	Raudavas (F)				33	34	34	41	33	34	34	41
96680010007001	Robežnieki (F)				31	31	32	38	31	32	32	39
96680010058001	Sudmalas (F)				36	37	37	43	36	37	37	43
96680010065001	Upeslejas (F)				34	35	35	41	34	35	35	42
96680020047001	Vīķkalni (F)				30	30	31	37	28	29	29	36
96680010083001	Zelmeņi (AT)				35	36	36	42	35	35	36	42

** Residential areas highlighted in red are where the World Health Organization recommended limit value for WTG noise could be exceeded.*

** Construction of WTG 16A and 17A would be possible if a certificate from the building board that the property does not in fact exist is acquired and the cadastre and land register entries are deleted for the residential building registered within the Inčkalni property.

Table 4.1.9. The highest calculated noise level in residential areas with WTG model Vestas V172-7.2 with standard blades *(in Estonia – calculated at 2 m above ground)*

Cadastral designation of the residential building	Cadastral designation of the residential building Residential area name AT - noise level measured in the development area F – noise level measured 2 m away from the facade	Noise score, dB(A)							
		Noise limit value		Noise generated by WTG *main alternative*			Noise generated by WTG *with 16A and 17A*		
		L_{day}	L_{night}	L_{day}	L_{night}	L_{24h}	L_{day}	L_{night}	L_{24h}
117000362	Järve (AT)	*60*	*45*	30	31	37	29	30	36
120536586	Kabaku (AT)			29	30	36	27	28	34
117000020	Kapteni (AT)			28	29	35	27	28	34
117000469	Kase (AT)			33	34	40	33	34	40
117000021	Kaupluse (AT)			29	29	36	37	28	34
117007323	Keskla (AT)			31	32	38	32	33	39
117000845	Kivioja (AT)			30	31	37	29	30	36
117000042	Leisi (AT)			30	31	37	30	31	37
112027098	Lillemaa (AT)			40	40	47	38	39	45
117000168	Matti (AT)			29	30	36	29	30	36
117000611	Merevahi (AT)			34	35	41	35	35	42
117000540	Mitimaja (AT)			33	33	40	33	34	40
117000220	Nahksepa (AT)			30	31	37	31	32	38
117006444	Pilvemäe (AT)			32	32	39	32	33	39
117006486	Puka (AT)			30	31	37	30	31	37
117000419	Puusepa (AT)			31	31	38	32	32	38

Cadastral designation of the residential building	Cadastral designation of the residential building Residential area name AT - noise level measured in the development area F – noise level measured 2 m away from the facade	Noise score, dB(A)							
		Noise limit value		Noise generated by WTG *main alternative*			Noise generated by WTG *with 16A and 17A*		
		L_{day}	L_{night}	L_{day}	L_{night}	L_{24h}	L_{day}	L_{night}	L_{24h}
117000145	Roosimäe (AT)			31	31	38	30	31	37
117000295	Rulli (AT)			32	33	39	33	33	40
120599962	Ruuna (AT)			32	33	39	33	33	40
117000880	Tammiku (AT)			32	32	39	32	33	39
120535522	Ületee (AT)			31	32	38	32	33	39
117000518	Uue-Kogra (AT)			28	29	35	27	28	34
117000150	Uus-Liiva (AT)			29	30	36	29	30	36
112031439	Vesiveski (AT)			31	32	38	30	31	37

** Residential areas highlighted in red are where the World Health Organization recommended limit value for WTG noise could be exceeded.*

The results of the environmental noise calculations show that the proposed activity can be implemented in compliance with the noise management requirements of Latvian and Estonian legislation; however, the construction of the loudest permissible stations is expected to result in noise levels in the four residential areas closest to the proposed wind farm exceeding the World Health Organization -recommended limit values for WTG noise.

Although there are currently no requirements for mandatory measures to avoid or reduce impact, it is recommended that the WTG noise level is taken into account in the process of selecting a WTG model to mitigate the impact of the proposed wind farm and that, if there are no other valid reasons for selecting a louder plant, a WTG with the lowest possible noise emission level should be selected and installed in Lode wind farm. The choice of quieter stations will allow bringing the level of impact in the nearest residential areas closer to or within the noise limits recommended by the World Health Organization for WTG noise.

4.1.6 Low-frequency noise assessment

Low-frequency noise levels were calculated for a total of 47 residential buildings situated within 2 km of the potential WTG construction sites, including residential buildings in Estonia. Calculations assume that the sound insulation performance of the enclosure structure of all residential buildings is that of a typical building as specified for the Danish calculation method. Considering that in the context of the overall low-frequency noise level the noise generated by WTG at one specific frequency can be crucial, the impact of low-frequency noise has been analysed for all WTG models assessed in this EIA report.

Unlike environmental noise whose dispersion is mainly influenced by the absorption characteristics of the atmosphere, indoor low-frequency noise levels are also influenced by the sound insulation performance of the façade, which can vary dramatically for sounds of a certain frequency. The Danish standard requires WTG to comply with the limit value when operating at wind speed of 6 m/s and 8 m/s at 10 m above the ground.

Details of the calculations are attached in Annex E.2 of the Report, while Tables 4.1.10 and 4.1.11 summarise the results of the calculations.

According to the calculations, the main location alternative and the alternative with the construction of WTG 16A and 17A, provided a certificate from the Building Board that the property does not in fact exist is acquired and the cadastre and land register entries are deleted for the residential building registered within the Inčkalni property, the operation of the WTG models assessed in the EIA will not exceed the limit value of 20 dB(A) in the residential buildings situated in the vicinity of the wind farm.

Table 4.1.10. WTG low-frequency noise level (dB(A)) in residential buildings near the wind farm

Building cadastral designation	Name	Vestas V172-7.2 (ST)		Vestas V172-7.2 (STE)		Vestas V162-6.2 (ST)		Vestas V162-6.2 (STE)		Siemens Gamesa SG170-6.6 (ST)		Nordex N163-5.7 (ST)		Nordex N163-5.7 (STE)	
		6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s
96680010049001	Akmeņgravas (LV)	15.1	15.1	14.0	14.4	11.7	12.1	10.4	10.6	10.8	11.1	13.1	13.7	12.4	13.1
96680010032001	Arakste (LV)	14.1	14.1	13.1	13.4	10.8	11.2	9.5	9.7	9.9	10.2	12.2	12.9	11.6	12.3
96680010066001	Arakstes muiža (LV)	14.0	13.9	12.9	13.3	10.6	11.0	9.3	9.5	9.8	10.0	12.0	12.7	11.4	12.1
96680010026001	Gaiduļi (LV)	15.5	15.5	14.5	14.8	12.2	12.6	10.8	11.1	11.3	11.5	13.6	14.2	12.9	13.6
96680010022001	Grantskalni (LV)	14.5	14.5	13.5	13.8	11.2	11.6	9.9	10.1	10.3	10.6	12.6	13.2	11.9	12.6
96680010088001	Inčkalni (LV)	18.5	18.5	17.4	17.8	15.2	15.6	13.8	14	14.3	14.5	16.5	17.2	15.9	16.5
96680010101001	Irbītes (LV)	13.6	13.6	12.6	12.9	10.3	10.6	8.9	9.2	9.4	9.7	11.7	12.4	11.0	11.7
117000362	Järve (EE)	10.9	10.8	9.8	10.2	7.5	7.9	6.2	6.4	6.7	7.0	9.0	9.7	8.4	9.1
96680010029001	Jaunotes (LV)	14.1	14.1	13.1	13.4	10.8	11.1	9.5	9.7	9.9	10.2	12.2	12.9	11.5	12.2
96680010092001	Jaunpuriņi (LV)	13.0	12.9	11.9	12.3	9.6	10.0	8.3	8.5	8.7	9.0	11.0	11.7	10.4	11.1
120536586	Kabaku (EE)	10.8	10.7	9.7	10.1	7.4	7.8	6.1	6.3	6.6	6.9	8.9	9.6	8.3	9.0
96680010063001	Kaktiņi (LV)	16.5	16.4	15.4	15.8	13.1	13.5	11.8	12	12.2	12.5	14.5	15.1	13.8	14.5
96680010031001	Kalniņi (LV)	13.9	13.8	12.8	13.2	10.5	10.9	9.2	9.4	9.7	9.9	12.0	12.6	11.3	12.0
96680020015001	Kalnsolteri (LV)	10.4	10.4	9.4	9.8	7.1	7.5	5.8	6.0	6.3	6.6	8.6	9.3	7.9	8.6
117000020	Kapteni (EE)	10.1	10.1	9.1	9.4	6.7	7.1	5.4	5.7	5.9	6.3	8.3	8.9	7.6	8.3
117000469	Kase (EE)	13.5	13.4	12.4	12.8	10.1	10.5	8.8	9.0	9.3	9.5	11.6	12.2	10.9	11.6
117000021	Kaupluse (EE)	10.4	10.3	9.4	9.7	7.0	7.4	5.7	6.0	6.2	6.5	8.5	9.2	7.9	8.6
96680010090001	Kazeri (LV)	13.8	13.8	12.8	13.1	10.5	10.8	9.1	9.4	9.6	9.9	11.9	12.5	11.2	11.9

Building cadastral designation	Name	Vestas V172-7.2 (ST)		Vestas V172-7.2 (STE)		Vestas V162-6.2 (ST)		Vestas V162-6.2 (STE)		Siemens Gamesa SG170-6.6 (ST)		Nordex N163-5.7 (ST)		Nordex N163-5.7 (STE)	
		6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s
117007323	Keskla (EE)	12.9	12.8	11.8	12.2	9.5	9.9	8.2	8.4	8.7	9.0	11.0	11.6	10.3	11.0
117000845	Kivioja (EE)	11.0	10.9	9.9	10.3	7.6	8.0	6.3	6.5	6.8	7.1	9.1	9.8	8.4	9.2
117000042	Leisi (EE)	11.9	11.8	10.8	11.2	8.5	8.9	7.2	7.4	7.7	8.0	10.0	10.7	9.3	10.1
96680010056001	Liepiņas (LV)	15.7	15.6	14.6	15	12.3	12.7	11.0	11.2	11.4	11.7	13.7	14.4	13.1	13.7
112027098	Lillemaa (EE)	17.1	17.1	16.0	16.4	13.7	14.1	12.4	12.6	12.8	13.0	15.1	15.7	14.4	15.1
96680010047001	Mālkalni (LV)	17.0	16.9	15.9	16.3	13.6	14.0	12.3	12.5	12.7	13.0	15.0	15.6	14.3	15.0
117000168	Matti (EE)	12.3	12.3	11.3	11.7	9.0	9.3	7.7	7.9	8.1	8.4	10.5	11.1	9.8	10.5
117000611	Merevahi (EE)	13.7	13.7	12.6	13	10.3	10.7	9.0	9.3	9.5	9.8	11.8	12.4	11.1	11.8
117000540	Mitimaja (EE)	13.4	13.3	12.3	12.7	10.0	10.4	8.7	8.9	9.2	9.4	11.5	12.1	10.8	11.5
117000220	Nahksepa (EE)	12.4	12.4	11.4	11.7	9.0	9.4	7.7	8	8.2	8.5	10.5	11.2	9.9	10.6
117006444	Pilvemäe (EE)	12.9	12.9	11.9	12.2	9.6	9.9	8.2	8.5	8.7	9.0	11.0	11.7	10.4	11.1
96680010057001	Puigas (LV)	17.6	17.6	16.5	16.9	14.3	14.6	12.9	13.1	13.4	13.6	15.6	16.2	14.9	15.6
117006486	Puka (EE)	11.9	11.8	10.8	11.2	8.5	8.9	7.2	7.4	7.7	8.0	10.0	10.7	9.4	10.1
117000419	Puusepa (EE)	12.7	12.7	11.6	12	9.3	9.7	8.0	8.2	8.5	8.8	10.8	11.5	10.1	10.9
96680010103001	Raudavas (LV)	13.3	13.3	12.3	12.6	10.0	10.3	8.6	8.9	9.1	9.4	11.4	12.1	10.8	11.5
96680010007001	Robežnieki (LV)	12.7	12.7	11.7	12.1	9.4	9.7	8.1	8.3	8.5	8.8	10.8	11.5	10.2	10.9
117000145	Roosimäe (EE)	11.8	11.7	10.7	11.1	8.4	8.8	7.1	7.3	7.6	7.9	9.9	10.6	9.2	10
117000295	Rulli (EE)	13.0	12.9	11.9	12.3	9.6	10.0	8.3	8.5	8.8	9.1	11.1	11.7	10.4	11.1
120599962	Ruuna (EE)	13.4	13.3	12.3	12.7	10.0	10.4	8.7	8.9	9.2	9.4	11.5	12.1	10.8	11.5

Building cadastral designation	Name	Vestas V172-7.2 (ST)		Vestas V172-7.2 (STE)		Vestas V162-6.2 (ST)		Vestas V162-6.2 (STE)		Siemens Gamesa SG170-6.6 (ST)		Nordex N163-5.7 (ST)		Nordex N163-5.7 (STE)	
		6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s
96680010058001	Sudmalas (LV)	15.3	15.3	14.2	14.6	11.9	12.3	10.6	10.8	11.1	11.3	13.4	14.0	12.7	13.4
117000880	Tammiku (EE)	12.9	12.9	11.8	12.2	9.5	9.9	8.2	8.5	8.7	9.0	11.0	11.7	10.3	11.1
120535522	Ületee (EE)	12.9	12.9	11.9	12.3	9.6	10	8.3	8.5	8.7	9.0	11.0	11.7	10.4	11.1
96680010065001	Upeslejas (LV)	14.0	13.9	12.9	13.3	10.6	11	9.3	9.5	9.8	10.0	12.0	12.7	11.4	12.1
117000518	Uue-Kogra (EE)	10.2	10.2	9.2	9.6	6.9	7.2	5.6	5.8	6.1	6.4	8.4	9.1	7.7	8.5
117000150	Uus-Liiva (EE)	12.4	12.3	11.3	11.7	9.0	9.4	7.7	7.9	8.2	8.5	10.5	11.2	9.8	10.6
112031439	Vesiveski (EE)	11.3	11.3	10.3	10.6	8.0	8.3	6.7	6.9	7.1	7.4	9.4	10.1	8.8	9.5
96680020047001	Vīķkalni (LV)	11.3	11.3	10.3	10.7	8.0	8.3	6.7	6.9	7.1	7.4	9.5	10.1	8.8	9.5
96680010083001	Zelmeņi (LV)	13.9	13.9	12.8	13.2	10.5	10.9	9.2	9.4	9.7	9.9	12.0	12.6	11.3	12

Table 4.1.11. WTG low-frequency noise level (dB(A)) in residential buildings near the wind farm with WTG 16A and 17A

Building cadas-tral designation	Name	Vestas V172-7.2 (ST)		Vestas V172-7.2 (STE)		Vestas V162-6.2 (ST)		Vestas V162-6.2 (STE)		Siemens Gamesa SG170-6.6 (ST)		Nordex N163-5.7 (ST)		Nordex N163-5.7 (STE)	
		6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s
96680010049001	Akmeņgravas (LV)	14.8	14.8	13.8	14.1	11.5	11.9	10.2	10.4	10.6	10.8	12.9	13.5	12.2	12.9
96680010032001	Arakste (LV)	14.2	14.2	13.2	13.5	10.9	11.2	9.5	9.8	10.0	10.3	12.3	12.9	11.6	12.3
96680010066001	Arakstes muiža (LV)	14.1	14	13.0	13.4	10.7	11.1	9.4	9.6	9.8	10.1	12.1	12.8	11.5	12.2
96680010026001	Gaiduļi (LV)	15.2	15.2	14.1	14.5	11.9	12.2	10.5	10.7	11.0	11.2	13.3	13.9	12.6	13.3
96680010022001	Grantskalni (LV)	14.7	14.7	13.6	14	11.3	11.7	10.0	10.2	10.5	10.7	12.7	13.4	12.1	12.8

Building cadastral designation	Name	Vestas V172-7.2 (ST)		Vestas V172-7.2 (STE)		Vestas V162-6.2 (ST)		Vestas V162-6.2 (STE)		Siemens Gamesa SG170-6.6 (ST)		Nordex N163-5.7 (ST)		Nordex N163-5.7 (STE)	
		6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s
96680010088001	Inčkalni (LV)*	20.3	20.3	19.2	19.6	17.0	17.3	15.6	15.8	16.1	16.2	18.3	18.9	17.6	18.3
96680010101001	Irbītes (LV)	13.8	13.8	12.7	13.1	10.4	10.8	9.1	9.3	9.6	9.9	11.9	12.5	11.2	11.9
117000362	Järve (EE)	10.6	10.6	9.6	10.0	7.3	7.7	6.0	6.2	6.5	6.8	8.8	9.5	8.1	8.8
96680010029001	Jaunotes (LV)	14.5	14.4	13.4	13.8	11.1	11.5	9.8	10.0	10.3	10.5	12.5	13.2	11.9	12.6
96680010092001	Jaunpuriņi (LV)	12.8	12.8	11.8	12.2	9.5	9.9	8.2	8.4	8.6	8.9	10.9	11.6	10.3	11
120536586	Kabaku (EE)	10.5	10.5	9.5	9.8	7.1	7.5	5.9	6.1	6.3	6.7	8.7	9.3	8.0	8.7
96680010063001	Kaktiņi (LV)	16.3	16.3	15.3	15.6	13	13.4	11.6	11.9	12.1	12.3	14.4	15.0	13.7	14.4
96680010031001	Kalniņi (LV)	14.2	14.2	13.2	13.5	10.9	11.3	9.6	9.8	10.0	10.3	12.3	13.0	11.6	12.3
96680020015001	Kalnsolteri (LV)	10.2	10.2	9.2	9.6	6.9	7.3	5.6	5.8	6.1	6.4	8.4	9.1	7.7	8.5
117000020	Kapteni (EE)	9.9	9.8	8.8	9.2	6.5	6.9	5.2	5.4	5.7	6.0	8.0	8.7	7.4	8.1
117000469	Kase (EE)	13.6	13.6	12.6	12.9	10.3	10.7	9	9.2	9.4	9.7	11.7	12.4	11.1	11.8
117000021	Kaupluse (EE)	10.1	10.1	9.1	9.5	6.8	7.2	5.5	5.7	6.0	6.3	8.3	9.0	7.7	8.4
96680010090001	Kazeri (LV)	13.9	13.9	12.9	13.2	10.6	11.0	9.3	9.5	9.7	10.0	12	12.7	11.4	12.1
117007323	Keskla (EE)	13.1	13.0	12.0	12.4	9.7	10.1	8.4	8.6	8.9	9.2	11.2	11.8	10.5	11.2
117000845	Kivioja (EE)	10.7	10.7	9.7	10.1	7.4	7.7	6.1	6.3	6.5	6.8	8.9	9.5	8.2	8.9
117000042	Leisi (EE)	11.8	11.8	10.8	11.2	8.5	8.9	7.2	7.4	7.7	8	10.0	10.7	9.3	10.0
96680010056001	Liepiņas (LV)	16.1	16.1	15.1	15.4	12.8	13.2	11.4	11.7	11.9	12.1	14.2	14.8	13.5	14.2
112027098	Lillemaa (EE)	16.2	16.1	15.1	15.4	12.8	13.2	11.5	11.7	11.9	12.1	14.2	14.8	13.5	14.2
96680010047001	Mālkalni (LV)	17.6	17.5	16.5	16.8	14.2	14.6	12.9	13.1	13.3	13.5	15.6	16.2	14.9	15.6

Building cadastral designation	**Name**	**Vestas V172-7.2 (ST)**		**Vestas V172-7.2 (STE)**		**Vestas V162-6.2 (ST)**		**Vestas V162-6.2 (STE)**		**Siemens Gamesa SG170-6.6 (ST)**		**Nordex N163-5.7 (ST)**		**Nordex N163-5.7 (STE)**	
		6 m/s	**8 m/s**	**6 m/s**	**8 m/s**	**6 m/s**	**8 m/s**	**6 m/s**	**8 m/s**	**6 m/s**	**8 m/s**	**6 m/s**	**8 m/s**	**6 m/s**	**8 m/s**
117000168	Matti (EE)	12.3	12.3	11.2	11.6	8.9	9.3	7.6	7.8	8.1	8.4	10.4	11.1	9.8	10.5
117000611	Merevahi (EE)	14.0	13.9	12.9	13.3	10.6	11	9.3	9.5	9.7	10.0	12	12.7	11.4	12.1
117000540	Mitimaja (EE)	13.5	13.5	12.5	12.9	10.2	10.6	8.9	9.1	9.3	9.6	11.6	12.3	11.0	11.7
117000220	Nahksepa (EE)	12.6	12.6	11.6	11.9	9.3	9.6	8.0	8.2	8.4	8.7	10.7	11.4	10.1	10.8
117006444	Pilvemäe (EE)	13.1	13.1	12	12.4	9.7	10.1	8.4	8.6	8.9	9.2	11.2	11.9	10.5	11.2
96680010057001	Puigas (LV)	18.4	18.4	17.3	17.7	15.0	15.4	13.7	13.9	14.1	14.3	16.4	17	15.7	16.4
117006486	Puka (EE)	11.9	11.8	10.8	11.2	8.5	8.9	7.2	7.4	7.7	8.0	10.0	10.7	9.3	10.1
117000419	Puusepa (EE)	12.9	12.9	11.9	12.2	9.6	9.9	8.2	8.5	8.7	9.0	11.0	11.7	10.4	11.1
96680010103001	Raudavas (LV)	13.4	13.4	12.3	12.7	10.0	10.4	8.7	8.9	9.2	9.5	11.5	12.1	10.8	11.5
96680010007001	Robežnieki (LV)	13.0	13.0	12.0	12.3	9.7	10.0	8.4	8.6	8.8	9.1	11.1	11.8	10.5	11.2
117000145	Roosimäe (EE)	11.5	11.5	10.4	10.8	8.1	8.5	6.8	7.1	7.3	7.6	9.6	10.3	9.0	9.7
117000295	Rulli (EE)	13.1	13.1	12.1	12.5	9.8	10.2	8.5	8.7	8.9	9.2	11.2	11.9	10.6	11.3
120599962	Ruuna (EE)	13.3	13.3	12.3	12.6	10.0	10.3	8.7	8.9	9.1	9.4	11.4	12.1	10.8	11.5
96680010058001	Sudmalas (LV)	15.7	15.7	14.6	15	12.3	12.7	11.0	11.2	11.5	11.7	13.7	14.4	13.1	13.8
117000880	Tammiku (EE)	13.1	13.0	12.0	12.4	9.7	10.1	8.4	8.6	8.9	9.2	11.2	11.8	10.5	11.2
120535522	Ületee (EE)	13.2	13.1	12.1	12.5	9.8	10.2	8.5	8.7	9.0	9.2	11.3	11.9	10.6	11.3
96680010065001	Upeslejas (LV)	14.2	14.2	13.1	13.5	10.9	11.2	9.5	9.8	10.0	10.3	12.3	12.9	11.6	12.3
117000518	Uue-Kogra (EE)	10.0	9.9	9.0	9.3	6.6	7.0	5.3	5.6	5.8	6.2	8.2	8.8	7.5	8.2
117000150	Uus-Liiva (EE)	12.3	12.3	11.3	11.7	9.0	9.4	7.7	7.9	8.2	8.5	10.5	11.1	9.8	10.5

Building cadastral designation	Name	Vestas V172-7.2 (ST)		Vestas V172-7.2 (STE)		Vestas V162-6.2 (ST)		Vestas V162-6.2 (STE)		Siemens Gamesa SG170-6.6 (ST)		Nordex N163-5.7 (ST)		Nordex N163-5.7 (STE)	
		6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s	6 m/s	8 m/s
112031439	Vesiveski (EE)	11.1	11.1	10.1	10.4	7.7	8.1	6.4	6.7	6.9	7.2	9.2	9.9	8.6	9.3
96680020047001	Vīķkalni (LV)	11.3	11.2	10.2	10.6	7.9	8.3	6.6	6.8	7.1	7.4	9.4	10.1	8.7	9.5
96680010083001	Zelmeņi (LV)	13.9	13.9	12.8	13.2	10.5	10.9	9.2	9.4	9.7	10.0	12.0	12.6	11.3	12.0

* Construction of WTG 16A and 17A would be possible if a certificate from the building board confirming that the property does not in fact exist is duly acquired, and the cadastre and land register entries are deleted for the residential building registered within the Inčkalni property.

4.1.7 Assessment of alternatives

The Environmental Impact Assessment compares several technological alternatives – the WTG models:

- Vestas V172 - 7.2 MW with standard blades and blades with improved aerodynamics;
- Vestas V162 - 6.2 MW with standard blades and blades with improved aerodynamics;
- Nordex N163-5.7. MW with standard blades and blades with improved aerodynamics.
- Siemens Gamesa SG170 - 6.6 MW with standard blades.

Environmental noise

The environmental noise assessment concluded that there is no reason to impose restrictions on any of the technological alternatives assessed in the EIA process, as according to the calculations, their operation would comply with the environmental noise limit values in both Latvia and Estonia. The alternative involving construction of WTG 16A and 17A would be possible if a certificate from the building board that the property does not in fact exist is duly acquired, and the cadastre and land register entries are deleted for the residential building registered within the Inčkalni property.

In some residential areas in the vicinity of the planned wind farm, the expected environmental noise level in the wind farm is 7.2 with the WTG model Vestas V172 The level of MW with standard blades installed could be higher than the World Health Organization recommended limits for WTG noise. A better technological choice in the context of public health protection would be a station design with a lower level of environment noise emissions, which would bring the level of impact closer or down to the noise limit values recommended by the World Health Organization for WTG noise.

Low-frequency noise

The assessment of low-frequency noise has shown that there are no reason to impose restrictions on any of the technological alternatives assessed in the EIA process, as according to the calculations, their operation would not exceed the limit value of 20 dB(A) in nearby residential buildings, including, if in the event of construction of WTG 16A and 17A a certificate from the building board that the property does not in fact exist is duly acquired, and the cadastre and land register entries are deleted for the residential building registered within the Inčkalni property. In the context of public health protection, the choice of a station model with a lower level of low-frequency noise is considered a better technological alternative.

It should also be emphasised that there are WTG models available on the market which would have lower noise levels and that the proponent of the proposed activity is also free to choose WTG models not assessed in this report. In such an event, during the construction design phase it should be demonstrated that the chosen technological alternative ensures that the low-frequency noise level in residential buildings does not exceed the limit of 20 dB(A).

4.2 Flicker effect

This section of the report assesses the potential impact of flicker from wind turbines on residential areas in Latvia and in the Estonian part in the vicinity of Lode wind farm.

The flicker (also known as disco effect or shadow flicker[22]) *is caused by the movement of the rotor blades as they periodically cover the sun and create moving shadows on the ground and on the surface of various objects (see Figure 4.2.1). The flickering effect is only noticeable when the sun is shining, but on days when the sun is obscured by clouds, the effect is not observed.*

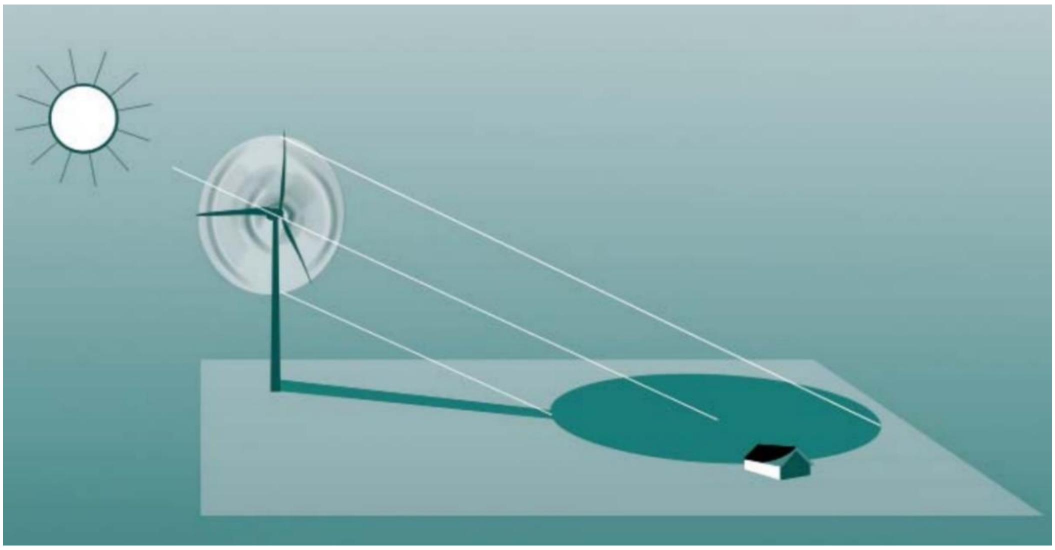


Figure 4.2.1. Illustrative representation of the area affected by flicker

Although there are no studies showing long-term negative effects of the flicker effect on public health, it is considered to be one of the nuisances to residents in the vicinity of a WTG. This impact should therefore be assessed during wind farm planning. According to guidelines developed by the Irish Department of Housing, Local Government and Heritage[23], if the distance between the turbine and the receiver (e.g. a residential house) is greater than about 500 metres, the flicker is usually only observed at sunrise or sunset when the shadow of the turbine is longest. At distances exceeding ten rotor diameters, the likelihood of flicker effects is low.

The flicker effect mainly affects people indoors. This is because the sunlight shining through the house window and illuminating the room in a limited or focused way is interrupted by the shadow of the wind turbine blade, creating a 'disco effect'. Outdoors, the light reaches a person from a much less focused source than through a window in a confined space, so the flickering effect is less disturbing when outdoors. Therefore, the assessment of the impact of flicker is usually performed for residential buildings situated close to wind farms.

WTG flicker can be accurately forecasted by using special software to calculate the flicker time taking into account the time, wind direction and sunny days in a month. If necessary, the flicker effect can be limited by automatically stopping the turbine during periods when they are likely to cause flicker in specific areas.

4.2.1 Legislative framework

Currently, there is no legislation in Latvia or Estonia that sets out how the flicker effect should be assessed and limit the permissible flicker level. A similar situation is observed in other EU

[22] https://www.sciencedirect.com/topics/earth-and-planetary-sciences/flicker
[23] Wind Energy Development Guidelines for Planning Authorities, 2006. Available at: https://www.gov.ie/en/publication/f449e-wind-energy-development-guidelines-2006/

countries where the flicker limit values are mainly set in guidelines rather than statutory regulations. This is because the flicker is seen and defined as a nuisance, but there is no scientific evidence of the impact of flicker on public health. Most of the countries which have set limit values base them on the German guideline limit values[24].

An analysis of the regulation of flicker impact assessment and time limitation in other countries identified the most commonly applied time limits for flicker impact[25]:

- maximum of 30 hours of flicker per year if calculated using the worst-case scenario method;
- maximum of 10 hours of flicker per year if calculated using a realistic scenario (in Germany, Belgium and Sweden, the recommended value is no more than 8 h per year);
- maximum 30 minutes per day if using both assessment scenarios.

The worst-case scenario method for calculating the flicker effect time assumes that the sun shines continuously during daylight hours and is always perpendicular to the rotor blades, which are constantly moving. Calculating the flicker time using the realistic scenario method, the total flicker effect time is calculated based on historical observations of hours of sunshine, wind speed and wind direction in the area.

4.2.2 Impact assessment approach

WindPro software (developed by EMD International) which has been developed to assess the impact of wind farms and includes a special module for calculating the flicker effect is used for the assessment of the flicker effect. The calculations are based on the European Centre for Medium-Range Weather Forecasts (ECMWF) model ERA5, which provides wind speed and wind direction data for the area of the proposed operation for the period from January 2014 to December 2023. For the real-time scenario, the average sunshine hours data of the nearest national grid meteorological station were used. The nearest meteorological station is Rūjiena, but its data is only available up to 2006, so the data from Zoseni station for the last 10 years is used (see Table 4.2.1).

Table 4.2.1. Average sunshine hours

Average sunshine hours (h/day) in a month											
I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VII**	**IX**	**X**	**XI**	**XII**
1.10	2.63	5.69	8.89	10.09	10.48	9.56	8.39	6.96	3.64	1.36	1.02

The flicker time was calculated for those residential buildings in Latvia which are registered in the state cadastre information system, while for residential development areas in Estonia it was determined based on the topographic information available from the Estonian land service (*Maa-Amet)* geoportal[26]. The calculation model includes all residential buildings situated

[24] Länderausschuss für Immissionsschutz, Arbeitskreis Lichtimmissionen, in Vorbereitung, Hinweise zur Ermittlung und Beurteilung der optischen Immissionen von Windenergieanlagen (WEA-Schattenwurf-Hinweise), 2002
[25] Guidelines for the Environmental Impact Assessment of Wind Turbines and Recommendations on Requirements for the Construction of Wind Turbines, 2011
[26] Available at: https://geoportaal.maaamet.ee/eng/Spatial-Data/Estonian-Topographic-Database-p305.html

up to 3 km around the planned wind farms as receivers. Homesteads and residential houses in villages are defined in the calculation model as points with windows perpendicular to all planned WTG (*greenhouse* technique).

WTG flicker impact time depends on a number of factors:

- turbine height,
- rotor diameter,
- wind conditions (WTG operation mode)
- sun elevation above the horizon in a year and in a day.

The impact was assessed for all WTG models listed in Table 3.2.1 (Siemens Gamesa SG170, Vestas V162, Vestas V170, Nordex N163) assuming that they would be built under the worst-case scenario method on the highest available mast specified in the table. For the purposes of this assessment, the flicker times are assessed using the limit values applied in other countries as described above, with the flicker effect calculated using the real-time scenario with the lowest limit value, i.e. 8 h/year.

4.2.3 Impact during operation

Detailed information on the results of the flicker time calculations is provided in Annex 4 of the Report, while Annex E.3 of the Report provides the summary of the WindPro calculation files.

According to the worst-case scenario method calculations (assuming continuous sunshine during the day always perpendicular to the continuously moving rotor blades), residential areas within approximately 1.5–2 km of the outermost wind turbines in the survey area may exceed the limit values set out in the guidelines in Chapter 4.2.1 (30 flicker hours per year). At distances greater than the above, the flicker limit values are not expected to be exceeded. However, as the distance decreases, the chance of exceeding the guideline limits increases every hundred metres.

Looking at the results of the flicker effect calculation, the flicker time per WTG ranges from 8 to 220 hours per year using the worst-case scenario method and from 30 min to 50 hours per year using the realistic scenario method depending on the chosen turbine model. According to the calculations, none of the calculation scenarios and selected technological alternative 8 turbines, i.e. L_03, L_05, L_07, L_08, L_11, L_12, L_13, L_18, produced flicker effect in the residential areas near the planned wind farm, while in the case of Nordex N163, no flicker effect produced by turbines L_04, L_09 and L_14, making it a total of 11 turbines that did not cause flicker effect in the residential areas in the vicinity of the proposed wind farm.

The highest possible exceeded flicker time limit values in residential areas are summarised in Table 4.2.2, which shows the maximum flicker time for all WTG models assessed. The results of the flicker effect calculation show that flicker time could exceed the 8 hours per year limit value of the German guidelines for the real-time scenario for up to 9 residential development areas depending on the WTG model alternative and the 30 h/year limit value with the worst-case scenario calculation method for up to 11 residential development areas depending on the WTG model alternative. The flicker time of each WTG model in the residential area is summarised in Annex 4. It should be noted that flicker time of Nordex N163 in residential areas is lower than for the other assessed WTG models, while the estimated highest cumulative flicker time per year (using the realistic and worst-case scenario methods) in residential areas could potentially be produced by Siemens Gamesa SG170 and Vestas V172. Figures 4.2.2 to 4.2.5 visualise the results of the calculation of the flicker effect time for each WTG model considered in the Report, obtained at using the worst-case scenario calculation method.

Table 4.2.2. Residential areas where flicker time limit values are expected to be exceeded specifying the highest value likely to be exceeded

Homestead name	Maximum calculated flicker time (hh:mm)		
	Worst-case scenario method		Realistic scenario method
	h/year	h/d	h/year
Kaktiņi	≤69:22	≤0:42	≤19:07
Akmeņgravas	≤40:02	≤0:44	≤12:06
Liepiņas	≤46:12	≤0:31	≤12:41
Mālkalni	≤46:54	≤0:37	≤11:35
Gaiduļi		≤0:40	
Puigas	≤38:08		≤10:09
Sudmalas	≤32:42	≤0:34	≤10:01
Inčkalni	≤79:36	≤01:14	≤22:12
Ruuna	≤31:34		≤10:39
Lillemaa	≤55:18	≤0:45	
Sooaru-Ennu	≤36:08		

The report also assessed the turbine L_16 and L_17 location alternatives, i.e. L_16A and L_17A (see Chapter 3.3). The highest possible exceeded flicker time limit values in residential areas assessing the two WTG location alternatives are summarised in Table 4.2.3, which shows the maximum flicker time for all WTG models evaluated. The results of the flicker effect calculation show that the flicker time could exceed the of the German guideline specified 8 h/year limit with realistic scenario and the 30 h/year limit value with the worst-case scenario method, in both cases up to 8 residential development areas depending on the WTG model alternative, which is 1 residential development area with the realistic scenario and 3 residential development areas for the worst-case scenario method fewer than for the main alternative. The flicker time of each WTG model in the residential area is summarised in Annex 4.

Table 4.2.3. Residential areas where flicker time limit values are expected to be exceeded in the event of selection of L_16A and L_17A location alternative specifying the highest value likely to be exceeded

Homestead name	Maximum calculated flicker time (hh:mm)		
	Worst-case scenario method		Realistic scenario method
	h/year	h/d	h/year
Akmeņgravas	≤40:02	≤0:44	≤12:06
Liepiņas	≤41:24	≤0:36	≤11:43
Mālkalni	≤85:58	≤01:14	≤24:22
Gaiduļi		≤0:40	

Homestead name	Maximum calculated flicker time (hh:mm)		
	Worst-case scenario method		Realistic scenario method
	h/year	h/d	h/year
Puigas	≤65:55	≤0:43	≤18:52
Irbītes			≤08:00
Sudmalas	≤42:55	≤0:34	≤12:51
Jaunotes			≤08:01
Ruuna	≤31:34		≤10:39
Lillemaa	≤48:52	≤0:45	
Sooaru-Ennu	≤36:08		

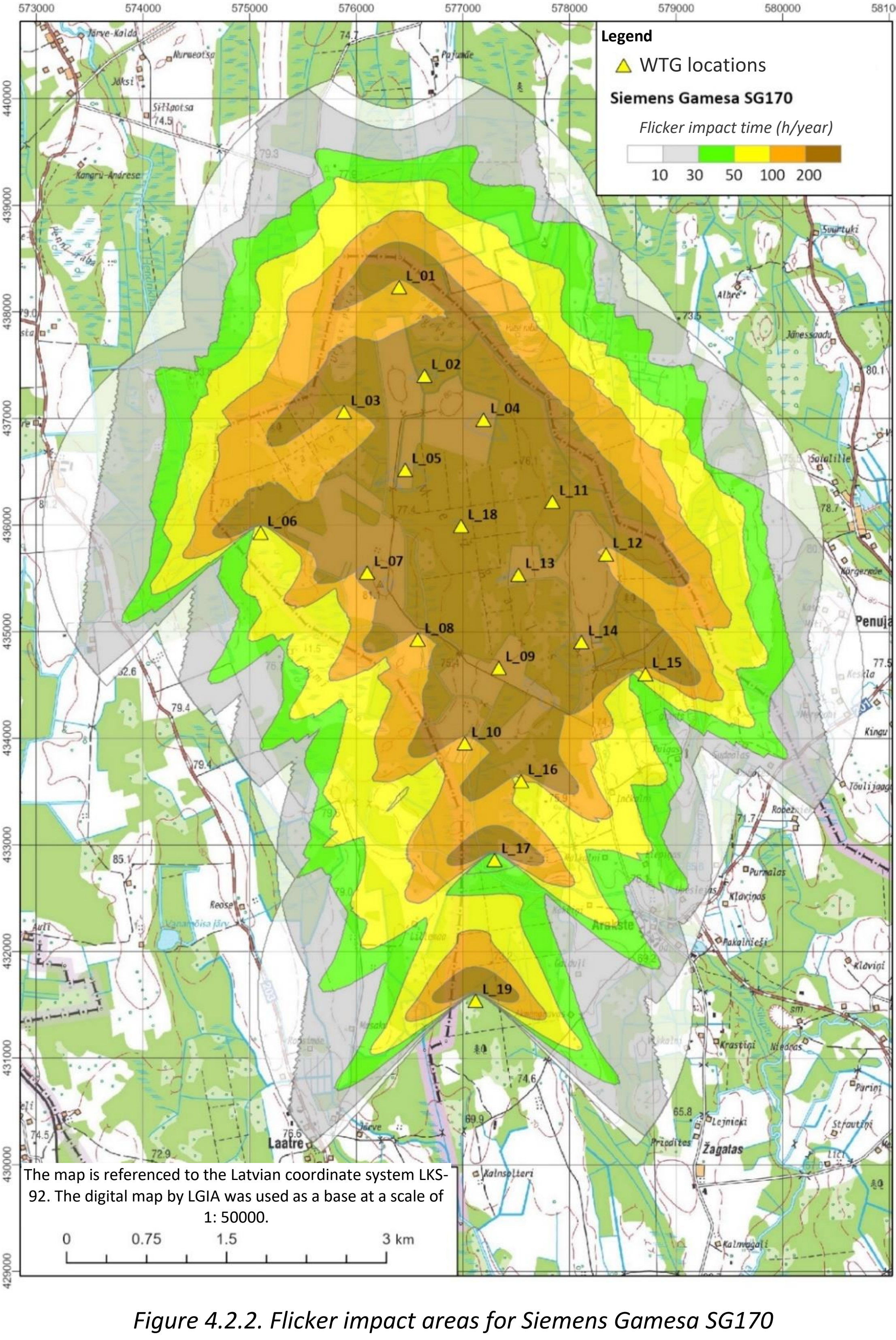


Figure 4.2.2. Flicker impact areas for Siemens Gamesa SG170

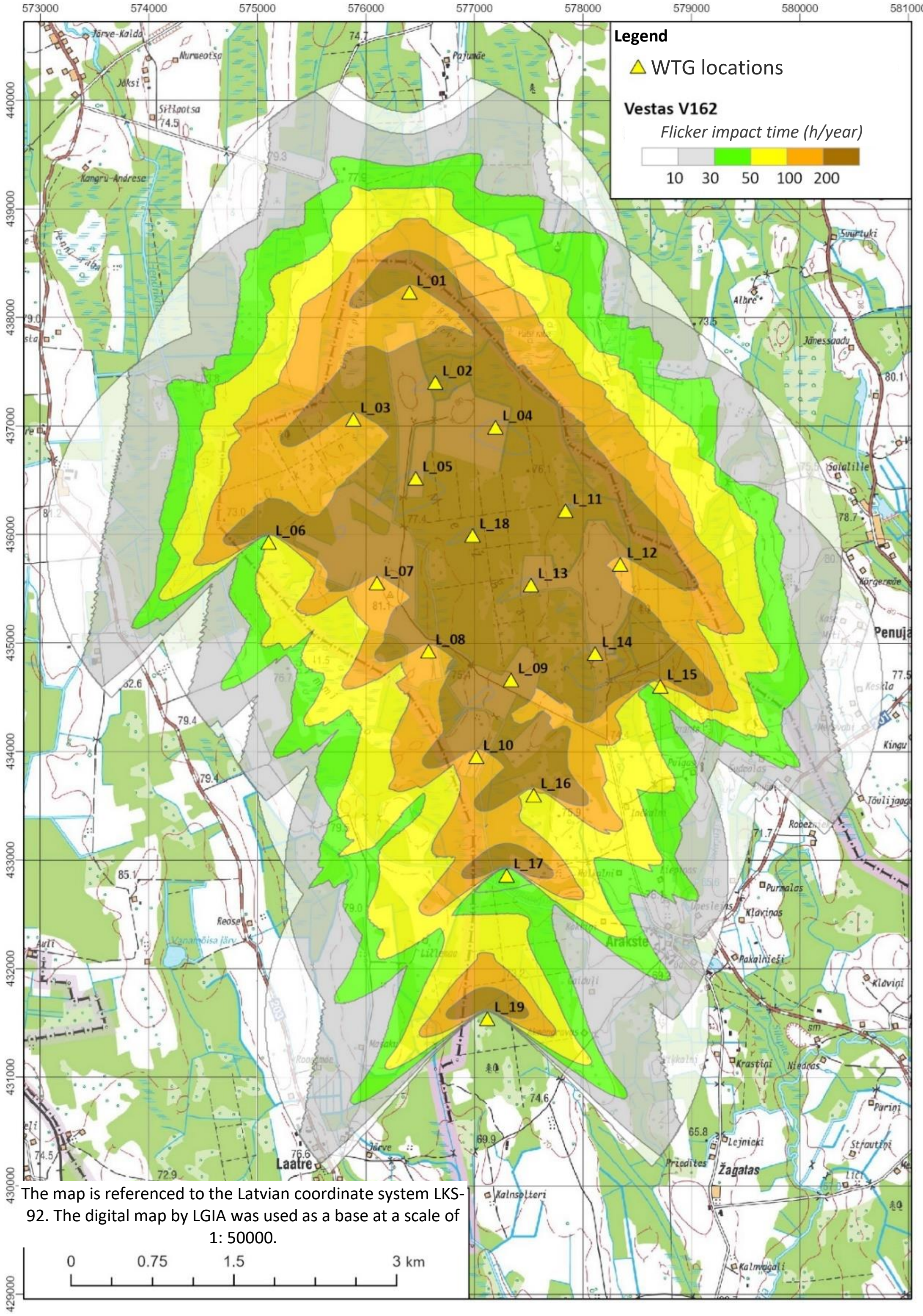


Figure 4.2.3. Flicker impact areas for Vestas V162

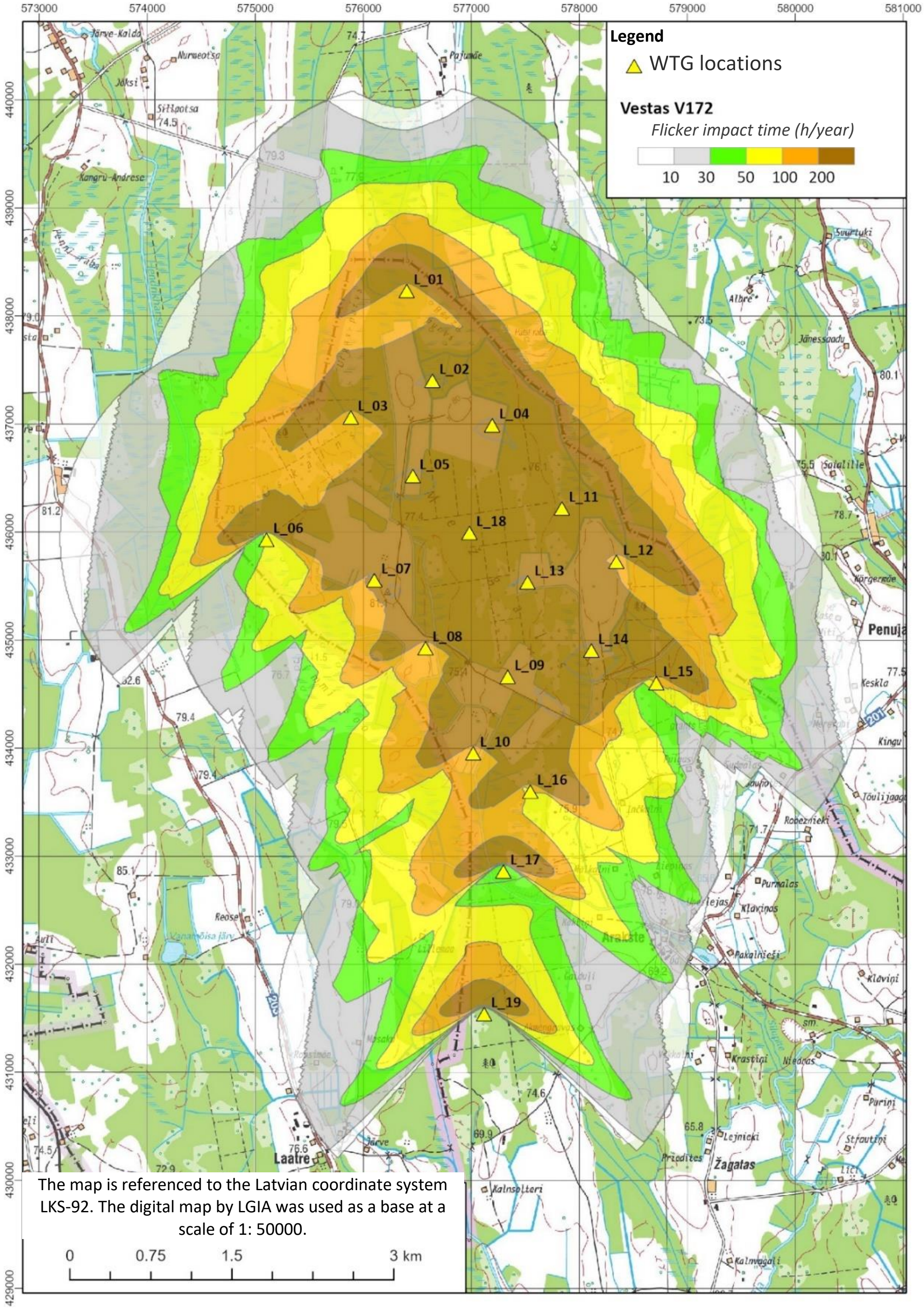


Figure 4.2.4. Flicker impact areas for Vestas V172

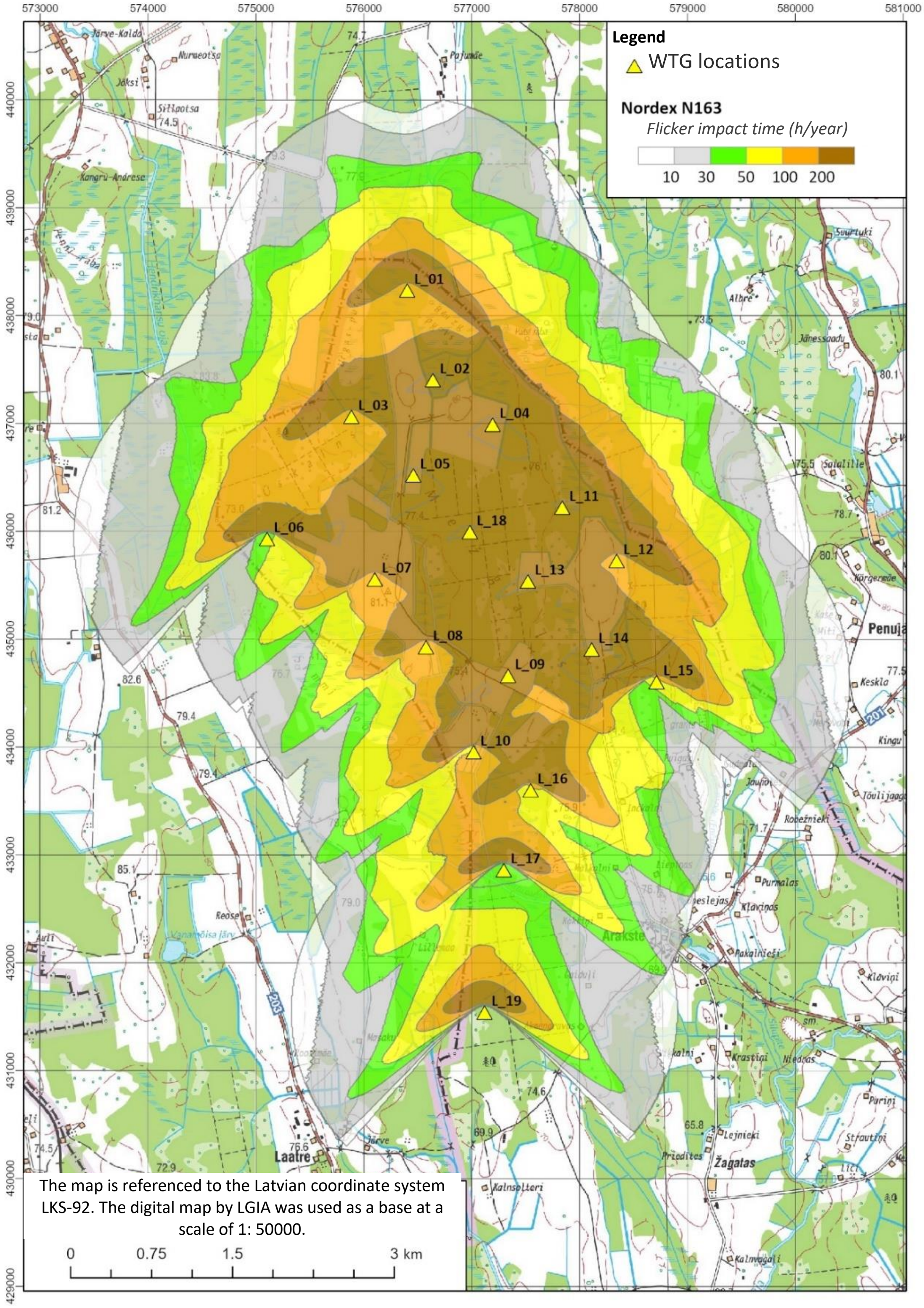


Figure 4.2.5. Flicker impact zones for Nordex N163

4.2.4 Mitigation measures

Calculations have shown that the WTG flicker effect from can cause disturbance above the recommended limit values in residential areas in the vicinity of the proposed activity site regardless of the WTG model chosen. The only technical solution to reduce the flicker time is to stop the flickering turbines during periods when they are likely to produce flicker in residential areas.

The manufacturers of all the WTG assessed as part of this EIA process provide their plants with operation modes that automatically shut down the WTGs at certain times. These operation modes can be set using both theoretical and actual sunshine times. The shutdown mode based on theoretical sunshine times is the simplest technological solution and does not require any additional equipment. This solution involves shutting down specific WTGs during periods when their operation could theoretically cause flicker regardless of whether the sun is shining at the time of the shutdown. This mode is set using the worst-case scenario method for calculating flicker time. The shutdown mode based on actual sunshine is a more technologically sophisticated solution, which involves shutting down certain WTGs only during periods when they are likely to produce flicker and the sun is shining. In this mode, the wind farm must be equipped with equipment that detects when the sun is shining. All of the WTG manufacturers assessed in this EIA process also offer installation of this equipment.

By using one of the above modes, negative effect of WTG flicker may be reduced or prevented. It is recommended to organise the operation of Lode wind farm so that the WTG flicker effect in residential and public areas does not exceed the following flicker limit values:

- 30 hours of flicker per year if calculated using the worst-case scenario method;
- 8 hours of flicker per year if calculated using the realistic scenario;
- 30 minutes per day if using both assessment scenarios.

The area affected by WTGs where the calculated flicker time using the worst-case scenario calculation method exceeds the 30 h/year limit value is also outside the wind farm site. Considering that new residential or public development is permitted there, it is recommended that during further planning and approval process, a solution is found to provide the equivalent level of protection for new development also if it is used for residential or public purposes.

At this stage, the WTG model and mast height have not yet been determined and the WTG locations may be revised during the construction design phase. If the chosen solution differs from those assessed in this report, the flicker effect time should be recalculated during the wind farm construction process, identifying the affected development areas and providing for appropriate shutdown regimes.

4.2.5 Assessment of alternatives

The environmental impact assessment compared different WTG model technological alternatives (see Table 4.2.3). It was concluded that flicker time of Nordex N163 in residential areas is lower than for the other assessed WTG models, while the estimated highest cumulative flicker time per year (using the realistic and worst-case scenario methods) in residential areas could potentially be produced by Siemens Gamesa SG170 and Vestas V172.

Looking at Table 4.2.4, which shows the changes in the flicker time and specific residential buildings depending on the technological alternative, it can be seen that the longest potential impact time was with Siemens Gamesa SG170 - 6.6 model. The Vestas V162 - 6.2 and Nordex N163 models are expected to have the lowest flicker impact of the proposed alternatives in terms of the maximum possible flicker time. In terms of the number of affected residential buildings, the difference between Vestas V162-6.2, Vestas V172-7.2 and Siemens Gamesa SG170-6.6 is insignificant. Nordex N163 will have the least impact in terms of the number of residential buildings.

Table 4.2.3. Number of affected residential buildings for each technological alternative

Technological alternative	**Number of affected residential buildings**		
	Maximum possible flicker time per year	**Maximum possible flicker time per day**	**Statistically possible flicker time per year**
Vestas V162-6.2	10	8	9
Vestas V172-7.2	10	9	8
Nordex N163	7	8	7
Siemens Gamesa SG170-6.6	11	9	9

Table 4.2.4. Maximum flicker time with the worst-case and realistic scenario methods in residential buildings for the compared alternative models

Homestead name	**Vestas V162-6.2**	**Vestas V172-72**	**Nordex N163-5.7**	**SIEMENS Gamesa SG170-6.6**
Maximum flicker time with the worst-case scenario method* (hh:mm)				
Kaktiņi	63:17	69:22	64:23	68:21
Akmeņgravas	35:20	40:02	35:54	39:00
Liepiņas	42:36	40:10	36:55	46:12
Mālkalni	42:13	46:54	32:57	46:05
Puigas	35:09	>30:00	>30:00	38:08
Sudmalas	30:08	32:42	>30:00	32:18
Inčkalni	70:32	79:36	71:27	77:32
Ruuna	>30:00	31:34	>30:00	31:06
Lillemaa	46:04	55:18	48:38	53:59
Sooaru-Ennu	32:02	36:08	>30:00	35:0
Maximum flicker time with the realistic scenario method** (hh:mm)				
Kaktiņi	17:30	19:07	17:07	18:51
Akmeņgravas	10:40	12:06	10:24	11:46

Liepiņas	11:41	11:59	10:35	12:41
Mālkalni	10:24	11:35	09:16	11:22
Puigas	09:21	>08:00	>08:00	10:09
Sudmalas	09:13	10:01	>08:00	09:53
Inčkalni	19:40	22:12	19:06	21:35
Ruuna	09:49	10:39	09:32	10:29

*Notes: *30 h/year limit value   **8 h/year limit value*

Regardless of the choice of the WTG model, the implementation of mitigation measures can ensure that the recommended limit values are met for all the alternatives considered. The impact of the flicker effect should not be considered as a decisive factor in the choice of an alternative, but should be seen in the context of other impacts and the performance of the planned wind farm.

4.3 Biodiversity – Plants and habitats

4.3.1 Legislative framework

Biodiversity protection is integrated into sectoral strategies and action plans and various regulatory documents to ensure that biodiversity is protected. The regulatory framework described in this chapter covers flora and fauna, as well as habitats.

The EU has developed a biodiversity strategy (Biodiversity Strategy 2030[27)] and also has legislation in place to ensure the preservation of biodiversity. The Natura 2000 network of protected areas of EU importance, which also includes special area of conservation in Latvia, is a key part of EU nature and biodiversity policy.

European Union and international commitments

Convention on biological diversity, to which Latvia acceded by the act on the Rio Convention on Biological Diversity of 5 June 1992 (31 August 1995). The objectives of the Convention are preservation of biodiversity and the sustainable use of nature.

The Council of Europe's Convention on the Conservation of European Wildlife and Natural Habitats (also known as the Bern Convention), approved in Latvia by the act on the Bern Convention (17 December 1996). The Convention aims to protect wild flora and fauna and their natural habitats, in particular those species and habitats whose conservation requires cooperation between multiple countries, and to promote such cooperation. Particular attention is paid to threatened and endangered species, including threatened and endangered migratory species.

The Convention on the Conservation of Migratory Species of Wild Animals (also known as the Bonn Convention) adopted by the act on the Bern Convention, 1979 (11 March 1999)). The Convention identifies migratory species at risk, migratory species with an unfavourable conservation status and the principles to be taken into account when implementing conservation measures for these species.

[27] https://ec.europa.eu/environment/strategy/biodiversity-strategy-2030_lv

European Council Directive 2009/147/EC of 30 November 2009 on the conservation of wild birds (the Birds Directive). The Directive was adopted to maintain populations of migratory species at levels that meet specific ecological, scientific and cultural requirements, while taking account of economic and recreational needs, or to regulate the size of populations of these species to levels that meet these requirements. Many wild bird species that occur naturally in Europe are declining, in some cases very rapidly, and this poses a serious threat to environmental protection, particularly as the biological balance is threatened.

European Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive). The Directive aims to contribute to the conservation of biodiversity by protecting natural habitats and flora and fauna. It requires Natura 2000 to create a Single European Ecological Network covering specially protected areas. This network should ensure that natural habitat types and relevant species are maintained or, where necessary, restored to a favourable conservation status within their natural range.

Latvian legislation for protection of the environment and nature

Act on the conservation of species and habitats (in force since 19 April 2000). The aforementioned act regulates matters related to the protection of protected plants, fungi, lichens, animal species, their habitats and biotopes. The objectives of the act are to ensure biodiversity by preserving the fauna, flora and biotopes characteristic of Latvia, to regulate the protection, management and monitoring of species and biotopes, to promote the conservation of populations and biotopes in accordance with economic and social conditions, as well as cultural and historical traditions, to regulate the procedure for designating specially protected species and biotopes, and to ensure the necessary measures for the maintenance of populations. Article 3.1 of the act sets out the requirements for habitats and species of EU significance and lists their features. The protection of natural habitats and species of EU significance in Latvia is ensured in accordance with legislation on nature conservation. The act sets out requirements for the protection of species and habitats.

Cabinet regulation no. 213, on criteria to be used in assessing the significance of the effects of damage to specially protected species or specially protected habitats (in force from 31 March 2007), sets out the criteria to be used in assessing the significance of the effects of damage to special protected species or special protected habitats in comparison with the baseline condition. The rules require that significant adverse changes from the baseline are determined using numerical data for species and measurable data for habitats.

Cabinet regulation no. 1055, a list of species of animals and plants of significance at EU level that are in need of protection and the list of individual species of animals and plants harvesting of which in the wild may be subject to restricted use conditions (in force from 19 September 2009) establishes the list of species of significance at EU level that are in need of protection (cabinet regulation no. 1055, Annex 1) and the list of individual animal and plant species of EU significance harvesting of which in the wild may be subject to restricted conditions of use (cabinet regulation no. 1055, Annex 2). This list has been taken into account in the description of the natural assets in the area surrounding the proposed activity.

Cabinet regulation no. 153, a list of the EU priority species and habitats occurring in Latvia (in force from 25 February 2006) contains the list of EU priority species and habitats in Latvia.

This list has been taken into account in the description of the natural assets in the area surrounding the proposed activity.

Cabinet regulation no. 350, a list of specially protected habitats (in force from 28 June 2017), defines the list of specially protected habitat types.

Cabinet regulation no. 396, a list of specially protected species and restricted use specially protected species (in force from 18 November 2000), lists the species of plants, animals and fungi that are especially protected and restricted for use in Latvia. The list has been taken into account in the description of the natural assets in the area surrounding the proposed activity.

Cabinet regulation no. 940, on the establishment and management of micro-reserves, their protection, and the establishment of micro-reserves and their buffer zones (in force from 1 January 2013), establishes the procedures for the establishment and management of micro-reserves, their protection, and the establishment of micro-reserves and their buffer zones. Annexes to the regulations:

1. specially protected species of mammals, amphibians, reptiles, invertebrates, vascular plants, mosses, algae, lichens and fungi for which micro-reserves can be established;
2. specially protected bird species for which micro-reserves may be established and the micro-reserve areas designated for them;
3. specially protected fish species for which micro-reserves can be created in their spawning grounds.

Act on special areas of conservation (in force since 7 April 1993). The act establishes the basic principles of the special areas of conservation system, the procedure for establishing and ensuring the existence of special areas of conservation, the procedure for managing special areas of conservation, monitoring their status and keeping records, and connects national, international, regional and private interests in the establishment, conservation, maintenance and protection of special areas of conservation. Amendments adopted on 15 September 2005 approved the Annex to the act with the Latvian Natura 2000 list of special areas of conservation of European significance where Natura 2000 sites are divided into three types: "A" – areas designated for the protection of specially protected bird species; "B" – areas designated for the protection of specially protected species other than birds and specially protected habitats; "C" – areas designated for the protection of specially protected species and specially protected habitats. The amendment of 17 March 2022 revises the annex by defining the purpose of establishing Latvian Natura 2000 sites, with a special area of conservation of European significance for each site.

Cabinet regulation no. 264, on general regulations on the protection and use of special areas of conservation (in force from 31 March 2010), establishes the general procedure for the protection and use of special areas of conservation, including the permitted and prohibited types of activities in the areas, as well as a special information sign template to be used in nature to mark the protected areas and the procedure for its use and establishment.

Cabinet regulation no. 511 of 7 July 2008, on the assessment of damage to natural monuments and calculation of the cost of remediation measures (in force from 12 July 2008), establishes the damage assessment and remediation measures for natural monuments designated by the cabinet of ministers as well as by municipalities.

The survey area and the proposed activity site are situated in the Special Area of Conservation in the North Vidzeme Biosphere Reserve, its neutral zone.

The protection requirements of the biosphere reserve are determined by cabinet regulation no. 303 of 19 April 2011. Special regulations for the protection and use of the North Vidzeme Biosphere Reserve and the act on the North Vidzeme biosphere reserve, adopted by the Parliament of Latvia on 11 December 1997. According to the special rules for the protection and use of the North Vidzeme biosphere reserve, the construction of wind turbines in the survey area is allowed without height limitation, subject to the following conditions: wind turbines may be installed upon a written permission from the nature conservation agency; wind turbines must be installed in groups not exceeding 20 wind turbines, minimising the distance between adjacent wind turbines. The distance between the groups must be at least two kilometres.

4.3.2 Impact assessment approach

Information on special area of conservation, micro-reserves, species and habitat sites on the proposed activity site and its vicinity was obtained from the public nature data management system OZOLS[28], portal www.dabasdati.lv, unpublished materials from species assessments according to IUCN categories in the project LIFE for Species and other materials available to experts.

Field surveys have been carried out the proposed activity site (WTG locations and infrastructure). The survey covered the planned access road construction sites within their potential construction width (8 m) and the planned technological sites for the construction of the WTGs in accordance with the sites shown in the cartographic material. It is assumed that various types of impact on protected forest habitats and protected vegetation species may occur up to 50 m around the proposed infrastructure route and development site (e.g. drainage impact or edge effects). During the survey, photographic evidence was collected and GPS equipment was used to record objects and information.

The survey area was surveyed by experts certified in species and habitat conservation:

1) Anete Pošiva-Bunkovska, certificate no. 116;
2) Toms Daniels Čakars, Certified Expert/Assistant Expert, Certificate no. 182;
3) Maija Fonteina-Kazeka, certified expert, certificate no. 233.

The expert opinion on the forest and heathland, swamps, grassland and vascular plant habitat groups in the area of the proposed development has been used for the preparation of this chapter.

Initially, a preliminary survey was performed to analyse cartographic information and information available in databases and assess the potential for identifying specially protected habitats and species. The survey used data from the NCA data management system OZOLS. The proposed activity site was inspected in the field on 27 July and 14 August 2023. In April 2024, the revised and new cable route layouts as well as the updated WTG L_16A and L_17A location

[28] https://ozols.gov.lv/pub

alternatives were surveyed. The section of the cable route in the parish of Ipiķi will be further surveyed in June 2024.

The WTG, technological site and access road locations were revised during the assessment taking into account the initial survey results. To avoid or minimise impact on natural assets, the locations were changed where necessary. Consequently, during the EIA procedure, actions have already been taken to reduce the impact on specially protected species and habitats.

Information on special area of conservation, micro-reserves, species and habitat sites in the vicinity of the proposed activity site in Estonia was obtained from the EELIS database (Estonian Nature Information System).

4.3.3 Description of the current situation

Special protected nature assets on the proposed activity site in Latvia

The survey area is situated in the border zone between the Burtnieka Plain of the North Vidzeme Lowland and the Erģeme Hills of the Sakala Upland. The area around the proposed WTG wind farm is characterised by moraine sediments, with moraine hills, hillocks and kames. The depressions are wet, damp and boggy forests on peaty soils and swamps. Higher ground is agricultural land and dry woodland.

There are no lakes in the area, but there are several small rivers flowing southeastwards towards the river Rūja in the Salaca basin - Veserupīte, Krūmiņupīte, Silupīte, Raudava, Melderīšupīte, Pestava. There are many swamps in the surrounding area - Urgas, Bērzu, Lucas, Lobinu, Titas.

The territory is generally uninhabited, with occasional ruins of ancient dwellings visible. The soils are relatively fertile, so that the vegetation types of the dry forests are dominated by heath and pine-spruce, and the wet forests – Myrtilloso polytrichosa, Caricoso-phragmitosa and swamps. Forestry activity has been and continues to be quite intense in the forests. In the past, population density was higher and there was more open farmland. In many places there are abandoned house sites and secondary overgrown farmland, but part of the area has been forest for a long time, for example in the Ūskalns, Mežgaļi un Akmeņgravas forest ranges. As a result, forests also have structures and species typical of natural forest habitats.

Special areas of conservation, micro-reserves, protected trees

According to the information in the Natural Data Management System Ozols of the Nature Conservation Agency, the survey area and the planned activity site are situated in a special area of conservation (hereinafter referred to as SAC), i.e. North Vidzeme Biosphere Reserve, its neutral zone (see Figure 4.3.1). There are no micro-reserves established for the protection of habitats or plant species on the proposed activity site. The nearest micro-reserves have been established to protect bird species (see Chapter 4.4).

The North Vidzeme Biosphere Reserve covers a wide area in North Vidzeme, including Limbaži, Valmiera and Valka counties, including the proposed activity site. It covers an area of 475,514 hectares, of which 457,708 hectares is land and 17,806 hectares sea. The Biosphere Reserve was established in 1997. Its objective is to achieve a balance, nationally and internationally, between protecting natural diversity, promoting economic development and preserving cultural values. The Biosphere Reserve represents internationally recognised temperate forest ecosystems on land and along the Baltic Sea coast. To ensure the conservation of the landscape, ecosystems, species and genetic diversity of the area and to promote sustainable economic development, the Biosphere Reserve is divided into functional zones (landscape protection area and neutral zone).

The neutral zone is the outer zone of the Biosphere Reserve where sustainable nature management is ensured as a prerequisite for local development. It is designed to promote the balanced and sustainable development of the populated localities within the Biosphere Reserve. The neutral zone includes all towns and villages within the Biosphere Reserve.

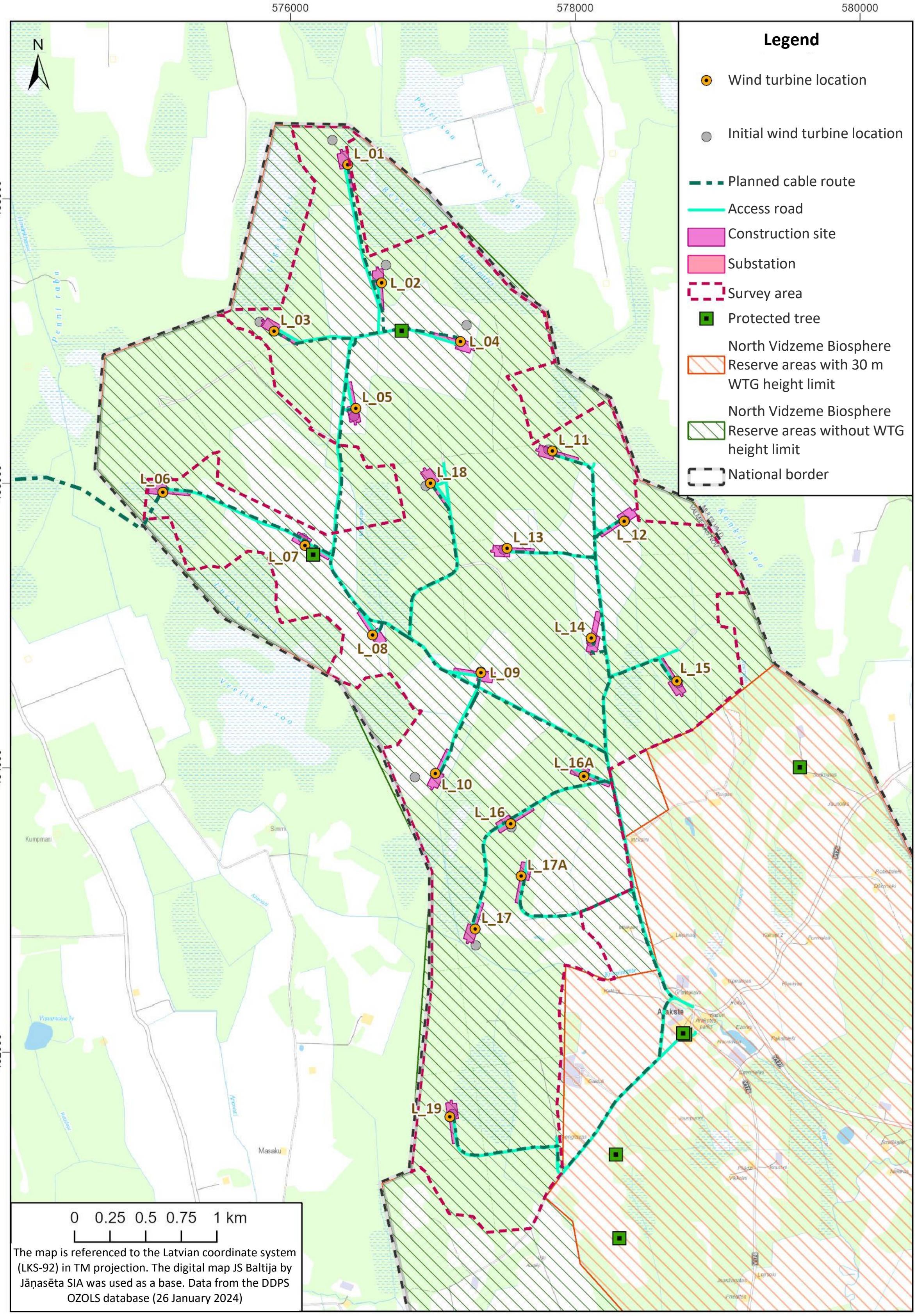


Figure 4.3.1. Location of the proposed activities, special area of conservation and natural assets in the parish of Lode.

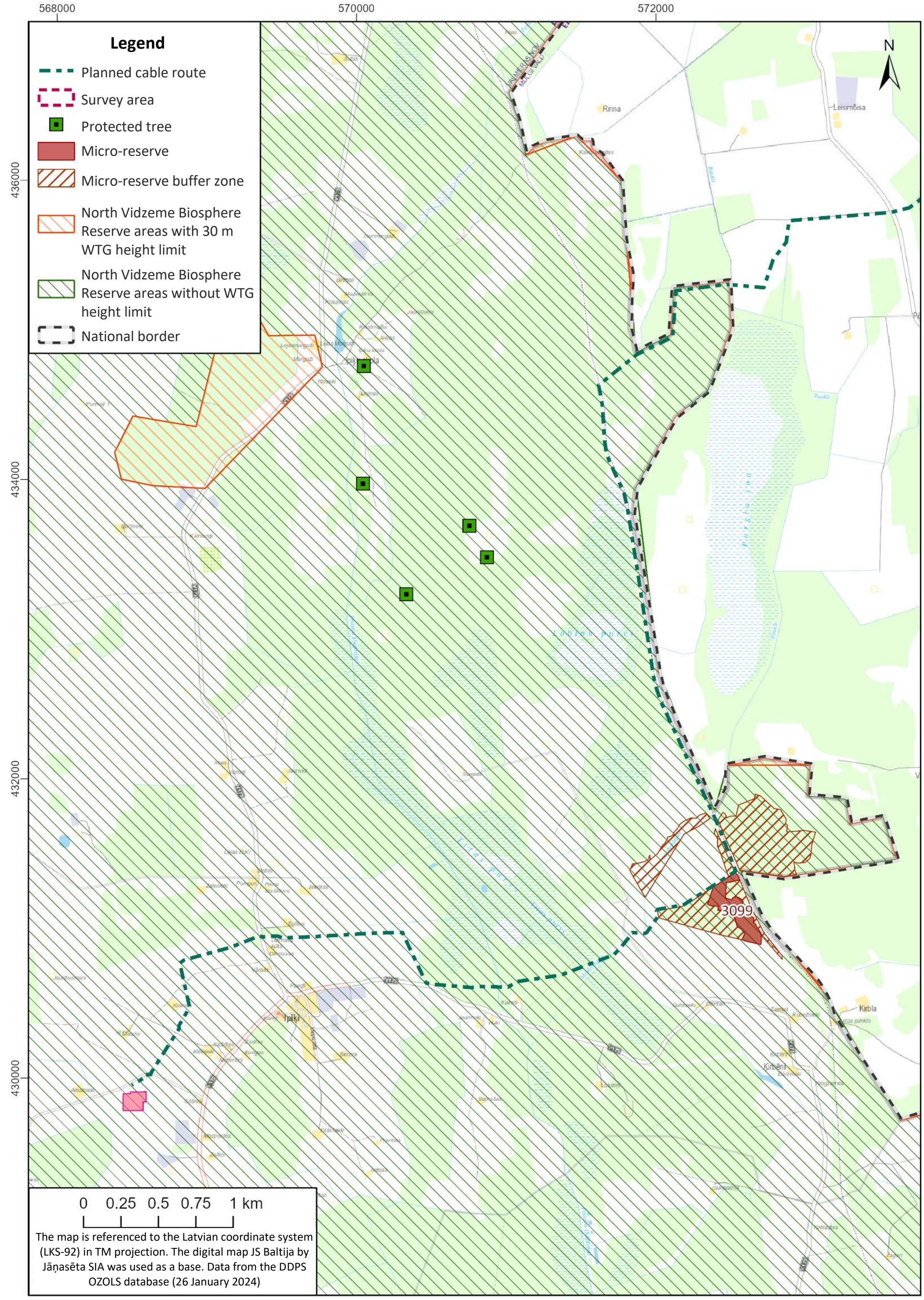


Figure 4.3.2. Location of the proposed activity, special areas of conservation and natural assets in the parish of Ipiķi.

Several potential ancient trees have been identified in the survey area and its vicinity, which meet the criteria of potential ancient trees defined by the Nature Conservation Agency (trees that have reached at least 90% of the size of an ancient tree according to the criteria of protected trees defined in cabinet regulation no. 264 of 16 March 2010, on general regulations on the protection and use of special areas of conservation), and trees important for the conservation of natural diversity. Two potential small-leaved linden ancient trees, *Tilia cordata*, identified during the survey are situated on the edge of the planned access road to WTG L_04. The already known potential *Larix* ancient trees (ID 33050 and 33051) are situated next to the road leading through Arakste.

Protected plant species and habitats

The survey area covered both the forest and swamp habitats of EU importance identified by the Natural Data Management System Ozols and new habitats of EU significance, if any were identified. Protected species of vascular plants, as well as rare and protected species of mosses, lichens, fungi and invertebrates associated with forest habitats are marked (see Figure 4.3.3).

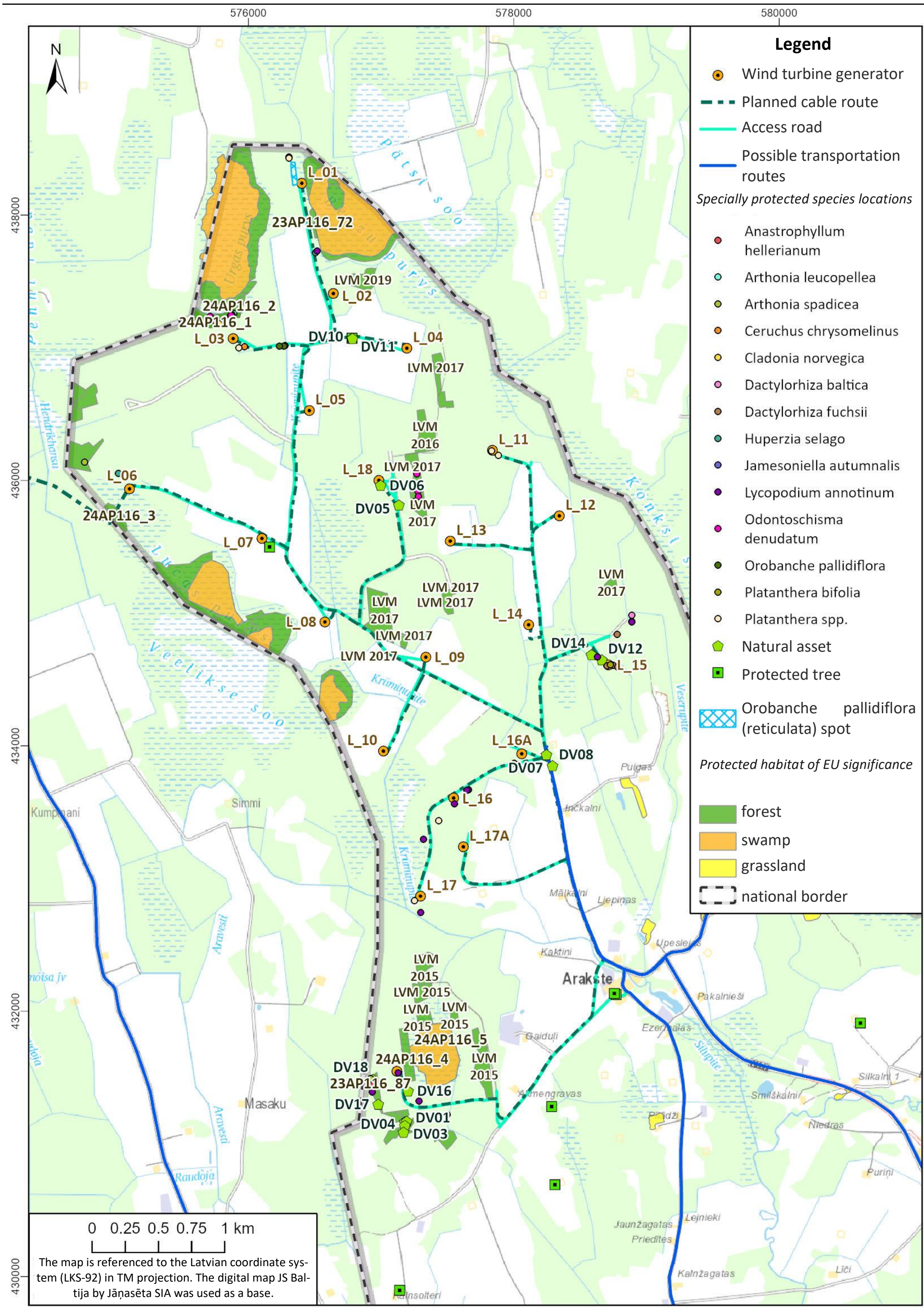


Figure 4.3.3. Habitats of EU significance and sites of rare and protected species in and around the proposed activity site in the parish of Lode

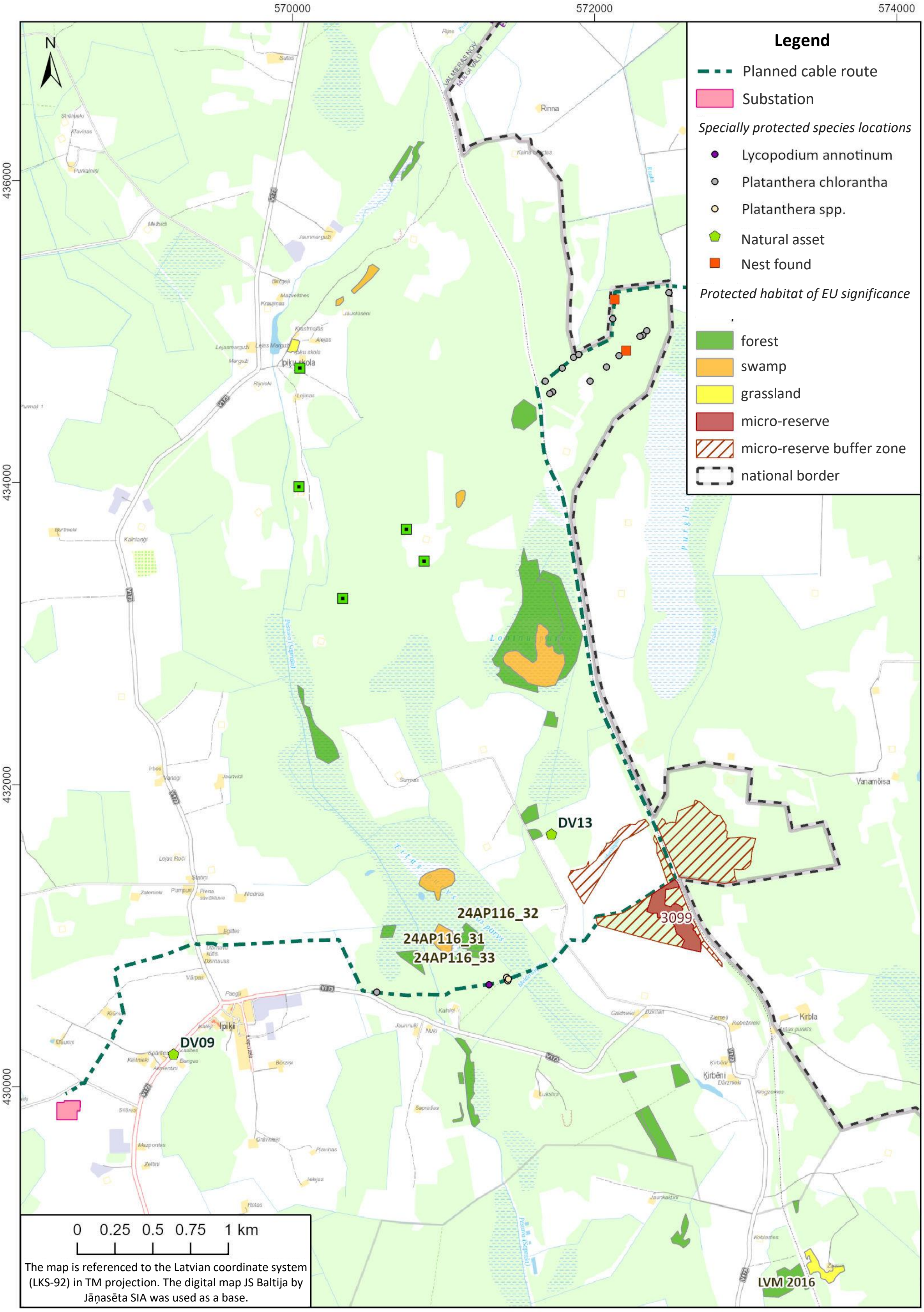


Figure 4.3.4. Habitats of EU significance and sites of rare and protected species in and around the proposed activity site in the parish of Ipiķi

In general, the area around the WTG sites and access roads is forested, some of it secondary forest on former agricultural land. So far, few localities of specially protected or rare plants, fungi, lichens and mosses have been recorded in the Natural Data Management System Ozols in the survey area (several *Platanthera sp*, *Huperzia selago* and *Lycopodium annotinum* sites have been noted).

The EU protected bog habitats are 7110 Active raised bogs, 7120 Degraded raised bogs where natural regeneration is possible or ongoing, and 7140 Transition mires.

The most common forest habitats in the wetland types are 9080* Swamp woods and 91D0* Bog woodland, probably because they are more difficult to harvest than dryland forests and the volume of wood available is lower. The most frequent habitats of EU significance in dryland forests are 9010* Old or natural boreal forest and 9050 Herb-rich spruce forests. No protected grassland habitats were found on the proposed wind farm site during the survey.

On the proposed activity site, as in all Latvian forest areas without sufficient protection status, habitats are most threatened by forestry activities – both in the habitat areas as such where clear-felling may result in habitat destruction and in adjacent areas where clear-felling and forestry infrastructure (road tracks, drainage ditches) create openings, increase ecosystem fragmentation and negatively affect stand microclimate, including through edge effects. Reclamation ditches can have a negative impact on forest habitats that require a high water table (e.g. 9080* Swamp woods), as well as all types of bog habitats.

The EU protected habitats present within the area of the planned WTG sites and access roads, as well as within the area of potential effects (up to 50 m from these sites), are shown in Table 4.3.1 and Figures 4.3.5 to 4.3.9.

Table 4.3.1. EU protected wetland and forest habitats in the area of potential impact of the planned WTG infrastructure (50 m)

Habitat code and name	Polygon number	Location
7120 Degraded raised bogs still capable of natural regeneration	17TK904_67	The habitat ground is situated in the northern part of the site, close to the planned WTG L_01 and L_02 sites and the access road.
	LVM 2020	In the vicinity of WTG L_09 construction site.
9010*_3, Old or natural boreal forest	24AP116_1, 24AP116_2	In the vicinity of WTG L_03 construction site.
9050 Herb-rich spruce forests	19SI05_17	On the edge of the planned cable route in the parish of Ipiķi.
91D0* Bog woodland	24AP116_4	WTG L_19, where the proposed location affects part of the habitat
	17TK904_70 23AP116_72	Near WTG L_01 location and access road
9080*_1	24AP116_3	The habitat ground is crossed by a cable route in the parish of Lode

The rare and protected species found in the area of the planned WTG sites and access roads, as well as in the area of potential impact (up to 50 m from these sites), are shown in Table 4.3.2 and Figures 4.3.5 to 4.3.9.

Table 4.3.2. Special-status species on the proposed activity site and in the area of its potential effect

Name	Species group, conservation category	Accessibility in the survey area
Common spotted orchid *Dactylorhiza fuchsia*	Flowering plant; SCC I, SG IV	L_15 location site and nearby
Northern firmoss *Huperzia selago*	Fern, SCC II, SG IV	Near the L_01 access road
Common club moss *Lycopodium annotinum*	Fern, SCC II, SG IV	Near the L_01 access road, on the L_15 site, near the L_16 site area, in the cable route corridor in the parish of Ipiķi
Liverwort *Odontoschisma denudatum*	Moss, SCC I, DMB IS	L_15 site
Broomrape *Orobanche pallidiflora (reticulata)*	Flowering plant; SCC, MIK, SG II	Near WTG L_01 location and access road Near the WTG L_03 access road
Lesser butterfly-orchid *Platanthera bifolia*, wild orchid *Platanthera sp.*	Flowering plant; SCC I, SG IV	Near the WTG L_01, L_03 site, on the L_15 site, on the L_16 access road route
Lesser butterfly-orchid *Platanthera chlorantha*	Flowering plant; SCC I, SG IV	Cable route corridor in the parish of Ipiķi

SCC I, II – cabinet regulation no. 396, 14 November 2000. List of Specially Protected Species and Restricted Species, Annex I or II.

SG - Latvian Red Book. The LSG uses the following categories of endangered species: I - endangered species; II - declining species; III - rare species; IV - little-known species.

MIK – cabinet regulation no. 940, 18 December 2012. Establishment and Management of Micro-reserves, their Protection, and the Designation of Micro-reserves and their Buffer Zones

DMB IS - natural forest habitat specialist species, acc. to Aunins, A. (ed.) 2013. European Union protected habitats in Latvia. Detection Manual. 2nd updated edition. Latvian Fund for Nature, Ministry of Environmental Protection and Regional Development, Rīga. Pages 350–355

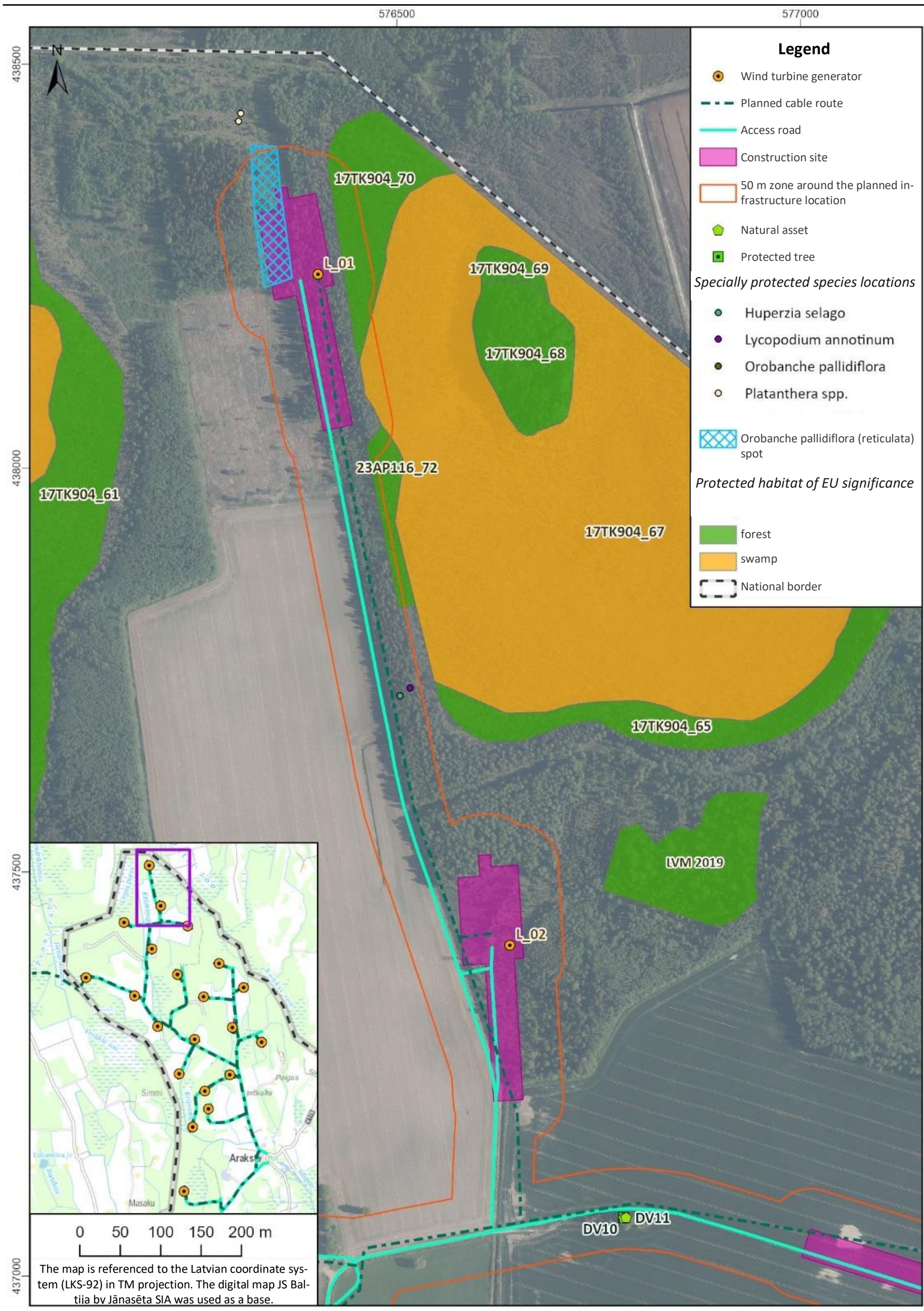


Figure 4.3.5. Sites of special protected species and protected habitats of EU significance near WTG L_01 and along the access road

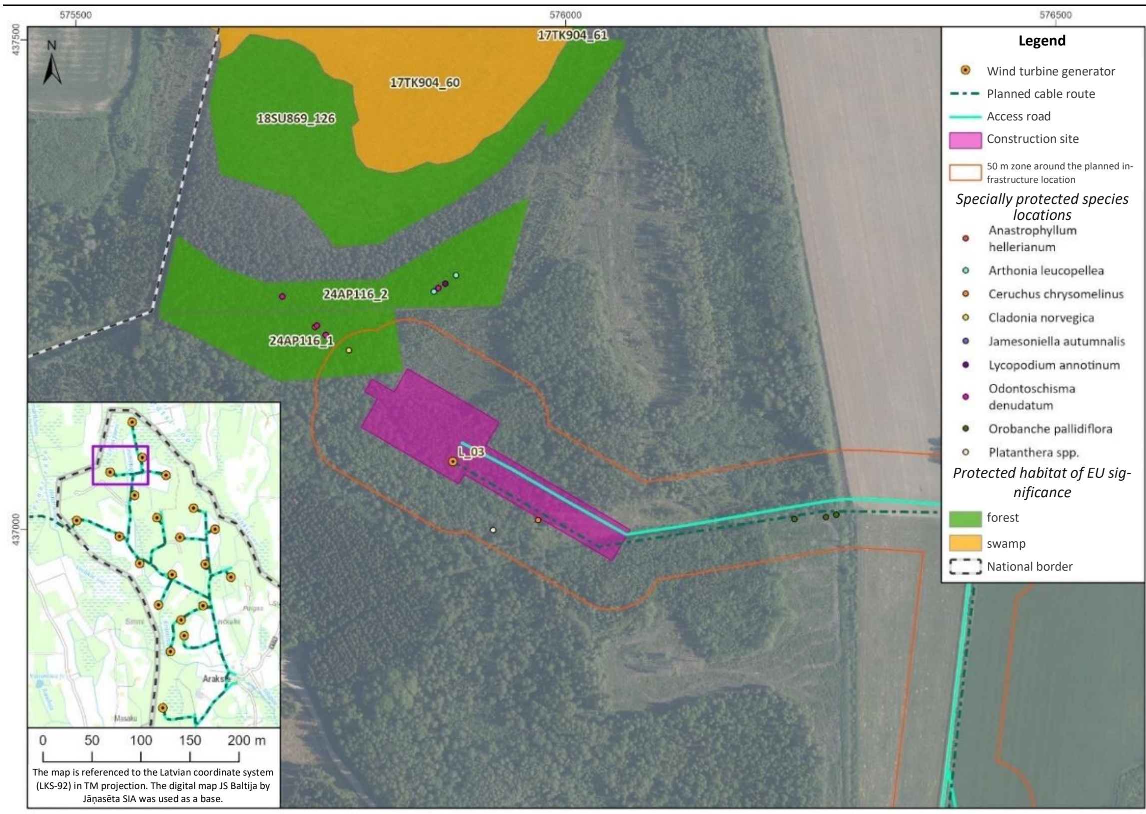


Figure 4.3.6. EU protected habitats on WTG L_03 site

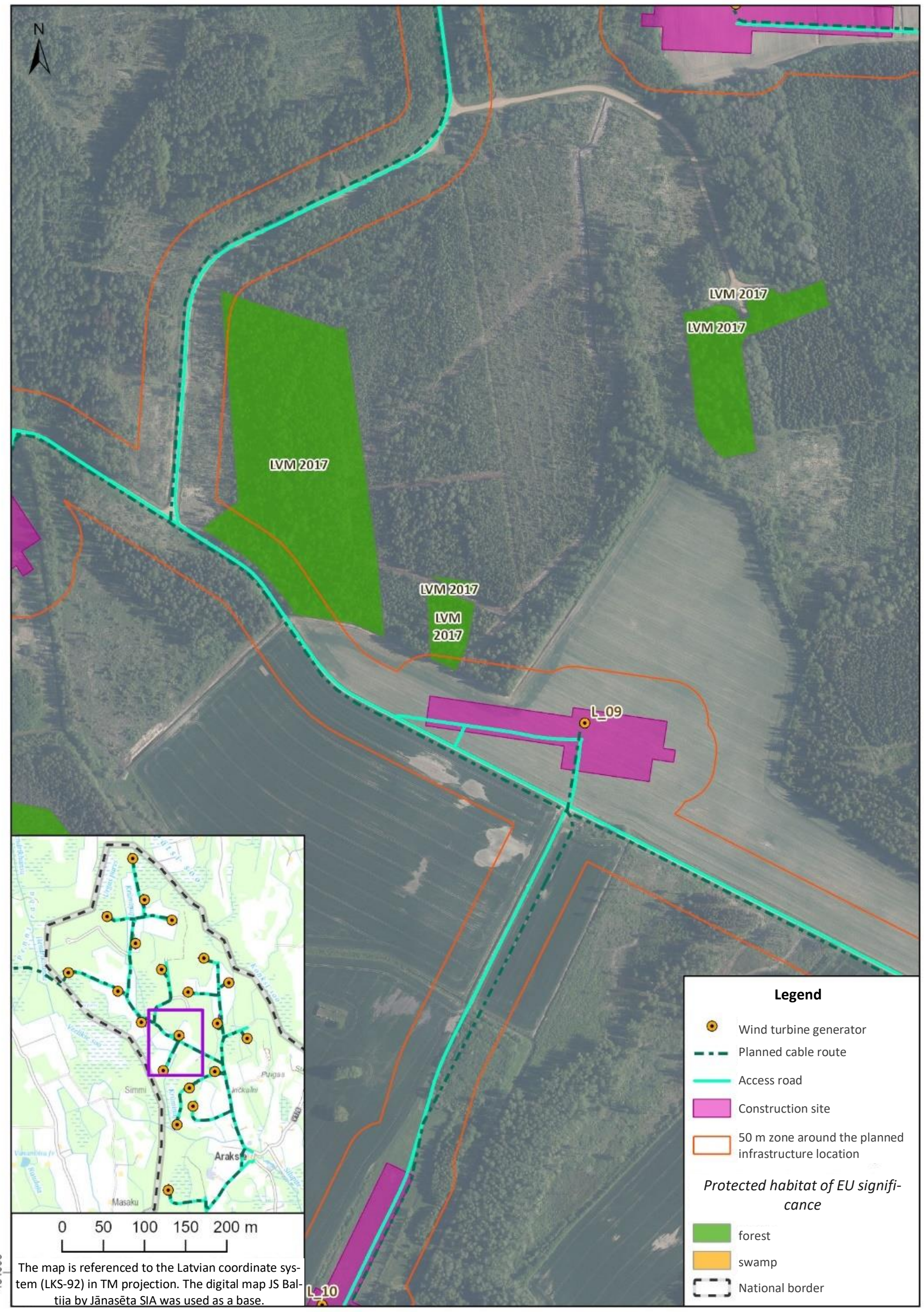


Figure 4.3.7. EU protected habitats along the access road to WTG L_09 site

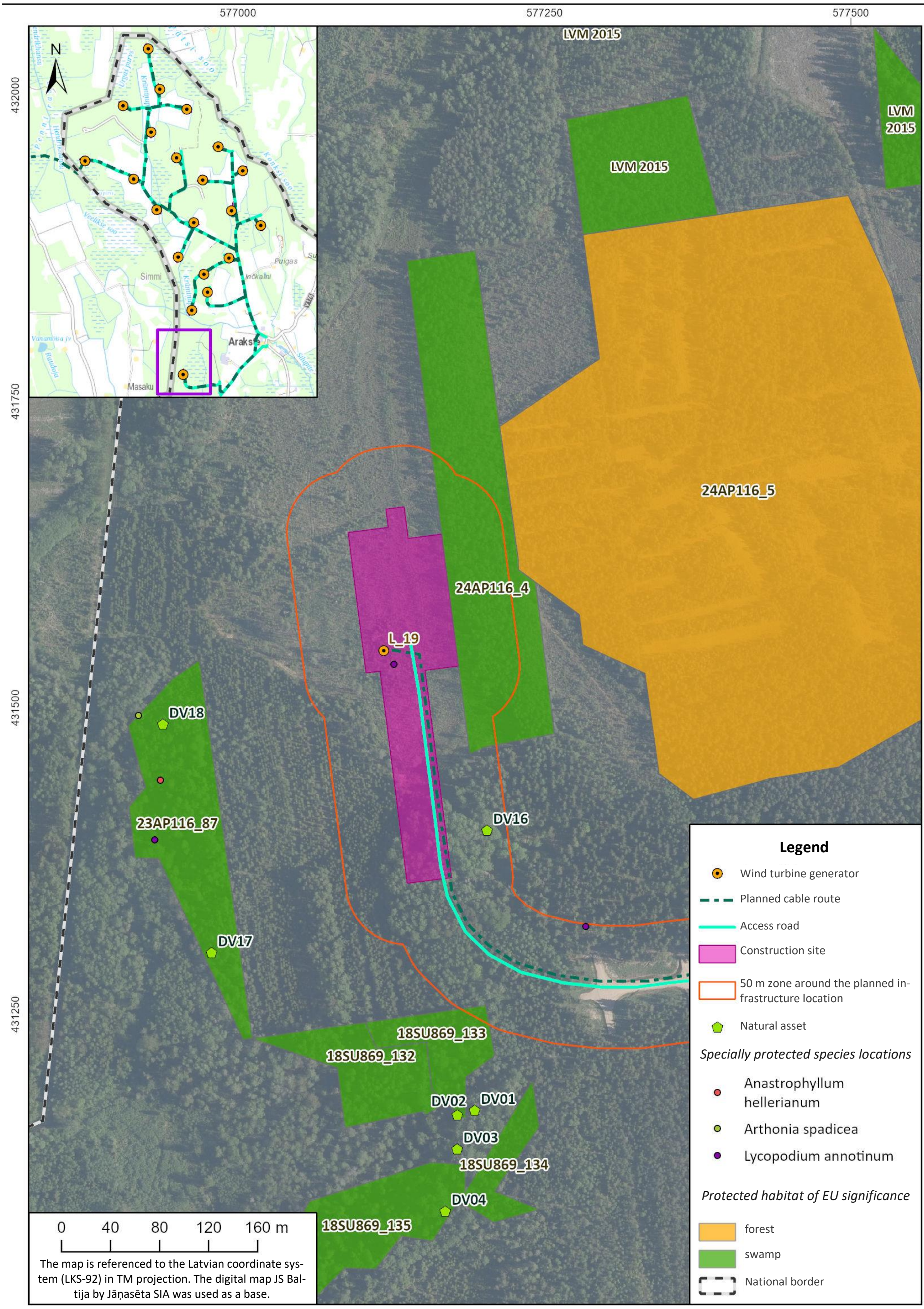


Figure 4.3.8. Specially protected habitats of EU significance on WTG L_19 site and along the access road

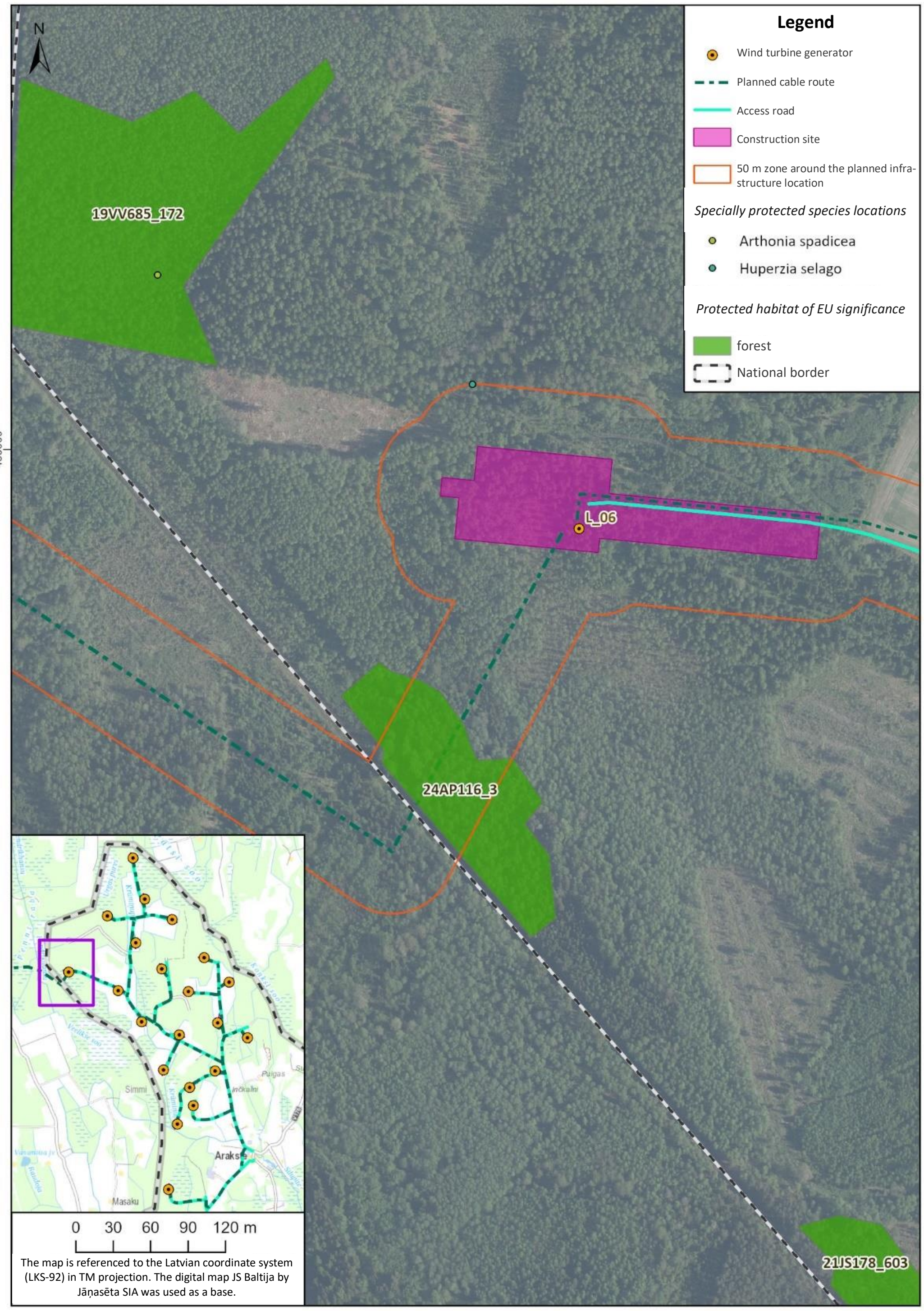


Figure 4.3.9. Protected habitats of EU significance in the cable line from WTG L_06

In the planned cable route in the parish of Ipiķi, Sosnowsky's hogweed *Heracleum sosnowskii* growths have been found along the border between the two countries and invasive common ninebark *Physocarpus opulifolius* growth have been found along the former railway embankment.

<u>*Natural assets in Estonian territory*</u>

Three protected habitats of European importance, i.e. forests and grasslands, are situated in the vicinity of the proposed activity in Estonia. The closest is Veelikse Bog, which corresponds to biotope 9080* *Swamp woods*. Part of the swamp extends into Latvia, where it is called Lucas Swamp. Veelikse bog and habitat 9080* are situated approximately 700 m south of WTG L_06, approximately 700 m southwest of L_07, approximately 400 m southwest of L_08, approximately 800 m west of L_09 and approximately 400 m west of L_10 (see Figure 4.3.10).

The cable route running between the parishes of Lode and Ipiķi is planned in the wetland area between the Penni Veelixe swamps. Beyond the V173 it continues through woodland.

Approximately 600 m north of the planned cable route on the banks of the river Ruukli, European protected habitat 6430 *Hydrophilous tall herb fringe communities* is found, also Purgla Swam.

Approximately 2.5 km east of L_15 European protected habitat 6450 *Alluvial meadows* is situated on the banks of the river Penuja.

One key habitat of pine and mixed pine forests is marked between Purgla swamp and road 24203 and is situated approximately 1.5 km north of the planned cable route.

No sites of specially protected or rare plants and no ancient trees have been identified in the vicinity of the proposed activity site in the territory of Estonia.

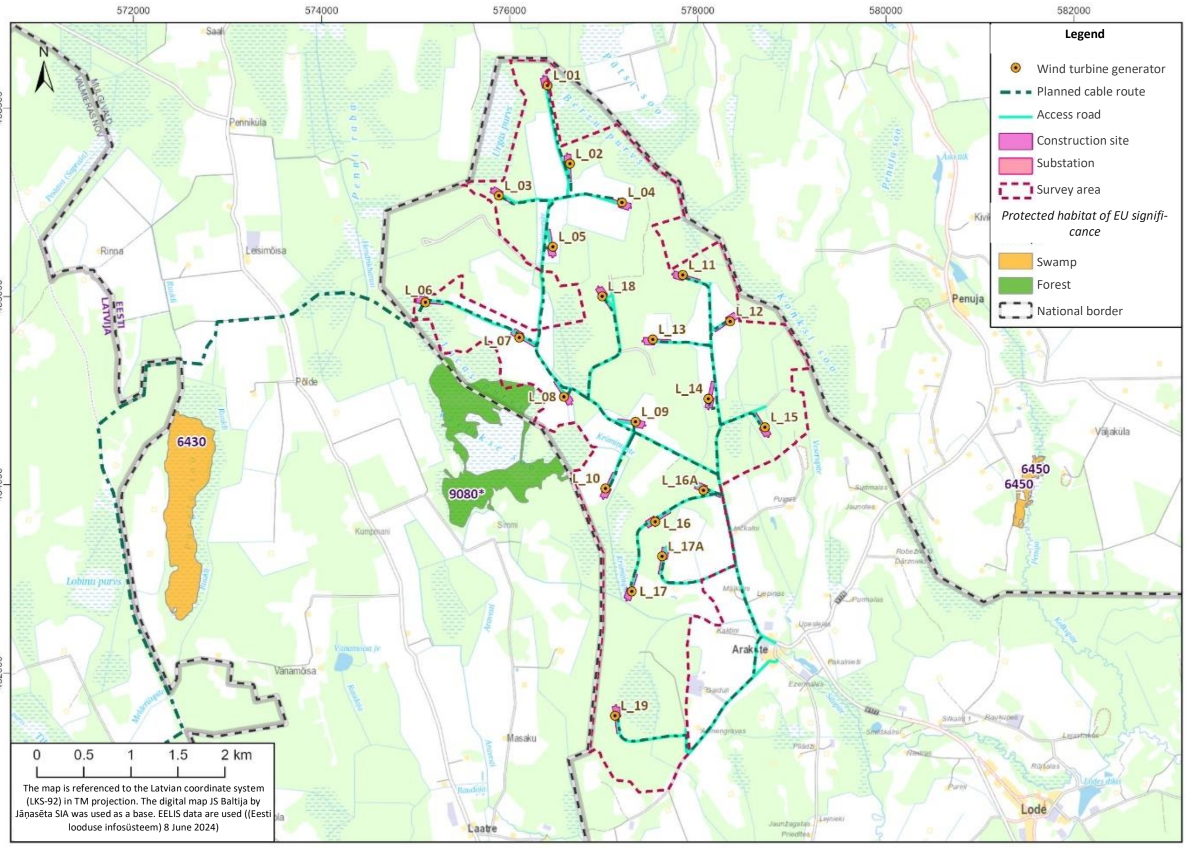


Figure 4.3.10. EU protected habitats in Estonia

4.3.4 Impact on special areas of conservation, trees, plants and habitats

Impact within Latvia

Although the proposed activity site is situated in the neutral zone of the North Vidzeme Biosphere Reserve, which has been designated in order to promote balanced and sustainable development of populated localities in the Biosphere Reserve without excluding the development of economic activities, no negative impact on this SPA is expected as a result of the proposed activity.

The construction of WTG L_01 would, if implemented as planned, have an unavoidable significant adverse effect on the 0.5 ha habitat of broomrape *Orobanche pallidiflora (O.reticulata*), resulting in its complete destruction.

Impact on protected habitats of EU significance due to changes in the hydrological regime caused by the proposed activity are considered to be insignificant at the regional and national scale, but significant at the local scale within the forest range:

- The construction of L_01 would result in negative impact on protected habitats: 7120 Degraded raised bogs still capable of natural regeneration 0.33 ha and 91D0* Bog woodland 1.37 ha;
- In case of construction of L_03, 0.44 ha of the habitat 9010* Old or natural boreal forest would be adversely affected. At the same time, it should be noted that the habitat is already at risk from forestry activities and may be felled regardless of the proposed activity;
- In the event of construction of L_19, 1 ha of the habitat 91D0* Bog woodland would be negatively affected.

For bog habitats, one of the main prerequisites for favourable conservation status is an adequate hydrological regime, i.e. the consistently high water table. The bog is characterised by permanent or prolonged wetness, specific vegetation and peat formation. Bogs form when rainfall exceeds evaporation. They are also encouraged by the topography and the distribution of poorly permeable, clayey sediments[29]. Potential threats to habitats 7110* (ground 17TK904_60, Urgas Swamp) and 7120 (ground 17TK904_67, Bērzu Swamp) are associated with the construction of WTG L_01 and WTG L_03 and the associated drainage of proposed adjacent areas.

Excavation and tree felling during the construction of the cable route in the parish of Lode between WTG L_06, and the Estonian border is expected to have a temporary negative effect on the habitat 9080*_1 Swamp Woods. In the long term, the creation of an up to 10 m wide clearance will have minor adverse impact on habitat 9080* *Swamp Woods* polygon 24AP116_3.

Overall, the proposed activity will have a negligible direct negative impact on protected habitats of EU significance and the potential impact from changes to the hydrological regime or

[29] Priede, A. (ed.). 2017. Guidelines for the conservation of protected habitats in Latvia. Volume 4. Swamps, springs and fens. Nature Conservation Agency. Sigulda. p. 207.

edge effects will be limited and not greater than those already caused by ongoing forestry activities and the restoration of the reclamation systems in the area.

Overall, it can be concluded that the proposed activity will not have an adverse effect on the protection status of protected habitats of EU significance at regional or national level.

The following special protected species have been identified in the area of direct impact of the proposed activity, which will be destroyed as a result of the proposed activity: stiff club-moss *Lycopodium annotinum*, wild orchids *Platanthera sp*, common spotted orchid *Dactylorhiza fuchsii.* The habitats of these species are typical for the area (wild orchids - non-specific habitats of fertile growing conditions in partial light conditions, spotted orchid - wet, moderately mineral-rich forests and adjacent slopes), so it is likely that the species occur not only in the surveyed area, but also in the wider area. It can be concluded that the proposed activity will not affect potential habitats of protected vascular plant species that would occur only in a small area and thus be threatened at a local scale.

Considering that a substantial part of the cable route is planned to run along the former railway embankment, on agricultural land and, in some sections, within the building lines of roads or road corridor without building lines, no additional adverse impact is expected from the construction of the cable routes planned as a part of the proposed activity, except where the location of the planned cable route crosses the habitats of specially protected species.

Impact on Estonian territory

Veelikse bog, which corresponds to biotope 9080* *Swamp woods,* is separated from the proposed WTG construction sites of and associated infrastructure by a strip of agricultural land. There will be no direct impact on the bog because of the distance from the proposed construction sites. Indirect effects that could result from changes in the hydrological regime of the bog are also not possible due to the separation of the construction sites from the bog by reclamation ditches and the low relief of the bog.

The European protected habitat 6430 *Hydrophilous tall herb fringe communities*, also marked as Purgla bog on the maps, is situated far from the proposed WTG construction sites and will not be affected. A cable route is planned relatively close by (600 m to the south). However, the cable route does not directly affect the habitat, but cannot indirectly affect the hydrological regime of the habitat, as the bog is in a low relief depression.

The European protected habitat 6450 alluvial meadows and the key woodland habitat, pine and mixed pine woodland, are sufficiently distant from the proposed development sites that the proposed development would not have a direct or indirect effect on them.

4.3.5 Precautions to mitigate impact

The implementation of the activity is not expected to have indirect negative impact on SPA or micro-reserves established for the protection of forest or wetland habitats. The implementation of the proposed activity does not pose a threat to the special area of conservation purposes or the integrity of the protection areas, either locally or regionally.

According to the approach defined in the guidelines for mitigation of impact of solar and wind energy projects[30], the area of the proposed activity is assessed as an area of natural ecosystems with a medium high biodiversity value, and accordingly the activity should ensure that the existing level of natural values is maintained *(no net loss).* Measures to prevent the loss of habitats and habitat areas of protected species or to compensate for the destruction of individuals or loss of habitats are recommended to mitigate and avoid the expected impact where the impact on the metapopulations of the species is significant.

Some of the potential impact of the wind farm has already been addressed by relocating the development site and access roads following an initial assessment of impact on species and habitats by experts.

The assessment of the areas affected by the proposed activity and the natural assets present there has identified impact that can be avoided through various measures and impact that cannot be avoided or would be significantly reduced if the proposed activity were carried out at its planned scale.

In order to minimise the impact of WTG L_01 on the broomrape *Orobanche pallidiflora* habitat, the design should be such so as not to disturb the identified site and preferably the embankment should be constructed without drainage ditches so as not to affect its hydrological regime. The use of black earth and sown grass is not recommended for reinforcing the edges of the development site, but locally sourced soil will allow the species to establish suitable growing conditions.

In the construction of the WTG L_03 site, technical solutions that are less draining on the surrounding areas are preferable in order to reduce the negative impact on the protected forest habitat 9010*. During the construction of this WTG, no machinery movements or other activities must be allowed south of the drainage ditch situated along the planned access road in Block 708, Lot 4, to avoid impact on the broomrape site.

It is recommended to design the configuration of the access road, the construction site and the VES_04 construction site in such a way that potentially protected trees are not affected.

When planning access solutions to WTG L_08, it should be taken into account that any road widening which would affect the 9010* habitat is not permissible.

When planning access solutions to WTG L_16 and widening of the existing road at the junction with the new access road, it is recommended to choose solutions that would preserve the roadside oaks.

When designing the WTG L_19 location, the development site and the access road, it is recommended to provide solutions that would allow creating embankments without excavating new ditches and draining the site.

Movement of machinery, placement of materials and other construction-related activities are also not allowed on the protected species sites indicated in the cartographic material of the report.

[30] Bennun, L., van Bochove, J., Ng, C., Fletcher, C., Wilson, D., Phair, N., Carbone, G. Mitigating biodiversity impacts associated with solar and wind energy development. Guidelines for project developers. Gland, Switzerland: IUCN and Cambridge, UK: The Biodiversity Consultancy, 2021.

It is preferable to retain large fallen trees and trees; if fallen trees are situated in the road alignment, they should be placed adjacent to the forest stand, as should ecological trees as fallen trees or individual large trees outside forest land if they need to be felled for construction purposes.

Large stones (> 4^{m3}) in the area of the WTG construction sites and new access roads, together with lichens and mosses growing on them, should preferably be moved to a location where they will not be affected by the proposed activity, if possible maintaining the position of the stone in relation to the sky.

4.3.6 Assessment of alternatives

It should be emphasised that measures to avoid and minimise potential impact on nature values have already been taken during the preparation of the EIA Report, by assessing the initial WTG and infrastructure locations and providing the planners with the information on the identified natural assets, possible alternative locations for the WTG and associated infrastructure, as well as explaining the basic principles for planning the WTG location to avoid affecting natural assets. In comparison with the original layout, the length of new access roads in this WTG wind farm configuration has been significantly reduced, the WTG locations have been planned as far away as possible from habitats that need to be undisturbed by the hydrological regime, and the number of planned WTGs has been reduced.

The assessment of the proposed activity examines both the technological alternatives, i.e. the different WTG models, and different alternatives for the WTG locations. Considering that all the technological alternatives under evaluation are considered to be similar in the context of factors that may affect the protection of habitats, plant species and conifers, there is currently no reason to define any of the assessed WTG models as superior to the others.

4.4 Biodiversity – bats

This chapter assesses the impact on bats in more detail. The relevant legislation is discussed in Chapter 4.3.1.

The opinion of Viesturs Vintulis, certificate no. 070 (valid until 30 September 2025), expert on the bat *Chiroptera* was used for this chapter. The expert opinion provides information on the potential impact of the proposed wind farm construction and operation on the populations of the bat species identified, as well as on the adjacent area and conditions, including recommendations for mitigation and future monitoring.

4.4.1 Impact assessment approach

The expert opinion has been drawn up in accordance with cabinet regulation no. 925 of 30 September 2010, on the content and minimum requirements for expert opinions in the field of species and habitat conservation, issued in accordance with the act on species and habitat conservation, article 4, paragraph 17, part 1, as well as the EUROBATS guidelines on compliance with bat conservation requirements in wind farm projects[31] and the guidelines for

[31] Rodrigues, L.; Bach, L.; Dubourg-Savage, M.-J.; Karapandza, B.;Kovac, D.; Kervyn, T.; Dekker, J.; Kepel, A.; Bach, P.; Collins, J.;Harbusch, C.; Park, K.; Micevski, B.; Minderman, J. Guidelines for Consideration of Bats in Wind Farm Projects - Revision 2014; EUROBATS Publication Serie; UNEP/EUROBATS: Bonn, 2015, p.133.

assessing the impact of wind turbines on bats developed by the Latvian bat research society in 2022[32].

Initially, the available information on bat species found in and around the proposed activity was assessed. Historical information on bat roosts in and near the survey area is assessed to be incomplete, and the area was surveyed.

The area was surveyed seven times within a season in 2023 using a previously validated methodology in Latvia, on two nights in May, June, July, the first half of August (until 15 August), the second half of August (after 15 August), the first half of September (until 15 September) and the second half of September (after 15 September). The time of the surveys was chosen according to the biological cycle of bats (reproduction, migration and mating). In August and September, surveys were carried out more frequently to check whether there was increased bat activity related to migration in the survey area. The area was surveyed on two consecutive nights in each period: on the first night, the N1 route and automatic enumeration points 1–4 were surveyed, on the second night the N2 route and automatic enumeration points 5–8 were surveyed.

Route surveys were started one hour after sunset and included ultrasonic recording of bat calls at eight survey points with a total recording time of 90 minutes. 2nd and 3rd hour after sunset were chosen for the route records because these are usually the hours of the night when the most nocturnal bat activity is observed. Automatic recorders at stations 1–8 recorded throughout the night.

The acoustic (ultrasonic detector) method was used to record bat activity and was mainly focused on the detection of so-called clade species. The orientation calls of clade species are adapted to hunting away from the trees or other obstacles in open space; they are relatively loud and have a strong constant or near-constant frequency component. Measurements of the constant frequency part in sound analysis software make it easier to identify these species. The clade species include species of the genera *Nyctalus*, *Vespertilio* and *Pipistrellus*. The open space bat species were significantly more likely to die in collisions with wind turbines than the other group, the woodland specialists (Rodriguez et al. 2015). The woodland group of bats consists of *Myotis*, *Plecotus* and *Barbastella* bats. These bats generally avoid flying in open spaces and hunt near trees and other structures, and their calls are quieter than those of open space species and do not have the constant-frequency component. Accurate identification of *Myotis* species from call records is usually impossible. For woodland species, deaths near wind turbines are less frequent, but have been recorded.

The objective limitations of this method must be taken into account when evaluating data obtained with ultrasonic detectors:

1. Ultrasound monitoring do not provide information on the number of bats at the monitoring site because it is not possible to determine whether the detector has detected multiple or repeated passes of the same bat. The results are therefore not the number of bats that have flown by, but the so-called activity index, i.e. the number of flights per unit time. It is generally assumed that there is a positive correlation between the

[32] Latvian Bat Research Society. 2022. Guidelines for assessing the WTG impact on bats.

number of bats and the number of overflights they record, i.e. more bats will result in more overflights[33;]

2. Bat species have different call volume and therefore the distance at which the detector picks up their calls also vary. Consequently, 'loud' species are overcounted and 'quiet' species undercounted in acoustic monitoring studies. In order to reduce the influence of different call volumes of different species on species activity indices, the following species perception coefficients were used to compare the frequency of occurrence of species:
   - Nathusius's pipistrelle *Pipistrellus nathusii* – 0.83;
   - Northern bat *Eptesicus nilssonii* and parti-coloured bat *Vespertilio murinus* – 0.5;
   - Common noctule *Nyctalus noctula* – 0.25.

For example, applying a species capture ratio reduces the activity ratio of the northern bat relative to the soprano pipistrelle by a factor of two and the activity ratio of the common noctule relative to the soprano pipistrelle by a factor of four. Species capture rates are used only for cross-species comparisons of activity in the area.

The choice of locations for the fixed monitoring spots was based on the planned location of the wind turbines and the behavioural characteristics of the bats. The selection of the habitat for the survey spots was based on the proportional distribution of the planned wind turbines in the habitats. In forest habitats, the so-called open space species, which are most frequently killed in collisions with wind turbines, usually hunt in various openings, i.e. above forest roads, in clearings and along forest edges, so the selected monitoring spots were chosen to be in the vicinity of these structures. In addition, routes were also recorded. The monitored routes were chosen to give an idea of the overall bat activity in and around the wind farm and were not linked to specific locations of the planned wind turbines.

The bat call recordings (sound files) made during the season in autumn and winter were checked using the sound analysis software *BatSound 4.1.4.* The quartile method was used to estimate bat activity. Using data from 14 sites in Latvia (including the site included in this survey) that were monitored for bats in 2019–2021 using the same methodology and ultrasonic detectors of the same model, activity values for quartiles 1 and 3 were calculated. Activity below the 1st quartile was assessed as low, activity in the intermediate quartiles (2nd and 3rd quartile) as medium and activity above the 3rd quartile as high.

4.4.2 Description of the current situation

The planned wind farm site, and the adjacent areas are relatively unsuitable for bat habitats due to the scarcity of old forest growth and ongoing intensive felling.

Nine of the wind turbines will be installed in forest, nine on agricultural land close to the forest edge (up to 100 m from the forest) and one turbine on agricultural land more than 100 m from the forest edge. The planned wind farm is situated in the immediate vicinity of the Latvian-Estonian border. Currently, there are no other existing or planned wind farms in Latvia or Estonia that would be less than 2 km from to the potential Lode wind farm site, which would have a cumulative impact.

[33] Barataud, 2015)

Bat species observed

A total of 1054 bat call records were recorded during the season, identifying 1119 bat overflights. From these records it was possible to determine which bat species are present in the potential wind farm area, as well as the frequency of occurrence of each species (relative to other species).

During the season, five bat species or genera were recorded in the survey area. The most abundant species was the northern bat *Eptesicus nilssonii*, with an occurrence rate (after applying a capture rate) of 64%. The common noctule *Nyctalus noctula* was relatively rarely observed in the survey area with the estimated occurrence of 2%. The northern bat and the common noctules are members of the so-called open-space species group, which are particularly sensitive to the effects of wind turbines.

The second most abundant bat group in the survey area is *Myotis* bats, with relative occurrence of 32% in the survey area. In the *Myotis* group, there are a total of five possible species of the mouse-eared bat genus: pond bat *Myotis dasycneme*, Daubenton's bat *M. daubentonii*, Brandt's bat *M. brandtii*, the whiskered bat *M. mystacinus*, and Natterer's bat *M. nattereri*. Distinguishing between different *Myotis* species by the calls they make is difficult and with current methodologies reliable identification to species is practically impossible. Current information suggests that the impact of wind farms on *Myotis* bats is relatively low (Latvian Bat Research Society Guidelines for Assessing the Impact of Wind farms on Bats). In view of these factors, no in-depth analysis was done for bats of this genus.

Brown long-eared bat *Plecotus auritus* and parti-coloured bat *Vespertilio murinus* were also observed in the area during the season. Only a few overflights were recorded for these species during the season and the occurrence rate for either did not reach 1%. In addition, bats that could not be identified or could only be identified to a species group due to the quality of the recording.

Bat species observed in the potential wind farm area differ in their foraging and hibernation behaviour. Table 4.4.1 summarises the species observed in the survey area and their status in Latvia.

Table 4.4.1. Bat species found in Lode wind farm survey area in May–September 2023

Bat species in English	Scientific name of bat	Migratory or wintering species	Protection status	Assessment of the conservation status of the species in Latvia
Northern bat	*Eptesicus nilssonii*	Wintering	SCC, EU IV, Berne Convention, Bonn Convention, EUROBATS	Favourable
Common noctule	*Nyctalus noctula*	Migratory	SCC, EU IV, Berne Convention, Bonn Convention, EUROBATS	Unfavourable-Insufficient
Parti-coloured bat	*Vespertilio murinus*	Partly migratory, partly wintering	SCC, EU IV, Berne Convention, Bonn Convention, EUROBATS	Favourable

Brown long-eared bat	*Plecotus auritus*	Wintering	SCC, EU IV, Berne Convention, Bonn Convention, EUROBATS	Unfavourable-Insufficient
Mouse-eared bat genus	*Myotis* spp.	All species wintering		

Acronyms:

EU*- European Council Directive 92/43/EEC (21 May 1992) on the conservation of natural habitats and of wild fauna and flora. Annex IV. Animal and plant species of Community interest in need of strict protection*

SCC – Species of conservation concern, Annexes 1 and 2 to cabinet regulation no. 396 of 14 November 2000, a list of specially protected species and specially protected restricted species

Berne Convention *– 16 September 1979 on the Conservation of European Wildlife and Natural Habitats*

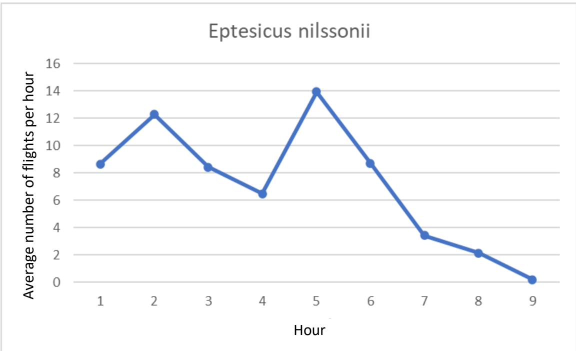
CITES – 3 March 1979 Washington Convention on International Trade in Endangered Species of Wild Fauna and Flora

Bonn Convention *23 June 1979 on the Conservation of Migratory Species of Wild Animals. Includes all bat species found in Latvia.*

EUROBATS *- Agreement on the Conservation of Populations of European Bats (descending from the Bonn Convention). Latvia has been a member since 2003.*

Bat night activity

Bat activity is not uniform throughout the night. Usually, the greatest bat activity occurs in the second and third hour after sunset. The activity of the most common bat species in the survey area (northern bat *Eptesicus nilssonii* and common noctule *Nyctalus noctula*) at specific times of the night can be seen in the graphs (see Figure 4.4.1).



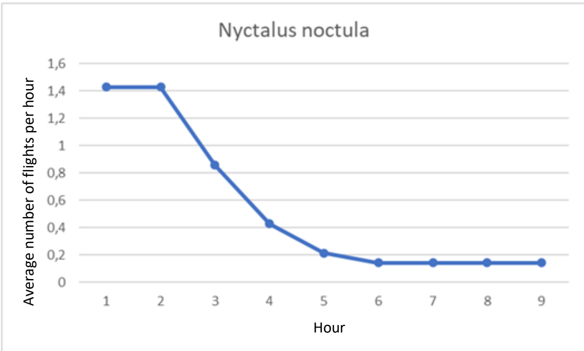
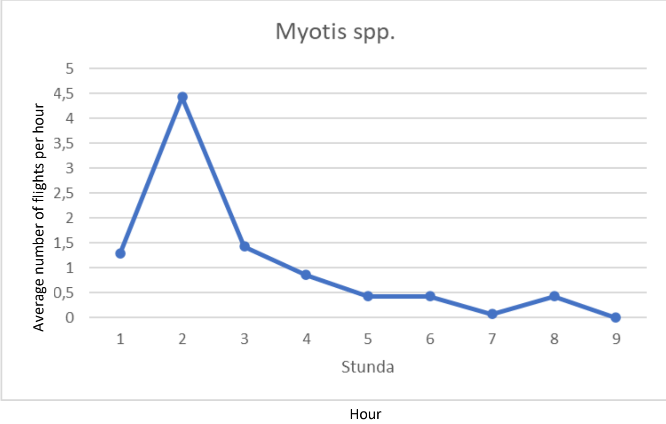


Figure 4.4.1. Northern bat and common noctule activity at night in the survey area in 2023

Both species show higher activity in the second hour of the monitoring compared to the rest of the night. An exception is the northern bat *Eptesicus nilssonii*, which had a slightly higher number of flights in the fifth hour during the season. For most of the season, this species was most active in the first three hours after sunset. However, in July and the first half of August, there was a significant increase in activity in the fifth hour of the night.



Myotis bats accounted for 32% of the bat recordings in the survey area in the 2023 season. Bats of this genus also peaked in the second hour after sunset (see Figure 4.4.2).

Figure 4.4.2. Myotis activity at night in the survey area in 2023

Bat activity at survey areas and habitats

The highest bat activity was observed in the first two night counting spots with an average of 6.2 passes per hour in spot 2 and 5.9 passes in spot 4. In all spots except spot 1, the dominant species observed was the northern bat *Eptesicus nilssonii* (see Figure 4.4.3).

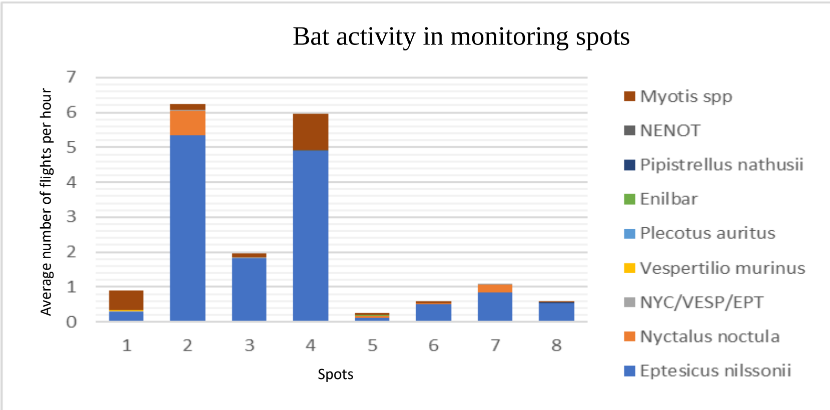


Figure 4.4.3. Average bat activity in stationary monitoring spots in the survey area in 2023

Legend: Eptesicus nilssonii – northern bat, Pipistrellus nathusii – Nathusius's pipistrelle, Nyctalus noctula – common noctule, Vespertilio murinus – parti-coloured bat, NYC/VESP/EPT – Nyctalus/Vespertilio/Eptesicu, Myotis spp – Myotis bats, NENOT – undetermined bat species, Plecotus auritus – long-eared bat.

Using the quartile method for bat activity, bat activity was rated as high in spots 2 and 4, medium in spot 3 and low in all other spots. Overall bat activity in all spots throughout the season averaged 0.24 flights per hour, which is considered low.

When analysing bat activity in specific habitats, the highest bat activity was observed in the forest edge (average 3.6 flights per hour). For the purposes of this assessment, woodland means an area within 100 m of a forest. All the forest edges were along cultivated farmland. 4 of the 8 recording spots were in this habitat.

Activity was more than four times lower in forest habitats where the average bat activity was 0.86 flights per hour. 3 of the 8 recording spots were in this habitat.

One monitoring spot (5) was in a clearing, which in the context of this assessment is considered to be an area more than 100 m away from any other type of habitat structure. The average number of overflights in that spot was 0.27 overflights per hour.

The northern bat *Eptesicus nilssonii* was the dominant species in all recording spots (see Figure 4.4.4). Using the quartile method to assess activity, bat activity is low in the open space and forest and high in the woodland habitats.

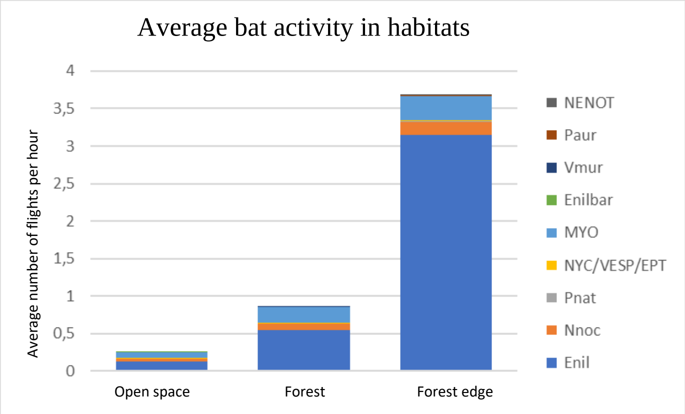


Figure 4.4.4. Bat activity in habitats in the survey area in 2023

Legend: Enil – northern bat Eptesicus nilssonii, Pnat – Nathusius' pipistrelle Pipistrellus nathusii, Nnoc – common noctule Nyctalus noctula, Vmur – parti-coloured bat Vespertilio murinus, NYC /VESP/EPT – Nyctalus/Vespertilio/Eptesicu, MYO – Myotis. and NENOT – undetermined bat species, Paur – Long-eared bat Plecotus auritus.

Bat monitoring along the route is carried out to get an idea of the overall bat activity on the planned wind farm site and in adjacent areas. The average bat activity along the route is greater than the average bat activity in any of the monitoring spots. However, it should be noted that the route monitoring carried out at the time when bat activity is highest (2nd and 3rd hour after the sunset). The average activity in the monitoring spots in the second and third hour after the sunset was 10.2 overflights per hour, 9 overflights per hour on the N1 route and 2.3 overflights per hour on the N2 route.

<u>Seasonal bat activity</u>

The seasonal behaviour of bats varies throughout the year. Analysing bat activity in specific seasons gives an idea of the role of a particular area for local and migratory populations.

The northern bat *Eptesicus nilssonii* is the most abundant bat species in the survey area. The average activity of this species in the monitoring spots throughout the season was 1.63 flights per hour, which is considered to be moderately low in the Latvian context.

The species is most active in July and the first half of August, when their activity is considered high. Bat activity in May and the second half of September is considered to be medium. In other monitoring periods, it is considered low.

In May and June, local animals were most likely recorded with possible colonies either within or very close to the survey area. The slightly higher activity in May may be due to bats moving from their wintering sites to their summer roosts. In July, there is an increase in activity, most likely because of the fledglings. The activity in the first half of August and second half of September could be due to partial migratory activity (the species is not migratory, but moves partly seasonally from summer to winter roosts, which can be tens of kilometres away), but also to more suitable feeding conditions in forests (high insect density) in the second half of summer and autumn, when nights become colder, especially in more open habitats. Such concentrations in certain locations may also increase the risk of collisions with wind turbines in the future.

The second most common bat species in the survey area is common noctule *Nyctalus noctula*. The average activity of this species on the wind farm site was 0.13 flights per hour. Compared to other areas in Latvia where bat counts have been carried out using the same method, this activity is considered low. Similar to the northern bat, there is increased activity in July and the first half of August. The increase in activity observed in July is most likely because of the fledglings. Common noctules leave Latvia in autumn for their wintering grounds in Central Europe. Again, the slight increase in activity in the first half of August could be due to the onset of migration and more suitable foraging conditions in the forest.

4.4.3 Impact on bat populations

Northern bat, the most common species in the survey area, is one of the species at highest risk from wind turbines. According to EUROBATS statistics on bat fatalities in wind farms across Europe in 2003–2014, the northern bat is the most frequent victim of wind turbines in Scandinavian countries. In Latvia, Nathusius' pipistrelle ranks first among registered victims of wind turbines, and the northern bat is second. Night bats are generally not considered a high-risk species, as they usually fly and hunt close to landscape structures and are relatively rarely seen at higher altitudes. The impact of wind turbines on these species is therefore considered low. The highest mortality of bats by wind turbines occurs during the autumn migration, when all species, both migratory and wintering, move to their wintering sites.

The recorded species activity in the survey area is lower than in other areas surveyed using identical methodology, most likely due to forest habitat degradation and deliberate site selection with few buildings as suitable roosting sites for bats. Potential spontaneous concentrations of bats at feeding sites may increase the otherwise low risk of collisions with the planned rotors.

The highest risk of bat mortality in the proposed wind farm is in July to September, i.e. during bat dispersal and migration. Bat activity is low in the first half of summer.

The greatest risk of bats dying by turbines is in the 2nd to 6th hour after the sunset.

Potentially higher risk of collision or damage for the bats is by the WTG to be installed close to the forest and other tree structures, and a lower risk of mortality at WTGs planned to be installed in the open field.

The current data in the survey area does not allow identifying specific WTGs or areas where the potential risk of bat mortality would be so high as to prohibit construction, but at least some bat mortality near rotors is possible, especially during migration.

A number of research publications[34,35] suggest that bat activity in wind farms may increase significantly after turbines are built and that bats may appear in large numbers in places where they were not detected during the main survey, including in theoretically unsuitable or poorly

[34] Solick D, Pham D, Nasman K, Bay K (2020) Bat activity rates do not predict bat fatality rates at wind energy facilities. *Acta Chiropterologica* 22: 135–146.

[35] Solick D, Pham D, Nasman K, Bay K (2020) Bat activity rates do not predict bat fatality rates at wind energy facilities. *Acta Chiropterologica* 22: 135–146.

suited landscapes for habitats. Bats are strongly attracted to wind turbines, although the reasons for this have not yet been established[36]. Therefore, monitoring is mandatory for at least two years after the installation of the turbines and launch of the wind farm.

4.4.4 Mitigation measures

The wind farm construction in the survey area is permissible provided that turbines that would be installed within 200 m of the nearest tree stand or water body are restricted. More extensive restrictions are not necessary initially, as the area has seen very low bat activity.

The operation restrictions should be ensured by the automatic shutdown or wind turbine off-time from 1 June to 30 September from sunset to sunrise if the following conditions are met:

- the wind speed at the top of the tower (nacelle) is 5 m/s or less;
- air temperature is higher than +6 ºC (Usually the temperature limit is +10 ºC, but observations in different areas of northern Latvia show that bat activity remains relatively high even when air temperature is within +6 ºC to +10 ºC, especially in autumn from late August to late September);
- rainfall does not exceed 1 mm per hour.

Depending on the results of the monitoring, which may or may not confirm increased bat activity and/or mortality by the installed turbines, the restrictions on wind turbine operation after the first and second years of post-construction monitoring could be removed altogether, relaxed or strengthened, specifically: the period during which turbine operation restrictions are required could be extended or reduced or the wind speed threshold at which turbine operation is allowed could be changed.

4.4.5 Assessment of alternatives

As part of the Environmental Impact Assessment, the options for the WTG locations were assessed and optimised taking into account the recommendations of the bat expert. The configuration of the WTG park has also been assessed to minimise impact on bats. At the same time, mitigation measures were recommended for the reduction of the potential negative impact of the WTGs on bat populations.

The technical alternatives assessed in the EIA, i.e. Vestas V162-6.2, Vestas V172-7.2, Nordex N163-5.7 and Siemens Gamesa SG6.6-170, comparing them in the context of their impact on bats. These technical alternatives are assessed as equivalent because the mast height is between 164 and 166 m, the rotor diameter ranges from 162 to 172 m, which means that the blade stands between 80 and 85 m above the ground. To minimise the impact on bat populations, a WTG model with rotor blades as high above the ground as possible should be preferred, with the Vestas V162-6.2 providing the greatest distance of 85 m. However, other models are also acceptable and the recommended options reduce the impact on bat populations and it is not possible to draw firm conclusions on the advantages or disadvantages of any technological alternative in the context of bat conservation.

[36] Rodrigues, L.; Bach, L.; Dubourg-Savage, M.-J.; Karapandza, B.;Kovac, D.; Kervyn, T.; Dekker, J.; Kepel, A.; Bach, P.; Collins, J.;Harbusch, C.; Park, K.; Micevski, B.; Minderman, J. Guidelines for Consideration of Bats in Wind Farm Projects - Revision 2014; EUROBATS Publication Serie; UNEP/EUROBATS: Bonn, 2015, p.133.

4.5 Biodiversity – ornithofauna

This chapter assesses the impact of the proposed wind farm on the ornithofauna. The relevant legislation is discussed in Chapter 4.3. For this chapter, the opinion of ornithologist Andris Dekants (expert certificate no. 183, valid until 10 July 2026) on the impact of the planned wind farm on bird fauna was used.

4.5.1 Impact assessment approach

In order to assess the impact of the proposed activity on the ornithofauna, accumulated data were analysed and the area was surveyed to identify the current situation. The purpose and objectives of the survey were based on the conditions identified in the initial data analysis.

The survey of the wind farm and adjacent areas, including field studies, began in spring 2023 and continued in spring 2024. The analysis used several survey methods to identify, as far as possible, all specially protected and micro-reserve bird species that inhabit and inhabit or breed in the survey area.

Additional surveys for lesser spotted eagles and inventories of adjacent forest areas were also carried out in Estonia, approximately 3 km away from the planned WTG.

At the time of writing the report, all species listed in the first Annex to Directive 2009/147/EEC of the European Parliament and of the Council on the conservation of wild birds were also assessed. Other bird species were also recorded, including migratory birds.

The survey included:

- Multiple walks and inventories of the site in different months;
- Site-wide search for large nests of those SP birds of prey for which the site has been established as the nesting place. The large nests found were described, mapped and photographed;
- Surveys from different spots in the area to detect diurnal birds of prey assess their migration and routes;
- Night monitoring from different spots to estimate night migration;
- Use of the habitat suitability map developed in the Owl and Woodpecker Conservation Plan;
- The survey methodology used for owl monitoring was that recommended in the Owl Conservation Plan (hereafter referred to as the Owl Plan)[37], and for the woodpecker counts was that recommended in the Woodpecker Conservation Plan (hereafter referred to as the Woodpecker Plan)[38]. In order to protect these bird groups, owl and woodpecker monitoring has been carried out in priority areas within or in close proximity to the planned WTG sites;
- checking the information on sightings since 1 January 2013 on the Dabasdati.lv portal;
- geospatial processing of collected bird data and habitats.

Overall, the amount of fieldwork carried out is sufficient to analyse and make data-based decisions on the WTG locations and the impact on bird populations in and around the planned Lode wind farm.

[37] https://www.daba.gov.lv/lv/sugu-un-biotopu-aizsardzibas-plani
[38] https://www.daba.gov.lv/lv/sugu-un-biotopu-aizsardzibas-plani

4.5.2 Description of the current situation

The survey area is situated in the neutral zone of the North Vidzeme Biosphere Reserve. There are no micro-reserves, nature reserves or Natura 2000 sites in the Latvian part of the survey area. The nearest micro-reserve (ID=185288) established for bird protection is approximately 4 km from the nearest land unit of the proposed wind farm towards Ipiķi.

The new cable line to connect the wind farm to the substation will run along the micro-reserve ML 3099, turning west by it and crossing the buffer zone of the micro-reserve. The position of the cable route in relation to the micro-reserve is shown in Figure 3.1.

On the Estonian side, several protection areas have been established to protect the lesser spotted eagle. Two of them, KLO3001938 and KLO3002473, are situated 300–850 m from the Latvian border to the west of the survey area. Another site KLO3001586 is situated approximately 1300 m from the border in the northern part of the survey area. See Figure 4.5.1 for the location.

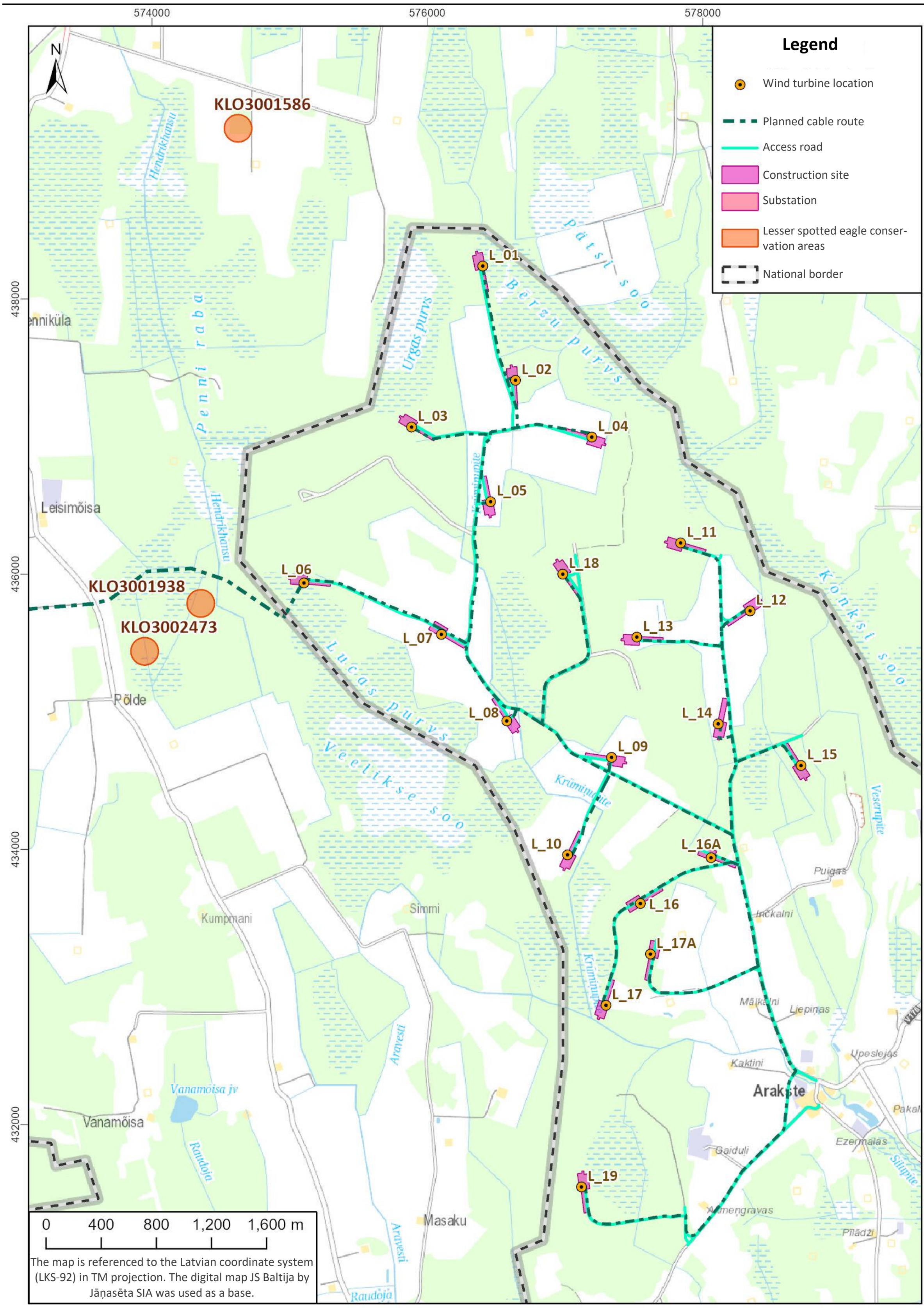


Figure 4.5.1. Micro-reserves in the vicinity of the proposed activity site

31 species of specially protected and micro-reserve birds have been established in the survey area. All SPA bird species sighing spots are shown in Figure 4.5.2 .

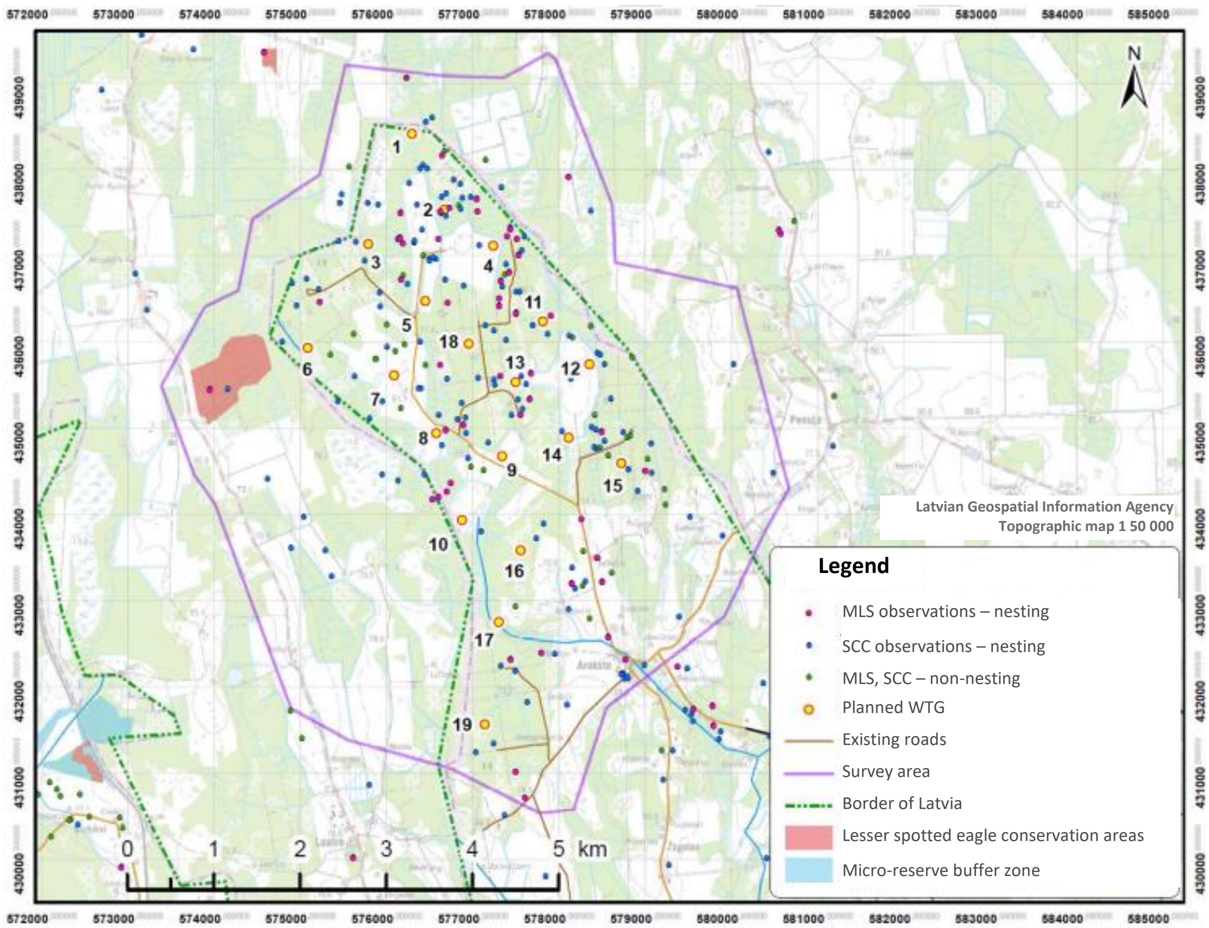


Figure 4.5.2. Sightings of specially protected and micro-reserve bird species in the survey area

The summary and assessment of the specially protected, threatened and potentially most affected species found in and around the survey area is provided below.

Western capercaillie *Tetrao urogallus* is a sedentary species which needs a specific habitat. It stays in its territory all year round. Latvian northern border area is important for the capercaillie and the Estonian and Latvian capercaillie populations exchange.

No pine forests with outstanding or highly suitable habitat for the species have been identified in the survey area. There are no micro-reserves or known nesting sites for capercaillie in the immediate area. Neither are there previously known sightings of capercaillie in the survey area. No sightings of the species were made during the inventory, but its presence was detected. It is most likely that the bird in question came from Estonia and is feeding in its diurnal territory on the site (20 ha of forest land) or it is a young bird which is not yet fully part of the breeding season. No mating site has been identified, but the most suitable breeding site is in the southern part of Veelikse Swamp (Lucas Swamp in Latvia) in Estonia where there is a wider tree belt (100–300 m) at the edge of the swamp and where no more than 2 to 3 roosters could be present (see Figure 4.5.3).

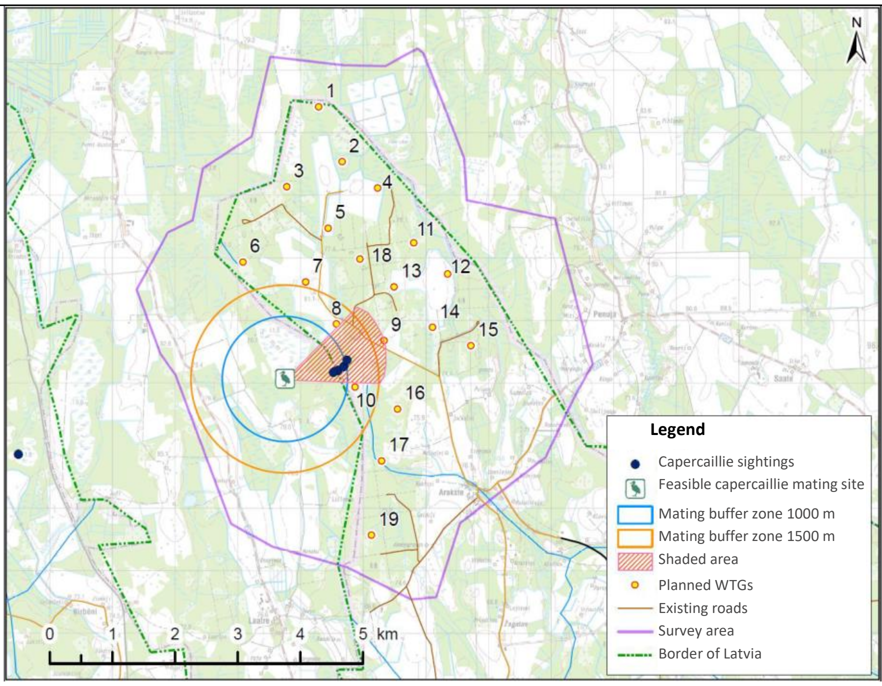


Figure 3.5.4. Capercaillie sightings, buffer zones and shaded area where WTG installation should be avoided

Black grouse *Lyrurus tetrix* is a sedentary bird and stays all year round on the planned wind farm site and its surroundings where it has long-term suitable habitats. During its nesting season, the black grouse is regularly found in the northern part of the site near all agricultural land plots near the swamp. Most of the time one bird was sighted, but the highest number of males observed at the same time was four (in the northern part of the site between Urgas and Bērzu Swamps). A group of 18 birds was sighted in the post-breeding period (see Figure 4.5.4). WTG L_02 and L_05 are situated approximately 500 m from a roost with four roosters, L_01, L_07 and L_12 are situated approximately 400 m from a roost with one roosting bird, possibly a satellite roost.

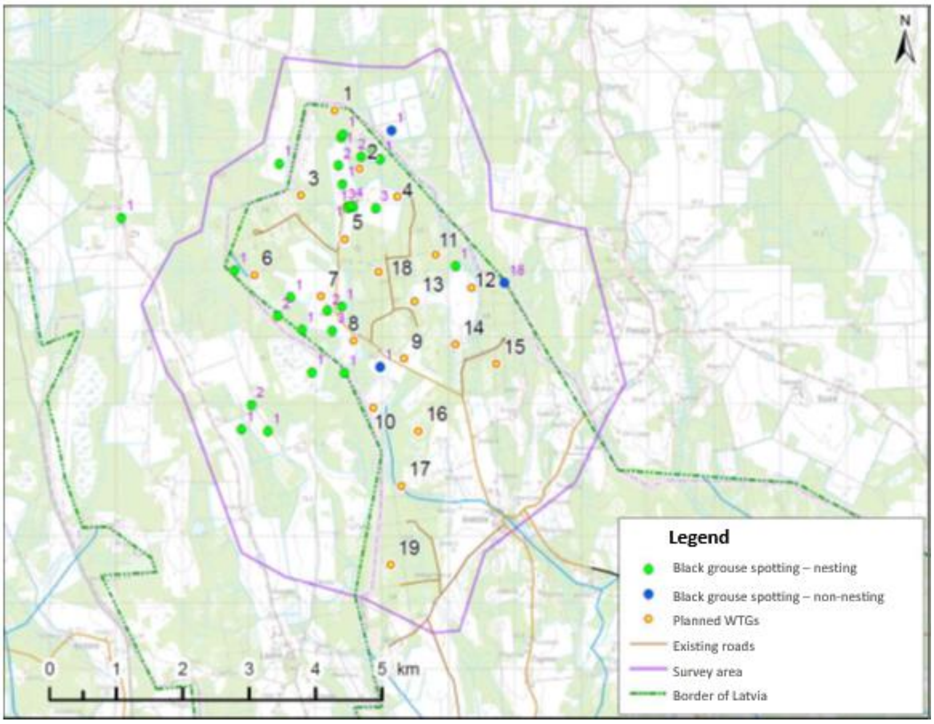


Figure 4.5.4. Black grouse spottings and numbers in the survey area

The woods on the planned activity site are an important habitat for **hazel grouse *Bonasa bonasia***. Hazel grouse is found throughout the area of the planned wind farm in at least 14 habitats (see Figure 4.5.5). At least five WTGs (L_02, L_03, L_11, L_12, L_15) are planned within 200 m of the nearest known hazel grouse habitat and another 12 planned WTGs are within 500 m (L_01, L_04, L_05, L_06, L_08, L_09, L_10, L_13, L_14, L_18, L_19).

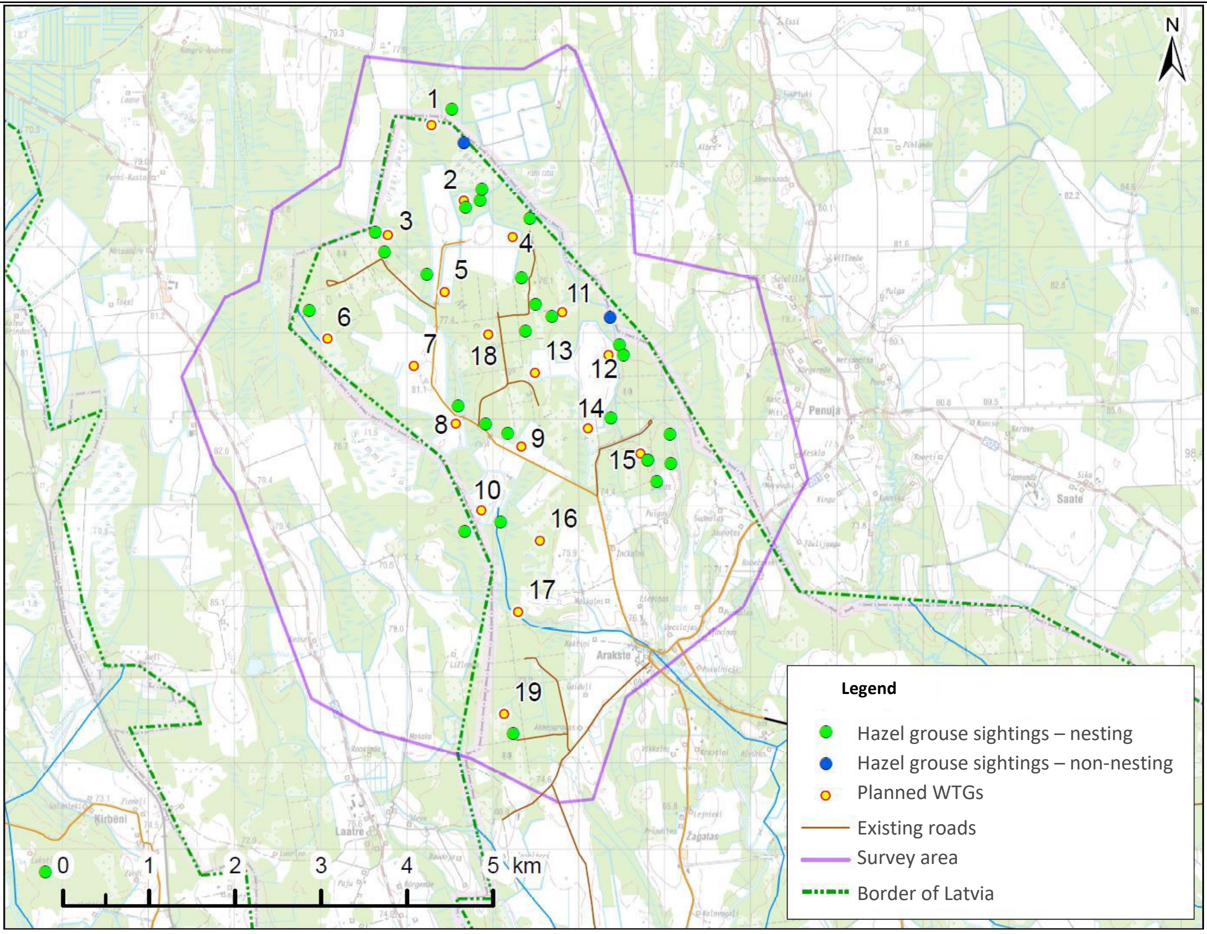


Figure 4.5.5. Hazel grouse spottings in the survey area

Grey partridge *Perdix perdix* is a sedentary species that lives in open farmland all year round. One songbird was spotted in the survey area in farmland between larger forest areas near WTG L_12 and L_14, as well as around Arakste.

Black stork *Ciconia nigra* is a long-distance migratory bird that mainly inhabits old and larger forests with watercourses and water bodies for breeding in Latvia. The nearest known black stork nest is in Estonia, approximately 12 km from the nearest planned WTG L_01.

One black stork was spotted in the survey area in spring 2023. It circled over the site and flew in the direction of Estonia (see Figure 4.5.7). It is believed to have been a passing bird. No black stork foraging or nesting sites have been recorded in the vicinity of the observation. From April to September, black storks can appear passing through or feeding in the wind farm, for example in the river Krūmiņupīte near Arakste or in the eastern part of the site along the Veserupīte river. The river Krūmiņupīte near the planned WTG L_17 is a promising black stork feeding site (see Figure 4.5.5), but closer to WTG L_10 it becomes a small stream and is unlikely to be a potential black stork feeding site.

Figure 4.5.6. Krūmiņupīte near WTG L_17

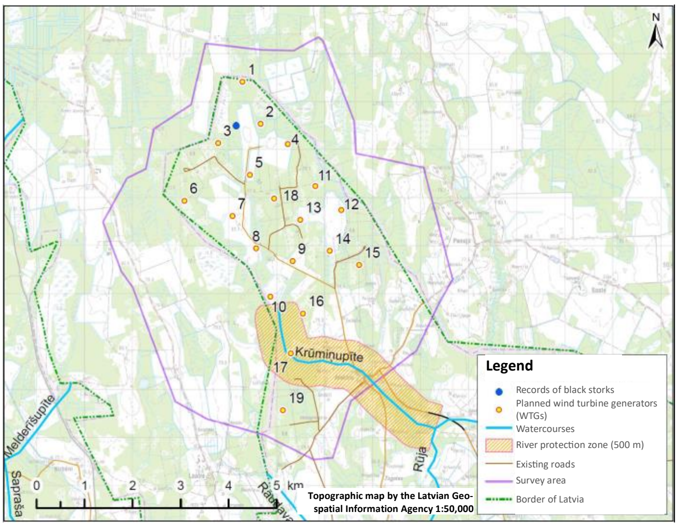


Figure 4.5.7. Black stork records in the study area and recommended protection zone along Krūmiņupīte

In the expert's opinion, a protection zone of approximately 1 km wide (500 m on either side from the middle of the river) should be maintained along Krūmiņupīte, which is a potentially suitable feeding area for the black stork (see Figure 4.5.7).

The **white stork *Ciconia ciconia*** is a migratory bird that in Latvia usually chooses nesting sites near human habitation. At least six occupied nests were recorded in the south of the study area and a further nine nests in the surrounding area (see Figure 4.5.8).

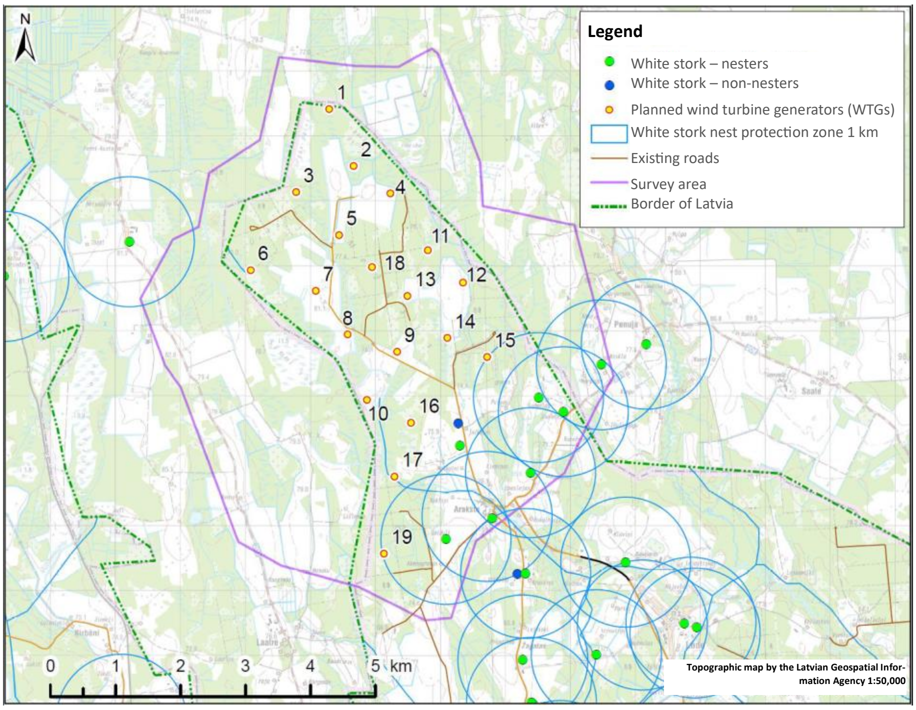


Figure 4.5.8. White stork nests and records in the study area

The **pygmy owl *Glaucidium passerinum*** is a sedentary inhabitant of old mixed forests and coniferous forests. In the opinion of the expert, the forests in the study area are considered suitable for nesting, passage and wintering: resting, feeding and nesting.

The pygmy owl has been recorded in at least four or five locations of the study area, mostly in its northern part, both within and close to the priority protected area.

According to the habitat suitability model of the species conservation plan, the suitability of the species in the cells of the planned WTGs ranges from 1.9% to 67.8%, with an average value among all planned generators of 34.4%. WTG L_18 is located in the pygmy owl priority protected area, and WTG L_11 is located approximately 10 m from this priority area, where successful nesting of the pygmy owl has been recorded, observing juveniles. The detected juveniles and currently suitable habitat are located approximately 550 to 850 m from WTGs L_18 and L_11. The location of the other planned generators is outside the priority protection areas defined in the Species Conservation Plan (see Figure 4.5.9).

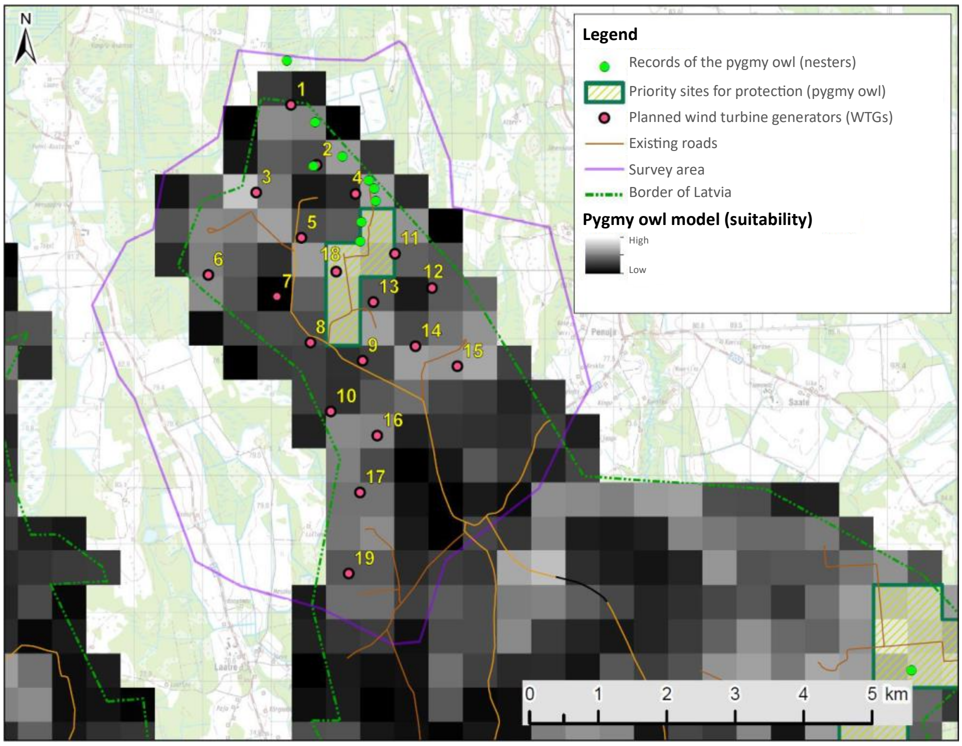


Figure 4.5.9. Observations of pygmy owl, suitability model and priority areas for conservation

The **Tengmalm's owl *Aegolius funereus*** inhabits larger old mixed and coniferous forests. The proposed activity area is partly suitable for the Tengmalm's owl. The inventory of the Tengmalm's owl did not reveal this species in the area of the proposed wind power plants. According to the habitat suitability model for the Tengmalm's owl developed under the Owl Conservation Plan, the suitability of the planned WTG cells ranges from 3 to 35%. The highest suitability is in the vicinity of WTGs L_07 and L_08, where it reaches 47% and 54% respectively. The study area is located outside the priority conservation areas identified in the species conservation plan (see Figure 4.5.10).

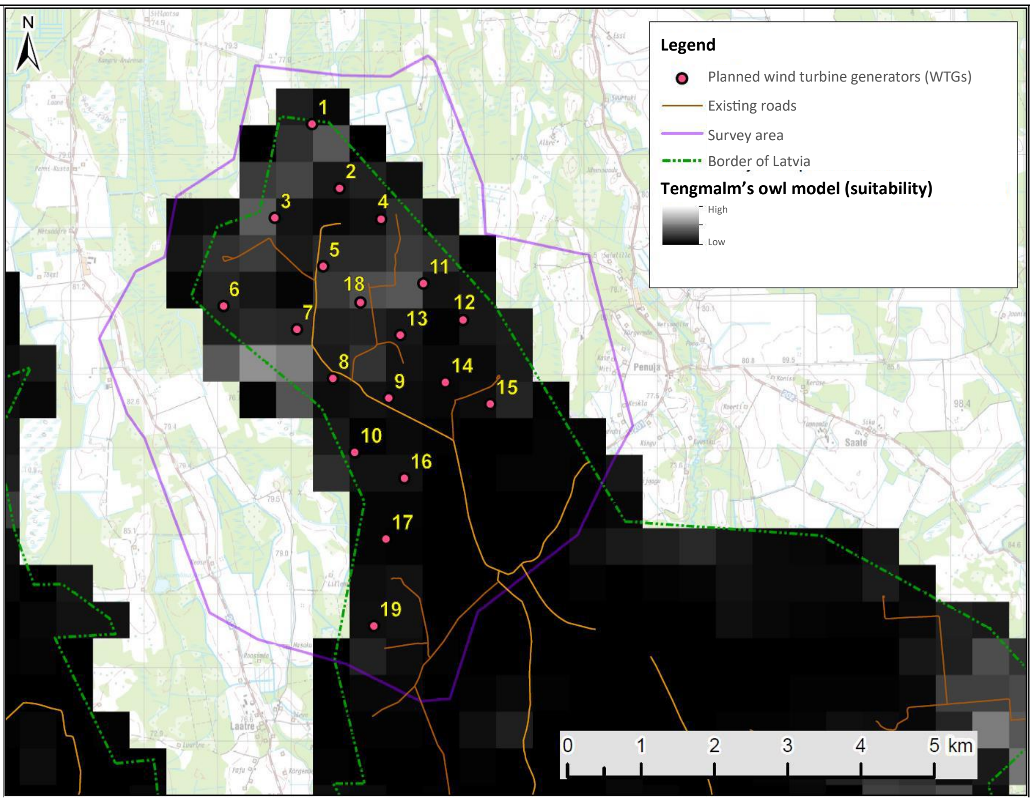


Figure 4.5.10. Site suitability model for the Tengmalm's owl

The **Ural owl *Strix uralensis*** is a sedentary bird that inhabits mostly large, continuous forest stands. The Ural owl was recorded at four sites in the study area (see Figure 4.5.11). Two records of the pygmy owl in Priority Conservation Areas and one at a distance of 150 m from these.

According to the species conservation plan model, the species suitability in the cells of the planned WTGs ranges from 1.7 to 36.2%, with an average value among all planned plants of 18.9%. The proposed WTGs are located outside the priority conservation areas identified in the Ural owl conservation plan and there are no such areas in the immediate vicinity. The Ural owl was detected approximately 330 m from WTG L_04, 430 m from L_11, 650 m from L_13, 320 m from L_18, 630 m from L_14, 360 m from L_15.

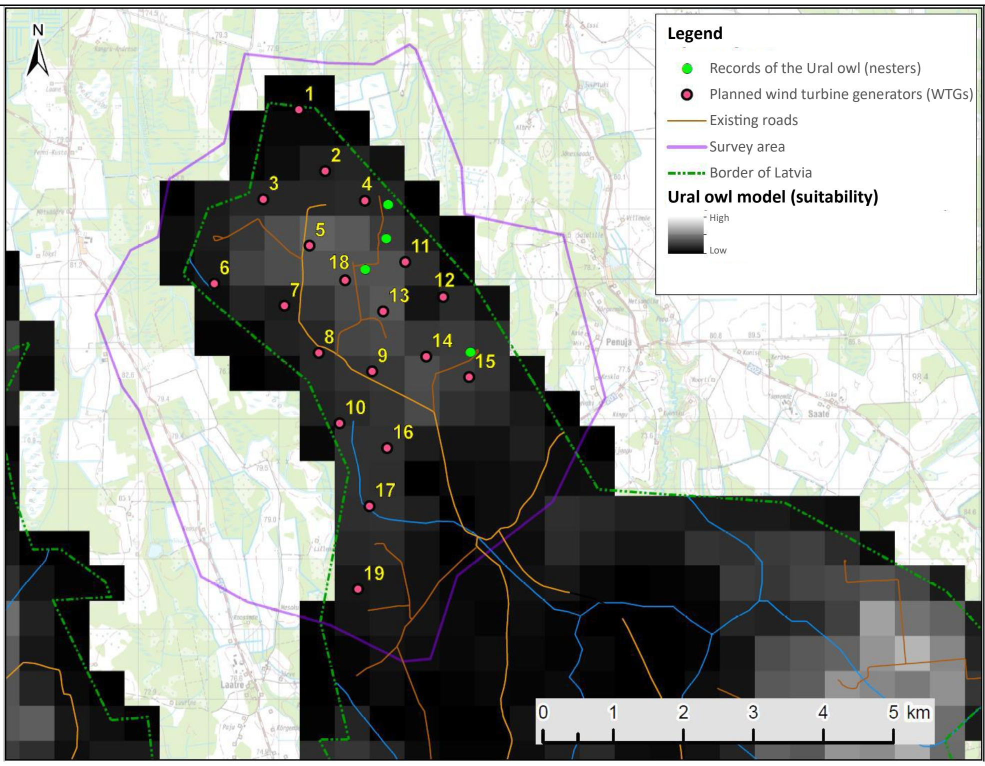


Figure 4.5.11. Ural owl records and site suitability model

The **Eurasian eagle-owl *Bubo bubo*** is a sedentary bird and the largest eagle-owl, inhabiting a variety of biotopes, including woodlands. According to the species conservation plan, there are no priority areas for the conservation of the eagle-owl in the area of the proposed wind power plants and the surrounding area. The species suitability in the planned WTG cells ranges from 1.7 to 19.2%, with an average value among all planned plants of 5.4% (see Figure 4.5.12). Historical data and site inventories have not revealed the presence of the eagle-owl in the study area and its surroundings.

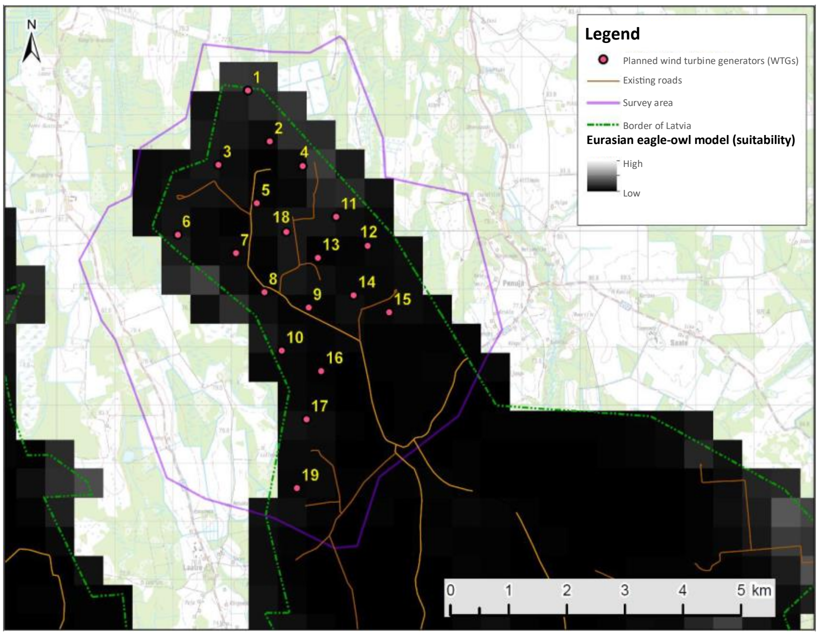


Figure 4.5.12. Site suitability model for the Eurasian eagle-owl

The Eurasian **three-toed woodpecker *Picoides tridactylus*** is a sedentary species, mainly inhabiting coniferous and mixed forests, as well as alder thickets. The following potentially suitable habitats have been identified in some locations in the study area. According to the Woodpecker Conservation Plan, the species suitability in the planned WTG cells ranges from 0.1 to 56.5%, with an average of 15.7% across the 20 planned generators. There are no priority protection areas for the three-toed woodpecker within and adjacent to the proposed wind power plant (Figure 4.5.13). During the breeding season, the three-toed woodpecker was recorded at three sites. The approximate distances from the observations to the nearest planned WTG are 190 m (L_04), 375 m (L_05) and 550 m (L_06).

Figure 4.5.13. Records, suitability model and priority conservation areas for the three-toed woodpecker

The **white-backed woodpecker *Dendrocopos leucotos*** inhabits old deciduous and mixed forests, including open landscapes. It is more common in eastern and northern Latvia. According to the species conservation plan, the species suitability in the cells of the planned WTG ranges from 1.8 to 32.4%, with an average value among all planned plants of 12.6%. Although the currently planned WTG are located outside the priority conservation areas identified in the species conservation plan, there are several such areas in the study territory (especially at the northern end), and the WTG are planned close to them. The nearest priority conservation area (with a pixel value of 63.2%) is approximately 10 m from the proposed WTG L_01, but the bird was not detected in this area during the survey year. Another protection area (with a pixel value of 75.1%, which also contains a white-backed woodpecker nest) is located approximately 130 m from the currently planned WTG L_02 and 290 m from WTG L_04. WTG L_03 is located approximately 10 m away from the priority conservation area with a pixel value of 56.4%, where the nesting white-backed woodpecker has been recorded. In total, four to six potentially suitable habitats have been identified in the area (see Figure 4.5.14).

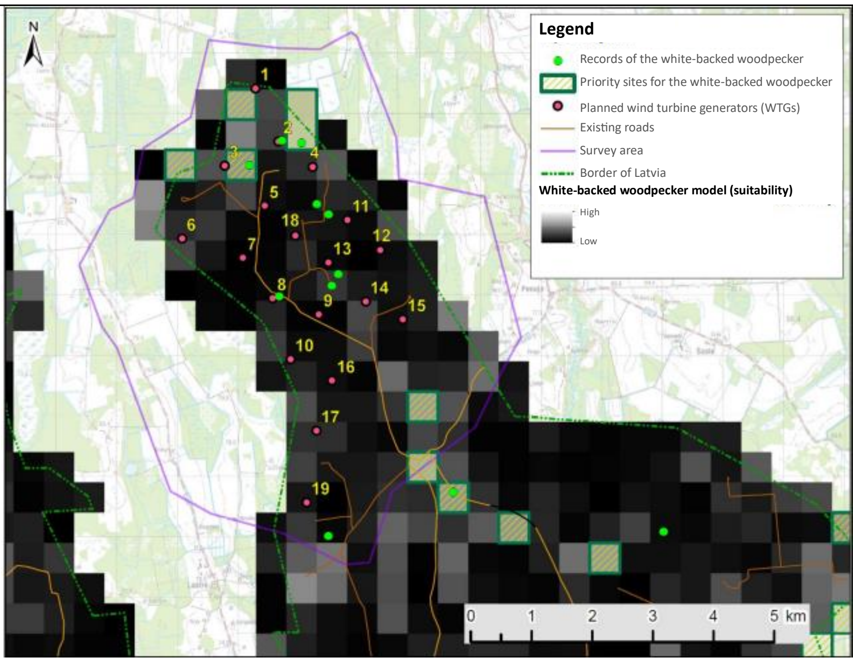


Figure 4.5.14. Records of the white-backed woodpecker, suitability model and priority conservation areas

During the breeding season, the white-backed woodpecker was also recorded 120 m from WTG L_08, 520 m from L_09, 320 m from L_11, 250 m from L_13 and 660 m from L_19. At this time, the white-backed woodpecker is likely to use an area of more than 2 km^2, which means that it may be present in the vicinity of all the planned WTG. Overall, the study area is characterised as an important breeding, resting and feeding site for the white-backed woodpecker throughout the year.

The **middle spotted woodpecker *Dendrocoptes medius*** is a sedentary species that lives mainly in broadleaved and mixed oak forests. No habitats suitable for this species have been identified in the vicinity of the proposed WTG. There are no priority areas identified in the species conservation plan in the vicinity of the proposed WTG. The nearest such area is more than 1500 m from the proposed WTG (Figure 4.5.15). The nearest record of the middle spotted woodpecker is approximately 800 m from L_16 and L_15.

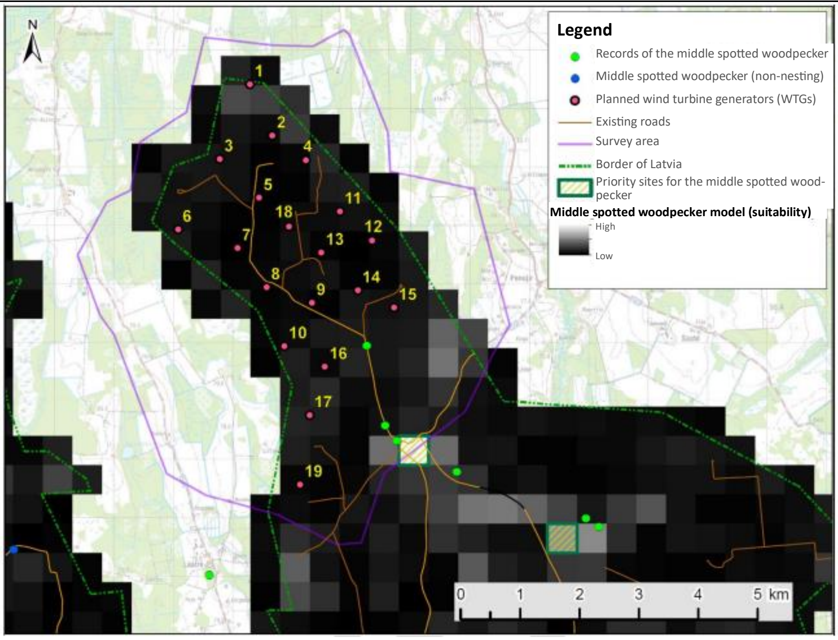


Figure 4.5.15. Records of the middle spotted woodpecker, site suitability model and priority conservation areas

The **black woodpecker *Dryocopus martius*** is a forest-dwelling species. It is a sedentary species, with extensive breeding territories. It is the most common protected species found in the study area and is evenly distributed throughout the entire territory of the planned wind power plants. During the breeding season, it has been detected in at least 10 to 14 locations, of which about 10 are in the immediate vicinity of the WTG. In the long term, the species is expected to continue to be present throughout the wind farm. According to the species conservation plan model, the species suitability in the cells of the planned WTG ranges from 8.3 to 63.3%, with an average value among all planned plants of 37.3% (see Figure 4.5.16).

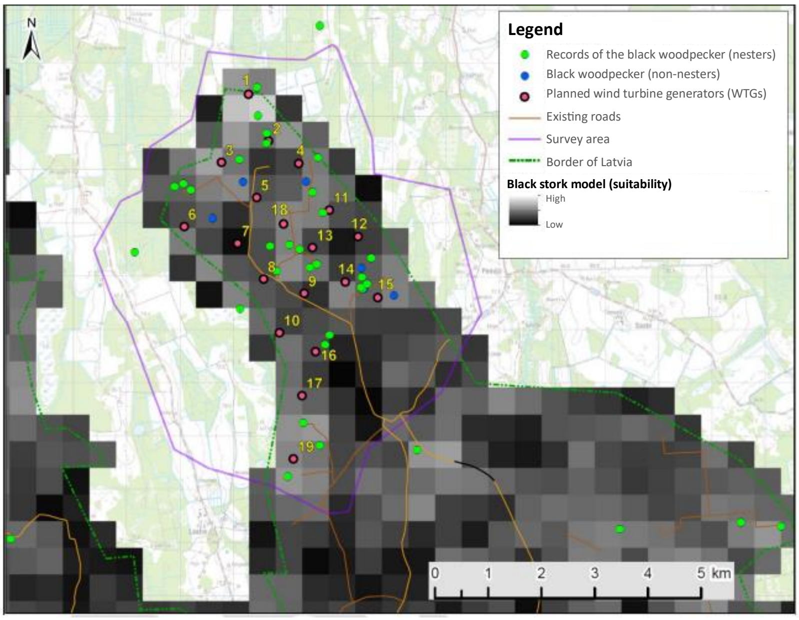


Figure 4.5.16. Records of the black woodpecker and the site suitability model

The **grey-headed woodpecker *Picus canus*** is mainly found in mosaic landscapes, but avoids larger woodlands. According to the species conservation plan model, the suitability of the grey-headed woodpecker in the planned WTG cells ranges from 3.6 to 64.1%, with an average value among all planned generators of 30.2% (see Figure 4.5.17).

The grey-headed woodpecker has been recorded as a breeder at three sites - WTG L_06, L_08 and L_13. WTG L_08 and L_13 are part of the same site, so there could be a total of two nesting sites in the planned wind farm. Outside the breeding season, this species can be found throughout the entire area of the proposed wind farm.

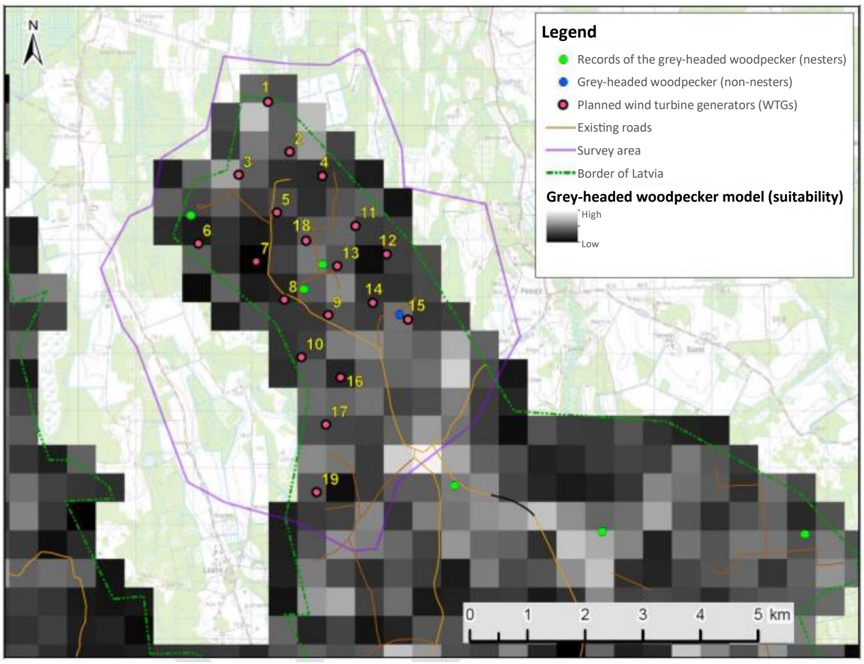


Figure 4.5.17. Records of the grey-headed woodpecker and the site suitability model

The **wryneck *Jynx torquilla*** is a long-distance migrant bird that inhabits open landscapes and woodlands near grasslands. The wryneck was recorded in the central part of the planned wind farm in two places where it is likely to nest. The nearest planned WTG L_13 is approximately 200 m away from the wryneck nesting site. The second record is at the Inčkalni houses, which is approximately 890 m from WTG L_16 (see Figure 4.5.18).

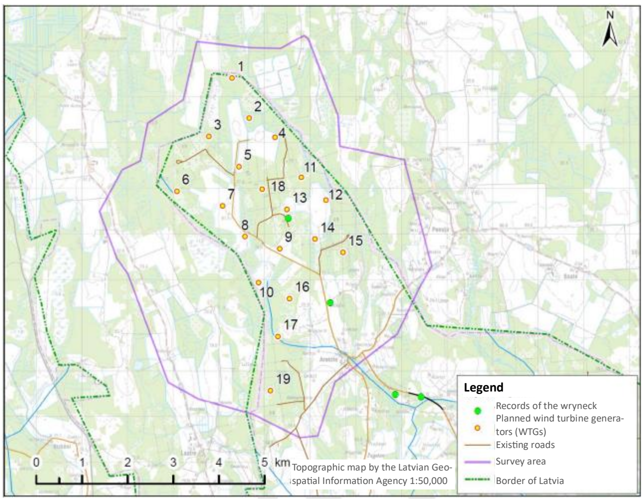


Figure 4.5.18. Records of the wryneck in the proposed activity area

The **lesser spotted eagle *Clanga pomarina*** is a long-distance migrant bird that returns to Latvia from its wintering grounds in early April. According to the Lesser Spotted Eagle Conservation Plan in Latvia, the bird feeds mainly on land used extensively for agriculture, mostly meadows and pastures (64%), but also on fallow land (22%) and less frequently on arable land with sown crops (9%). Mown meadows and harvested crops, where food items are readily available, are particularly suitable. In Latvia, 90% of the nests are located within 400 m of the forest edge, close to grasslands.

Five occupied nests of the lesser spotted eagle and associated feeding areas have been identified in the vicinity of the proposed wind farm (see Figure 4.5.19).

The distances from the occupied nests of the lesser spotted eagle between WTG L_17 and L_19 to the WTG are: L_17 - 450 m, L_19 - 810 m, L_16 - 1300 m, L_10 - 1710 m, L_09 - 2360 m, L_15 - 2610 m, L_14 - 2655 m and L_08 - 2760 m. The nests of the lesser spotted eagle (ID 680341820) found in Estonia are located 1200 m from WTG L_06, 2145 m from L_07, 2490 m from L_03, 2680 m from L_08 and 2700 m from L_05.

The nests of the lesser spotted eagle (ID 1115379091) found in Estonia are located 1850 m from WTG L_01, 2450 m from L_03 and 2670 m from L_02.

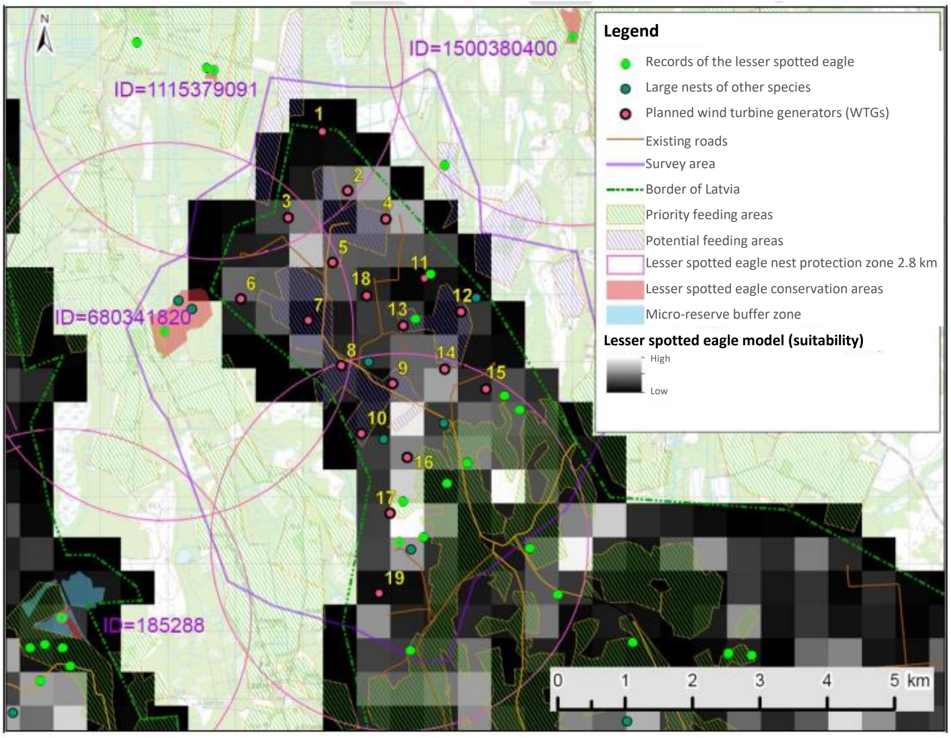


Figure 4.5.19. Records of the lesser spotted eagle, habitat suitability and large nests found

The **European honey buzzard *Pernis apivorus*** is a long-distance migratory bird that inhabits various types of forests in Latvia. During the survey one nest was found in the lesser spotted eagle conservation area in Estonia (ID 680341820). The distance from the nest to WTG L_06 is approximately 740 m, L_07 approximately 1730 m and L_03 approximately 1970 m. The planned area of the wind farm, especially its periphery, is characterised as well populated and well suited for the long term, with the honey buzzard residing from approximately the second decade of May to mid-September.

Feeding flights for the honey buzzard are mostly low, but mating flights and territory guarding are at rotor height, so the WTG should be built as far away as possible from all known honey buzzard nests.

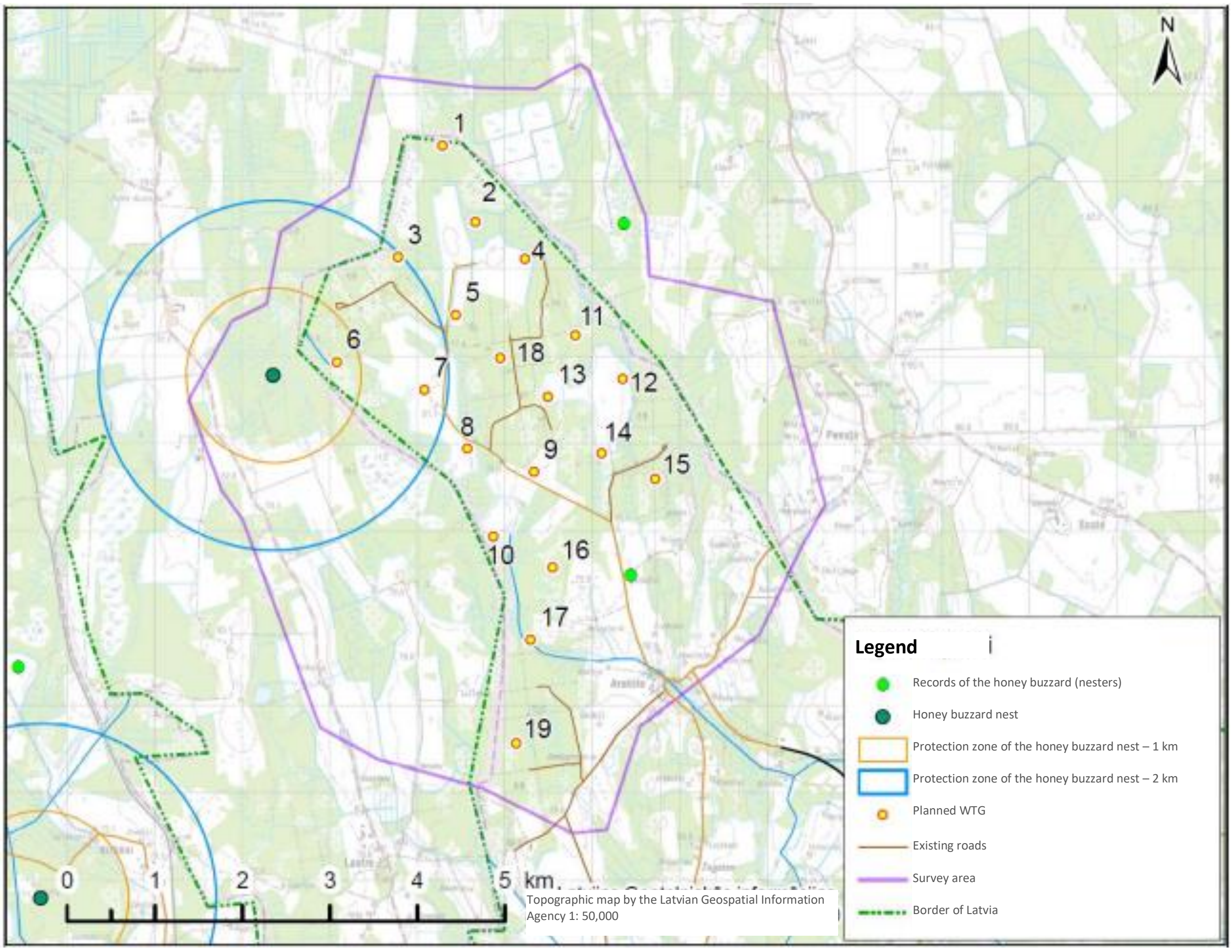


Figure 4.5.20. Records of the honey buzzard and nests in the study area

The **common buzzard *Buteo buteo*** is a diverse forest-dweller and is not currently listed as a specially protected species. Currently only their large nests are protected[39]. However, the common buzzard can be found all year round in Latvia and is the most common bird of prey in the country. The common buzzard is also the most commonly recorded diurnal bird of prey species in the study area. The whole site is characterised as an important breeding, resting and feeding area for the common buzzard, where it can be found throughout the year, especially during the breeding season.

[39] cabinet regulation no. 935, paragraph 54.2, on the felling of trees in forests

At least five occupied common buzzard nests have been recorded in the study area (see Figure 5.4.21), and another nest is likely to be located near WTG L_06, where the bird is regularly observed during the season.

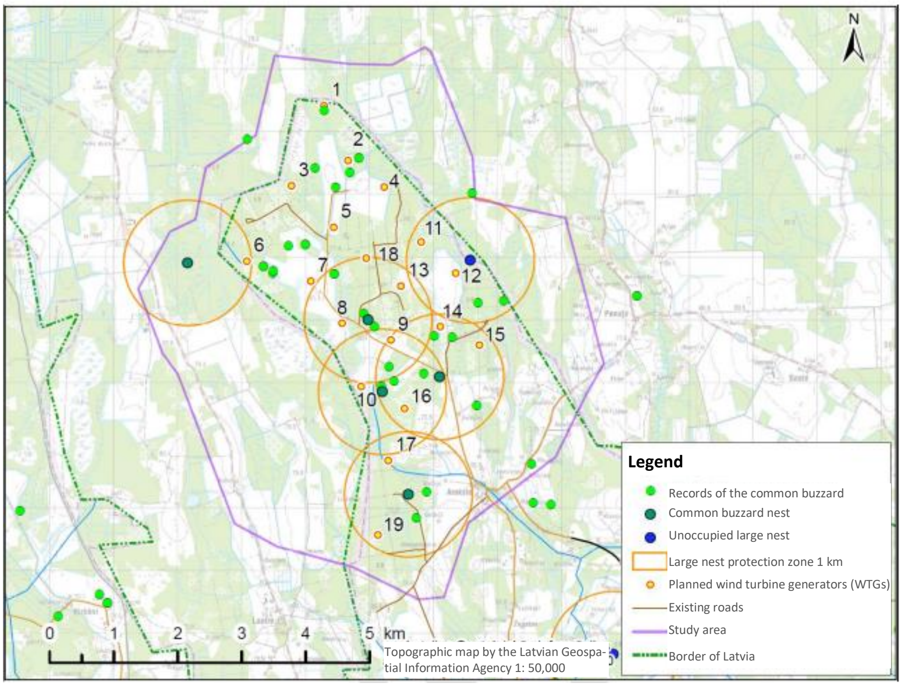


Figure 4.5.21. Observations and nests of the common buzzard in the study area of the Lode wind farm

The **Eurasian goshawk *Accipiter gentilis*** is a forest-dwelling, sedentary species. During the survey, one goshawk was observed twice in the area between WTG L_05, L_07 and L_18 (see Figure 4.5.22). Although no nest or reoccurrence of the species was detected during the search of the surrounding forests, it is possible that the goshawk nests in the periphery of the site. The goshawk can be found in the area throughout the year, and the surrounding forests are suitable for nesting, increasing the risk of impacts and collisions throughout the lifetime of the wind park.

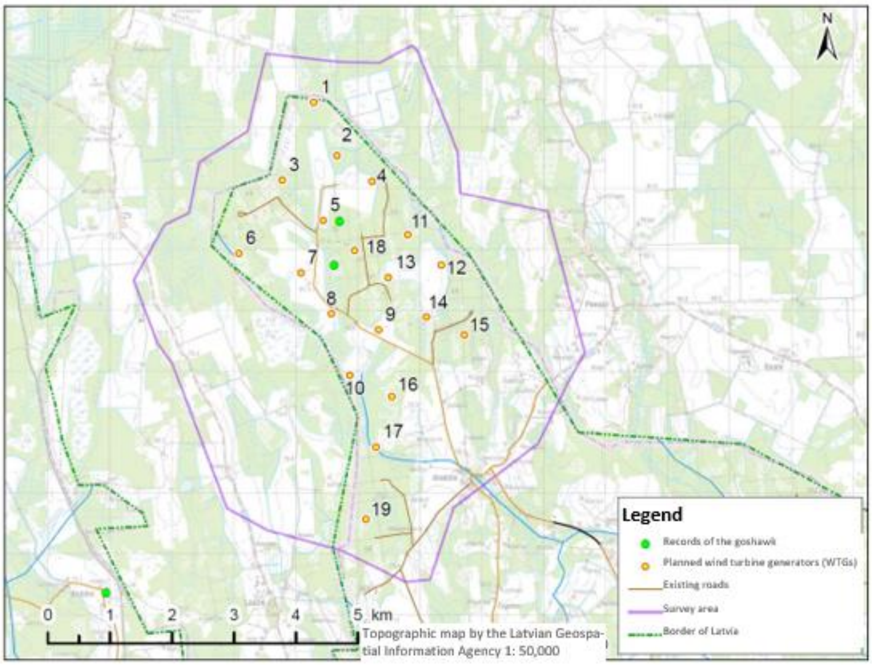


Figure 4.5.22. Observations of the goshawk in and around the study area

The **white-tailed eagle *Haliaeetus albicilla*** inhabits forests, which are usually close to water bodies, and stays in Latvia throughout the year. Juveniles tend to wander long distances, while adults mostly stay close to the breeding area. The nearest known territory of the white-tailed eagle is in Estonia, approximately 8 km north of WTG L_01 at Kariste lake. During the survey, the white-tailed eagle was detected twice: in spring and autumn. Both times, the bird flying over the area was immature and had not reached breeding age. These observations were made between WTG L_11, L_12 and L_14. The risk of collisions is assessed as being low.

The **western marsh harrier *Circus aeruginosus*** is a long-distance migratory bird that returns to Latvia in late March and early April. Breeding in Latvia is usually associated with water bodies, but they often fly to agricultural landscapes in search of food. During the survey, three records were made on agricultural land at WTG L_05, between L_07 and L_08, and at Arakste. Several records were also made in the periphery (see Figure 4.5.23), but these were all associated with low feeding flight and the western marsh harrier is not thought to nest in the vicinity of any of the planned generators.

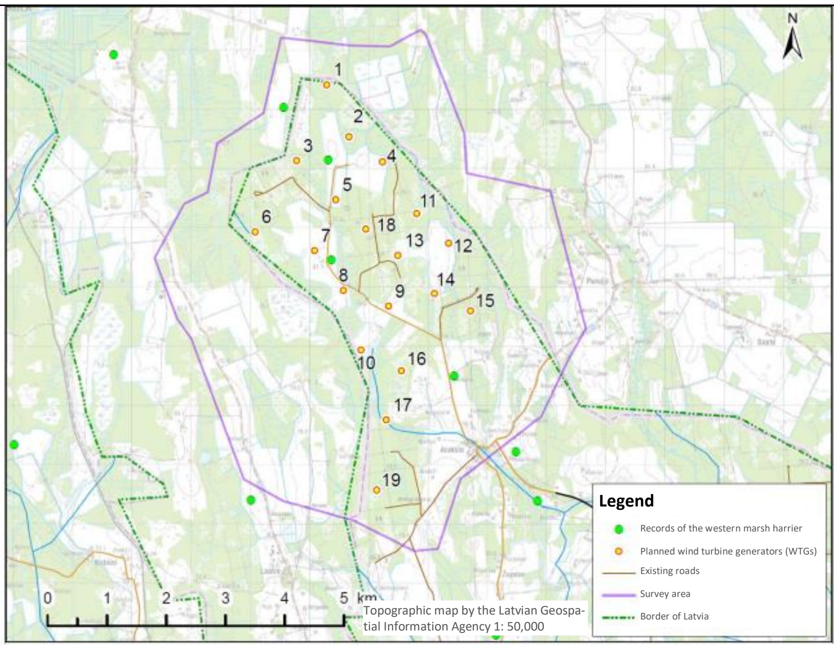


Figure 4.5.23. Records of the western marsh harrier in the study area

The **sparrowhawk** ***Accipiter nisus*** can be observed in the vicinity of all generators throughout the year. The sparrowhawk is not a specially protected species. However, it has been found in at least six locations on the periphery of the study area. One occupied nest was found in Estonia at a distance of approximately 310 m from WTG L_10.

The **common crane** ***Grus grus*** is a close migrant and can be found in the wettest areas throughout the study area as early as March. In total, the common crane has been observed at least five to seven sites during the breeding season, but not all of them have nested. Three nests were found, all located on the periphery of the study area (see Figure 4.5.24). Repeated observations suggest that the common crane probably also breeds north of WTG L_03 in the vicinity of the Urga bog. There are currently few suitable nesting sites in the study area.

No large migratory flocks of migratory birds have been detected. The highest number of migrants recorded is 12 birds in a single site, and one to three birds in a local open landscape. No large flocks of roosting common cranes have been found in the area (e.g. in marshes).

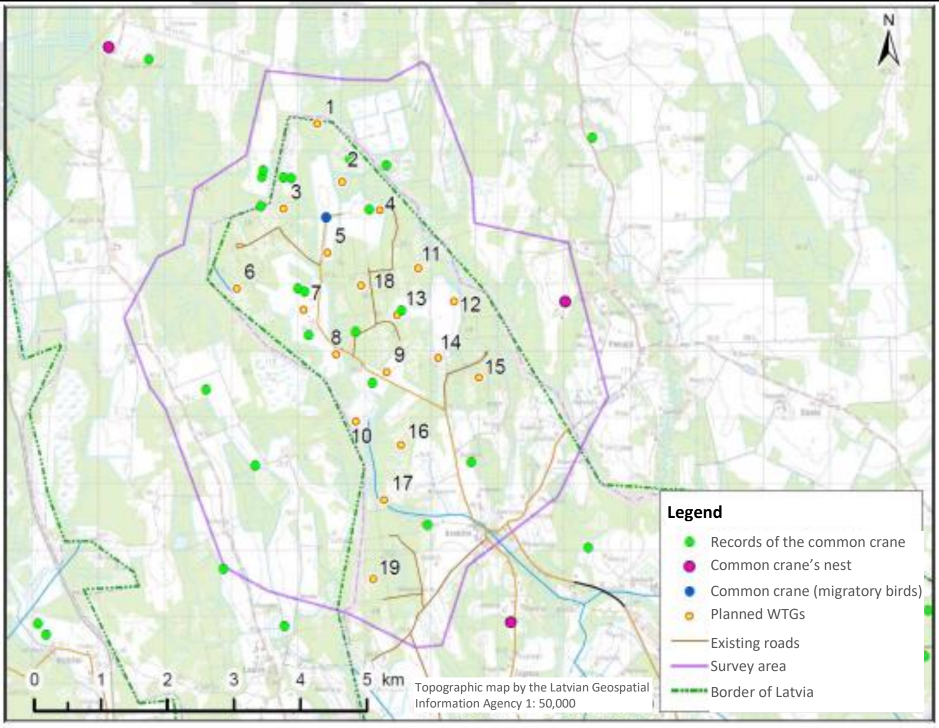


Figure 4.5.24. Common crane observations in the study area and nests found

The **corn crake *Crex crex*** is a long-distance migratory bird that inhabits farmland. During the survey, the corn crake was recorded on agricultural land only in the vicinity of Arakste (approximately 620 m from WTG L_16 and 850 m from L_17).

The **stock dove *Columba oenas*** is a migratory bird that arrives at its breeding sites (in different types of forests) in early March. During the breeding season, the stock dove was recorded at four sites in the central and northern part of the study area (see Figure 4.5.25).

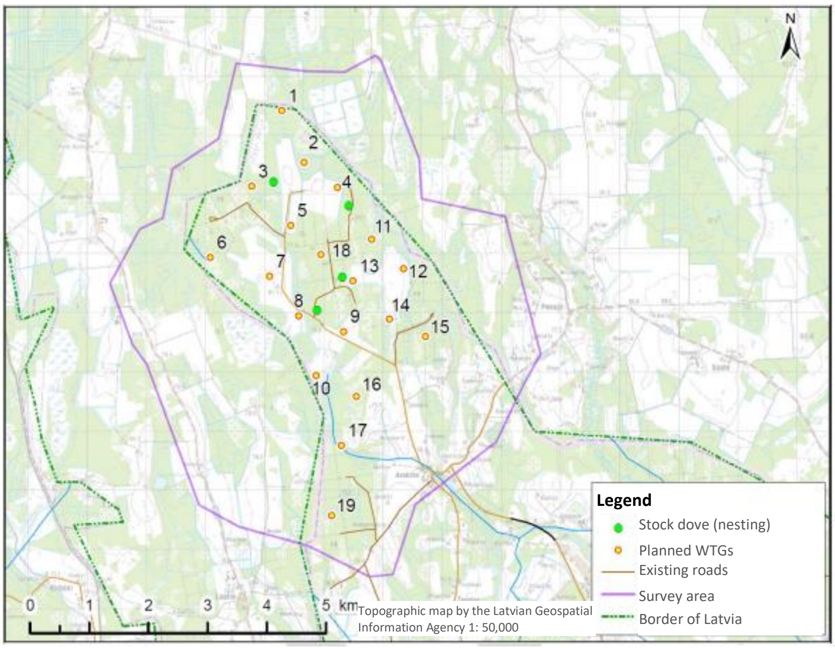


Figure 4.5.25. Records of the stock dove in the study area

The **European nightjar *Caprimulgus europaeus*** is a long-distance migratory bird that inhabits pine and mixed forests, clearings and marshes in Latvia during the breeding season, returning from wintering grounds in early May. The density of the European nightjar found during the site survey is low.

The **woodlark *Lullula arborea*** is a migratory bird that returns to its breeding grounds in the second half of March. In the study area, the woodlark was recorded breeding on at least 11 sites (see Figure 4.5.26), mostly in open countryside: farmland and forest edges.

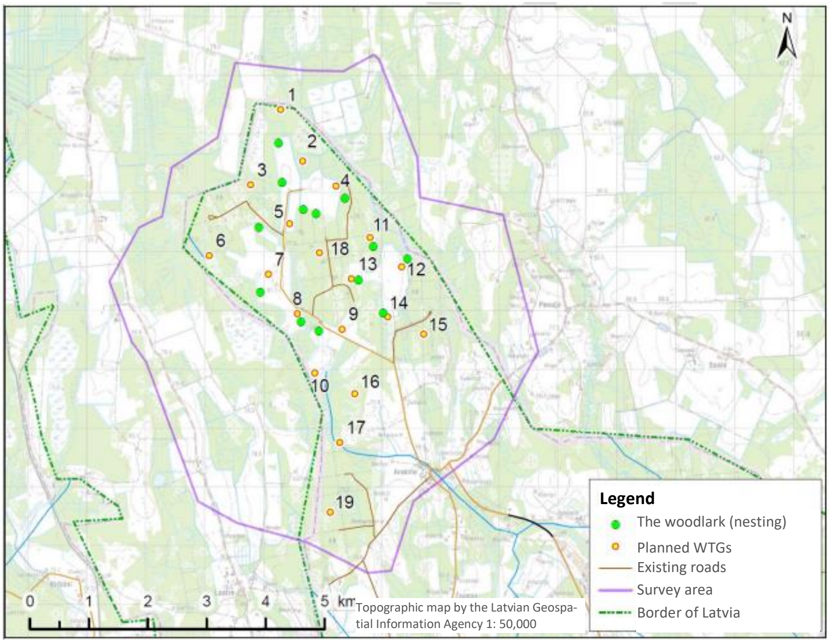


Figure 4.5.26. The woodlark observations in the study area

The **whooper swan *Cygnus cygnus*** is a semi-feral migratory bird that has been recorded – from 3 to 19 local birds in the vicinity of WTG L_07 during spring migration (first and second decade of April) in the area of the planned wind farm. Although the breeding sites of the whooper swan can be protected by the creation of a micro-reserve, there are no suitable breeding sites in the territory and its surroundings, and no breeding has been recorded. The nearest breeding was recorded in Lode village. The risk of collisions with the mast or rotor is generally low.

The **common snipe *Gallinago gallinago*** is a migratory bird that arrives in the area in early April. During the breeding season, it was found at 10 to 11 sites, mostly on the periphery of the study area, next to marshes. The common snipe is not a specially protected species. Currently, the nearest WTG L_04 is planned at approximately 80 m, L_03 at 110 m, L_16 at 130 m, L_13 at 200 m, WTG L_1 at 250 m and WTG L_08 at approximately 300 m (see Figure 4.5.27).

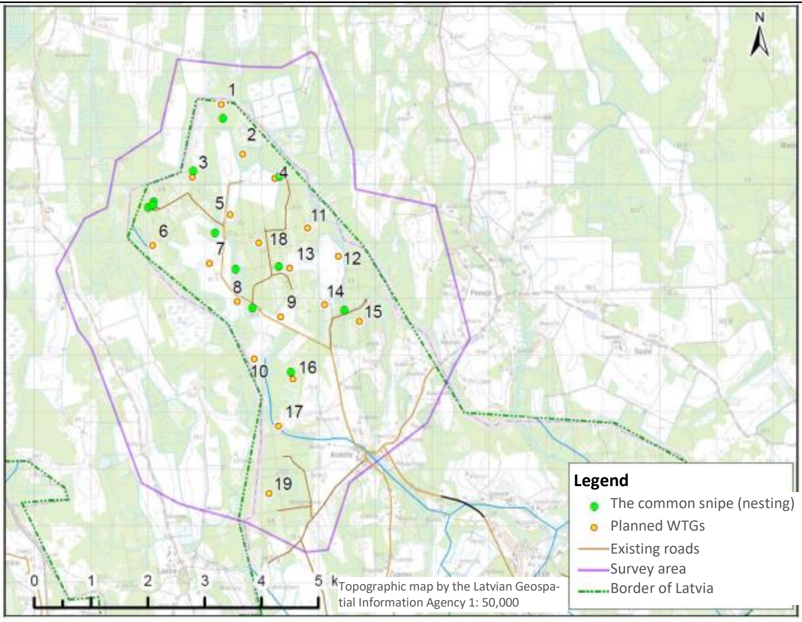


Figure 4.5.27. Records of the common snipe in the study area

The **Eurasian woodcock *Scolopax rusticola* is a** close migrant bird that returns to its breeding territories in spring in the third decade of March. The Eurasian woodcock inhabit different types of forests and have been recorded 8 times in the study area.

The Eurasian woodcock has been recorded in the immediate vicinity of WTG L_04, L_11, L_13, L_15, L_17, L_18, but due to its extensive flight range it is likely to occur throughout the study area.

The **lesser spotted woodpecker** *Dryobates minor* has been recorded at nine sites: four sites during breeding, with one record at approximately 50 m from WTG L_02, and five different sites in the wind farm during autumn migration.

In October, during migration near Arakste, two **European golden plovers** *Pluvialis apricaria* were found on agricultural land. No breeding of this species has been recorded in the surrounding marshes.

The **northern lapwing** *Vanellus vanellus* has been recorded both as a breeder (3-4 pairs) on agricultural land near WTG L_07, L_08, L_12 and L_14, and in migration, flying over the area and feeding up to 130 birds in the vicinity of Arakste.

The **common kingfisher** *Alcedo atthis* was observed in autumn at two sites along the Veserupīte. In autumn and winter, the common kingfisher may be seen in the watercourses and bodies of water closest to the wind farm that are not frozen. During the autumn migration, three **Eurasian curlews** *Numenius arquata* were observed flying over the area.

The **bean goose** *Anser fabalis* and the **greater white-fronted goose** *Anser albifrons* were recorded in migration low over the site. This migration of geese has been recorded in flocks of 10 to about 200 birds in both spring and autumn. As there are no large areas where geese can feed, rest or roost, geese have only been seen flying over. No such stops have been found in the surrounding area. Geese observe wind farms and have an avoidance response, and therefore collisions are rare.

In general, most spring and autumn migration through the planned wind farm area takes place at low-elevation tree level. It should be noted that in poor visibility and adverse weather conditions, the trajectories of high-flying birds are generally lower, increasing the risk of collisions with both mast and blades. The most active migration takes place in the morning, when passerines pass through in a broad front. The largest migrants in numbers are the **Eurasian chaffinch** *Fringilla coelebs*, the **Eurasian siskin** *Spinus spinus*, the **parus** *Parus sp* and the **wood thrush** *Turdus sp*. Migration routes are roughly south-north. On some days in autumn, migration is high, with large numbers of birds passing through continuously.

In general, the site is outside the main narrow migration routes and there is no reason to believe that the number, flow or composition of migratory birds would differ significantly from equivalent forests in the surrounding area. The proposed WTG layout is located in a south-north direction, thus occupying as little of the migration corridor as possible.

4.5.3 Impact on ornithofauna

There are three main ways in which birds can be affected by the construction of a wind farm:

- causing persistent noise pollution,

Noise pollution is related to both the construction period of the wind farm, when birds may be disturbed by noise from construction machinery and human presence, and the operational phase of the wind farm, when disturbance is mainly from noise from the WTGs. Some studies, however, draw a broader link, indicating that the presence of WTGs, in general, causes significant disturbance (e.g. wing movement).

Noise pollution has the greatest impact on species that are ecologically adapted to silence during certain key periods of their lives. These include all owls, which hunt largely by hearing, the western capercaillie, the black grouse, and all species that live in opaque environments and use their voice to communicate and their hearing to detect their enemies, such as the corncrake and the black stork. Important landfill sites have been identified in the area of the proposed operation to ensure the conservation of threatened owl species.

Similar to the noise generated by the WTGs during operation, construction activities in or close to forests may cause disturbance to passerine bird and owl species. Although these impacts are generally considered to be temporary, construction activities during periods of particular importance for birds are clearly likely to have a significant negative impact on at least the breeding success of that year. Given the relatively short duration of the impact, there is no reason to believe that the impacts on bird populations from construction activities would be significant overall.

- posing a direct risk of collision and death to species that hunt from the air or migrate at night when the towers are not visible,

In most studies in Western Europe, hawks and falcons are considered to be at high risk from wind farms (collision risk), due to their relatively small population sizes, low reproductive rates, long flight distances and their avoidance of wind farm sites. In particular, unlike large migrants, including geese, swans and cranes, which often change their flight routes and avoid the wind farm area after wind farms are built, this avoidance is less pronounced in diurnal birds of prey. Although some studies also identify avoidance of wind farm by diurnal birds of prey, this avoidance response is not as well established as it is in the context of large migratory birds.

- This significantly reduces the available habitats.

Habitat loss, especially in forested areas, is also a major concern in the context of wind farm construction. Habitat loss takes two forms. For species that inhabit landscapes with little variability, habitat loss is caused by the construction of infrastructure associated with the wind farm: access roads and power lines. There is very little research specifically on habitat fragmentation caused by wind farm infrastructure, but there is no reason to believe that it is any different from the fragmentation of continuous landscapes caused by any infrastructure. The landscape of the forest interior disappears at least 50 m on each side of the new track, forest edges are exposed, increasing the risk of predation, new predators and generalists enter the forest along the tracks, etc.

In terms of impacts on **migratory birds**, the proposed action area is generally outside the main narrow migration routes, which is also confirmed by the observations made during the assessment. The proposed layout of the WTGs is located in a south-north direction, thus occupying as little of the migration corridor as possible and not causing significant negative impacts on migratory birds.

Priority species in and around the wind farm area that require special attention in the context of impacts are the **lesser spotted eagle**, the **black grouse**, the **hazel hen**, the **pygmy owl**, the **three-toed woodpecker** and the **white-backed woodpecker** (see Figure 4.5.28), as well as the **common buzzard**, which is not currently a specially protected species but the most common bird of prey species in the area of the planned wind farm.

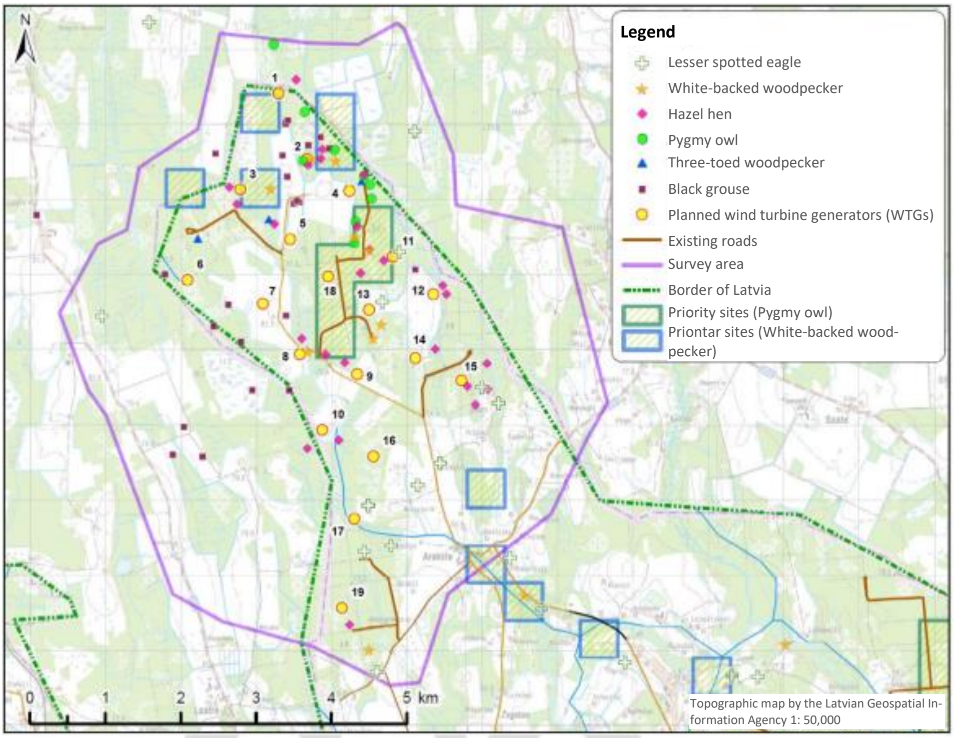


Figure 4.5.28. Priority species observations and protection areas in the area of the planned Lode wind farm

Lesser Spotted Eagle *Clanga pomarina*

The lesser spotted eagle is currently not a threatened species (Least Concern) both globally and regionally. According to the latest estimate, 3,753 to 4,914 pairs breed in Latvia, and the population trend is stable in the long term but increasing in the short term[40].

The closest distance threshold from the nest to the wind farm, as defined in the lesser spotted eagle species conservation plan, is almost 3 km (2,765 m), although this can be as high as 5 km in unfavourable feeding conditions.

Although WTGs L_17 and L_19 are 450-800 m from a successful nest in Latvia and L_06 is 1,200 m from a nest in Estonia, it has been found that the most potentially important hunting (foraging) habitats are in the vicinity of nests rather than in the central part of the planned wind farm. One of the factors why the central area of the planned wind farm is not important for food production is the relatively small amount of agricultural land under sown crops, while permanent grassland is not found. The second barrier is a 1.5 km-wide forest strip between the eagle nests in Estonia and the agricultural areas in the wind farm. These factors generally contribute to the lesser spotted eagle's preference for foraging in large areas around the nest, and the planned wind farm area is not a priority foraging area for the lesser spotted eagle, although it may be. Therefore, the expected significant negative impacts due to the short distance from the WTGs to the nest should be considered in the context of the low importance of the site as a foraging area. Consequently, impacts will be significantly reduced by appropriate mitigation measures (see Chapter 4.5.4).

Given that the nesting and main feeding areas are located in the vicinity of the proposed wind farm, although WTGs L_01, L_02, L_03, L_05, L_06, L_07, L_08, L_09, L_10, L_14, L_15, L-16 are located within 2,800 m of an occupied nest, they are not expected to have a significant negative impact on the Lesser Spotted Eagle or fragment its habitat when equipped with bird identification systems.

In addition, in the Utilitase Saarde wind farm, about 20 km away, two of the nine WTGs are closer than 1 km (580 and 730 m) and one turbine is 1,240 m from a nest of the lesser spotted eagle.

The route of the new cable line to be built is planned in the buffer zone of the micro-reserve directly along the micro-reserve itself. The impact of the proposed action on this micro-reserve has been assessed by an external expert in consultation. According to the expert, in order to ensure that the conditions of the micro-reserve are not degraded, it is important that the planned cable line is located away from the projection of the canopy of the outermost trees, as damage to the roots of the trees growing there could have a negative impact on the micro-reserve itself. Similarly, construction work during the lesser spotted eagle's stay in the micro-reserve could degrade the quality of the habitat.

Black grouse *Lyrurus tetrix*

Habitat loss of the black grouse can be affected by fragmentation, noise, collisions with WTGs or fences.

[40] Ķerus V., Dekants A., Auniņš A., Mārdega I. (2021). Breeding bird atlases of Latvia 1980–2017. Riga: Latvian Ornithological Society.

In good, clear weather, when wind speeds are low, the grouse's bark (song) can be heard up to 3 km away. When the noise from the WTGs exceeds the song of the grouse, bird communication is disrupted, which can lead to nest abandonment, loss of territory and reduced bird numbers. However, the noise impact of the WTG during the grouse rutting (song), which occurs at low wind speeds of between 5 and 7 m/s, is negligible, as the WTG starts operating at a wind speed of 3 m/s and its output increases gradually as the wind speed increases.

The black grouse flies low, so the risk of collisions with WTG blades is low. However, as grouses are not very agile fliers, they are at a higher risk of collisions with various structures, including masts or fences. This risk is particularly high in low visibility conditions and in spring, when grouses fly to their breeding grounds in the dark. At these times, they may not be able to see the overhead lines and assess the distance to them. The risk of collisions with masts is high at all planned stations in the northern part of the Lode wind farm.

The construction of the wind farm will have a negative impact on grouses, so it is important to implement mitigation measures (see Chapter 4.5.4).

The **hazel grouse** *Bonasa bonasia*

The habitat of the hazel grouse is mixed coniferous and deciduous forests. It is a pronounced sedentary, living most of its life in a relatively small area, so any change or disturbance to its habitat will have an ongoing impact on it.

There are no detailed studies on the impact of wind farms on the hazel grouse. However, it is likely that the most significant negative impacts on the hazel grouse may result from the reduction of available habitat. This decline can range from a decline in habitat quality to habitat destruction. Habitat quality can be compromised by noise from WTG and other anthropogenic disturbances.

WTG in forests will have a negative impact on the hazel grouse. The most significant impacts may be from the degradation or loss of available habitats and the risk of collisions with turbine masts and fences. Five generators (WTGs L_02, L_03, L_11, L_12, L_15) are planned within 200 m of the nearest known habitat of the hazel grouse, and 16 planned generators are within 500 m of these (additional WTGs L_01, L_04, L_05, L_08, L_09, L_10, L_14, L_13, L_16, L_18, L_19).

The expert concludes that no significant negative impacts on the hazel grouse by the Lode wind farm are expected from the implementation of the mitigation measures (see Chapter 4.5.4).

Pygmy owl *Glaucidium passerinum*

As the pygmy owl needs forests that are little affected by economic activities, habitat degradation or loss is considered to be the most significant potential adverse effect.

The construction of WTG L_18 in the pygmy owl priority protected area and L_11 within 10 m of the pygmy owl priority protected area will make the areas unsuitable or at least less suitable for the pygmy owl during the entire lifetime of the wind farm, causing noise emissions and other anthropogenic impacts. The developers of the environmental impact assessment consider that the compensatory measures recommended by the expert (see Chapter 4.5.4) will offset these impacts by creating the conditions for the development of an area suitable for the species. At the same time, monitoring measures in the affected habitats are also foreseen.

The location of the other planned generators is outside the priority conservation areas defined in the Species Conservation Plan.

The risk of collisions, which is mainly associated with the mast of the WTG, is assessed as low if the requirements and actions in Chapter 4.5.4 are ensured.

Three-toed woodpecker *Picoides tridactylus*

At the global level, the three-toed woodpecker is not considered a species of least concern, but at the regional level in Latvia it is critically endangered, with an extremely high risk of extinction, and therefore its conservation requires special attention. There is a lack of research on how noise pollution affects the three-toed woodpecker and its habitat selection. While it is believed that the conservation of existing habitats is paramount, it is advisable to keep abreast of changes in the area for this species and to comply with the technical requirements provided in the opinion for noise mitigation at WTGs.

In the case of the Lode wind farm construction, the habitats of the three-toed woodpecker will be preserved, as the planned WTGs are located beyond them.

The risk of collisions with blades is assessed as low, but the mast needs to be painted in a contrasting colour to make it visible in low visibility conditions (see Chapter 4.5.4). In view of these requirements, the impact will be negligible.

White-backed woodpecker *Dendrocopos leucotos*

The WTGs are located outside the priority conservation areas identified in the species conservation plan, but there are several (especially in the northern part of the study area) and the WTGs are planned close to them.

To maintain the good quality of the habitats of the white-backed woodpecker, it is important not to destroy or drain them, while preserving their hydrological regime. WTGs should be located as far as possible from priority protected areas and the white-backed woodpecker habitats. In this way, habitats will not be fragmented and will have the least possible negative effect.

The risk of collisions with blades is assessed as low. The requirements for the colour of the mast and its visibility in conditions of low visibility as specified in Chapter 4.5.4 must be taken into account.

Common buzzard *Buteo buteo*

As the entire area of the proposed wind farm is characterised as an important breeding, resting and feeding area for the common buzzard, where it can be found throughout the year, especially during the breeding season, the overall negative impacts of the proposed activities are considered to be high. The common buzzard is a species that shows little or no avoidance behaviour in the vicinity of WTGs, and may build nests between existing stations. It is the species of bird of prey most often found dead near WTGs in northern Europe, mainly adult birds.

As the common buzzard is continuously present throughout the site, its population is in long-term decline and the risk of collisions is high, it is essential to comply with the technical requirements for generators, in particular for bird detection systems, as outlined in Section 4.5.4.

The following is an overview of the expected impacts of the proposed Lode wind farm on other specially protected bird species and micro-reserve bird species, subject to the requirements and mitigation measures outlined in Section 4.5.4:

- **Western capercaillie** *Tetrao urogallus.* The construction of the wind farm may have a significant impact on the populations of capercaillie, leading to habitat degradation, loss, fragmentation and noise pollution. No WTGs are planned in the study area within 1 km from the centres of the capercaillie rutting areas. If the changes result in a WTG planned closer than 1 km, the theoretical location of the rutting area should be verified by specifying if and where it is located, and then adjusting the WTG operation during the morning hours of April and May to reduce the impact of noise and flicker.

  At present, it is not expected that the construction of the wind farm will result in the destruction of suitable habitats or that the planned wind farm will have a significant negative impact on the surrounding population of capercaillie.

  The risk of collisions with WTG blades is low, but it is possible with masts or fences.

  The implementation of the mitigation measures identified in Chapter 4.5.4 will not have a significant adverse effect on the local population of capercaillie.

- **Grey partridge** *Perdix perdix*. As the density of this species is low in the area and the most important habitats for the grey partridge are located outside the planned wind farm area, the construction of the wind farm is not expected to have a significant negative effect on the local population of the grey partridge.

  The risk of collisions with wind turbine masts and fences is high, while the risk of collisions with WTG blades is low.

- **Black stork** *Ciconia nigra*. No feeding or nesting territories of the black stork have been identified in the area of the proposed activity and its immediate vicinity. Potentially suitable feeding areas include some sites along the Krūmiņupīte. However, in the view of the report's authors, this is not a sufficient justification for imposing restrictions on activities along the Krūmiņupīte.

- **White stork** *Ciconia ciconia*. The white stork inhabits farmland, where it forages in the open landscape within a radius of 1 to 2 km around its nest. As all the nearest planned WTGs are located in forested landscapes and at least 1 km from the nest, storks are not expected to forage in the vicinity of the WTGs. Overall, the risk of collisions with WTGs during both breeding and migration is low, and the overall impact of the wind farm on the species is expected to be negligible.

- **Boreal owl** *Aegolius funereus*. To ensure a favourable conservation status, it is essential to maintain and sustain a sufficiently large habitat with mature and overgrown coniferous stands, minimising the impact of economic activities and limiting sound pollution. Subject to the requirements and mitigation actions outlined in Chapter 4.5.4, the risk of impacts is low.

- **Ural owl** *Strix uralensis*. The proposed WTGs are located outside the priority conservation areas identified in the Ural owl conservation plan and there are no such areas in the immediate vicinity. Negative impacts are associated with the abandonment of nesting territories due to disturbance (e.g. noise) or habitat destruction (logging). If the recommended protection measures for the pygmy owl are followed, they will also be effective in protecting the Ural owl. In addition, potential nesting sites such as trunks, trees with large cavities and large nests should be preserved. The risk of collisions with the mast of the generator is medium.

- **Three-toed woodpecker** *Picoides tridactylus.* It is critically endangered in Latvia at the regional level, with an extremely high risk of extinction, and therefore its conservation requires special attention. In the case of the planned wind farm, the habitats of the three-toed woodpecker will be preserved as the planned WTGs are located outside them.

  The risk of collisions with blades is low, but by ensuring the mast is painted and visible in low visibility conditions, the impact will be negligible.

- **Middle spotted woodpecker** *Dendrocoptes medius*. The risk of collisions with blades or masts is low and the impact of the proposed wind farm, including noise, will not be significant.
- **Black woodpecker** *Dryocopus martius*. The construction of the wind farm will have a negative impact on the habitats of the black woodpecker in the vicinity of the generators. Ensuring the favourable status of the black woodpecker is important for other protected species, such as the pygmy owl and the stock dove, which use the hollowed-out cavity of the black woodpecker as secondary cavity nesting sites. Although the risk of collisions with WTG blades is low, the black woodpecker's active flight in the wider area means that its risk of collisions with masts is much higher throughout the year. Ensuring that the mast is painted and visible in low visibility conditions reduces this risk.
- **Grey-headed woodpecker** *Picus canus*. The risk of collisions with the WTG blades at the planned height is low, but the risk of collisions with the mast during migration may be medium, so it is important to ensure that the mast is painted and visible in low visibility conditions. The construction of the wind farm will not have a significant negative impact on the breeding habitat of the grey-headed woodpecker.
- **Wryneck** *Jynx torquilla*. The risk of collisions with blades is low, but during migration there is a risk of collisions with the mast, so it is important to ensure that the mast is painted and visible in low visibility conditions. If these requirements are met, the resulting impacts will be insignificant.
- **European honey buzzard** *Pernis apivorus.* The planned wind farm generators are currently located close to the area populated by the European honey buzzard. Therefore, it is expected that during the breeding season, the European honey buzzards (one to two pairs) may be regularly observed in the vicinity of all planned WTGs. WTG L_06 is located approximately 740 m from the honey buzzard's nest, causing significant adverse impacts as the honey buzzard's foraging flights are predominantly low, while its mating flights and territory guarding are at rotor height. Mitigation measures are described in Chapter 4.5.4.

  The risk of collisions is medium to high, for which the requirements of Chapter 4.5.4 are essential.

- The **Eurasian goshawk** *Accipiter gentilis* has not been recorded in the area of the proposed activity. The risk of collisions is medium.
- The **white-tailed eagle** *Haliaeetus albicilla* has not been recorded in the area of the proposed activity. The risk of collisions is assessed as being low.
- **Hen harrier** *Circus cyaneus*. According to the latest count, few or no birds nest in Latvia. One passerine bird has been recorded in the vicinity of the proposed activity area. Overall, the impact and risk of collisions is low.
- **Western marsh harrier** *Circus aeruginosus*. The flight of the western marsh harrier in the vicinity of the breeding site may reach the currently planned rotor height, but is not currently expected in the area. The impact and collision risk is low.
- **Common crane** *Grus grus*. There are not many suitable nesting sites in the area of the proposed action. Large flocks of migratory birds, either migratory or local, were not detected in the counts. Therefore, the negative effects of the proposed action are considered to be minor, as the common cranes exhibit strong avoidance behaviour.
- **Corn crake** *Crex crex*. is not found in the area of the proposed activity. The risk of impacts and collisions is assessed as low.
- **Stock dove** *Columba oenas.* No breeding sites of the stock dove will be destroyed as a result of the proposed action.

  There is a risk of collisions when nesting in the immediate vicinity of WTG, but the risk is low. The construction of the wind farm will not have a significant impact on the growing stock dove population in Latvia.
- **European nightjar** *Caprimulgus europaeus.* Suitable nesting habitats (marshes and margins) are available in the area and the wind farm is unlikely to have a significant negative impact on breeding or available habitats of the European nightjar in the long term. The risk of collisions is low.
- **Woodlark** *Lullula arborea*. Given the high and long breeding flight, which is possible both day and night, as well as the recurrent late breeding, the risk of collisions is assessed as medium. The development of the wind farm is not expected to have a significant impact on the amount of habitats available. Overall, the construction of the wind farm is not expected to have a significant negative impact on the currently stable population of the Latvian woodlark.
- **Whooper swan** *Cygnus cygnus.* The impact and risk of collision with the mast or rotor is generally low.
- **Common snipe** *Gallinago gallinago*. The common snipe is not a specially protected species. However, during the breeding season, the species is characterised by a wide arcing flight with sharp dives that reach the planned rotor height of WTGs. The currently assessed risk of collisions could be potentially significant. Noise from WTGs can also have a negative effect by drowning out the rutting 'song' of the common snipe's flight. It is advisable to keep an eye on this species and its changes during monitoring.
- **Eurasian woodcock** *Scolopax rusticola*. The Eurasian woodcock is not a specially protected species, but will be adversely affected by the proposed activity. During the

breeding season, the Eurasian woodcock will circle over large areas of forest at dusk, emitting a specific low-pitched rutting call that will be muffled by noise from the WTGs.

As several generators have a planned spacing of around 700 m between turbines, it is likely that the Eurasian woodcock will not fly between the generators and part of this area will no longer be used.

In the opinion of the authors of the report, it is worth noting that any assessment of the impact of any proposed wind farm on 'forest bird' species, whether in the context of habitat loss, noise impacts or other factors, is an assessment with a very high degree of uncertainty. Wind farms have only been built on a large scale in forests in the last 5 to 10 years, but there are very few studies on the consequences of locating WTGs in such areas, and even the few studies paint a less than positive picture for future populations of 'forest birds', especially in regions where large numbers of wind farms are being built. The report repeatedly points out that the study area is mainly forest, which has been overgrown by agricultural land, most of which has been cleared in recent decades. The condition of the existing forests, the diversity of birds assessed during the fieldwork and the number of observations suggest that the impact on forest bird populations may not be significant if the WTGs are located in the area of the planned wind farm, but the actual impact should be monitored more closely during the construction and operation of the wind farm by ornithofauna monitoring in and around the periphery of the wind farm.

An important aspect that is assessed in environmental impact assessment processes is the cumulative impact of the proposed development on other activities or developments. Cumulative impacts can also arise in the context of bird conservation, especially if several wind farms are built in a given region. In the view of the report's authors, a full assessment of cumulative impacts in the context of bird conservation is not currently possible. It is clearly possible to argue that such impacts will arise from the number of wind farms planned in the Valmiera and Limbaži regions alone, as well as in the Estonian border area of Mulgi.

In light of the above, the planned wind farms in the region are expected to have cumulatively negative impacts on bird populations, which may also be significant in their extent. Unfortunately, it is not practically possible to quantify the magnitude of the impact. In the view of the rapporteur, the precautionary principle applied in the environmental impact assessment processes leads to conclusions based on a worst-case scenario, i.e. all the planned wind farms are built. Given that it is not possible to plan joint mitigation measures at regional or national level, the report considers that all possible mitigation measures should be taken in each wind farm, which can potentially lead to a situation where the overall impact does not pose a significant threat to the conservation of certain bird species populations. This approach has also been taken into account in identifying and recommending mitigation measures (see more in Chapter 4.5.4 of the report).

4.5.4 Mitigation measures

The developers of the planned wind farm should take into account that the situation of birds in nature is dynamic. This assessment takes into account the current state of the site and the current bird attractions. These conditions are bound to change during the construction and operation of the wind farm, so even after all permits have been granted, additional mitigation measures may be required if significant impacts are identified.

The ornithologists involved in the EIA have not indicated that specific protection measures should be implemented to protect birds that pass through or use the study area during migration seasons. In the view of the report's authors, having assessed the data collected by the experts, as well as the location of various sites attracting migratory birds, there is reason to agree with the ornithologists' opinion that no specific measures need to be planned at present. The risks of migratory birds colliding with the proposed wind farms are assessed as low, but given the high uncertainty in the current forecast, it would not be considered prudent and evidence-based to prescribe specific mitigation measures at this time. If monitoring during the operation of the proposed wind farm reveals evidence of significant impacts on migratory birds, mitigation measures may be imposed to protect birds during both migration seasons.

WTGs and cable line route location analysis

During the operation of the planned Lode wind farm, the main negative impact on birds is the loss of habitat for some species and the deterioration of habitat quality over several decades. Loss of habitats[41] can be manifested by habitat destruction, abandonment and avoidance (due to noise, light, flicker, anthropogenic pressure, etc.). It is the location of stations and assembly sites that will most determine the magnitude of these negative impacts.

In the context of the bird species breeding in the area or its periphery, the expert has recommended a number of mitigation measures, which are described below, supplementing the expert's recommendations with the views of the report's authors.

It is recognised that the most important action to mitigate risk is to select station locations that will have the least cumulative negative impact on the surrounding habitats and populations of bird species. During the environmental impact assessment process, the location of the wind farm has been adjusted in line with the expert's recommendations, including the removal of WTGs whose significant negative impacts cannot be reduced by appropriate mitigation measures or compensated for by compensatory measures.

The guidance to plan the WTGs in a south-north direction, trying to occupy as narrow an area as possible, has been fully endorsed during the planning of the WTG siting and wind farm configuration. It also requires that they be located in, or as close as possible to, young woodland or farmland rather than mature woodland. The planned stations will be located as far as possible from areas with high densities of specially protected and micro-reserve bird species or suitable priority habitats for them, avoiding locations that contribute to habitat fragmentation for these species.

The report's authors point to the need to ensure a balance between economic development and environmental preservation, promoting harmonious interaction between man and nature. This principle is implemented in a way that the negative environmental impacts of any development activity are either mitigated or compensated for by appropriate measures. This approach should also be followed in the case of the impacts from the WTG concerned of the planned Lode wind farm.

The report's authors agree with the expert's conclusion that the construction of WTG L_17 on the planned site is not recommended, in preference to WTG L_17A if it is feasible. It also supports the ornithologist's view that for the protection of the lesser spotted eagle and the common buzzard, the equipping of WTGs with systems that identify birds and stop the wind farm

[41] Habitat means both a place where a bird can breed and nest and a place where a bird can feed and rest.

in the event of a collision threat significantly reduces the negative impact of WTG on these species. Given that their most important foraging habitats are concentrated in the vicinity of breeding sites that do not affect the central part of the planned wind farm, the equipping of WTGs with appropriate bird identification systems can be assessed as a sufficient mitigation measure.

Recommended by expert for WTG no. L_02 mitigation measures for potential adverse effects during the period 1 March to 1 July, in the mornings one and a half hours before and up to five hours after sunrise and in the evenings two hours before and up to one and a half hours after sunset to keep the station switched off provided that the wind speed is less than 5 m/s during this period, are assessed as sufficient to mitigate the adverse effects.

The report advocates a special precautionary approach to the retaining of the priority conservation area to avoid the risk of reducing its quality and significance. Noise has been identified as a major source of risk. As construction of WTG no. L_11 and no. L_18 further from the pygmy owl priority conservation area is not feasible, measures should be applied to compensate for negative impacts. In addition, in order to ensure an adequate quiet regime and to mitigate the noise impact of WTGs, restrictions on their operation by prohibiting their operation at wind speeds below 5 m/s should be considered sufficient and consistent with the precautionary approach.

The location of WTGs L_01 and L_03 has been adjusted during the EIA process in line with the expert's recommendations. The construction process and operation of the WTGs (including station maintenance) generate noise that can affect the feeding and nesting activities of white-backed woodpeckers. By limiting WTG operations and human activity (during construction and maintenance) during the breeding season from the beginning of March to the end of June, potential negative impacts are mitigated. In the absence of studies on the impact of sound from wind farms on white-backed woodpeckers, caution and further monitoring should be taken to assess the impact of WTGs due to noise and disturbance. This includes studying bird behaviour and adapting the operation of WTGs to the observed data.

According to the expert's recommendations, in order to mitigate the impact of the planned construction of the cable line on the quality of the micro-reserve, the route should be located at least at the distance of the crown projection of the outermost growing trees from the micro-reserve area. According to the expert's opinion, the restrictions laid down in the legal provisions for the lesser spotted eagle micro-reserve buffer zone between 1 March and 31 July apply to the construction of the cable line. These restrictions also apply to construction works in the canopy projection of trees located outside the micro-reserve buffer zone. In the expert's opinion, it is recommended that the construction of this section of the cable line through and along the buffer zone of the micro-reserve be carried out as late as possible in the autumn. The ideal time for construction work is from 1 September to 29 February. With these precautions, the construction of the cable line will not have a negative impact on the micro-reserve.

Mitigation measures for construction and technical characteristics of WTGs

The expert involved in the impact assessment has pointed to a number of general measures for the construction of the proposed wind farm:

- For electricity supply and communication, lay buried cable lines along roads;
- necessary <u>deforestation works</u> outside the bird breeding season <u>from 1 August to 1 March</u> and the retention of ecological and hollow trees in clearings;

- It is preferable not to use fencing around stations. However, if a fence is necessary (also in the case of a substation), it should be as low as possible and avoid hurdles, which can be more difficult for birds to see.

The expert opinion also includes mitigation measures for wind farms:

- choose the quietest possible stations to minimise noise disturbance;
- The mast must be smooth and tubular so that birds cannot perch on it;
- the lower 45 m or so of the mast should be coloured dark, e.g. the colour of the surrounding trees and environment. This will reduce the number of potential collisions, e.g. for the black grouse, the hazel grouse and various migratory and other bird species;
- Find a way to increase the contrast of at least one blade (especially at the tip of the blades), as both moving and stationary, hardly visible WTG blades present an increased risk of collisions during migration;
- stations must be equipped with automated bird detection and identification systems capable of identifying large bird species and, if necessary, momentarily reducing the rotor speed or stopping it completely. The number of detection systems must be such that they cover the entire area of the wind farm or a radius of at least 1.5 km around the masts of all generators. They should have bird identification devices, not bird deterrent devices.

In the view of the report's authors, the implementation of such measures significantly reduces the potential impact on the site's ornithofauna. The analysis concluded that some of these measures have already been taken into account during the planning and EIA process for the wind farm: only buried cable lines are planned, infrastructure is to be located as close to the road network as possible, and the construction of the WTGs is planned without affecting the hydrological regime of large surrounding areas.

The report supports the expert's recommendation for automatic detection and generator stopping equipment in the planned wind farm. The use of detection devices would allow to protect both the dispersed part of the population (non-nesting and migratory birds) and the part of the birds nesting in the wind farm or its periphery. According to the report's authors, the equipment should primarily provide identification of bird species with large breeding territories, including honey buzzards, white-tailed eagles, ospreys and golden eagles. Taking into account the information on known breeding sites as well as the observation data, the lesser spotted eagle, goshawk, black stork, white stork and common buzzard should certainly be included in the above list of species. There are currently two types of detection equipment available on the market to stop generators:

- Equipment that tracks the flight paths of birds defined as sensitive and stops the operation of certain generators by predicting the risk of collisions;
- Equipment that tracks the flight paths of birds defined as sensitive by identifying them, activates deterrent systems if the bird approaches a station, and stops the operation of certain generators if the bird does not change its flight path.

According to the view of the report's authors, the operation of wind farms in general should be ensured to cause as little disturbance to birds as possible, and therefore only Group 1 installations should be allowed in the planned wind farm. Although the planned WTGs cover a relatively small area overall, the use of deterrent systems is likely to make them less attractive to birds, even if they contain good feeding areas. Painting of the lower part of the WTG tower is also supported as it may reduce the likelihood of collisions with passerines.

The recommendation to choose the quietest possible WTGs is also welcomed as it would reduce the impact of the proposed wind farm on bird species that may be disturbed by noise from the WTGs. For example, stations with serrated trailing edge wings are 2 to 3 dB quieter. Such wind farms reduce the size of the noise impact zone more than twice. Currently, all manufacturers evaluated offer serrated trailing edge wings for their stations, even if this is not considered a standard solution, which should be recommended not only to reduce the noise impact on natural values but also for people living in the wind farm surroundings. In addition to the use of wings, it is advisable to choose the quietest possible stations, as the noise emissions from the stations themselves can also vary considerably, unless there are other environmental reasons why louder stations are the best technical solution.

See Table 6.1.2 for a summary of the required mitigation measures.

Although the implementation of the above measures will significantly reduce the negative impacts, it will not be possible to eliminate them completely for owl species, for which additional compensatory measures must be planned, including the placement of suitable cages (in accordance with article 7 of the regulations on habitats). This should include the installation of cages for owls and woodpeckers in the priority conservation areas of the proposed wind farm and its surroundings, as well as around the observation sites (with signs of breeding) for these species: at least 10 cages for the pygmy owl and at least seven cages for the Ural owl, with monitoring of the use of these cages.

The expert also recommends that the possibility of maintaining mature forests (see Figure 4.5.29) or other forests of equivalent conditions in the vicinity of WTGs L_02 and L_03 during the operation of the wind farm should be considered, carrying out no cutting in such forest sections.

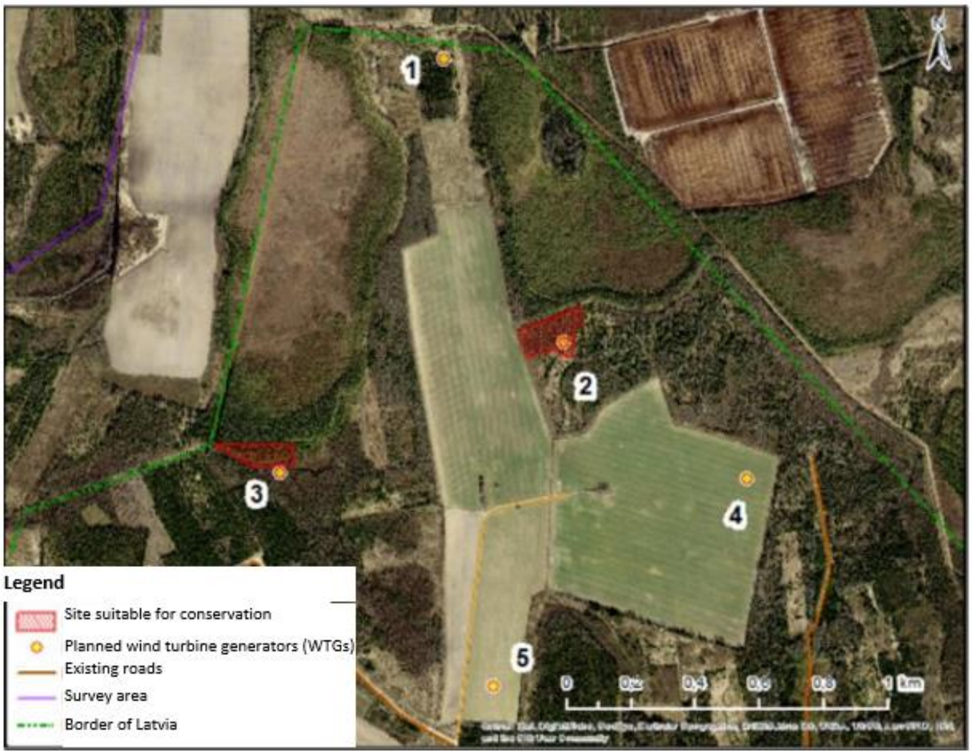


Figure 4.5.29. Recommended mitigation sites where it is desirable to maintain mature forest during the lifetime of the wind farm

4.5.5 Evaluation of alternatives

As indicated in Chapter 3.1 of the report, no mutually comparable alternatives have been defined for the location of the proposed Lode wind farm, but the option (alternative) advanced for in-depth assessment is based directly on the proposals made initially and during the process by nature experts relating to birds, bats and habitats.

According to the available information, the environmental impact assessment process has shown that none of the models assessed has any known characteristics or technical advantages that would make it superior to others in the context of ornithofauna conservation. Each of these models lacks a compelling advantage that would warrant a more prominent assessment in this respect. Therefore, from an ornithofauna conservation perspective, the chosen model has no relevance or particular impact.

4.6 Landscape and visual impact

This chapter assesses the significance of the impacts of the proposed Lode wind farm on the surrounding landscape and makes recommendations for avoiding or reducing the significance of impacts in the event of the proposed development. The report was prepared by certified landscape architect Gunita Čepanone (LAAA certificate no. 45–201), which is attached as Annex 8 to the report and has been prepared on the landscape impact in the territory of Latvia, as well as the opinion of the Estonian landscape architect Heikki Kalbergs, which is attached as Annex 9 to the report and has been prepared on the landscape impact in the territory of Estonia. Landscape protection policy and legislation

Latvian landscape policy

Latvian landscape policy is based on the European Landscape Convention (also called the Florence Convention), which Latvia ratified in 2007. By ratifying the convention, Latvia has undertaken to implement the measures set out in the convention, including integrating landscape policy into its regional and urban planning policies, cultural, environmental, agricultural, social and economic policies, as well as any other policies that may directly or indirectly affect landscapes. Wind farm development has a significant impact on the landscape, and environmental impact assessment is one of the tools to assess and minimise this impact. Latvia does not currently have any up-to-date policy document directly related to the national landscape policy, but aspects of landscape value, use and protection are integrated into various sectoral policies and regulatory frameworks. Within the framework of the national research programme on sustainable management of land resources and landscapes: assessment of challenges, methodological solutions and proposals[42], landscapes of national importance have been defined, among which the area for the construction of the Lode wind farm is not included[43].

Highlighting the most outstanding values of the Latvian landscape, the Latvian cultural canon includes eight cultural landscapes, among which the landscape of the Lode area is not included[44]. The list of Latvia's more than 50 landscape treasures, nominated by the Latvian public and selected by experts, also does not include the landscapes located in the development area of the Lode wind farm[45].

Spatial planning documents

There is no unified regulatory framework for landscape assessment, planning, management and use in Latvia. One of the instruments of landscape policy in the country is spatial planning documents at different levels.

According to the Valmiera municipal sustainable development strategy for the 2022–2038 period, there are no particularly valuable landscape areas or road sections defined in the area of the planned activity. The closest of these areas is the Rūja River landscape, which is also designated as a landscape conservation area of the Northern Vidzeme Biosphere Reserve (NVBR)

[42] https://www.arei.lv/lv/projekti/2020/ilgtspejiga-zemes-resursu-un-ainavu-parvaldiba
[43] https://experience.arcgis.com/experience/495c3f2dc51b439180c4afafb4b0fc83/page/Ainavas-kart%C4%93s/?views=Nacion%C4%81l%C4%81s-ainavas
[44] https://kulturaskanons.lv/2021/06/03/latvijas-kulturas-kanons-papildinats-ar-ainavu-sadalu/
[45] https://ainavudargumi.lv/saraksts/?section=5

and is located on the southeastern side of the proposed development area, approximately 3 km from the nearest WTG.

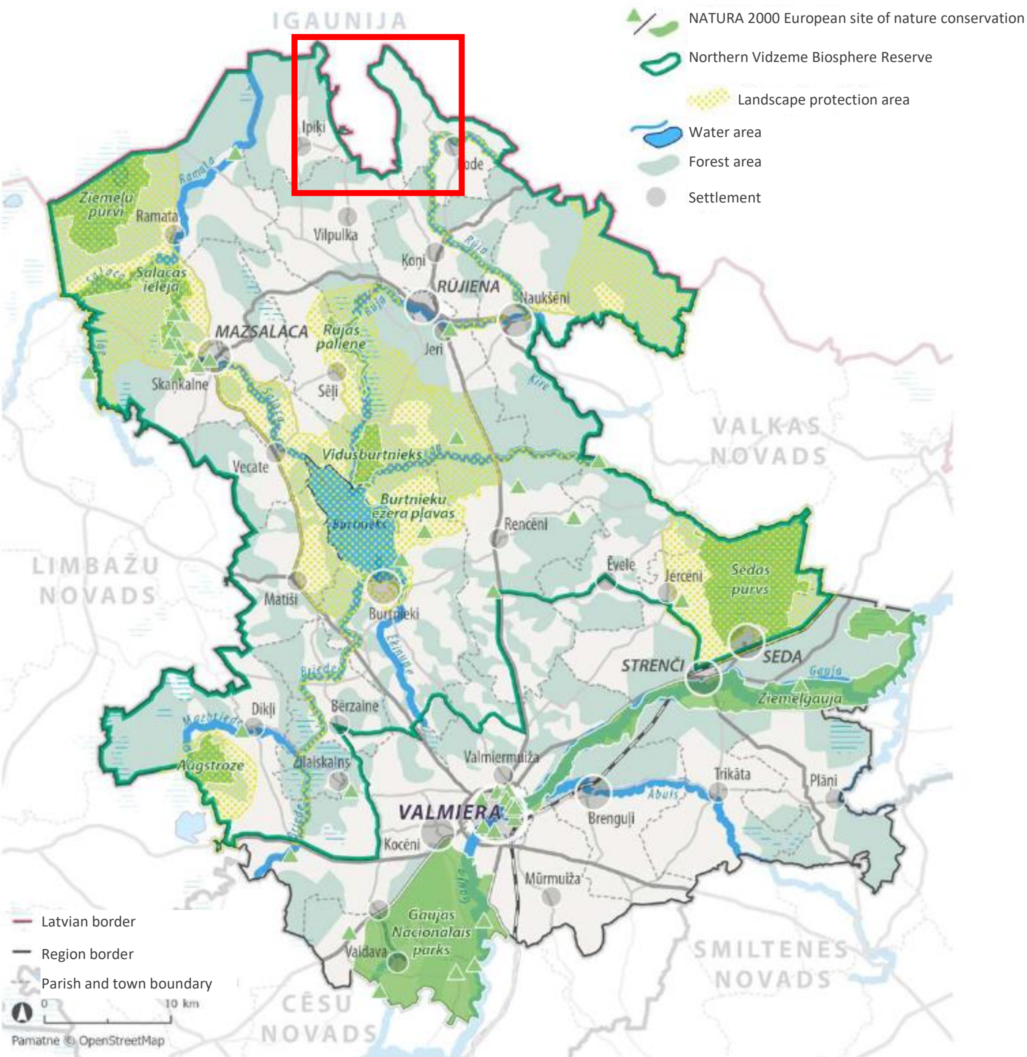


Figure 4.6.1. Spatial structure map of Valmiera region nature territories (map source: Valmiera region sustainable development strategy 2022–2038) (red square marks the location of the proposed activity area)

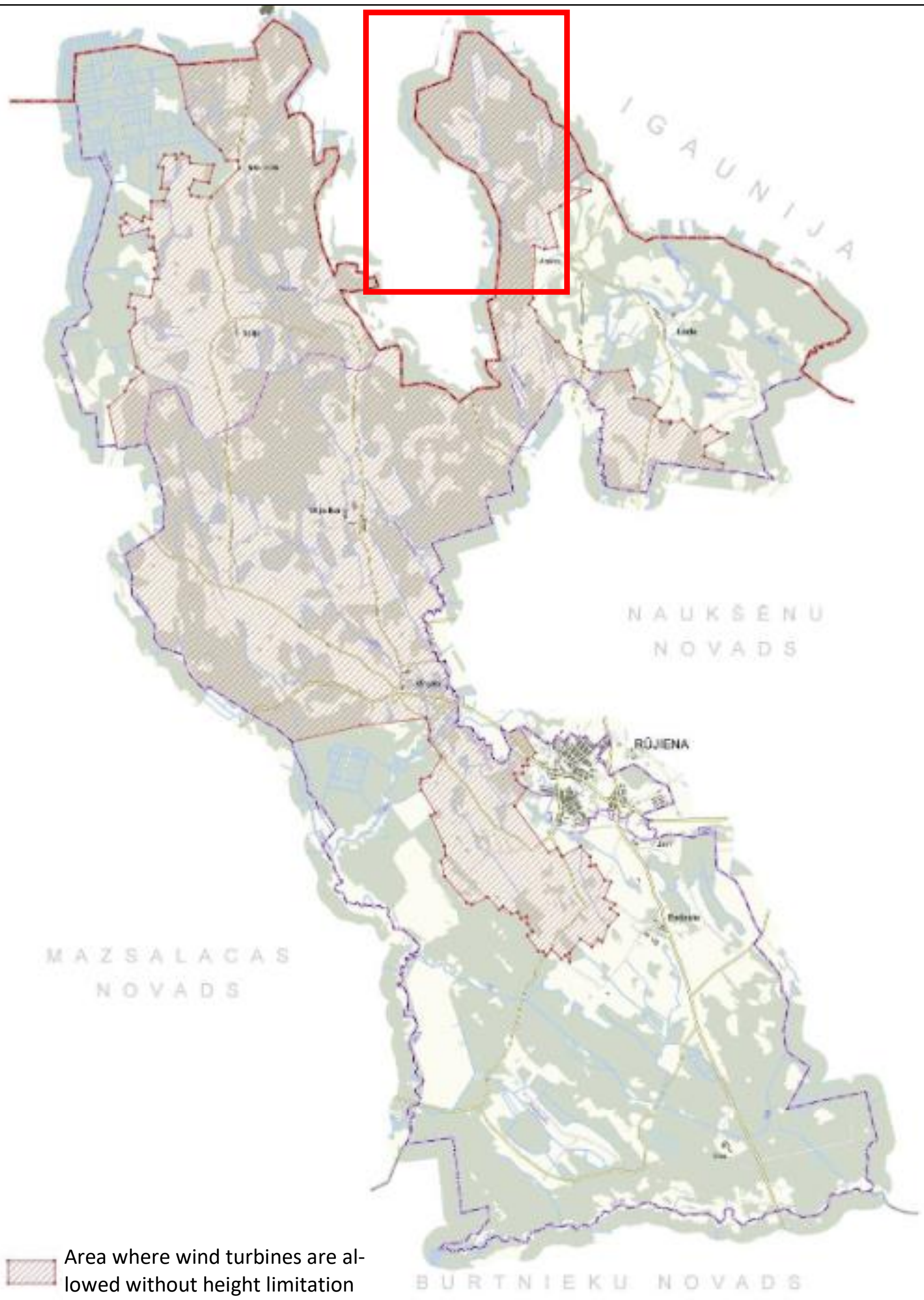


Figure 4.6.2. Map of Annex 5 to the Rūjiena region spatial plan binding for the territory of the planned activity entitled Territory where it is allowed to build wind power plants without height restrictions (red square marks the location of the territory of the planned activity)

Based on the spatial plan of Rūjiena region for 2012–2024, which is binding for the territory of the planned activity, the WTG is located in the territories with permitted (planned) use of agricultural territories (L) and forest territories (M). Taking into account that paragraph 25.1.4 of the territorial use and development regulations states that wind power plants with a capacity exceeding 20 kW are allowed to be located in the territories of industrial and technical facilities (R), and in the local planning, including in agricultural territories (L; see Chapter 2).

According to the act on the North Vidzeme biosphere reserve (NVBR), all areas of the proposed activity fall within the NVBR neutral zone. According to Annex 2 of cabinet regulation no. 303, on individual rules for the protection and use of the North Vidzeme biosphere reserve, the areas where the installation of WTGs is allowed without height limitation are defined, and among them is the area of the planned activity. The indicated areas also coincide with the scheme of Annex 5 to the binding spatial plan entitled Area where wind power plants without height restrictions are allowed to be built, but it should be taken into account that the area may be subject to exclusion zones for the installation of WTGs, as part of various sectoral studies.

Landscape impact legislation in Estonia

In Estonia, landscape protection is regulated by a series of acts aimed at preserving natural habitats, biodiversity and cultural heritage as part of the landscape. The main regulatory enactments on landscape protection in Estonia are listed below:

- Nature Conservation Act (Looduskaitseseadus[46]):

The Nature Conservation Act sets out the general framework for the principles and rules for the conservation of landscapes, ecosystems and biodiversity. The act establishes various protected areas, including national parks, nature reserves and landscape protection zones. It also sets out general principles for the management and use of these sites to ensure their protection.

- Planning Act (Planeerimisseadus[47]):

The Planning Act regulates land use planning to ensure sustainable development and landscape protection. It sets out the processes for preparing and implementing national, regional and local plans.

The act stresses the need to take account of environmental impacts, including landscape impacts, at all levels of planning.

- Act on environmental impact assessment and environmental management (Keskkonnamõju hindamise ja keskkonnajuhtimissüsteemi seadus[48]):

The act requires an environmental impact assessment (EIA) for projects that are expected to have significant effects on the environment, including landscapes.

- Act on the preservation of cultural heritage (Muinsuskaitseseadus[49]):

The act on the preservation of cultural heritage provides for the protection of cultural heritage, including landscapes with historical and cultural values. This act includes requirements for the designation and management of areas for the protection of cultural heritage in order to preserve their cultural and landscape values.

- Forestry Act (Metsaseadus[50]):

[46] https://www.riigiteataja.ee/akt/LKS
[47] https://www.riigiteataja.ee/akt/PlanS
[48] https://www.riigiteataja.ee/akt/KeHJS
[49] https://www.riigiteataja.ee/akt/119032019013
[50] https://www.riigiteataja.ee/akt/MS

The Forestry Act regulates the sustainable management and use of forests. It includes provisions aimed at protecting forest landscapes and preserving biodiversity. This act sets out requirements for forest management plans and the protection of valuable forest habitats.

According to the regulatory framework, requirements and restrictions for planned activities, including in the context of landscape protection, are determined at the level of local governments, in their planning documents and building regulations.

The area of the proposed activity in Mulgi, bordering Estonia (Mulgi vald, before the administrative reform of Abja municipality), whose general planning document[51] states that the construction of wind farms is not allowed in areas of scenic value identified in the municipality's planning document.

In Estonia, minimum distance requirements between wind farms and residential areas are not set at national level. Instead, these distances are set by local authorities in their building regulations. The Mulgi county binding rules do not impose restrictions, such as minimum distances to dwellings.

4.6.1 Impact assessment approach

Landscape impact assessment approach in Latvia

To assess the development of wind farms in Latvia, the guidelines for environmental impact assessment and recommendations on requirements for the construction of wind power plants[52] and the guidelines for initial environmental impact assessment for the construction of wind power plants[53] have been developed, which also include guidelines for landscape impact assessment and some mitigation solutions.

In assessing the visual impact of the proposed Lode wind farm, methods based on the assessment of the visual structure of the surrounding landscape using the characterisation and assessment method have been applied. These include:

- onsite inspection of the site and the terrain of the proposed operation;
- study of available cartographic material;
- identification of existing acts, regulations and other binding documents;
- identification of areas with particularly valuable landscape features;
- assessing impacts from publicly relevant vantage points;
- identification of potentially sensitive sites, such as nearby settlements (rural villages and farmsteads), valuable and important cultural and historical heritage sites;
- assessment of potential cumulative impacts;

[51]https://mulgivald.ee/documents/18442398/21825375/Lisa+12.+Abja+valla+%C3%BCldplaneeringu+seletuskiri.pdf/1e38e3be-b413-41f8-b8c0-f235d9eebf43

[52] Guidelines for environmental impact assessment and recommendations regarding requirements for the construction of wind power plants Available at: https://www.vpvb.gov.lv/lv/media/827/download

[53] Guidelines for initial environmental impact assessment for the construction of wind power plants Available at: https://www.vvd.gov.lv/lv/jaunums/izstradatas-vadlinijas-veja-parku-ietekmes-uz-vidi-sakotnejo-izvertejumu-veiksanai

- assessment of potential supply routes for stations;
- identification of visual impact (visibility) zones, supplemented by a map of visual impact zones, photomontages and working models, prepared by the EIA contractor, showing the actual scale of the proposed activity, to get a full picture of the expected changes. The locations of the specific viewpoints to be modelled were selected on the basis of a field survey and taking into account nearby significant open viewpoints and other visually significant view areas.

The photomontages are prepared using the WindPRO 3.5 visual modelling software, in which the images are prepared with 3D modelling solutions, taking into account the surface and vegetation height of the study area in relation to the starting point of a given view, projecting the planned WTGs on their real scale. Before taking the photographs used for the photomontages, a feasibility study of the site is carried out, modelling the theoretical visual impact zones. The map of visual impact zones is created using spatial data, such as topography, vegetation, of the area in question, which are mapped against the dimensions and layout of the proposed WTGs, thus providing data on the extent of the visual impact of the proposed facility.

As no specific WTG model has been selected at this stage, but several suitable for the site are being evaluated, the WTG model Vestas V172 has been used for the photomontages. The station has an approximate height of 250 m and is made up of a 166 m high mast supporting a rotor with a diameter of 172 m. However, the possibility of using stations with smaller dimensions cannot be excluded. Generators are spaced with a minimum distance of 650 m between them.

<u>Landscape impact assessment approach in Estonia</u>

The assessment is based on the valued landscapes methodology[54], the Mulgi municipality master plan55, the methodology for assessing visual changes caused by the construction of wind farms[56], the field experience, the work and the visualisations prepared by the client during the environmental impact assessment process.

Landscape values are determined on a three-point scale:

- low or unclear;
- medium or uneven;
- high.

Valued landscapes are defined by the following five types of value:

- cultural and historical value;
- aesthetic value;

[54] K. Hellström, H. Alumäe, A.Palo, H. Palang, K. Sepp, A.Koppelmaa. 2001. Väärtuslike maastike määratlemine. Metoodika ja kogemused. Hiiumaa-Tartu-Viljandi.

[55] https://mulgivald.ee/documents/18442398/21825375/Lisa+12.+Abja+valla+%C3%BCldplaneeringu+seletuskiri.pdf/1e38e3be-b413-41f8-b8c0-f235d9eebf43

[56] A. Tara. 2022. DVC as a Supplement to ZVI: Mapping Degree of Visible Change for Wind Farms. https://www.researchgate.net/publication/362429091_DVC_as_a_Supplement_to_ZVI_Mapping_Degree_of_Visible_Change_for_Wind_Farms. Accessed 20 February 2024

- natural value;
- the value of identity;
- recreational and tourism potential, i.e. recreational value.

The analysis of the impact of the proposed activity on landscapes identifies and assesses the impact on valued landscapes in the potential area of influence.

4.6.2 Description of the current situation

The environmental impact assessment process has considered the landscape areas that could be affected directly or indirectly (visually from a landscape perspective) by the Lode wind farm.

The area of the proposed action is directly bordered by Estonian territory to the east, north and west, and the EIA process is also applicable in Estonia for the development of the wind farm in question.

Assessing the study area in the context of the Latvian cultural canon[57], which includes eight canonical landscapes that represent the beauty and diversity of Latvia, it is concluded that the planned activity most directly affects the Latvian forest landscape, as part of the WTG is to be installed in areas that are currently identifiable as forest areas. This in turn means that the areas in question will require deforestation, including clearing of overgrowth. The approximate area to be deforested per station is 1 ha. At the same time, however, the canon does not define a specific boundary or location for the forest landscape, as it characterises the entire Latvian forest landscape as a whole. Therefore, in the given situation it would not be objective to state that the proposed activity will have a significant impact on the Latvian forest landscape.

Lode wind farm is geographically located in the northern part of Valmiera region, at the border of Estonia, where the contour of the administrative territory of Latvia forms a protrusion. From the north, east and west, the WTGs will therefore have the most direct impact on the Estonian landscape. On the Latvian side, the visual impact can be seen from the south and partly from the west, where the contour of the Estonian territory forms a notch of about 3 to 5 km wide and almost 10 km long in the Latvian contour.

Public roads that are considered to be major transport corridors and also provide visual accessibility to the area of the proposed development are (see Figure 4.6.3):

- national road of local importance V177 (Koņi-Lode-Arakste);
- national road of local importance V176 (Sīļi-Estonian border), which becomes road 201 (Latvian border-Abja-Paluoja) in Estonia and runs along the eastern side of the WTG wind farm. Near the town of Abja-Palojia, the road connects to the higher importance road no. 6 (Valga-Uulu). The road is located approximately four km away and goes along the northern part of the WTG wind farm. On the other hand, as the territory of the WTG wind farm is directly adjacent to the Estonian territory in the west, the primary visual access will be from the Estonian territory – road no.

[57] https://kulturaskanons.lv/list/?l=8#landscapes

203 (Veelikse-Laatre-Latvian border), which crosses the border into the national road V175 (Rūjiena-Estonian border).

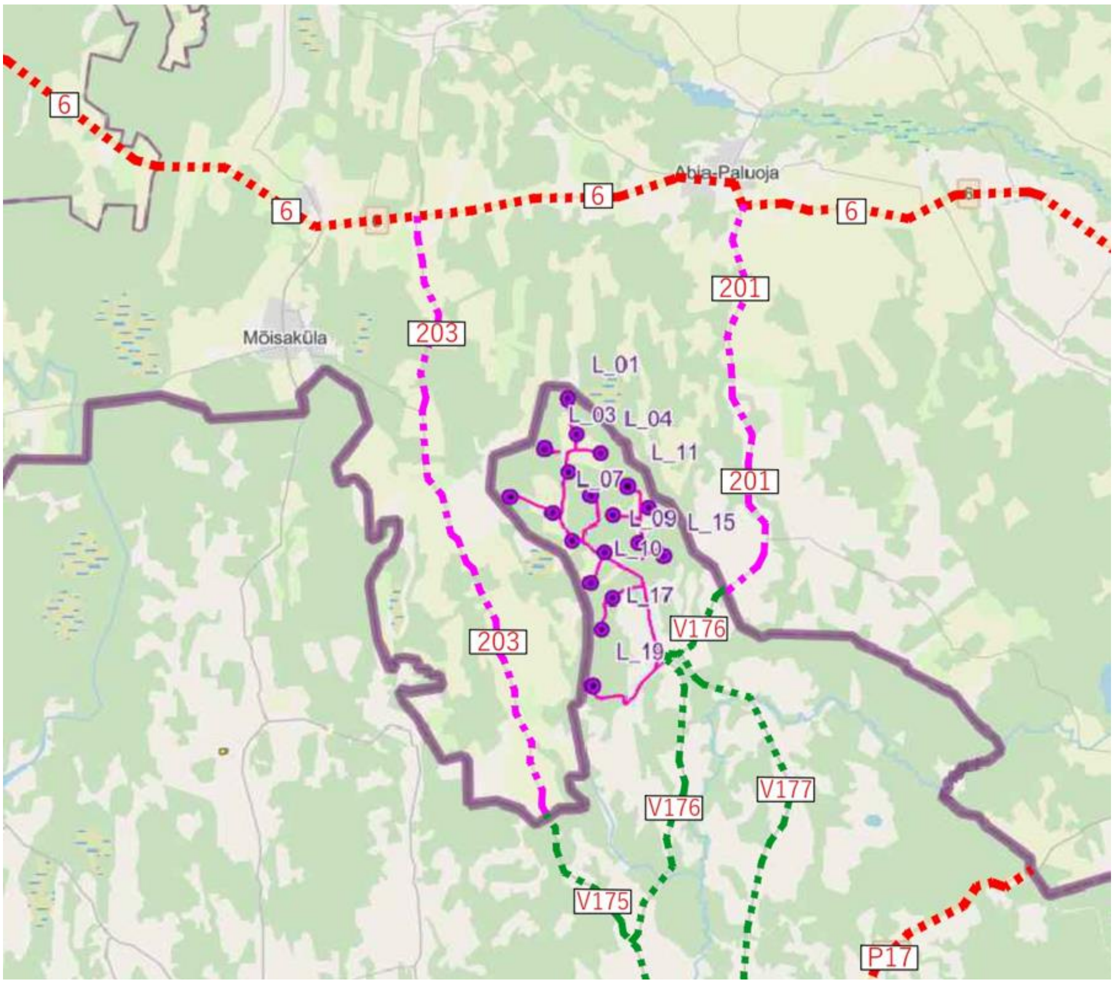


Figure 4.6.3. Roads covering the study area of the planned Lode wind farm

The nearest settlement to the area of the proposed development is Arakste, which is less than 1.5 km from the nearest wind farm. The local centres of Lode village and Ipiķi are located less than 5 km and 7.5 km respectively from the proposed WTG site. Rūjiena, the nearest development centre of the region, is almost 14 km away.

According to the landscape map drawn up by Oļģerts Nikodemus[58,] based on the geomorphological features of the hinterland and the nature of the landscape cover, the area intended for placement of the Lode wind farm is located in a landscape of forested moraine hills, the southwestern part of which is covered by a heavily cultivated landscape of drumlin acres. The area is part of the Ērģemes hills (known as the Sakala highlands in parts of Estonia).

The terrain is characterised by a mosaic, with farmland interspersed with larger and smaller woodlands, sometimes complemented by groups, clusters, rows or avenues of trees. The topography is locally characterised as flat, but when viewed on a larger scale, e.g. in cartographic material with an active terrain model layer, the longitudinal undulations that are characteristic

[58] Sector review for the development of the Landscape protection district plan: MoEPRD, 2000

of the drumlin landscape are clearly visible. Further afield, there are some areas of greater variation in the topography, with more extensive lowlands, for example along rivers.

The hills are also characterised by a high degree of biodiversity, and thus landscape diversity, as the interplay of small lowlands and hills provides a variety of hydrological conditions. Wetter areas form at lower elevations, which in this particular situation have developed as marshes. However, the slopes and changing conditions are a constraint on agricultural development, and much of the area is forested. In general, the mix of woodland and farmland also provides a variety of views, with open vistas merging into close and sometimes even completely secluded slopes.

The relief is largely homogeneous over a wider area with fine structural features extending as far as the Halliste river in Estonia, where there are marked relief fluctuations. The vegetation cover shows a more homogeneous mix of forest and farmland in Estonia. In contrast, vegetation cover in the area of the proposed action and the adjacent Latvian territory is more fragmented, with smaller and more intensive intermingling of fields and forests.

Overall, the surrounding landscape is characterised as simple, with a good sense of the character of the area in terms of topography, vegetation and other landscape features. Most of the views are wide and open, limited in some places by forest patches closer to existing roads or by scattered clusters and rows of trees, which provide variation in views. The survey of the area did not reveal any views of particular scenic value, but there are qualitative features in places where the starting point is higher in relation to the surroundings, with more such views on the Estonian side, e.g. on the road 182 (Abja – Paluoja – Vana – Kariste – Kamali).

The WTG wind farm itself is characterised more as a forest area with some larger and smaller patches of farmland and marshland. Both intensive agriculture and forestry can be found here. The intermingling of farmland and woodland also provides a change of view at a local level (within the WTG wind farm): as woodland recedes, the view of the surrounding countryside opens up wide, while as it gets closer to the road, the view is restricted or completely blocked. In some places, solitary or small clumps of trees can be seen in the countryside, which are both biologically and scenically important natural features.

4.6.3 Impact on the landscape during construction of the WTGs

The delivery and installation of the power plant structures will require the construction of new or the reconstruction of existing potential supply routes and the clearing or deforestation of forest land. The clearing of the supply-widened right of way is a temporary disturbance to the forest landscape, where natural or artificial reforestation is possible after the installation of wind turbines. Deforestation at the site of wind farm supply and installation is an irreversible process in the landscape, resulting in openings in the forest landscape that change the spatial structure of the landscape, increasing fragmentation.

When assessing the works to be carried out to clear transport routes for the transport of turbine parts, it was found that in Estonia the works are more related to the relocation or temporary dismantling of overhead power lines below and the temporary dismantling of existing road infrastructure such as lanterns, road signs. In Latvia, however, most of the work involves cutting or trimming roadside vegetation, including trees, shrubs and bushes, to ensure sufficiently wide corridors or adequate radii on bends and curves.

In assessing the significance of landscape impacts, it is concluded that the trajectory of transport route 2 (see Chapter 3.5.5) will have the greatest adverse impact, as it affects a large proportion of valuable and mosaic-like green structure elements such as solitary trees, tree rows and avenues. In addition, it should be noted that the P17 section Endzele-Baloži is also within the ZBR landscape protection zone, so it is particularly important not to carry out any felling works in this section.

The preferred approach is not to correct or remove the vegetation completely in some areas, but to seek solutions for temporary road alignments around existing obstacles, for example by using adjacent agricultural land to construct or install appropriate temporary structures.

4.6.4 Impact on the landscape during operation of the WTGs

With wind farm projects, WTGs will become one of the most important features of the landscape over a relatively long period of time – up to 25 years. Large wind farms in particular, with more than 15 WTGs, radically transform the character of the landscape space and have a significant impact on the landscape character[59].

When assessing the perceptibility of the WTG wind farm and its visual impact on the landscape, there are two visual aspects to consider: visibility and conspicuity.

Visibility is determined by the geomorphology of the landscape, the character of the landscape, which also determines the visual impact zones. They can be divided into very high, high, medium, low and negligible.

Visibility is primarily determined by the physiology of human vision – how well an object can be seen and perceived – as well as by specific atmospheric conditions, such as the brightness of sunlight, including meteorological conditions, which directly affect the visual perception in which the objects are integrated. In both cases, the context and structure of the landscape also play an important role.

Based on the already realised field surveys of wind farms, four hypothetical visibility zones can be identified.

- Present visibility zone – WTGs can be seen at close range, allowing details to be seen, and are dominant or even overpowering. Approximate width of the zone – up to 1 km from the WTGs.
- Very good visibility zone – about 2 to 3 km from the WTGs. They are still seen as dominant, but are gradually beginning to be perceived as part of the overall view, allowing an appreciation of their proportion and scale, as well as their visual interaction with other landscape elements. In the case of WTGs, it should be noted that areas of presence and high visibility need to be assessed locally in the context of nearby farmsteads, more densely populated areas and sites of cultural and historic interest.
- Good visibility zone is 3 to 7 km away and the WTG become a visual element of the landscape, embedded in the overall landscape, because as the length of the line of sight increases, so does the amount of visual information in the landscape space, making it less likely that the view will focus on one particular thing for a long time.

[59] Scottish Natural Heritage, 2009. Siting and designing windfarms in the landscape. Version 1.

- Low visibility zone is approximately 7–12 km from the WTGs. At maximum distance, WTGs can only be seen at longer distances, and this is largely influenced by meteorological conditions and the overall visibility of the landscape. At this distance, prior knowledge of the area and its features is also important, i.e. if a person is looking around with the intention of finding something specific, they will notice it more quickly, but if the feature is a surprise, they are more likely to notice it at this distance if they are looking frontally.

Given the possible dimensions of the WTGs, it is possible that the visibility in some areas may exceed 12 km, but in this case it will be very small. There are also certain aspects to this visibility, such as the landscape should be as flat as possible, open, free from other landscape elements that allow for very distant sight lines. It should be borne in mind that any landscape, especially from roads, is mostly perceived as moving rather than static, so the view that emerges is variable and harder to focus on one particular element.

The assessment of the visual impact zones for the planned Lode wind farm concludes that the greatest impact is to the east and west, with high visual impact 5 to 6 km from the WTGs, and low visual impact to the north and south at a radius of 5 km.

With regard to the visibility of the WTGs, it should be noted how, in the specific case where the site itself or its edge is not crossed by roads of public importance, the significance of visual visibility becomes secondary. In turn, the mix of different elements in the landscape makes it much easier to incorporate new elements, as the variety of topography and vegetation structure ensures a constantly changing view.

In assessing the viewpoints from which to model photomontages for assessing the significance of the proposed action, the most important viewpoints are those with a starting point in areas of high and medium visual impact and providing good views from visually scenic areas and nearby settlements. Figure 4.6.4 shows the visual impact zones and selected photomontage viewpoints of the proposed Lode wind farm.

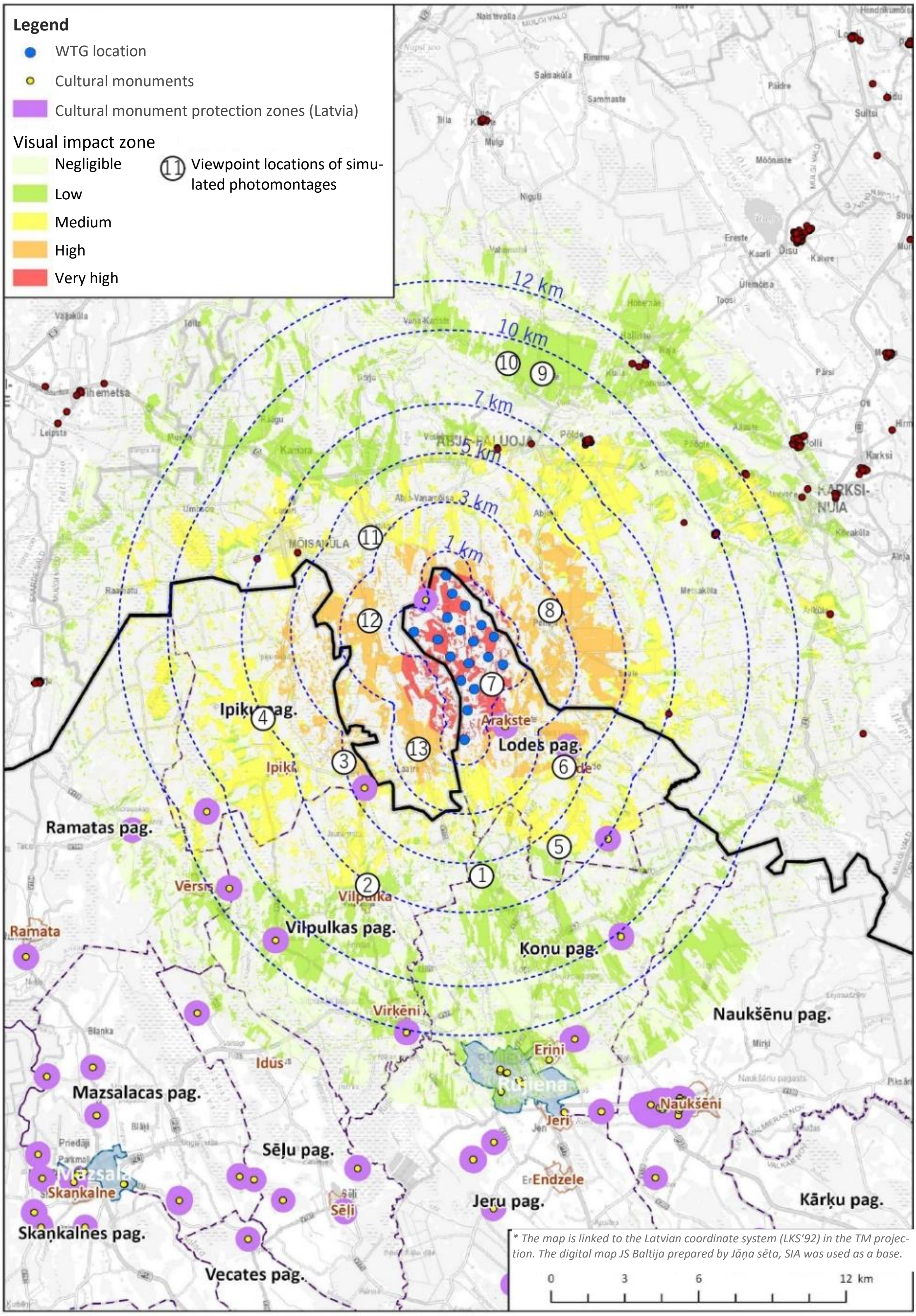


Figure 4.6.4. Visual impact zones and evaluated photomontage viewpoints of the planned Lode wind farm.

See Annex 8 for photomontages showing the visual changes caused by the proposed WTGs.

The visual impact of the photomontage and the proposed operation as a whole is assessed, and it is concluded that the diverse vegetation structure acts as a visual limiting factor and often even completely obscures the view of the WTGs. However, where the viewpoint is higher in relation to the area of the proposed development and offers extensive panoramic views, the distance to them is sufficient to avoid them being perceived as a dominant element.

The sparse network of public roads in Latvia also reduces visual accessibility, which is an important criterion for assessing landscape quality. Also, the relatively sparse rural development (farmsteads) reduces conflicts for the assessment of visual impacts on residential buildings and nearby villages. The situation is different on the Estonian side, where the density of development is higher in the adjacent area.

In assessing the proposed development, it can be concluded that it will have a clear visual impact on the landscape of the area.

4.6.5 Description of the existing situation and expected impacts in Estonia

The study area covers the Halliste river valley with a relatively flat and undulating agricultural landscape bordering it from Abja to Karksi-Nui. Historically, this was a typical area of extensive farmland, with only the valley of the Halliste river, whose slopes were mostly overgrown or wooded, and open floodplain meadows were observed on Abja side. There are also older woodlands and belts in the Halliste valley and on the valley slopes. There have been several manor houses (Abja, Pornuse, Pöogle and Kaubi). In general, the territory was dominated by scattered farmsteads and individual villages – Allaste, Leeli, Univere and Mäkiste.

Today, the rural character of the area has been preserved. Agricultural areas are still used, but to a lesser extent and some are overgrown. In the 1960s and 1970s, agricultural areas were extensively reclaimed, losing their structure and the groves between them, as well as some farmsteads. The road network north of the Halliste valley is well preserved, while the Karksi-Nuia-Abja road was straightened and renovated in the early 2000s. In places, spruce hedges and groups of trees still remain along the roadside.

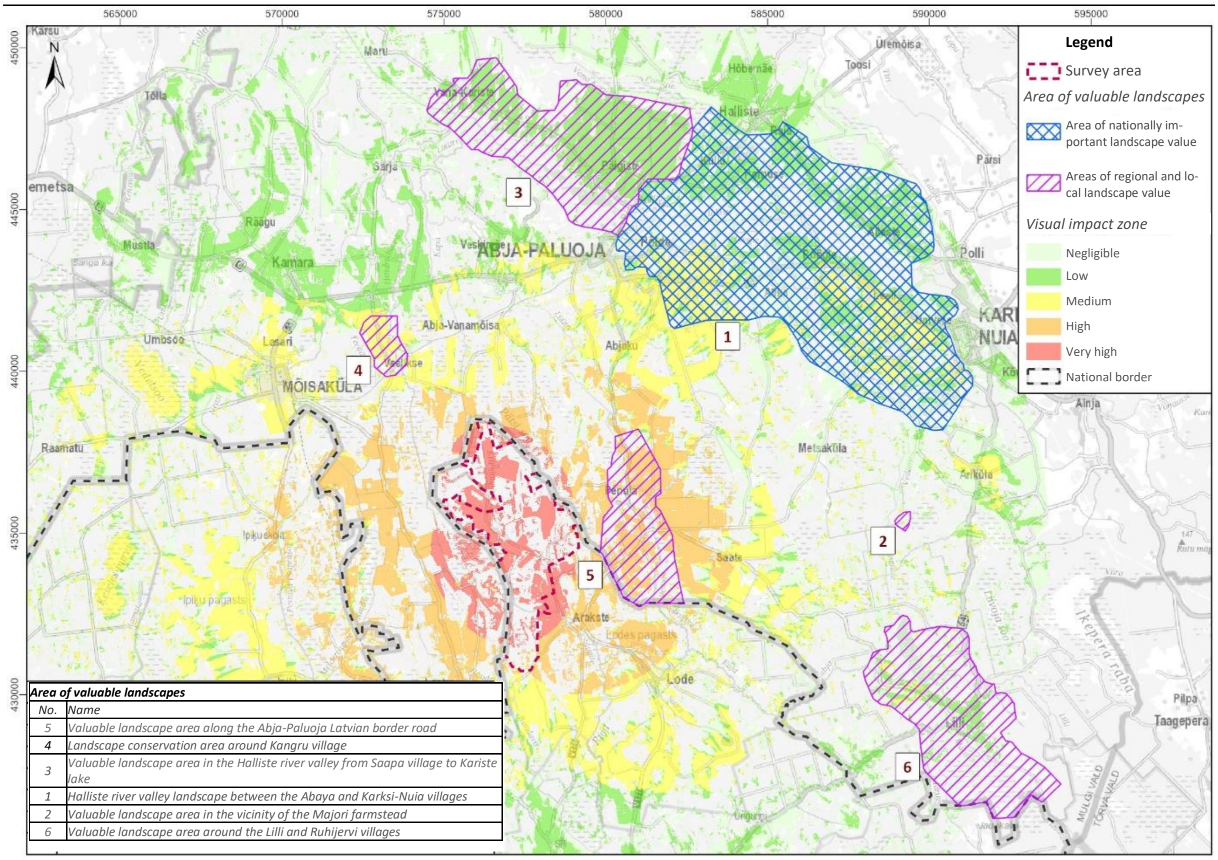


Figure 4.6.16. Valuable landscapes in the vicinity of the planned wind farm (wind farm in the middle of the red oval)

The <u>Halliste river valley between the Abaja and Karksi-Nuia villages, which is a landscape of regional importance (with potential national significance)</u> (see Figure 4.6.16, item 1)

The landscapes of the former manor houses, where the outlines of their territories and partially preserved manor buildings can be seen, as well as farmsteads, are of high cultural and historical value in the landscape.

The extensive views over the Halliste valley and from the roads to the immediate surroundings are of high aesthetic value.

The natural values are represented by various elements in the landscape: the valley of the Halliste river with floodplain meadows, some of which are overgrown, and the forest masses and small clusters of trees.

The recreational value of the site is medium, mainly due to the views from the roads. However, due to the poor condition of the historic manor houses, they are not attractive recreational destinations.

Overall, the proposed wind farm will have little or no impact on the northern part of the Halliste valley.

Significant landscape changes are expected to the south of the Valga–Uulu road no. 3, where the wind turbines will be clearly visible from the road. However, these impacts are not considered to be very negative, as the landscape has already been changing over time and is not considered to be historically significant. See Annex 9 for visualisations.

Homesteads (Majori homestead) landscape, which is a landscape of local (municipal) importance (see Figure 4.6.16, item 2). It is located approximately 10 km to the east of the proposed area of operation.

Majori farmstead is located approximately 5 to 6 km southwest of Karksi-Nuia, on the western edge of the Saaretse marsh, at the highest elevation of the surrounding area. The farm has been restored and covers an area of about 20 ha, which are tended in the traditional way. The farm is surrounded by diverse, mostly swampy forests, with some swamps where peat extraction was carried out in the 1950s.

The high cultural and historic value of this landscape is due to its preservation in good condition, as some of the buildings are over 200 years old. The old military road, built on logs, passes through the Saaretse marshes.

Its high aesthetic value is due to its beautiful, well-maintained, traditional farmhouse, situated in a beautiful natural area with varying topography.

The identity value of the homestead is medium, as it is recognisable outside the Mulgi district. The recreational value of the area is medium, mainly consisting of hiking trails and ecotourism, which is not very extensive.

The impact of the proposed action is low or negligible, as the farmstead is located in the middle of a forest where the WTGs will be practically invisible.

Valuable landscape of local importance in the Halliste river valley from Saapaküla village to Kariste lake (see Figure 4.6.16, item 3) (the area is located approximately 5.5 km from the wind farm to the north and northeast)

The area includes the Halliste river valley and the farmsteads and settlements north of it (villages: Päigiste küla, Saapaküla, Vana-Kariste). The Vana-Kariste Manor and the dam on Kariste lake are also located in the area. The north of the area is a vast agricultural landscape with undulating topography, the south is the valley of the Halliste river surrounded by forests. Kariste lake is also mostly surrounded by forest.

Only one building of the side part of the Vana-Kariste manor complex has been preserved. The manor grounds offer a view (one of the few) of Vana-Kariste lake. The view is spoilt by the Soviet-era collective farm barn next to the manor house.

The former Liplapi school of housekeeping (1910–27) is situated on the side of the Uue-Kariste road and has park-like grounds with deciduous plantations.

The average heritage value of the area is mainly due to the well-preserved rural structure and additional management, as well as the well-defined road network. The landscape is of medium aesthetic value, with extensive views, including from the Vana-Kariste estate to the lake. The recreational value of the landscape is also medium, mainly due to the recreational opportunities offered by the guesthouses in the northern part of Kariste lake.

The visual impact of the proposed wind farm is low or insignificant. In the area of scenic vistas, WTGs become visible in the background, but their effect is not dominant. The landscape values are not affected by the proposed wind farm as they are quite site specific and not related to the historically preserved panoramic view. See Annex 9 for visualisations.

<u>Kangru village, located approximately 3.3 km northwest of the proposed wind farm (Figure 4.6.16, item 4)</u>

Kangru village is a valuable landscape conservation area located along the Veelikse – Laatre – Latvian border road. Kangru village is part of Veelikse village. Farms are clustered along the roadside, with a variety of roadside planting. Farmland is managed and maintained. The main scenic assets of the site are the small water body and the small dam, the Laatre railway station building, which is also an architectural monument.

The Valga – Uulu road towards the Latvian border offers scenic views of the varied landscape, long and open viewing areas, large trees standing alone, and stands of trees and ornamental shrubs along the road. The landscape is accentuated by farmsteads of different periods. At the same time, a 330 kV high-voltage power line crosses the view.

The visual impact of the proposed wind farm is low, as the landscape is wide open. WTGs will be highly visible and will increasingly stand out in the landscape when approaching the Latvian border. At the same time, the distance between WTGs is more than three kilometres, and they do not have a dominant effect. The planned wind farm will not affect or diminish the value of the valued landscape. See Annex 9 for visualisations.

<u>Penuja, Abja – Paluoja – Latvian border road, located approximately 2 km east of the proposed activity area (see Figure 4.6.16, item 5)</u>

Penuja is a valuable landscape area along the road Abja – Paluoja – Latvian border. The road is not designated as a scenic road, although the views from the road are considered by the expert to be of value. These include views of the village with the ruins of the church and former school buildings, diverse roadside planting near farmsteads, and both managed and abandoned farmland. It is partly designated as a valuable built-up area in the Abja parish masterplan (2008).

From the road, the landscape offers a mix of very well-kept farms (Kaidiaia, Känsi), old and poorly maintained, recently-built households and partially dilapidated buildings. These buildings are from more than one period. Power lines, a substation and small solar farms can also be seen from the road.

The Lode wind farm is to the west of the road, where the terrain is more wooded. The open views are more on the east side of the road. Around the village of Penujas, there are more views of the wind farm, and the WTGs will be clearly visible. The nearest WTG is about 1.3 km from residential development.

The visual impact of the planned wind farm in the Penujas village and the western part of Sate village is significant due to the short distance. The construction of the wind farm will result in a reduction of the natural aesthetic value of the landscape. The section of road and the village of Penujas described above are not of heritage value, but contain buildings from different eras. In addition, it has a well-maintained landscape with future potential. Penujas village, its surroundings and built environment have changed over time and are likely to continue to change in the future regardless of the construction of the Lode wind farm. From a landscaping point of view, the wind farm is acceptable. See Annex 9 for visualisations.

The Lilli-Ruhijärve landscape, located approximately 10 km southeast of the wind farm (see Figure 4.6.16, item 6).

During the 2015 inventory, the Lilli-Ruhijärvi landscape was included in the list of category II landscape conservation areas. The area includes the villages of Lilli, Pera (Peraküla), Ruhijärvi and the Teringi Landscape Conservation Area. The terrain is hilly and variable, crossed by the valley of the Lilli river. The elevations are dominated by both agricultural land and woodland. The lower areas, including around Ruhijärvi, are mostly forest. The road through Lilli (Viljandi – Karksi – Ruhja) is probably very old, having been used as a military road by the Knights of the Order in the 13th century and for transporting goods to the Riga market in the 19th century. In the last assessment, the scenic value of the site has been reduced, mainly due to the newly built road to Lilli village.

The visual impact of the proposed activity on the area is medium and sometimes low. The landscape values are not affected by the proposed wind farm, as they are quite site specific and not associated with a historically preserved panoramic view. See Annex 9 for visualisations.

Overall, the expert considers that the impact of the proposed activity is negligible, although the surrounding landscape will undoubtedly change, particularly in areas closer to the proposed wind farm.

4.6.6 Cumulative impact on the landscape

Given the importance of alternative energy, planned wind farms should not only be considered within the sphere of influence, but also in relation to adjacent and planned wind farm developments. This would help to identify areas of conflict early on and find solutions to avoid degradation of the visual quality of the wider landscape.

The Saarde wind farm is located approximately 10 km northwest of the proposed area of operation (Estonia) and another wind farm, Saarde II, is planned for a total of 18 wind turbines with a total height of 230 m. On the eastern side, possible areas for the development of two new WTG wind farms have been identified.

In Latvia, the Aloja wind farm is planned to the southwest, about 25 km away from the planned WTG wind farms for which EIAs are currently underway. It is planned to accommodate up to 31 stations with a maximum height of 250 m. In the same vicinity, the EIA process has started for another wind farm Matīši, where eight WTGs are to be installed as originally planned, with a height of 261 m. The proposed wind farm is approximately 30 km from the area of the proposed activity.

Two wind farms of SIA Latvijas vēja parki are planned about 50 km away: the Valmiera-Valka wind farm in the southeastern direction with 60 planned WTG, and the Limbaži wind farm in the southwestern direction with 20 planned WTGs. In both wind farms, WTGs with a maximum height of 300 m are planned during the EIA process.

Information on these planned wind farms is summarised in Figure 4.6.17.

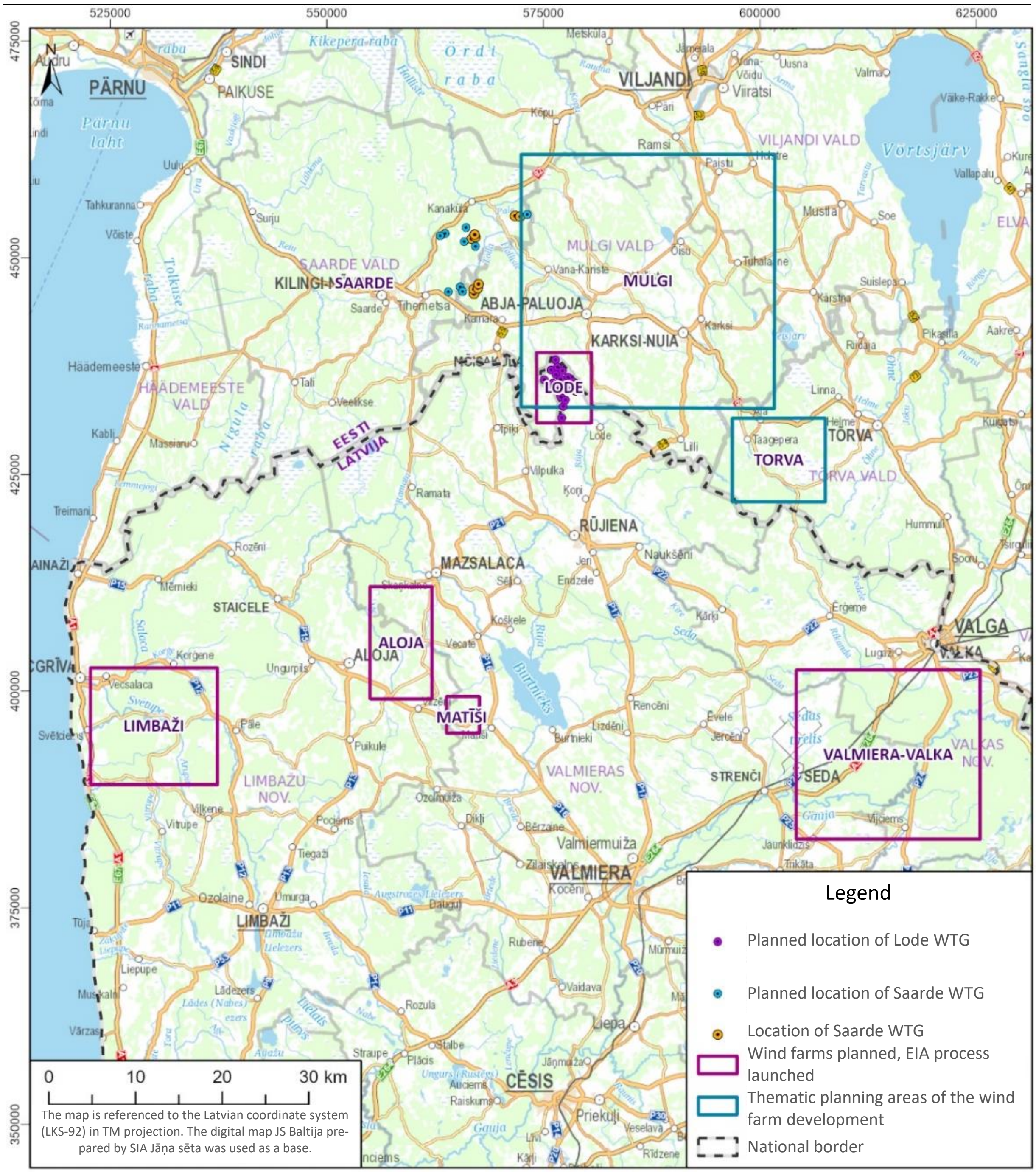


Figure 4.6.17. Existing and planned wind farms in the vicinity of the Lode WTG wind farm.

Assessing the current situation and based on the distances of the visibility zones, the cumulative effect could result in visual congestion between Lode wind farm and the two Saarde wind farms in Estonia, as there is a good overlap of the visibility zones. However, as the visual impact map shows that the Lode WTG wind farm has a low visual impact on the surrounding area already at a distance of 6 km, the overlap of visibility zones is not considered significant.

4.6.7 Mitigation measures

To reduce the impact of the proposed Lode wind farm on the visual quality of the landscape and to ensure the integration of the wind farm into the existing landscape, the following mitigation proposals are made:

1) Reducing the sight distance and visual impact of wind farms on the perception, character and value of the landscape as a resource requires a strong focus on the colour of wind farms. It is recommended to paint the tower and rotor wings of wind turbines white, as this makes the turbines blend in better from the ground, while making them bright enough to be easily seen by pilots in the air. The white colour also reflects sunlight, preventing the equipment from overheating.
2) To reduce the impact of wind turbine signal lighting on the landscape in the evening and at night, it is recommended to use one colour of lighting.
3) In forest lands and roadsides where deforestation is to be carried out for the transport and assembly of power plant structures, artificial reforestation is recommended to reduce the direct impact of the WTG structures on close-up views.
4) Considering that there are a number of valuable trees in the area of the proposed development, ensure the protection of these trees, both by not locating WTGs in their immediate vicinity and by engaging a certified arborist during the design and construction phase to provide guidance on mitigation measures for the proposed development. A certified arborist should also be involved if it has been decided to reduce the canopy of individual trees or groups of trees.
5) When planning delivery routes, it is important to choose delivery routes that eliminate the need for extensive roadside clearance for the delivery of bulky elements of the WTGs. Temporary diversion routes should be created where possible to minimise the potential felling or cutting of trees, groups of trees, rows or avenues.

4.6.8 Comparison of alternatives

The parameters of the technological alternatives assessed in the EIA process are equivalent and in the context of landscape protection the technological alternatives are assessed as equivalent and there is no reason to define any of the assessed WTG models as better than the others. To mitigate the impact of WTGs on the visual quality of the landscape and to ensure the integration of the wind farm into the existing landscape, the expert has made recommendations for mitigation.

4.7 Cultural heritage

This chapter analyses the potential impact of the proposed wind farm on archaeological and cultural heritage. It provides a detailed overview of the proposed activity and the area affected, considering possible implications and options for the conservation and protection of the cultural heritage.

4.7.1 Regulatory framework and impact assessment approach

During the design and construction of wind farms, acts and regulations designed to preserve cultural heritage must be taken into account. The European Convention for the Protection of the Archaeological Heritage, adopted in Valletta on 16 January 1992 and in force in Latvia since 19 June 2003 by the act on the protection of the archaeological heritage, applies to this area. Also relevant in the context of the project is the Latvian act on protection of cultural monuments (in force since 11 March 1992, as amended until 31 March 2022). Section 22 of the act on the protection of cultural monuments states that before commencing construction, land amelioration, road construction, extraction of mineral resources, and other economic activity the commissioning party thereof must ensure surveying of cultural values in the area of intended activity. Natural persons and legal persons who as a result of economic activity discover archaeological or other objects with cultural and historical value must immediately notify the National Heritage Board (NHB) thereof, and further activity must be suspended. On the basis of this act, on 26 December 2021 cabinet regulation no. 720 was issued, on the record-keeping, protection, inventory and restoration of cultural monuments was issued. It entered into force on 1 January 2022. According to article 32 of this regulation, having received a notification from a natural or legal person who has discovered an object of cultural heritage value in the course of construction or other works, the NHB must, within one month, organise the identification of the discovered object, ascertain its cultural heritage value and determine measures for its conservation. According to section 38, clause 1 of the act on protected zones (adopted 5 February 1997, in force from 11 March 1997), economic activity in the protection zones (protection strips) around cultural monuments may only be performed with a permit from the State Inspection for Heritage Protection and the owner of the cultural monument.

To identify and assess the cultural and historical values in and around the wind farm study area, information available from public information sources, collections and elsewhere has been summarised.

4.7.2 Description of the existing situation and assessment of impacts

The planned wind farm will be located on a narrow strip of land in Lode, in Vidzeme municipality. In ancient times, the territory of the parish of Lode was also sparsely populated, as it was located on the southern periphery of the ancient Estonian lands of Sakala and on the northern periphery of the ancient Latgalian lands of Talava. The development of the frontier settlement was also hampered by conflict. Arakstes Manor was built at the beginning of the 15th century. Lode was first mentioned in written sources at the beginning of the 16th century. The population was moderately dense until the Second World War, with fewer forests and more farmland.

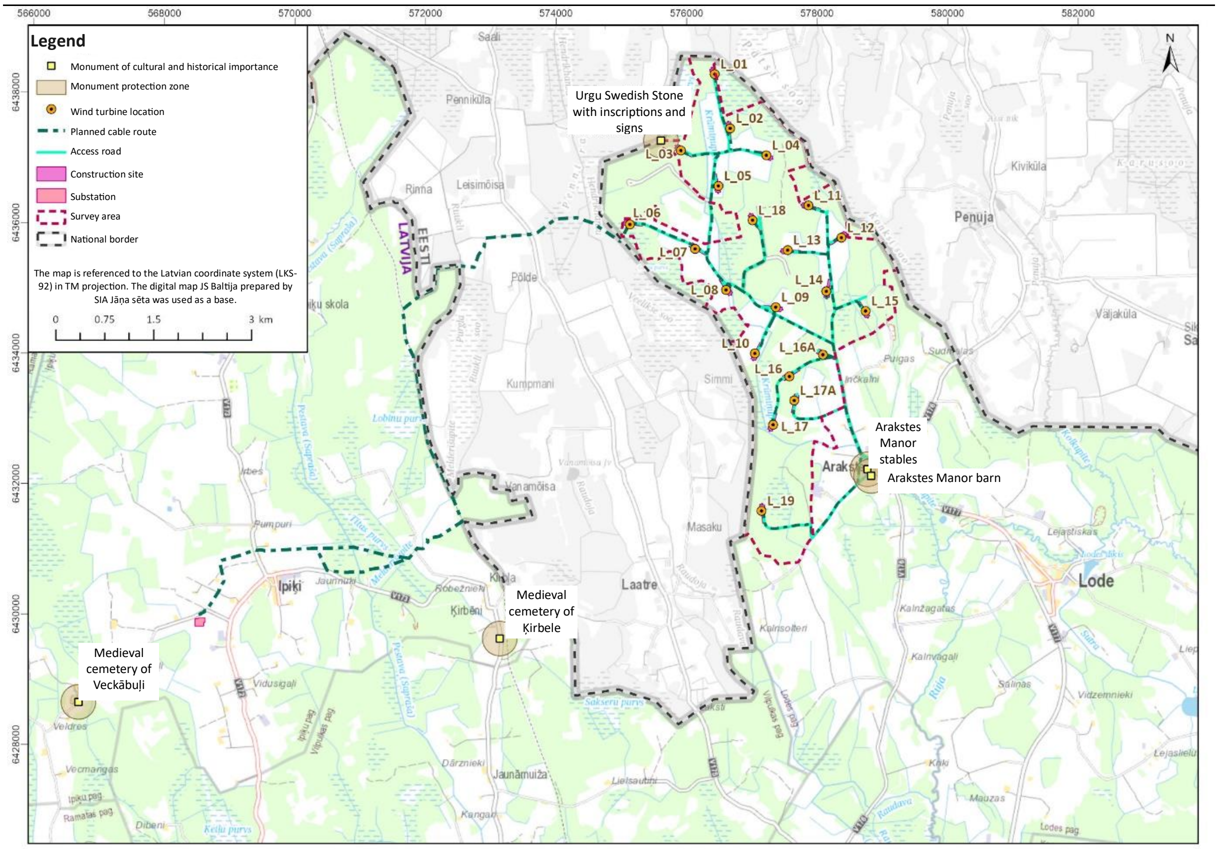


Figure 4.7.1. The location of WTGs and the state-protected cultural heritage in the vicinity of the planned wind farm.

According to the map of cultural monuments on the NHB website, in the immediate vicinity of the planned wind farm there is one state-protected cultural monument: Urgu Swedish Stone with inscriptions and signs, which is a cultural monument of regional importance – Archaeological Monument No 2458.

The Urgu Swedish Stone is located on the Latvian-Estonian border, but a few metres away in Latvia. The stone is 3.9 m long, 2.5 m wide and 1.3 m high. Carved into the stone are the numbers 301 and 1800, a cross and a triangular sign. The different carving techniques suggest that they were carved at different times. Tales and stories date back to the Swedish War. The stone is said to have served as a seat for the King of Sweden. The stone is said to have floated down the Zviedru river, which was formed from the blood of Swedish soldiers. The Swedish war chest or the king's golden sword are said to be buried under the stone. It is also said that the spring that flows from the bottom of the stone is formed from the tears of the oppressed people, which is why the stone is also called the Stone of Tears. It is not possible to determine the real meaning of the Urgu Swedish Stone from the folklore, but it is possible to estimate that it had some connection with wars or battles or other violent events. Today, it serves as a boundary stone.

The protection zone of the Urgu Swedish Stone is 500 m. The planned WTG L_03 will be located within the monument protection zone at a distance of approximately 400 m from the stone. As the cable communications of the wind turbine are to be laid to the southeast, i.e. on the opposite side of the stone, the construction and operation of this WTG will not pose a threat to the Urgu Swedish Stone.

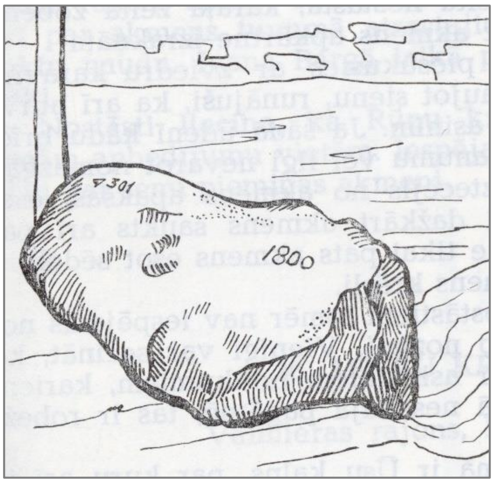



Figure 4.7.2. On the left is Urgu Swedish Stone (NHB); on the right is Urgu Swedish Stone (Urtāns, 1990)

To the south of the proposed wind farm is Arakstes Manor. The Arakstes Manor complex was formed in the first half of the 19th century, when a manor house, a servants' house, stables, a barn, a cattleshed and a forge were built there. In 1881, a cellar and other outbuildings were built. The manor house was built as a one-storey brick building with a gabled roof and a high plinth. In the second half of the 19th century, a two-storey block was added to the house. The main facade had a porch with a four-columned portico. After the estates were expropriated in 1922, a school was arranged in the building, and after the Second World War there was a club.

Two buildings in the manor house complex are under national protection as a cultural monument of regional importance – the manor barn (protection no. 6904, see Figure 4.7.3) and the manor stables (protection no. 6905, see Figure 4.7.4). Both buildings date from the first half of the 19th century. The manor complex is currently in a poor state of preservation.

There is a "Love stone" in Arakstes Manor park on the right bank of the Arakstes river. It is 4.7 m long, 2.7 m wide and 2.5 m high. The stone has steep sides, a flat and level surface, and at least ten people can stand on it at the same time. A copper bell is said to be under the stone [60].

[60] NHB PDC inv. no. p. 1490 I, p. 1558 I

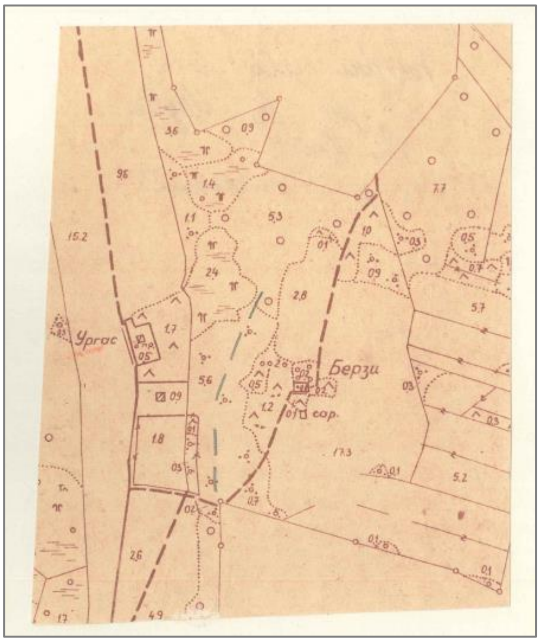
Figure 4.7.3. Arakstes Manor barn (NHB)

Figure 4.7.4. Arakstes Manor stables (NHB)

The buildings under national protection and the “Love stone” are located approximately 2 km from the nearest WTG L_19, L_17 and L_16, and therefore the construction of these wind turbines and associated communications will not pose any threat to these heritage values.

About 4 to 5 km from the WTG there is another archaeological monument – Kalnalammiki settlement and Upurakmens – a cult site (cultural monument of regional importance in the parish of Lode in the municipality of Valmiera near Kalnalammiki, protection no. 2456). This site will also not be endangered by the construction of the wind farm.

The route of the wind farm’s electricity cables is planned to be about 1.4 km from the medieval cemetery of Ķirbele (a cultural monument (archaeological monument) of regional importance in the parish of Ipiķi of the municipality of Valmiera, protection no. 2436) and about 2 km from the medieval cemetery of Veckābuļi (a cultural monument (archaeological monument) of regional importance in the parish of Ipiķi in the municipality of Valmiera, protection no. 2437). These medieval cemeteries will not be threatened by the planned cable routes.



In addition to the currently known and state-protected cultural monuments, there is information on other sites of possible cultural and historical significance in and around the area of the planned wind farm.

The monument documentation centre of the National Heritage Board (Nacionālā kultūras mantojuma pārvaldes Pieminekļu dokumentācijas centrs, NKMP PDC) published a report in 1985 on the Swedish Road running from north to south between the Urga and Bērzu houses. The road site is marked as an elevation. The site is not precisely located in nature, but could coincide with the cable routes between WTGs L01, L_02, L_03, L_04, L_05 and L_07 (NHB PDC inv.No 23056/5435-2 I).

Figure 4.7.5. Possible fragment of the Swedish road between Urga and Bērzu houses (NHB PDC inv.Nr.23056/5435-2 I).

About 0.8 km southwest of the Urgu Swedish Stone is a group of hills called Ūskalns. There are indications that tales and legends have also been told about the site (Urtāns, 1990–40). The expert suggests that Ūskalns, rising above the generally low and marshy surrounding area, may have played a historically significant role (settlement, burial site).

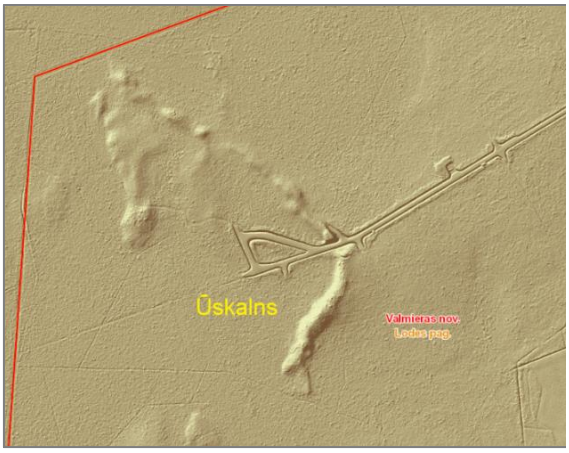


Figure 4.7.6. Ūskalns (available online at kartes.lgia.gov.lv)

Figure 4.7.7. Penannular brooch from the destroyed medieval cemetery of Lode (LNVM AD inv. No. A 12746:1)

There is no evidence of medieval or modern cemeteries in the northern part of the parish of Lode, where the wind turbines are planned to be built. However, given that there are several medieval burial sites to the south of Arakstes Manor, the possibility that there was a small local cemetery in this part cannot be ruled out. So far, the nearest medieval cemetery to the planned wind farm is known to be in the area of Arakstes Manor near the Grantskalnu houses. The cemetery was destroyed by the opening of a gravel quarry in the 1980s. The medieval cemetery at the Lode village mill (Smilškalni) was similarly destroyed. A small penannular brooch and three 16th-century cemeteries from the graves are in the collection of the LNVM AD. There are also reports of human bones being found at the Kalniņi houses south of Lode. The Swedish cemetery, where human bones were found around 1935 during construction of the post office, is in the village of Lode, which is near Podnieki. There are also records of an ancient tomb and church site at Žagatas, about 2 km south of Arakste. The site of the church and the cemetery at Labrenči (currently about 1.3 km southwest of Arakste, in the vicinity of the Akmengravi houses) are also mentioned in the visitation protocols.

These sites, if preserved, are not threatened by the planned construction of the Lode wind farm. However, the high concentration of burial sites to the south of Arakstes Manor indicates that, similarly, the areas to the north of Arakstes Manor, where the wind farm is planned, may contain hitherto unknown cemeteries. In the 17th and 18th centuries, peasants living far from official cemeteries often secretly buried their dead in unconsecrated places. This was more often the case in epidemics of plague and other diseases.

4.7.3 Impacts on heritage assets, and mitigation measures

According to expert opinion, the implementation of the proposed activity does not pose a threat to the state-protected cultural monument Urgu Swedish stone, the buildings of Arakstes Manor, the medieval cemetery of Ķirbele or the medieval cemetery of Veckābuļi.

When constructing the wind farm communications and fencing, if planned, free access to cultural monuments in and around the wind farm must be ensured.

As there are various reports and artefacts suggesting several medieval burial sites to the south of Arakstes Manor, it is possible that some as-yet unknown illegal medieval burial sites could also exist to the north of Arakste in the area of the planned wind farm. Therefore, prior to the construction of the wind farm (after the topsoil has been removed), the wind farm area should be surveyed by an archaeologist to check for archaeological sites in the areas where the wind turbines and utilities are to be built. It should be observed that according to article 32 of cabinet regulation no. 720, if objects of cultural and historical value are discovered, including during construction, the works must be stopped and the findings must be reported to the National Cultural Heritage Board (NKMP).

There are currently no reports of battles or burial sites in the area of the planned wind farm. However, during both the First World War (1914–1918) and the War of Independence (1918–1920), armies moved and clashed in the area. This is also evidenced by the monuments and memorial plaques in the municipality of Rūjiena to the members of the parish of Rūjiena who died in these wars. The inhabitants of the parish of Lode belonged to the Rūjiena parish churches. During the Second World War (1939–1945), in 1941 and 1944 troops crossed the border parishes of Latvia and Estonia. If graves of soldiers are found during excavation work, it is important to notify the police and the soldiers' cemetery association (Brāļu kapu komiteja) (bkkomiteja@apollo.lv).

Any explosive hazards that are found should be reported to the nearest state police office (tel. 110), before cordoning off the area where they were found.

All of the above requirements also apply to the planned cable trenching sites in the parish of Ipiķi.

4.7.4 Evaluation of alternatives

Given that all the technological alternatives evaluated are considered to be similar in the context of factors that may affect the protection of heritage assets, there is currently no reason to consider any of the wind turbine generator (WTG) models that have been evaluated as being superior to the others. To mitigate potential impacts on heritage assets, the expert has provided guidance to be taken into account when undertaking the construction of the proposed wind farm.

4.8 Air quality

The analysis of the processes to be carried out during the construction and operation of the planned Lode wind farm has shown that potentially significant emissions of air pollutants are associated with the processes planned for the construction phase of the wind farm, while no significant sources of emissions can be identified during the operation period. Accordingly, this assessment involves an analysis of the potential emissions of dust, PM_{10} particles, $PM_{2.5}$

particles and nitrogen dioxide during construction activities and from the movement of construction vehicles through the area of the proposed activity and transport routes.

The potential changes in air quality during the construction phase of the proposed wind farm are expected to occur only in the territory of Latvia and no transboundary impacts are foreseeable. Therefore, this chapter assesses changes in air quality and compliance with air quality threshold values in accordance with Latvian regulatory enactments.

4.8.1 Legislative framework

For PM_{10} particles, $PM_{2.5}$ particles and nitrogen dioxide (NO_2), air quality limit values – the scientifically based pollution levels are set to prevent, avoid or reduce harmful effects of pollution on human health or the environment. The corresponding threshold values have been used to assess the existing pollution levels in the study area and the sensitivity of the site to a short-term potential increase in pollution levels during the construction phase.

Information on the concentration limit values for pollutants is provided in Table 4.7.1 in accordance with cabinet regulation no. 1290 of 3 November 2009, on air quality.

Table 4.8.1. Air quality standards

Pollutant	Determination period	Threshold
PM_{10} particles	Calendar year	40 µg/m^3
PM_{10} particles	24 hours	50 µg/m^3 (not to be exceeded more than 35 times per calendar year)
$PM_{2.5}$ particles	Calendar year	20 µg/m^3
Nitrogen dioxide	1 hour	200 µg/m^3 (not to be exceeded more than 18 times per calendar year)
Nitrogen dioxide	Calendar year	40 µg/m^3

In addition, the potential for dust generation from construction activities has also been assessed. Dust pollution is considered a disturbance because the short-term and long-term effects on human health are attributable only to PM_{10} particles and $PM2_{.5}$ particles available in dust, known as respirable particles, which can enter the thoracic part of the respiratory system[61]. Air quality standards for the relevant dust fractions are set out in Table 4.8.1 and are assessed separately. Dust disturbance is expressed as visual seen dust clouds and dust deposits on surfaces.

4.8.2 Existing air quality

The assessment of the existing air quality has been prepared using the data on the existing pollution levels in the vicinity of the study area provided by the Latvian Environment, Geology and Meteorology Centre (LVGMC) in its letter no. 4–6/246 of 26 February 2024. The statement

[61] Effects of suspended particulate matter, published by the Health Inspectorate (available in Latvian at https://www.vi.gov.lv/lv/suspendeto-cieto-dalinu-ie-tekme?utm_source=https%3A%2F%2Fwww.google.com%2F)

provided by the LVGMC is attached as Annex 11, and the following figures provide a description of the spatial dispersion of the pollution.

As can be seen from the figures, air pollution concentrations in the vicinity of the proposed activity are low and do not exceed the limit values set by the cabinet. Moreover, for all pollutants, the concentrations reported by the LVGMC are lower than the lower pollution assessment threshold (65% of the annual limit value for nitrogen oxide and 50% of the annual limit value for particulate matter, respectively). This means that the existing air quality in the study area is good and there is no need to plan measures to improve air quality. As the spatial dispersion of pollution shows, the highest concentrations of pollution sources are observed in the vicinity of two national local roads V176 Sīļi-Estonian border and V177 Ķoņi-Lode-Arakste, which are related to road traffic. Another potential source of pollution is peat extraction in the Kongsi bog in Estonia. As information on emissions from peat extraction is not available, this is not taken into account in the assessment below, as in any case the impact on air quality from peat extraction is assessed as significant only in the immediate vicinity of the source and does not affect potential WTG sites, while mineral transport does not occur in the area of influence of the proposed activity.

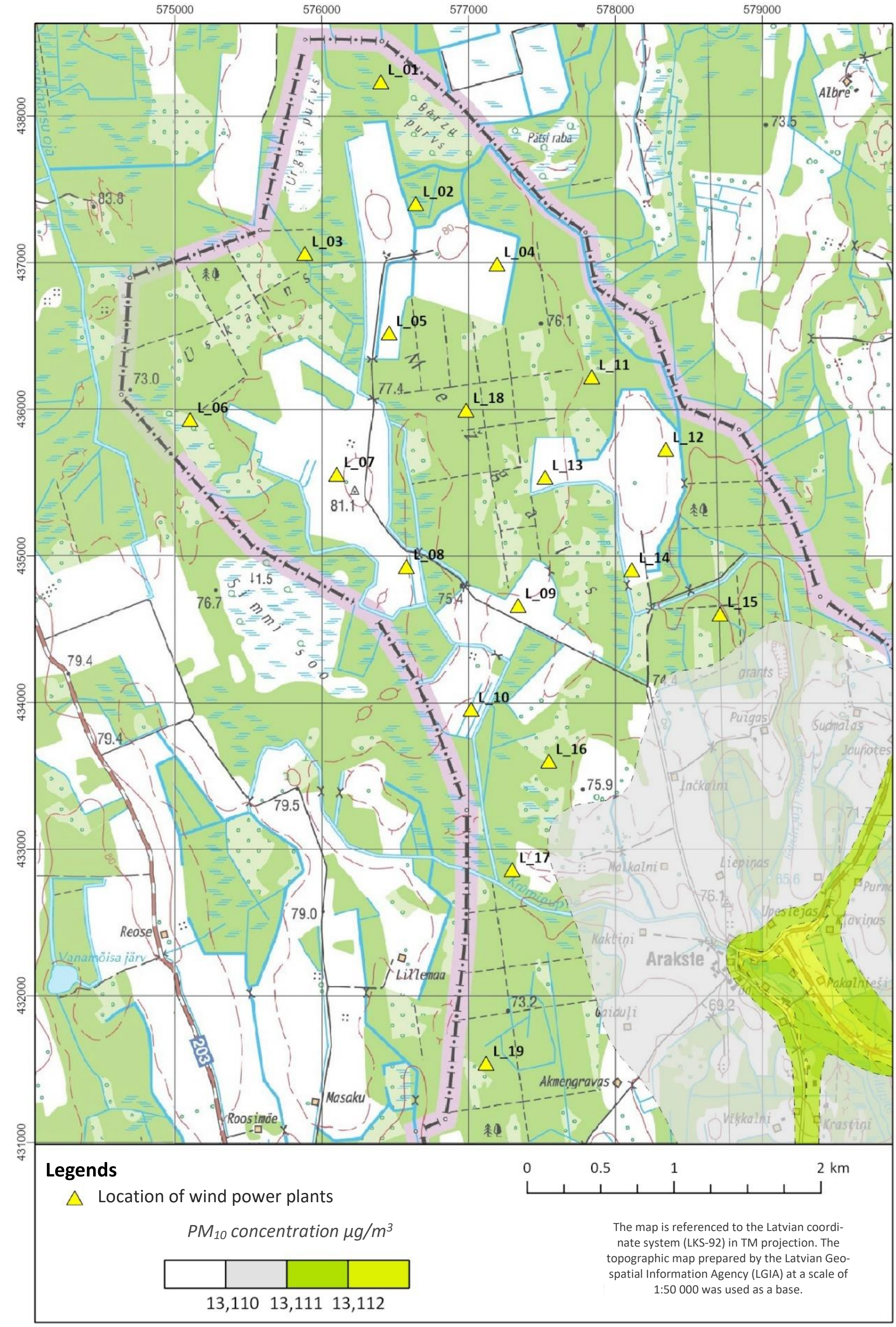


Figure 4.8.1. Annual mean concentration of PM10 particles - the current pollution level

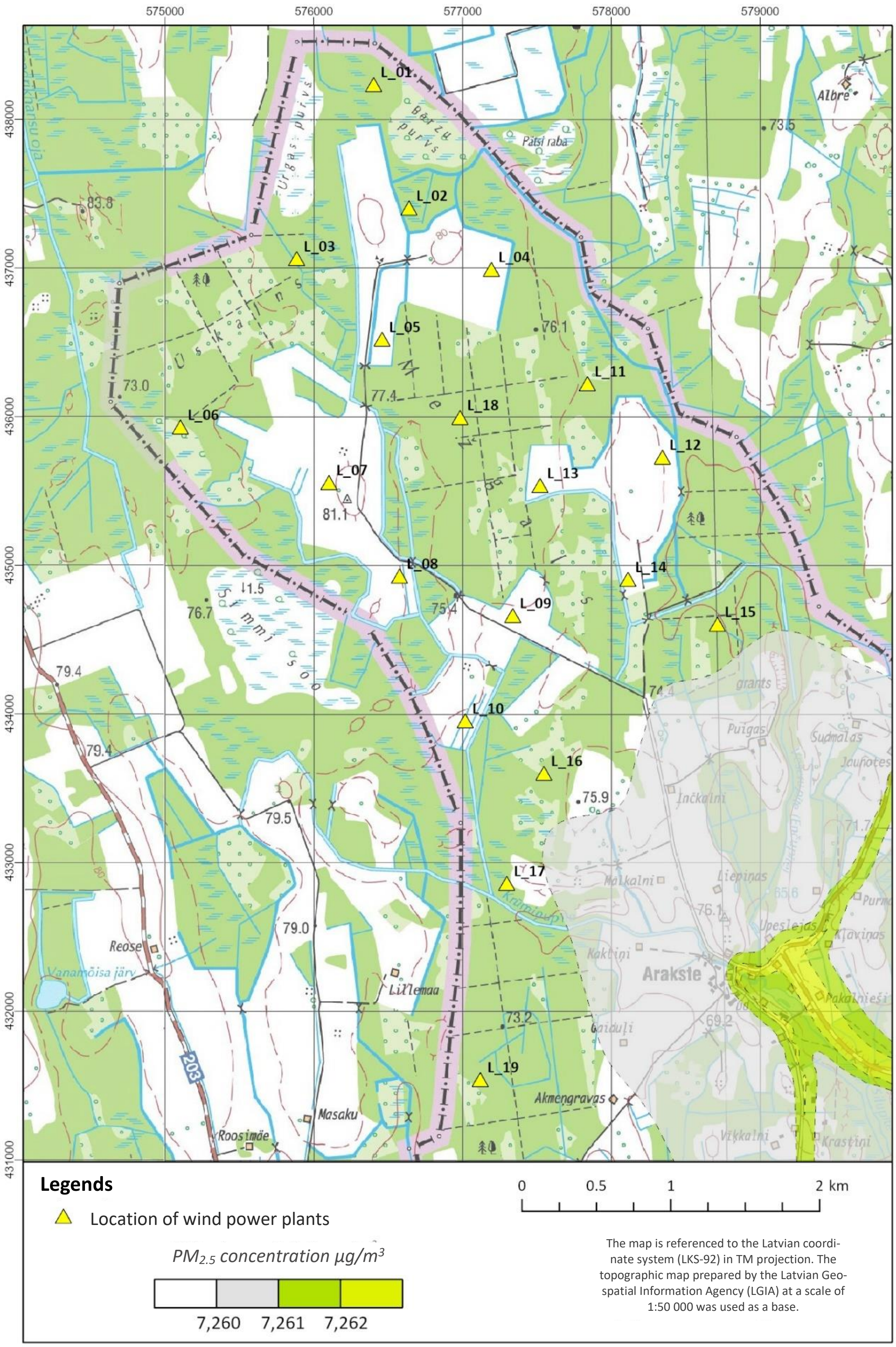


Figure 4.8.2. Annual mean concentration of $PM_{2.5}$ particles – the current pollution level

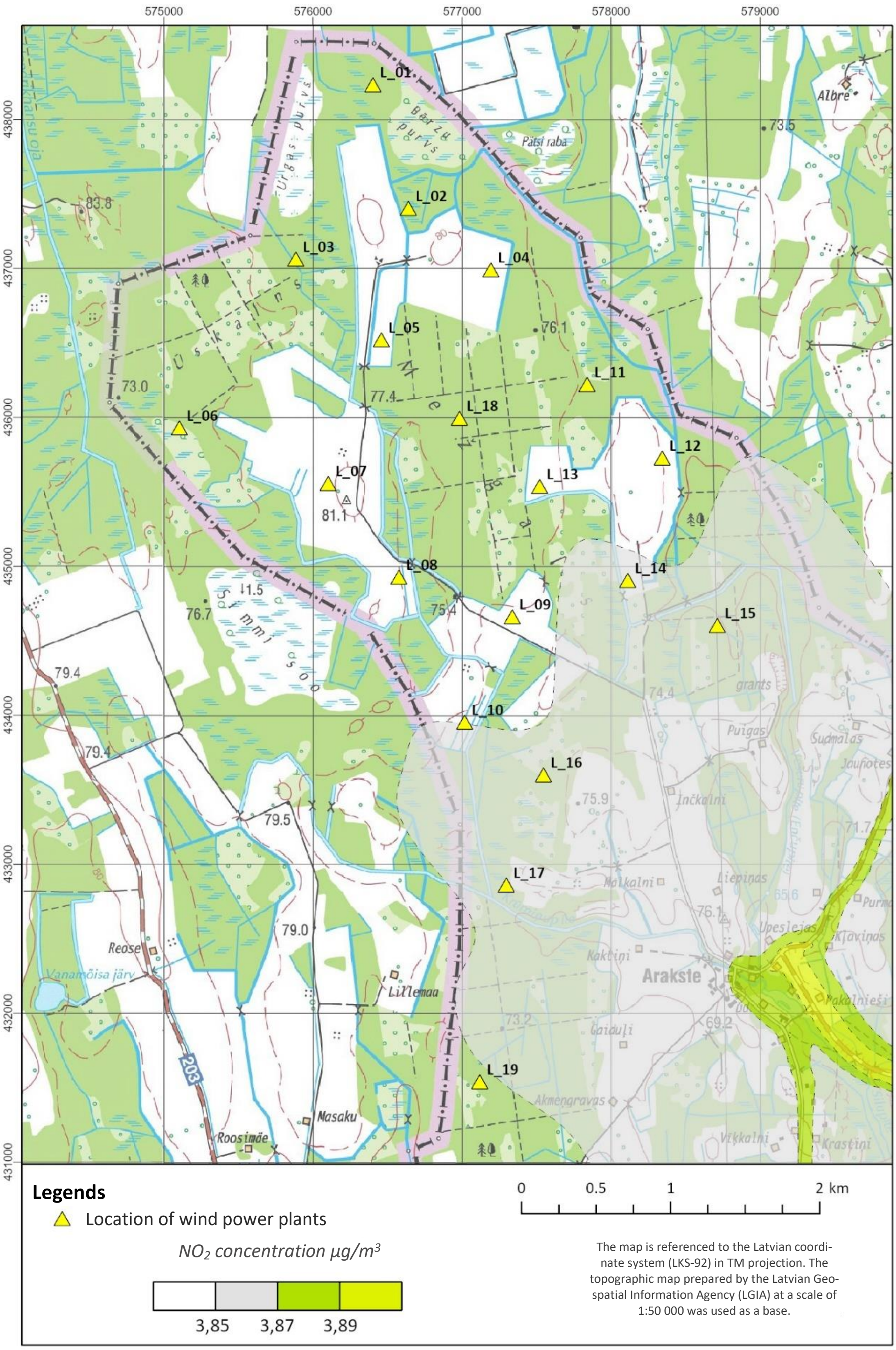


Figure 4.8.3. Annual average concentration of nitrogen dioxide – the current pollution level

4.8.3 Impact assessment approach

The impacts of construction have been assessed using a qualitative approach, as described in the following guidelines for assessing air quality impacts from construction activities:

- Guidance on the assessment of dust from demolition and construction[62] (Institute of Air Quality Management (IAQM) guidance),
- Guidelines for the treatment of air quality during the planning and construction of national road schemes[63] TII guidelines),
- Sustainability & Environmental Appraisal, LA 105, air quality Design Manual for Roads and Bridges (DMRB) guidelines)[64].

The guidelines apply to the assessment of air pollution from construction and demolition activities.

The main air quality impacts that may arise during construction are:

- visually visible dust clouds;
- dust deposits;
- increased concentrations of PM_{10} particles from construction activities;
- Increases in concentrations of NO_2, PM_{10} particles and $PM_{2.5}$ particles due to exhaust emissions from construction machinery and delivery vehicles.

The guidelines take into account the potential for pollution emissions from various dust-generating activities, such as demolition of existing structures, earthworks, new construction and removal of dusty material. Earthworks include soil removal, land levelling, excavation and landscaping, while the removal of dusty material assesses the potential for such material to be deposited on public roads where it accumulates and may re-ascend into the atmosphere as a result of vehicular traffic.

The guidelines address three groups of potential consequences:

- disturbance caused by dust pollution;
- damage to ecosystems;
- impact on human health.

Using the method presented in the IAQM Guidelines, it is possible to classify the significance of the impacts from construction activities by assessing the potential dust load (high, medium or low) together with the existing background pollution levels and the proximity of the site to the nearest recipients. According to the guidelines, where significant impacts are expected appropriate mitigation measures must be implemented. The set of measures reduces the impact of air pollution from construction to a negligible level. The method described in the guidelines involves five assessment steps: (1) evaluating the need for the assessment, (2) assessing the level of pollution risk, (3) identifying mitigation measures, (4) assessing the significance of the effects, and (5) producing the assessment result.

[62] http://iaqm.co.uk/text/guidance/construction-dust-2014.pdf
[63] https://www.tii.ie/technical-services/environment/planning/Guidelines-for-the-Treatment-of-Air-Quality-during-the-Planning-and-Construction-of-National-Road-Schemes.pdf
[64] https://www.standardsforhighways.co.uk/prod/attachments/10191621-07df-44a3-892e-c1d5c7a28d90?inline=true

This approach has been chosen for the assessment of impacts because the number and type of vehicles involved in construction and works, the duration of the works and the travel routes cannot be determined with sufficient confidence at an early stage of the project to allow a detailed assessment of impacts using air pollution dispersion modelling.

The criteria for the need for assessment contained in the guidelines in relation to construction works are summarised in Table 4.8.2.

Table 4.8.2. Assessment necessity criteria

Sensitive recipient	Criterion
Residential buildings, schools, hospitals, places of worship, sports centres and shops, i.e. places where members of the public are likely to be regularly	- 350 m from the boundary of the construction site; or - 50 m from the route(s) of construction vehicles on public roads up to 500 m from the point of entry to the construction site
Protected plant or species habitat, protected biotopes	- 50 m from the boundary of the construction site; or - 50 m from the route(s) of construction vehicles on public roads up to 500 m from the point of entry to the construction site

The DMRB guidelines, in turn, prescribe the assessment criteria for assessing the impacts of road traffic on public roads. According to these guidelines, the impact on air quality from road traffic from construction activities should be assessed if the duration of construction activities exceeds two years. According to the information provided by the proponent, the total time for the construction of the wind farm is expected to be approximately two years (see Chapter 3.5), and hence no further assessment of the air quality impacts of traffic movements on public roads is made. Also, based on the information provided in Chapter 3.5 on the traffic volumes of construction activities, it can be concluded that the annual average daily traffic volume (ADTV) will be less than 1,000 vehicles, while the ADTV of freight vehicles will not exceed 200 vehicles per day, which is assessed as having a negligible effect on air quality in accordance with the DMRB guidelines.

4.8.4 Impact on air quality during construction

Dust pollution from construction work

All construction sites have been assessed and assigned an appropriate level of impact risk based on the scale and nature of the works and the sensitivity of the site to pollution impacts. The level of risk of impact determines the choice of mitigation measures. Risks are assessed qualitatively, with an appropriate risk rating of low, medium or high.

The criteria defined in the IAQM guidelines (see pages 14 to 15 of the guidelines) have been used to assess the amount of dust emissions. The results are summarised in the following tables.

Table 4.8.3 provides a significance rating for the amount of dust likely to be generated by earthworks, construction activities and from the removal of dusty material. The volume is estimated for one assembly area.

Table 4.8.3. Assessment of dust emissions from construction work

Activity	Emission volume significance	Substantiation
Earthworks	Medium	Assembly area 2,500 – 10,000 m^2
Construction	Low	Construction volume < 25,000 m^3
Material removal	High	Length of unpaved roads > 100 m

The sensitivity of an area is assessed by taking into account the distance to the sensitive recipient, the number of recipients and the concentration of background pollution. Both the potential disturbance from construction activities (visually observable dust clouds and deposition) and the potential impact of PM_{10} particles on human health are analysed. Having assessed the information on the sensitivity of the area to dust disturbance, it has been concluded that the potential WTG sites are not in close proximity to human habitation, and therefore the construction of these plants will not cause disturbance to people living in the vicinity. Potential disturbance could occur on sections of road to be newly built or rebuilt and at potential substation construction sites.

In addition to the location of residential dwellings, background pollution levels are also taken into account to assess the sensitivity of the site to potential health effects from pollution (see also Chapter 4.8.2). There are eight sensitive recipients in the area of potential impact from the construction of the wind farm, one within 100 m, four within 200 m and two within 350 m of the boundary of the construction site, including a section of road under construction, and one sensitive recipient within 50 m of the route of vehicles involved in the construction. Taking into account the above and the fact that the level of PM_{10} particles in the area of influence of the proposed activity does not exceed the lower assessment limit value (< 24 µg/m^3), it can be concluded that the construction activities are expected to have a negligible (low) impact on human health.

The information provided in Chapter 4.3 on the natural values of the site and its vicinity, the location of protected habitats and species in and around the area of the proposed activity, and the expert opinion have been used to assess the potential ecological harm. Within a 50-metre radius of the construction vehicle routes on the access roads to the WTGs, two EU habitats 9010*_1 Old or natural boreal forest (biotope polygon LVM 2015 and LVN 2017) are located within 500 m of the infrastructure to be constructed, while within 50 m distance from WTGs L_01, L_03, L_19 assembly sites there are the following EU habitats 9010*_1 Old or natural boreal forest (biotope polygon no. 18SU869_125), 91D0*_1 (biotope polygon No LVM 2018) and 91D0*_3 Swamp forests (biotope polygon No 17TK904_70) 7120_1 Degraded raised bogs with potential or ongoing natural regeneration (biotope polygon No 17TK904_67), as well as a site of *Spinulum annotinum* (*Lycopodium annotinum*) up to 50 m from the WTG L_16 assembly site and a habitat of Orobanche pallidiflora at the WTG L_01 assembly site. These habitats of EU importance may be temporarily exposed to dust from construction works, which may contribute to a slightly more rapid change in the species composition of the habitats in the exposed part of the habitat. However, the loss of habitats and the impact on the species composition in the other parts of the habitats are not expected; for this reason, the impact of dust from construction works is not identified as a negative anthropogenic factor and this group of potential effects is therefore excluded from further assessment.

The overall level of risk of an impact according to the approach described in the IAQM guidelines should be determined by considering the interaction of all the factors listed above. According to the results of the assessment, it can be concluded that the construction of the stations will have a negligible impact and therefore only non-specific mitigation measures are recommended in planning the construction works.

4.8.5 Mitigation measures

Given that the level of risk of construction effects is assessed as insignificant and no quantifiable significant effects from vehicular movements on the access roads are expected, non-specific mitigation measures are applicable to the operation and should be implemented. The recommended measures are summarised in Table 4.8.4.

Table 4.8.4. Measures to be implemented during construction to mitigate air quality impacts

Recommended mitigation measures	Where and when applicable
Construction management	
Record all complaints received about foaming and/or air quality, identify their causes and implement corrective actions	At all construction sites, at all construction phases
Record all emergencies resulting in increased foaming and/or air pollution and the actions taken to address the impact	At all construction sites, at all construction phases
Monitoring	
Carry out regular inspections of construction sites and assess the implementation of anti-foaming measures	At all construction sites, at all construction phases
Organisation of works	
Identify and provide sufficient water for the construction site and haul road wetting	Transport routes, at all stages of construction
Machinery involved in construction work	
Engines must not be allowed to idle, i.e. they should be switched off when not in operation	At all construction sites, at all construction phases
Transport	
Ensuring that road surfaces are wetted or treated with anti-dust material in the event of complaints from residents about dust nuisance	At all construction sites, at all construction phases *To be implemented for foaming in favourable weather conditions, on gravel roads*

Recommended mitigation measures	Where and when applicable
Prioritise the use of asphalted roads for transport, gravel roads only where justified, including where there are no alternative transport routes.	At all construction sites, at all construction phases

4.8.6 Evaluation of alternatives

Given that all the technological alternatives evaluated are considered to be similar in the context of factors that may affect air quality, there is currently no reason to consider any of the WTG models under evaluation as superior to the others. To mitigate potential impacts, guidance is provided on what to consider when starting construction of the proposed wind farm.

4.9 Climate

Climate change is one of the most complex global challenges faced by society today, as well as the systems that sustain humanity, such as the world's oceans and terrestrial ecosystems. Climate change is mainly linked to rising levels of greenhouse gases in the atmosphere, which are having an increasing impact on global climate processes. Greenhouse gases (GHGs) from human activities are mainly produced by burning fossil fuels for energy and by the use of fossil fuels in various forms of transport. Significant emissions are also associated with the effects of land-use change, such as emissions from drainage-affected, organic-rich soils (peat soils) and emissions from deforestation for agricultural land. Scientists predict that the frequency of extreme weather events such as storms, extreme precipitation, floods, extreme droughts and hot spells will increase as the climate changes. In addition, climate change trends can put pressure on both natural systems – ecosystems, animals and plants that cannot adapt to a rapidly changing environment – and on economies – causing damage, extra costs or risks of economic loss. Moving away from fossil-fuelled power plants and towards renewable energy sources (RES) is essential to reduce greenhouse gas emissions from human activities and tackle climate change.

4.9.1 International, EU and national climate regulatory frameworks

In the context of international agreements, climate protection targets in Latvia have been set within the framework of the EU Joint Commitment[65] to mitigate climate change by 2030, which was made under the Paris Agreement of the United Nations Framework Convention on Climate Change[66:]

1) Reducing GHG emissions and increasing CO_2 sequestration in all sectors;
2) reduce total GHG emissions of all EU member states by at least 40% below 1990 levels by 2030 in a cost-effective way.

The European Union's climate planning documents anticipate:

- European Commission 2020 communication on increasing the EU zone's ambitions related to mitigating climate change up to 2030. Investing in a climate-neutral future

[65] https://eur-lex.europa.eu/legal-content/LV/TXT/?uri=CELEX:32016D1841
[66] https://likumi.lv/ta/lv/starptautiskie-ligumi/id/1730

for citizens[67] – aim for GHG emission reductions of at least 55% by 2030 and climate neutrality by 2050;

- EU roadmap for transforming the EU into a competitive, low-carbon economy by 2050[68]: in order to transition to a competitive low-carbon economy, the EU is ready to reduce its total emissions by 80-95% by 2050 compared to 1990 levels;
- *Opinion of the Committee of the Regions — A Clean Planet for all — A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy*[69] – The EU is ready to achieve climate neutrality by 2050, which defines a non-zero EU total GHG emissions pathway where overall GHG emissions are fully covered by CO2 sequestration, or no GHG emissions are emitted due to the use of certain technologies;
- Decision of the European Parliament and of the Council of the European Union of 6 April 2022, on a general EU environment action programme for 2030, setting out a general EU environment action programme for the period up to 31 December 2030 (8. Environment Action Programme)[70], formulates the priority objective of reducing greenhouse gas emissions rapidly and predictably while increasing removals in natural sinks in the EU in order to achieve the 2030 greenhouse gas emission reduction target set out in Regulation (EU) 2021/1119, in line with the EU climate and environment objectives, and to achieve climate neutrality in the EU by 2050.

To meet the 55% GHG emissions reduction target by 2030, some EU legislation was revised to ensure EU policies are in line with the new climate targets, including by revising the effort-sharing regulation [71] and setting Latvia a target to reduce its non-EU emissions trading system (ETS) GHG emissions by 17% compared to 2005 levels.

European climate policy is closely linked to the renewable energy policy. In May 2022, the REPowerEU plan of the European Commission was adopted[72], one of the pillars of which is to significantly increase renewable energy capacity in the EU. REPowerEU sets a binding target of 42.5% renewable energy by 2030, with the aim of increasing the target to 45%.

Latvia currently has a number of policy planning documents on climate change mitigation, which set energy and climate change mitigation targets and also define policies to achieve these targets.

The sustainable development strategy of Latvia until 2030[73] *aims to ensure the country's energy independence by increasing energy self-sufficiency and integrating into EU energy networks. The strategy also sets numerical targets for GHG emission reductions, renewable energy sources (RES) and energy intensity, as well as innovation targets for 2030. The target for*

[67] https://eur-lex.europa.eu/legal-content/LV/TXT/HTML/?uri=CELEX:52020DC0562&from=LV
[68] https://eur-lex.europa.eu/legal-content/LV/TXT/PDF/?uri=CELEX:32018R1999&from=LV
[69] https://eur-lex.europa.eu/legal-content/LV/TXT/HTML/?uri=CELEX:52018DC0773&qid=1575363669558&from=LV
[70] https://eur-lex.europa.eu/legal-content/LV/TXT/HTML/?uri=CELEX:32022D0591&from=EN
[71] https://eur-lex.europa.eu/legal-content/LV/TXT/HTML/?uri=CELEX:32023R0857
[72] https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/repowereu-affordable-secure-and-sustainable-energy-europe_en
[73] https://pkc.gov.lv/lv/valsts-attistibas-planosana/latvijas-ilgtspejigas-attistibas-strategija

the share of energy from renewable sources in total gross final energy consumption for 2030 is set at 50%.

The national development plan of Latvia for the 2021–2027 period [74]sets out the task of reducing the Latvian economy's greenhouse gas emissions through climate change mitigation solutions and climate technology breakthroughs, and ensuring increased carbon sequestration towards a climate-resilient economy, targeting high energy efficiency and decarbonising the transport system. The plan sets the target of reducing GHG emissions intensity on a trajectory towards the target for 2030: 292 t CO_2 eq per EUR million

The national energy and climate plan for the 2021–2030[75] period forecasts an increase in GHG emission reductions and RES production, with the increase in energy production mainly coming from wind farms, but also a small increase in solar electricity production. According to the targets of this plan, the share of electricity generated from RES should reach at least 67% in 2030.

The Latvian climate act is also currently being drafted. The draft climate act was put out to public consideration in October 2023.[76] The aim of the act is to ensure climate change mitigation and climate resilience in order to achieve climate neutrality by 2050 at the latest, ensuring the achievement of national climate targets in line with European Union and international commitments, taking into account ecological, social and economic sustainability. The act is based on the Paris Agreement commitments under the United Nations Framework Convention on Climate Change.

4.9.2 Impact assessment approach

A plan has been made for the creation of a capacity of approximately 19 WTG (one WTG is expected to have a rated generation capacity of more than 6 MW) at Lode wind farm.

The climate impacts of the proposed action consist of the direct GHG emissions associated with the construction and operation of the WTG and the GHG emission reductions associated with the substitution of fossil fuel energy production and associated GHG emissions with RES energy.

GHG emissions associated with the development of the WTG wind farm include:

a) Life cycle emissions – GHG emissions related to the manufacture, transport, installation and post-operational dismantling of a wind power plant;
b) GHG emissions and loss of sinks associated with land-use change (deforestation, drainage of peat or peatland soils, and loss of potential CO_2 sinks in deforested areas);
c) Reduction or substitution of GHG emissions.

The life cycle of a wind power plant can be divided into five main phases: (1) extraction of materials, (2) manufacture of major components, (3) installation, (4) operation and maintenance, (5) dismantling, recycling and end-of-life disposal. The assessment of each life cycle stage includes the relevant transport activities and energy consumption.

[74] https://pkc.gov.lv/lv/nap2027
[75] https://www.em.gov.lv/lv/nacionalais-energetikas-un-klimata-plans
[76] https://tapportals.mk.gov.lv/structuralizer/data/nodes/d3c99cf3-67bb-455d-b908-7fa182b2d87d/preview

In addition to the burning of fossil fuels, greenhouse gases are also emitted to the atmosphere through natural processes, from natural sources. These processes occur at different phases, such as during the decomposition of carbon-containing organic compounds. Carbon-containing compounds can accumulate in organic litter in forest ecosystems and in soils in both forest and agricultural areas, and in particularly high concentrations in peat and organic sediments in wetland ecosystems. Accordingly, another potentially significant source of GHG emissions to be assessed in the context of the development of WTG wind farms is emissions related to land-use change, including emissions that may arise from peat soils as a result of their drainage.

Changes in GHG emissions associated with the land use, land use change and forestry (ZIZIMM) sector should be assessed taking into account the existing distribution of land uses on the site of the proposed activity and the planned land-use change, which involves a transformation of land use from forest and agricultural land to built-up areas (WTG sites and roads) (according to the IPCC guidelines). Deforestation of all kinds is one of the most important sources of emissions, which tend to increase with the development of the road network and industrial infrastructure, with a corresponding transformation of areas for housing in the WTG wind farm. In contrast, agricultural areas, in particular arable land, are among the largest emitters of GHGs. Accordingly, changing the land use of these areas to a use that is neither GHG-trapping nor GHG-emitting can be conditionally considered as reducing GHG emissions.

The change in emissions associated with the land use, land use change and forestry (ZIZIMM) sector must be measured as the difference between the GHG emissions/ removals before the implementation of the measure and the GHG emissions or removals in ecosystems after the implementation of the measure in the area of the proposed activity.

The calculation of GHG emissions and CO_2 removals uses the guidelines developed by the Intergovernmental Panel on Climate Change (IPCC), as set out in the reporting guidelines under the convention – the 2006 IPCC guidelines for the preparation of national greenhouse gas inventories.

The third aspect of GHG emissions covered by the assessment is the impact of the proposed activity on the reduction or substitution of GHG emissions in energy production, in the form of the substitution of fossil energy (and associated GHG emissions) by RES-generated energy.

4.9.3 Calculation of GHG emissions and removals from the proposed activity

The climate impact of the proposed activity is assessed as the change in the type and amount of greenhouse gas emissions resulting from the proposed activity. These consist of changes in GHG emissions associated with the implementation of the proposed activity (1) the life cycle of the WTG, (2) construction – deforestation emissions and emissions associated with land-use change, and (3) reduction or substitution of GHG emissions associated with the implementation of the proposed activity – substitution of energy (and associated GHG emissions) from fossil resources by energy produced from RES.

WTG life cycle emissions

According to the estimates of the IPPC Task Force[77,] analysing the life cycle CO2 emissions of different types of electricity generation, electricity generation in a WTG only emits an average

[77] https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_chapter7.pdf

of 7 g to 56 g CO_2eq, with most of the emissions coming from the construction of infrastructure and the extraction of materials. These emissions are significantly lower than those associated with, for example, the power generation a combined cycle gas plant generates (which is approximately 500 g CO_2eq, and where emissions consist of both direct emissions and emissions associated with the gas extraction process and associated methane losses), or biomass plants (which is approximately 125 g CO_2eq, and where a large part of the emissions are due to infrastructure development and biogenic emissions and albedo effects).

GHG emissions from the WTG construction

A preliminary assessment suggests that an area of approximately 46.76 ha (including access roads within the assembly field) would be required for the construction of all 19 potential WTG sites. According to the information available at the time of the environmental impact assessment, the assembly areas and the additional access roads to be constructed will be located on agricultural land, uncultivated agricultural land and forested areas.

For the calculation of GHG removals, it is assumed that the area to be converted to other land uses in the area of the proposed activity is converted to an industrial land use, with no GHG removals or emissions. This results in a worst-case scenario, as it will actually be possible to use part of the land to be transformed for future economic activities after the construction of the WTGs (see Chapter 3.3). The land uses in the area of the proposed activity that are planned to be transformed into other land uses are:

- agricultural land is considered to be a source of GHG emissions, so the implementation of the proposed activity and the change of existing land uses to non-GHG emitting uses will reduce GHG emissions from the proposed activity;
- 17.3 ha of forest, where GHG removals are estimated as CO_2 sequestration in living biomass (wood), dead wood and soil organic matter. The transformation of this area will be associated with an increase in GHG emissions. It is important to note that the proposed wind farm is subject to the requirements of the act on the facilitated procedures for the construction of the energy supply buildings required for the promotion of energy security and autonomy, and article 9, paragraph one of the act provides that if wind power plants are built on forest land, the negative effects of deforestation must be compensated by afforestation. Afforestation of new areas is expected to lead to a long-term recovery of the capacity to sequester emissions.

Accordingly, it can be concluded that the long term impact of GHG emissions from the ZIZIMM sector can be assessed as neutral, taking into account the compensation mechanism envisaged.

GHG substitution or sequestration

The most significant part of the GHG emissions balance is the reduction or substitution of GHG emissions associated with the proposed activity – the replacement of fossil energy (and associated GHG emissions) by RES energy.

In order to estimate the GHG emissions displaced by RES-based power generation, a calculation of the GHG emissions change associated with the transfer of electricity produced during the introduction of new power generation technologies to the electricity grid has been carried out. Cabinet regulation no. 42 of 23 January 2018, on a methodology for calculation of GHGs, establishes a common methodology for the calculation of GHG emissions to assess the climate change impact of measures and projects, including the climate change impact of planned or implemented measures that are intended to introduce renewable energy technologies. The change in GHG emissions associated with the introduction of new electricity generation technologies during the transfer of the electricity generated to the electricity grid is calculated using the following equation:

$$m\ SEG\ izm = Q\ sar\ AER \times K\ el\ vid - Q\ sar\ AER \times K\ el\ par, kur$$

$m\ SEG\ izm$ – Change in GHG emissions, in t CO_2 eq per year;

$Q\ sar\ AER$ – the amount of electricity generated by renewable energy technologies to be fed into the grid, in MWh per year;

$K\ el\ vid$ – CO_2 emission factor for electricity in accordance with article 1 of Annex 1 to cabinet regulation no. 42 of 23 January 2018, on a methodology for calculation of greenhouse gas emissions, in t CO_2/MWh;

$K\ el\ par$ – CO_2 emission factor for electricity transmission in the electricity grid in accordance with article 1 of Annex 1 to cabinet regulation no. 42 of 23 January 2018, a methodology for calculation of greenhouse gas emissions, in tCO_2/MWh.

Based on the forecasts of the energy production potential provided by the WTG producers, as well as the data on wind speeds in the area of the proposed operation accumulated so far, it is estimated that the Lode wind farm could generate between **374.49** and **594.51 GWh** of electricity per year.

In accordance with Article 1 of Annex 1 to cabinet regulation no. 42 of 23 January 2018, on a methodology for calculation of greenhouse gas emissions, the factor for electricity transmission in the electricity grid is set at 0.007 t CO_2/MWh. In accordance with Annex 1 to the aforementioned regulation, the CO_2 emission factor for electricity produced in Latvia must be calculated using the following formula:

$$K\ el\ vid = \Sigma(Q\ sar\ fos\ el \times K\ kur)\ Q\ sar\ el, kur$$

$K\ el\ vid$ – CO_2 emission factor for electricity produced in Latvia, t CO_2/MWh;

$Q\ sar\ fos\ el$ – amount of electricity produced in Latvia using fossil fuels, MWh;

$K\ kur$ – CO_2 emission factor for the type of fuel used in accordance with article 1 of Annex 1 to cabinet regulation no. 42 of 23 January 2018, on a methodology for calculation of GHGs, in tCO_2/MWh;

$Q\ sar\ el$– amount of electricity produced in Latvia, MWh.

Based on data provided by the Ministry of Climate and Energy (KEM)[78], the CO_2 emission factor for electricity produced in Latvia in 2021 (latest available information) is 0.0735 t CO_2/MWh.

In line with the above, the potential reduction of GHG emissions associated with the transfer of electricity produced by new generation technologies to the electricity grid is estimated to

[78] https://www.kem.gov.lv/lv/siltumnicefekta-gazu-emisiju-aprekina-metodika

range from 24 791.24 t CO_2 eq./year to 39 356.56 t CO_2 eq per year, depending on the selected model of the WTG turbines.

The avoided GHG emissions from power generation over the lifetime of the WTG (25 years) are estimated (depending on the WTG technology) at between 619 781 and 983 914 t CO_2eq.

4.9.4 Measures to mitigate climate impacts

In the event of implementing the proposed activities, energy generation from renewable sources will be ensured. The electricity generated will replace the fossil fuel energy and associated greenhouse gas emissions needed to produce it, with benefits for the climate. The proposed activity will help to reduce CO_2 emissions that would otherwise occur if the same energy produced by the proposed WTG were otherwise partially or wholly produced in conventional fossil fuel-fired power generation plants. Given the potential lifetime of the proposed WTG of 25-30 years, the replacement of emissions will take place over a substantial period of time. This is a significant positive effect in the long term.

The replacement of GHG emissions over the lifetime of the WTG is expected to be significantly higher than the life cycle emissions of the turbines as well as the emissions associated with the deforestation required for the planned construction of the WTG and the proposed activity has a positive effect on the climate. In view of the above, no mitigation measures are required.

4.9.5 Evaluation of alternatives

In the context of technological alternatives, the construction of plants with the highest electricity generation potential, increasing the avoided GHG emissions, is considered a better option.

4.10 Geology and hydrology

In line with the EIA programme, this chapter presents:

- a description of the geological structure and engineering geological conditions of the site that determine the construction conditions;
- the geological description of the site, a description of the mineral extraction sites and the impact of the proposed activity on them;
- characteristics of the watercourses and water bodies in the area
- characteristics of natural drainage and amelioration systems likely to be affected by the proposed activity, including during construction, characteristics of the potential for flooding (including flow directions);
- characteristics and use of nearby water abstraction points and groundwater deposits.

A summary of the potential impacts on these aspects is presented at the end of the chapter.

4.10.1 Impact assessment approach

The information gathered and the impact assessment were based on information available in the municipality's planning documents and public information sources:

1) Information from the Latvian Centre for Environment, Geology and Meteorology (LVGMC):

- Subsoil information systems[79];
- Water and flood management information systems[80];
- Unified environmental information systems (information on groundwater and bore-holes)[81];

2) Ministry of Agriculture real estate (MARE) information from:
   - Land amelioration cadastre information system[82].

4.10.2 Geomorphological, geological and engineering geological conditions

The planned area of the Lode wind farm is located in the northern part of the Burtnieka Plain in the North Vidzeme lowlands, to the west of the Ērģemes hills of the Sakalas upland. The North Vidzeme lowland is a divergent lowland; it occupies a large depression in the bedrock surface that expands in the direction of glacial flow. Its topography is formed by extensive fields of divergent drumlins, which formed under conditions of outburst flow of ice masses, and thus their long axis forms a spreading fan. As the ice masses slowed unevenly along the slope of the Ērģemes hills in the Sakalas upland, convergent drumlin fields are also observed in the vicinity of the assessment area, where the long axis of the drumlins coalesces in the direction of glacier flow. The Burtnieka Plain is located in a depression in the bedrock surface that was filled by the Burtnieka ice sheet during the last glaciation.

The plain is characterised by a thin quaternary cover. It is structured as undulating plains with drumlin landforms.[83] Drumlins are elongated hills and mounds oriented in the direction of glacial flow. Divergent drumlins are composed of folded glacigenic or glaciolacustrine sediments (older moraine – sandy gravel or clayey sediments). Convergent drumlins are composed of diapiric folded glaciofluvial sediments or pre-quaternary sediments: aleurolite, sandstone and clay.[84] The assessment area is underlain by quaternary sediments of the Middle Devonian Burtnieki suite *D_2br*, consisting of red-brown or yellow-brown micaceous sandstones, mottled and red-brown, sometimes green-grey aleurolites, aleurotic clays and claystones, and, in the northernmost part of the site, the *D_2ar* sedimentary rocks of the Middle Devonian Arukilas suite, consisting of fine-grained, light red-brown sandstones, red-brown, sometimes green-grey, mottled, aleurotic clays, claystones and aleurolites.[85] The thickness of the quaternary sediment cover in the area is mostly in the range of 10 m to 20 m, up to 10 m near the Arakstes village, and over 20 m south of Ipiķi.[86]

[79] https://videscentrs.lvgmc.lv/iebuvets/zemes-dzilu-informacijas-sistema
[80] https://videscentrs.lvgmc.lv/lapas/udens-apsaimniekosana-un-pludu-parvaldiba
[81] https://videscentrs.lvgmc.lv/lapas/vienota-vides-informacijas-sistema
[82] https://www.melioracija.lv/
[83] Zelčs, V. 2018. Large landforms. Nikodemus, O. et al. (eds. in chief) Latvia. Land. Nature. Nation. Country. Riga: Academic Publishing House of the University of Latvia, 89–93.
[84] Zelčs, V. 2018. Glacial landforms. Nikodemus, O. et al. (eds. in chief) Latvia. Land. Nature. Nation. Country. Riga: Academic Publishing House of the University of Latvia, 93–109.
[85] Map of pre-quaternary sediments. 2010. Map of pre-quaternary sediments at a scale of 1:200 000. LU ĢZZF WMS. Available at: http://kartes.geo.lu.lv/karte/
[86] Quaternary thickness map, 2010. Map of quaternary sediment thicknesses. Available at: http://www.geo.lu.lv/karte/

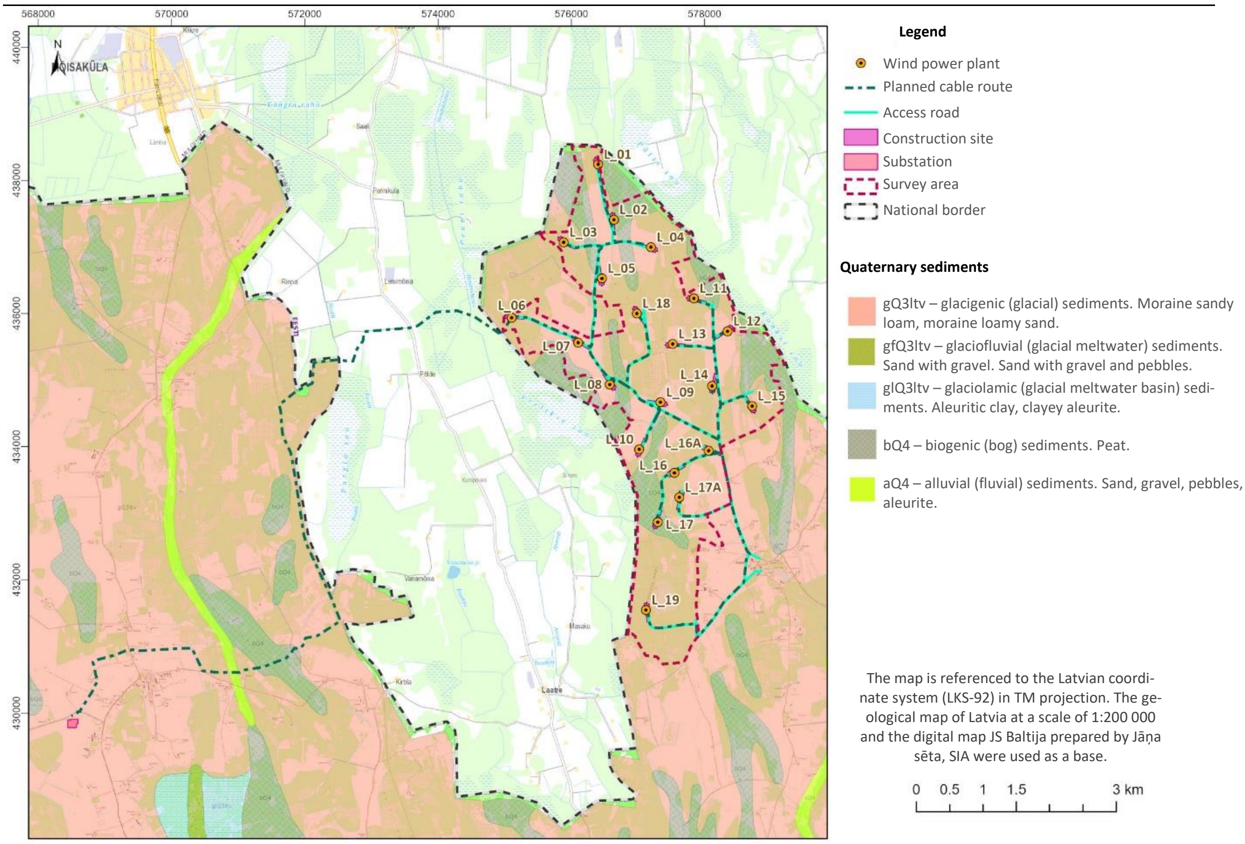


Figure 4.10.1. Quaternary sediments in and around the WTG study area

The area around the planned WTG is characterised by moraine deposits, with moraine hills, dykes and ridges. But the planned cable line connecting the Lode WTG with the existing 330 kV line TEC-2 – EST in the parish of Ipiķi and the substation construction site is located in the moraine plain, with a characteristic drumlin terrain.[87] Peat deposits occur in the inter-tidal depressions.[88] The topography in the area of the planned WTG wind farm, northwest of the village of Arakstes, varies between 69 and 81 m, and in the path of the planned cable route from 63 m. There are no lakes in the area, but there are several small rivers flowing southeastwards towards the river Rūja in the Salaca basin - Veserupīte, Krūmiņupīte, Silupīte, Raudava, Melderīšupīte, Pestava. The surrounding area is home to frequent bogs: Urgas, Bērzu, Lucas, Lobinu and Titas bogs.[89]

The following quaternary sediments are present at potential WTG construction sites:

- **gQ3ltv** - glacigenic (glacial) sediments - moraine sandy loam, moraine loamy sand (WTG L_02, L_04, L_05, L_06, L_07, L_08, L_09, L_10, L_11, L_12, L_13, L_14, L_15, L_16, L_17, L_18, L_19, substation, partly also VES L_01, L_03, L_06, L_15);
- **bQ$_4$** - Biogenic (bog) sediments - peat (WTG L_01, L_03, L_06, L_15, partly also WTG L_02, L_08, L_10, L_19).

[87] Latvian terrain. National Encyclopedia. Available at: https://enciklopedija.lv/skirklis/26548-Latvijas-reljefs
[88] Map of quaternary sediments. LVM GEO. Available at: http://www.lvmgeo.lv/kartes
[89] LVM GEO. Geographic information system. Available at: www.lvmgeo.lv/kartes

Information on the distribution of quaternary sediments in the study area and its vicinity is provided in Figure 4.10.1. The distribution of sediments shown on the map is more informative and may not correspond to the actual situation on the ground, given the scale and level of detail of the map. The assessment of the sediments present at the WTG construction sites has already been analysed in more detail, taking into account the terrain and forest types. To obtain more precise data, exploratory drilling should be carried out at specific locations of the planned infrastructure during the design phase.

According to the Latvian Building Code LBN-207-15, on geotechnical design, a detailed engineering investigation is required for the construction of a WTG to determine the structure of the soil, its physical and mechanical properties and possible changes during construction and operation of the structure. In the case of footing or piling, foundation design should be carried out to calculate the depth and dimensions of the foundations and to determine the most appropriate methods of construction.[90]

According to the depth-to-water mapping data[91,] the groundwater table in most of the area of the proposed operation is up to 5 m deep, and up to 10 m to 15 m deep near the village of Ipiķi. According to the mapping data, the groundwater table at seven potential WTG sites (WRG L_01, L_03, L_06, L_15, L_16, L_17, L_19) is up to 1 m deep (see Figure 4.10.2).

According to the results of the analysis of long-term data from the Baltic Area Seismological Observation Network (BASEVEN), the study area is located in a seismically low-active zone, where the epicentres of almost all recorded earthquakes are outside Latvia. In 2022, 214 credible seismic events have been recorded in the Baltic region. 19 seismic events have been recorded in Latvia's land territory and maritime area. Seismic observations have been recorded mainly in the western part of Latvia. The strongest event was observed on 20 September on the Latvian land territory near Kolka, with a magnitude of 2.6.[92] In the map of seismogenic zones of Latvia, where the existing and potential future earthquakes have been analysed, the nearest safe zone (ZCR) to the study area is Sigulda, the potential zone (ZCRP) is Valmiera and the seismotectonic zone (ST) is Svētupe. These areas are subject to possible tremors with an intensity of up to 6 on the MSK-64 scale at the epicentre.[93]

[90] Regulations on Latvian building code LBN 207-15, on geotechnical design. cabinet regulation no. 265. adopted on 2 June 2015.

[91] Interreg Baltic Sea Region project WAMBAF Tool Box (#X007) and a LIFE study on the demonstration of climate change mitigation options in fertile organic soils in the Baltic States and Finland (LIFE OrgBalt, LIFE18 CCM/LV/001158).

[92] https://videscentrs.lvgmc.lv/lapas/seismologiskais-monitorings

[93] https://dspace.lu.lv/dspace/bitstream/handle/7/4865/36137-Valerijs_Nikulins_2008.pdf?sequence=1

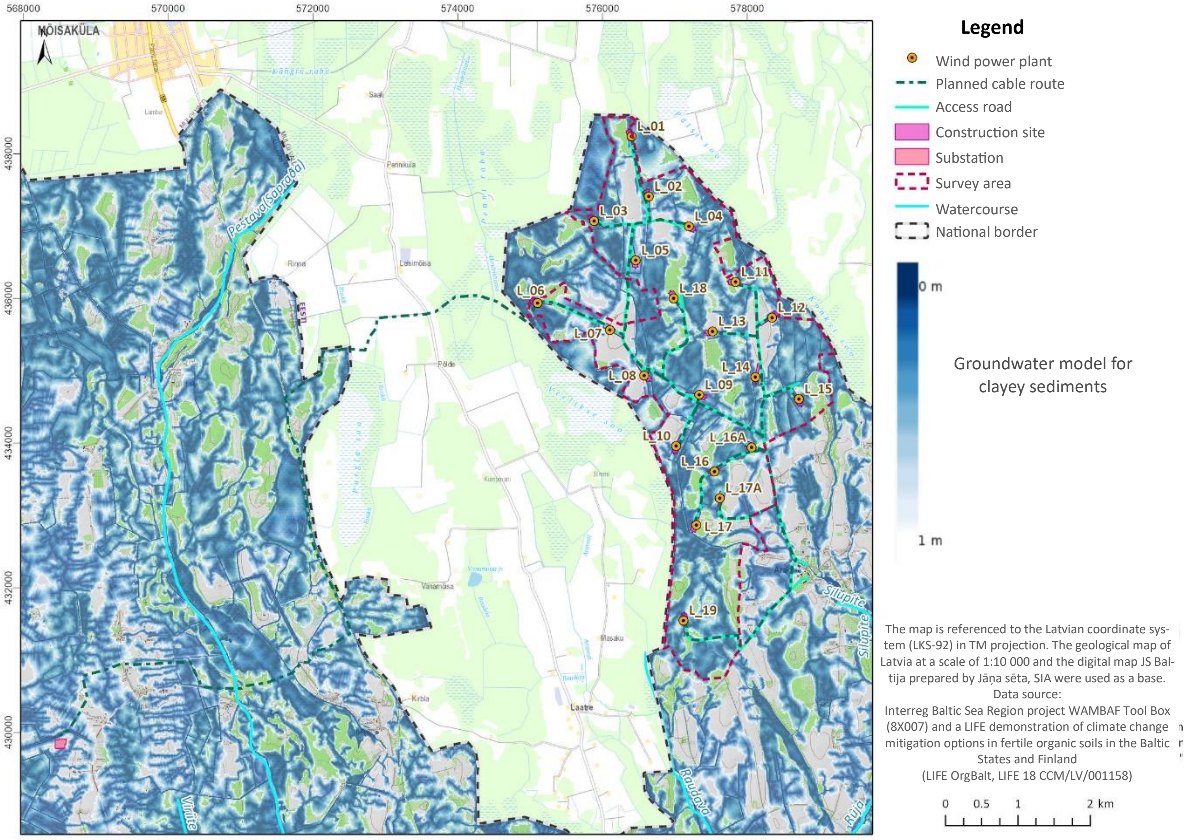


Figure 4.10.2. Groundwater model for clayey sediments in and around the WTG study area

4.10.3 Mineral deposits

According to the information available in the subsoil information system of the Latvian Environment, Geology and Meteorology Centre (LVGMC)[94] and the Estonian Land Service subsoil information system[95], there are relatively numerous peat deposits and deposits in the territory of the proposed activity and its vicinity. Real peat extraction has been carried out in the Akmeņgravas forest massif swamp, and also in a small area in the Tītas swamp. Peat extraction is currently active in the Pätsi peat bog in Estonia. There are also sand and sand-gravel deposits, a freshwater limestone deposit and areas of inferred sand and sand-gravel resources within or in close proximity to the assessment area (see Figure 4.10.3).

The nearest mineral extraction site, Arakste (B1864), is located to the east of the site, approximately 300 m from the construction site of WTG L_15, while the nearest predicted mineral resource site, Ūskalns (B17132), is located to the north of the site, approximately 400 m from the construction site of WTG L_06. Geological surveys on the Arakstes deposit (B1864) were carried out in 1982. It has sand and sand-gravel resources of varying coarseness. The site has a history of mineral extraction and information is available on the issue of a mining licence on 5 June 2009, which was annulled on 1 November 2013. According to the available information, there is currently no mineral extraction from the deposit. As of 2015, the estimated reserves (category N) are 7,800 m^3 sand-gravel and 51,100 m^3 of sand.

[94] https://videscentrs.lvgmc.lv/iebuvets/zemes-dzilu-informacijas-sistema
[95] https://xgis.maaamet.ee/xgis2/page/app/maardlad

The Estonian peat extraction site Pätsi (VILM-037) is located approximately 420 m from the construction site of WTG L_01. The site contains poorly to well decomposed peat. The mining licence was issued on 6 September 2007.

Prospecting for minerals at the Ūskalna (B17132) inferred mineral resource area was carried out in 2019. Two potential sand fields with estimated reserves (category P) of 147,400 m^3 and 7,800 m^3. The exploration concluded that the reseves are characterised as low-grade, and are not a prospective mineral deposit.

In the western part of the assessment area, in the parish of Ipiķi, there are three mineral deposits and inferred resource areas in the vicinity of the planned cable route and substation.

- Prospecting for minerals at the Ķirbēnu (B17340) prospected mineral resource area was carried out in 2021. Resources of sand and gravel were identified. As of 2022, the estimated reserves (category N) were 180,000 m^3 of sand-gravel and 147,700 m^3 of sand.
- Geological surveys were carried out in 1963 on the Lake Tītas deposit (B450). It contains greyish-white or blue-grey freshwater lime. It is loose and powdery, with remains of plant roots and shells. According to the available information, no mineral extraction has been carried out in the deposit. As of 1963, the explored reserves (category A) amounted to 31,000 m^3 of freshwater lime.
- Geological prospecting of the Veckabuli deposit (B1170) was carried out in 1984. It has fine-grain to medium-grain sand resources, some of which are gravelly. The deposit has a history of mineral extraction, but according to the available information, no mineral extraction is currently taking place. As of 1984, the explored reserves (category A) amounted to 36,000 m^3 of sand.

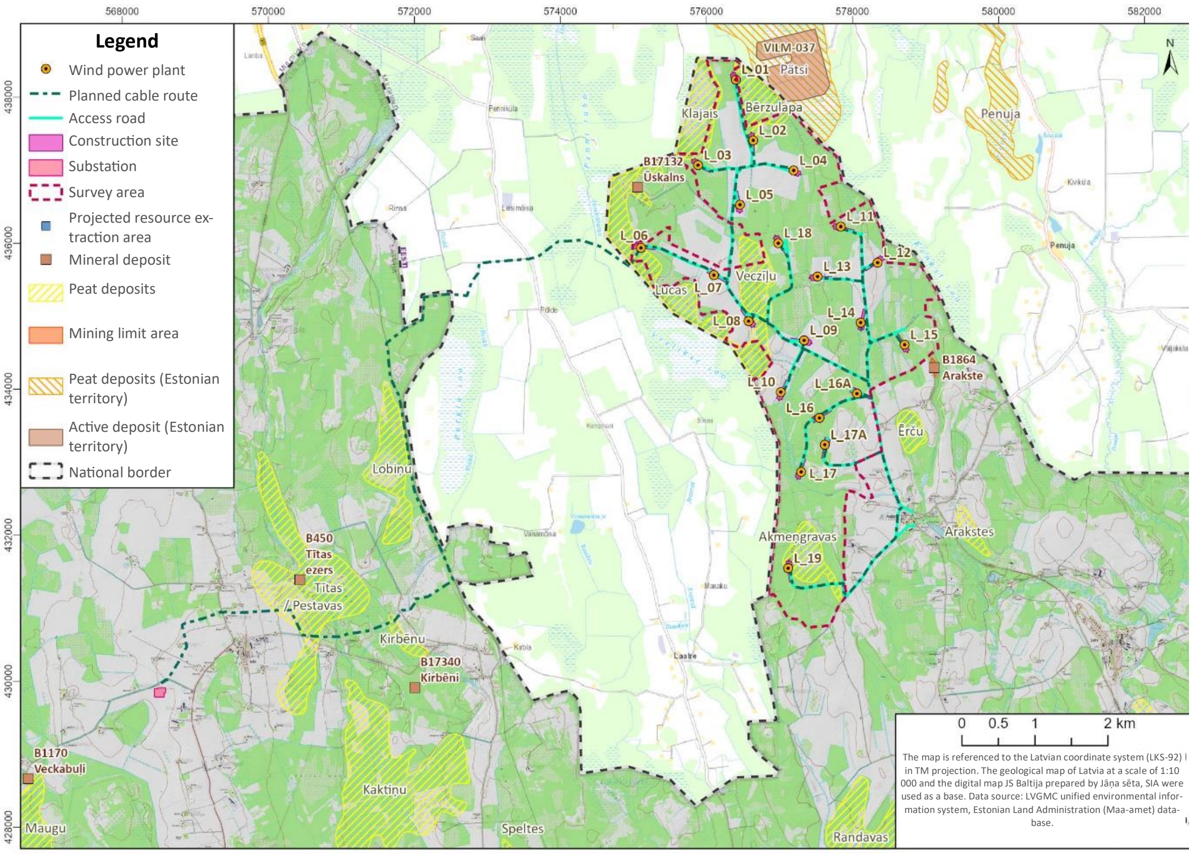


Figure 4.10.3. Mineral deposits and inferred resource areas in and around the WTG study area

Table 4.10.1 summarises information on mineral deposits and inferred resource areas in the vicinity of the proposed activity.

Table 4.10.1. Mineral deposits in the vicinity of the proposed activity

Name	Minerals	Status	Distance to the nearest WTG construction site, m
Arakste (B1864)	Sand, sand-gravel	Extraction suspended	320 (WTG L_15)
Pätsi (VILM-037)	Peat	Active extraction	420 (WTG L_01)
Uskalns (B17132)	Sand	Projected resource area	770 (WTG L_06)
Lake Tītas (B450)	Freshwater limestone	Extraction not started	415 (cable route) 6500 (L_06)
Ķirbēni (B17340)	Sand, sand-gravel	Projected resource area	955 (cable route) 5300 (L_19)
Veckabuļi (B1170)	Sand	Extraction suspended	2100 (substation)

4.10.4 Characteristics and use of nearby water abstraction points and groundwater deposits

The area of the proposed activity is located in the eastern part of the Baltic artesian basin and is part of the Arukila-Amata (D_{2-3}ar-am) groundwater aquifer complex. Taking into account the information available in the LVGMC unified environmental information system[96], where information on groundwater and boreholes is maintained and updated, there are no registered water supply boreholes in the study area of the proposed activity, but 10 boreholes (D_2ar, D_2br, Q) providing water supply are registered within a radius of 1 km (see Figure 4.10.4).

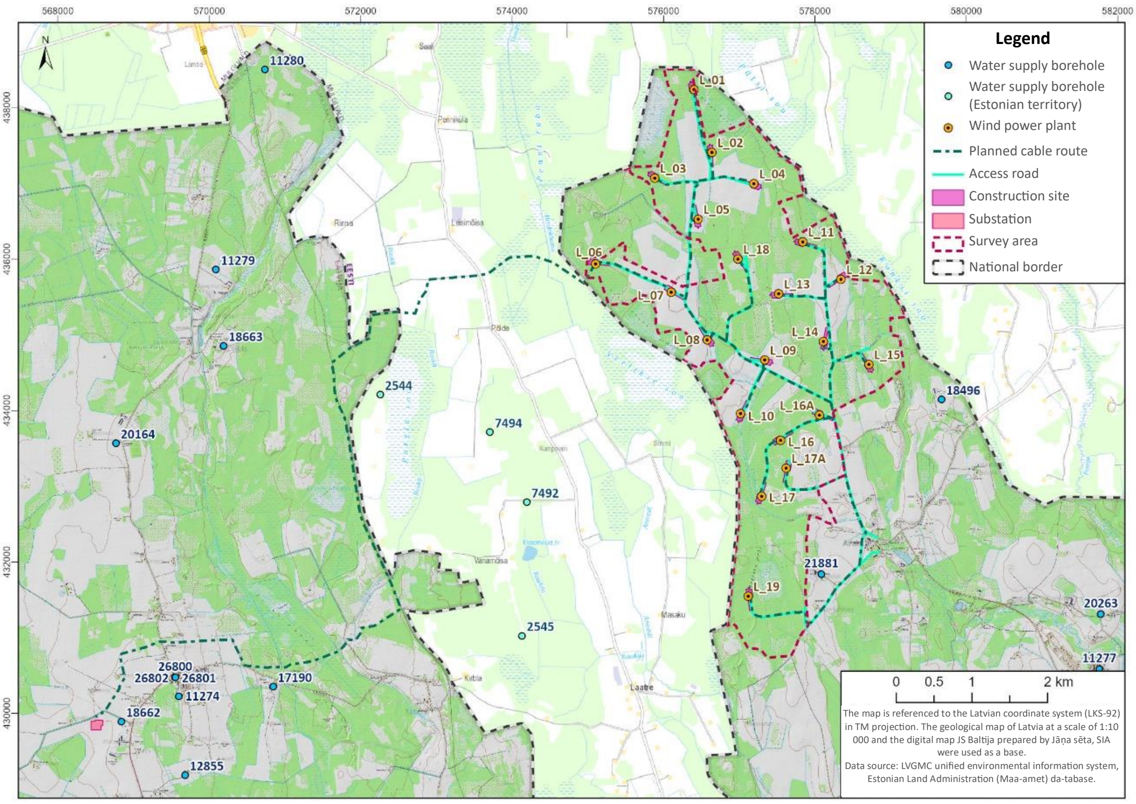


Figure 4.10.4. Water supply boreholes in and around the WTG study area

The information available on the water boreholes in the vicinity of the proposed activity in the unified environmental information system of the LVGMC is summarised in Table 4.10.2.

[96] https://videscentrs.lvgmc.lv/lapas/vienota-vides-informacijas-sistema

Table 4.10.2. Underground water supply boreholes closest to the proposed development and adjacent area

Bore-hole No.	Address	Year of drilling	Water aquifer (geological in-dex)	Bore-hole depth, m	Borehole status
11,274	Ipiķi, Ipiķi water tower	1969	D_2ar	100	opera-tional
17190	Nuķi village	1965	D_2ar	97	un-known
18,496	Sudmalas (the former Vecātes farm)	1967	D_2ar	70	un-known
18,662	Rentes farm	1974	D_2ar	100	un-known
21881	Gaiduļi	2007	D_2ar	88	un-known
26,800	Ipiki, land parcel Depo	2022	*Q*	11	un-known
26,801	Ipiki, land parcel Depo	2022	D_2br	24	un-known
26,802	Ipiki, land parcel Depo	2022	D_2ar	100	un-known
7,492	-	-	-	-	-
7,494	-	-	-	-	-

4.10.5 Characteristics of the surface water bodies closest to or crossing the site

The territory of the proposed activity falls within the Gauja river basin district[97] and according to the information from the melioration cadastre of the Ministry of Agriculture[98] the territory falls within the catchment areas of the Veserupīte, Krūminupīte, Roja, Raudava, Pestava and Ramat[a99] rivers. Watercourses of national importance crossing the study area of the proposed activity are:

- Veserupīte (land amelioration cadastre no. 5452984:01);
- Krūminupīte (land amelioration cadastre no. 5452982:01);
- Pestava (land amelioration cadastre no. 54526:01).

Shared watercourses are located in the eastern and western parts of the study area. The agricultural land in the area, which is mainly located on elevated terrain, has a dense drainage network, while drainage ditches have been installed in depressions in the terrain, which are

[97] Water management act. Available at: https://likumi.lv/ta/id/66885-udens-apsaimniekosanas-likums
[98]Land amelioration cadastre information system. Available at: https://www.melioracija.lv/
[99] cabinet regulation no. 397. Regulation on the classification of water management districts. Available at: https://likumi.lv/ta/id/300155-noteikumi-par-udens-saimniecisko-iecirknu-klasifikatoru

predominantly forested. A denser network of ditches is located in the southern part of the WTG wind farm, in the vicinity of WTG L_19 (see Figure 4.10.5).

The planned infrastructure associated with the wind farm is mostly located on well-drained agricultural land, while the locations and construction sites of the WTGs themselves are located both on agricultural land and in forested areas, which are also mostly reclaimed. Currently, the spatial plan of Rūjiena Region is in force in the assessment area, according to the division of administrative territories as it was before the administrative-territorial reform, as the new spatial plan of Valmiera Region is still under development.

In accordance with the regulation on the use and development of the territory of Rūjiena region (TIAN)[100], any surface water and groundwater drainage system in the territory of the proposed activity must be maintained throughout the land unit and along its perimeter, unless otherwise specified in the building regulations or detailed planning. Detailed information on the widths of the protection zones for water bodies is provided in chapter 2.2 of the EIA report.

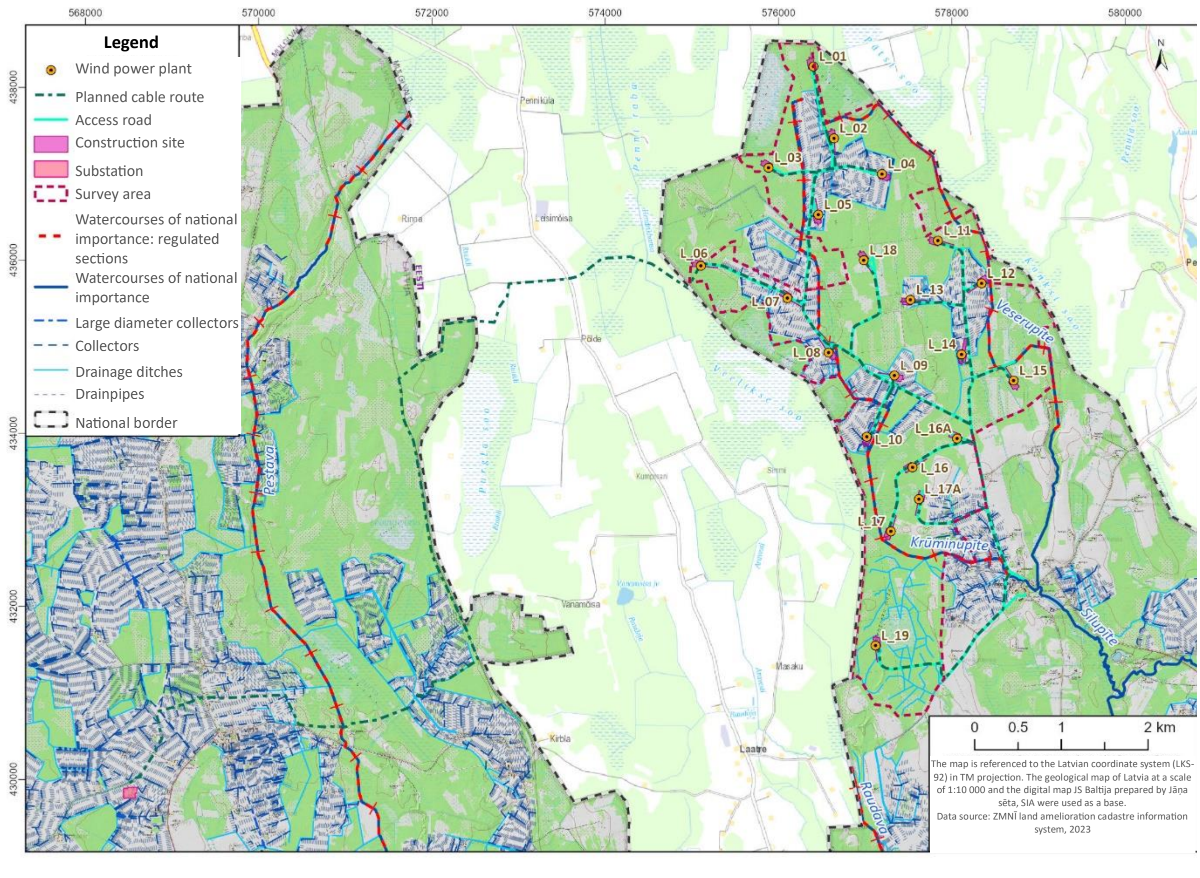


Figure 4.10.5. Watercourses and drainage ditches of national importance in and around the WTG study area

As part of the proposed action, it is planned to construct new access roads over the Krūmiņupīte, connecting WTG L_09 with WTG L_10 and WTG L_03 with WTG L_05. The planned access roads will also include cable lines in the right of way, which will feed the

[100] Rūjiena Region: spatial plan 1.0. Available at: https: https://geolatvija.lv/geo/tapis#document_70

generated electricity from the stations to the 330 kV substation. The potential route of the cable line to the proposed substation site crosses the protection zones of the Melderīšupīte river and the Pestava river (see Figure 4.10.6).

According to the regulation on the use and development of the territory of the region of Rūjiena, the Pestava, Melderīšupīte and Raudava rivers have a 50 m wide protection zone, while the Krūmiņupīte and Veserupīte have a 10 m wide protection zone. Lake Tīta and the Arakstes pond also have a 10 m protection zone. Lake Tīta is now completely drained and there is a marsh in its place. The lake was historically drained by dredging the Pestava rive and diverting its waters past the lake. According to section 37, paragraph 3 of the act on protection zones, it is prohibited to perform clear felling in a zone that is 50 metres in width or in the entire width of the protection zone if the protection zone is narrower than 50 metres, except for a forest stand where the dominant tree species is white alder, to perform trees felling for the liquidation of the consequences of emergency situations and for the liquidation of the consequences of windthrow, windfall, and snow-thrown wood, and also for the regeneration and management of alluvial meadows. According to section 37, paragraph five, clause b of the above act, it is prohibited in the 10-metre zone to build or to place any buildings and structures, including fences (except for the renovation of existing structures; restoration of cultural monuments; construction of transport and electronic communications networks.

Detailed information on the extent of the protection zones for water bodies is summarised in Chapter 2.2 of the EIA report. The assessment of the potential WTG sites indicates that the WTG L_08 site is located within the 10 m protection zone of Krūmiņupīte, but the site does not require clear-cutting. The construction sites of WTGs L_10 and L_17 are also planned relatively close to the river, approximately 15 m to 30 m from it. In the areas where the pitches are to be built, there are ditch systems that are directly connected to the Krūmiņupīte, and for this reason the construction design must provide solutions that ensure the functioning of the existing drainage systems.

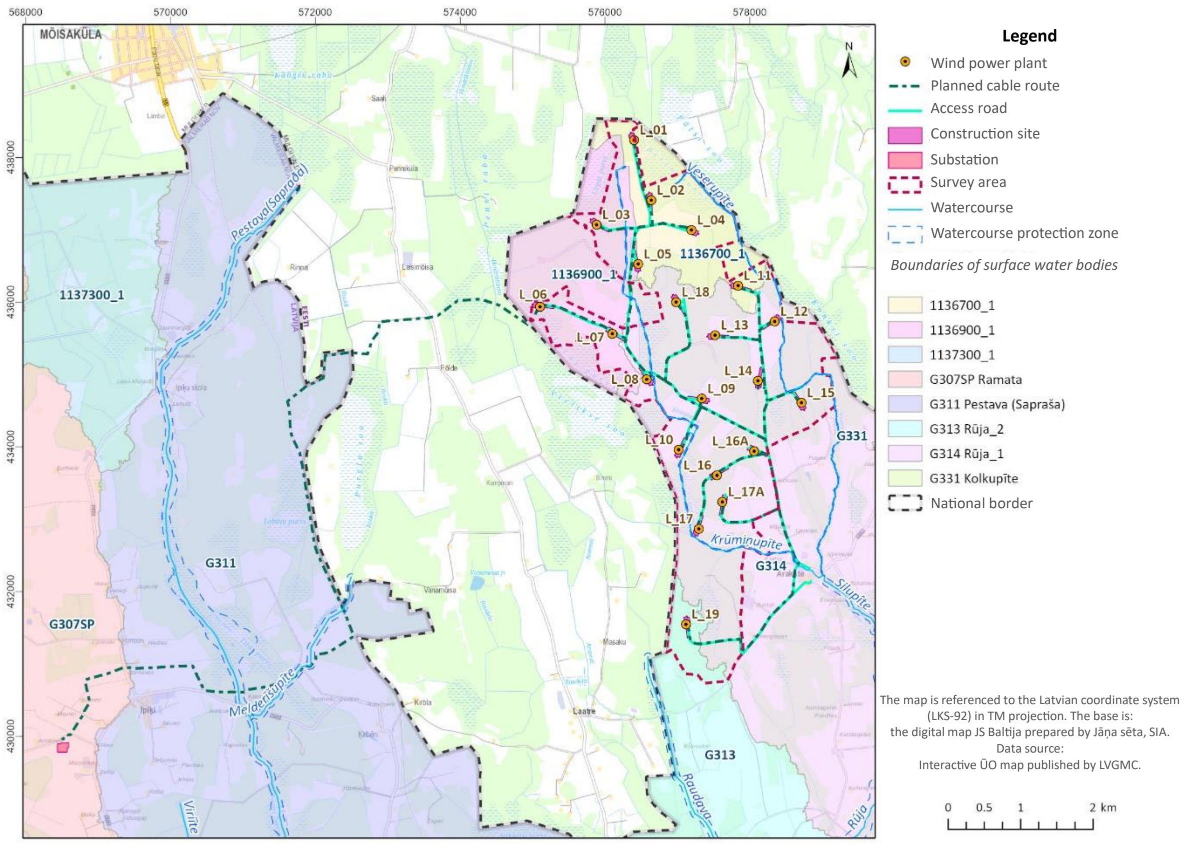


Figure 4.9.6. Surface water bodies and watercourse protection zones in and around the WTG study area

In accordance with Directive 2007/60/EC of the European Parliament and of the Council[101] on the assessment and management of flood risks (adopted on 23 October 2007) and the Latvian water management act, significant flood risk areas have been identified for each river basin[102], flood risk maps have been developed and flood risk management plans have been prepared. Flood risk maps for river basins, which are a probabilistic model of recurrent flood risk based on mathematical calculations, were approved by the Ministry of Environmental Protection and Regional Development on 11 March 2020. According to the Gauja river basin district flood risk management plan for the 2022–2027 period[103], the proposed action site is not located in a flood risk area of national importance (VNPRT). The nearest area at risk of flooding is located approximately 3.5 km to the southeast, in the floodplain of the River Rūja and adjacent land.

The Gauja River basin district management plan assesses the ecological quality of water bodies. The assessment is presented for the water bodies Ramata (G307), Rūja_2 (G310) and Rūja_4 (G312) (see Figure 4.10.6). The ecological status of water body G307 Ramata is

[101] Directive 2007/60/EC of the European Parliament and of the Council on the assessment and management of flood risks. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32007L0060
[102] Flood risk and flood hazard maps. Available at: https://videscentrs.lvgmc.lv/iebuvets/pludu-riska-un-pludu-draudu-kartes
[103] Gaujas upju baseinu apgabala apsaimniekošanas un plūdu riska pārvaldības plāns 2022. – 2027. gadam. Pieejams: https://videscentrs.lvgmc.lv/lapas/udens-apsaimniekosana-un-pludu-parvaldiba

assessed as good. The ecological quality of the river has improved from medium to good. The ecological status of the water bodies G312 Rūja_2 and G310 Rūja_4 is assessed as moderately good. In Rūja_4, it has remained unchanged, but there are no data for Rūja_2 in the last observation cycle.

The progress of the ecological status of the water bodies is summarised in Table 4.10.3.

Table 4.10.3. Progress on the ecological status of surface water bodies[104]

Water object (WO)	Code	2nd cycle – 2015	2nd cycle – 2021	3rd cycle – 2021	Changes
Ramata	G307	Poor	Medium	Good	Improvement (+1)
Rūja_2	G312	Medium	Medium	No data	
Rūja_4	G310	Medium	Medium	Medium	No change

4.10.6 Potential impacts and mitigation measures

Geological and engineering geological conditions

The geological and engineering geological conditions of the site must be taken into account when constructing a WTG. Prior to the construction of the WTGs in the area of the proposed operation, an engineering geological survey is required, and geotechnical supervision of the construction works must be ensured. Taking into account the Latvian Building Code LBN 207-15, on geotechnical design, the foundation footing should be deeper than the probable long-term frost depth in order to avoid foundation deformation due to soil deformation. The construction works should not be carried out in a prolonged period of time when the subsoil is wet, as clayey soils are plastic and prolonged exposure to precipitation significantly reduces the bearing capacity of the subsoil. The design of the substructure must prevent flooding of the site and limit the impact of water by means of drainage or water drainage channels.

The available geological material indicates that the area of the proposed development is suitable for construction and that no engineering geological conditions have been identified that would preclude the construction of the wind farm. According to the quaternary sediment map, the upper part of the geotechnical section consists of naturally stable soils that can serve as a natural base for the structures: glacigenic moraine sandy loam and sandy clay. In some places, there are also peat deposits unsuitable for construction. It is likely that in such locations, the peat will need to be replaced with suitable soil, foundations constructed on piles or the planned location of the WTGs changed to one with more suitable geology and soils with adequate bearing capacity.

No impacts on the geological and engineering conditions of the site are expected from the construction or operation of the WTGs.

Mineral deposits

[104] Ibid.

Given the location of the proposed wind farm in relation to nearby mineral deposits, the construction and operation of the WTGs is not expected to have a negative impact on the mineral deposits or projected resource areas.

Nearest water abstraction points and underground water deposits

The construction of the WTGs is not expected to have any negative impacts on the quality of water abstraction points (boreholes), groundwater wells and groundwater and water levels.

According to the register of contaminated and potentially contaminated sites maintained by the LVGMC, there are no contaminated or potentially contaminated sites (see Chapter 2.1) in the area of the proposed wind farm that could affect groundwater quality.

The proposed operation, construction, operation and subsequent reclamation of the WTGs and access roads will involve temporary topsoil stripping and excavation works, during which geotechnical supervision of the works must be provided to ensure monitoring of groundwater levels and quality. The foundation solution for each WTG to be constructed will be determined taking into account the soil bearing capacity and groundwater level in the area of the proposed operation.

During construction activities in the area of the proposed operation, there is a risk of contamination of the ground or groundwater in the event of spills of fuel or lubricants from construction machinery. Although the extent of such contamination could be small if the construction process is carried out in accordance with the construction organisation and using equipment and machinery in good working order, the proponent intends to take precautionary measures in those areas where construction machinery will be permanently present, by carrying out a soil contamination assessment before dismantling the sites and deciding on the further use of the removed soil.

Although such precautionary measures do not eliminate the possibility of contamination of soil and groundwater, they will ensure that contaminated soil, if found, as well as the area where it is located, will be remediated in accordance with regulatory requirements, preventing the spread of contamination to soil and groundwater.

Surface water bodies closest to/crossing the site

Given that most of the potential WTG construction sites are located in forest land, including areas where groundwater levels are reportedly high, it may be necessary to regulate the moisture content of forest land. In accordance with article 116 of cabinet regulation no. 329, on the Latvian building standard LBN 224-15 and melioration systems and hydraulic structures (in force from 1 July 2015), the regulation of forest land humidity is ensured by the regulating network: drainage ditches, runoff guides and road ditches. Article 4 of the aforementioned regulation stipulates that drainage systems and hydraulic structures must be designed in accordance with this building standard and other normative acts in the field of construction, drainage and environmental protection. All activities related to the modification/development of the drainage system will be carried out in parallel with site preparation works, as well as the construction of access roads and plazas.

Where existing and planned roads cross open watercourses, new culverts should be built or the need to rebuild existing culverts should be assessed.

Based on the available information on the planned construction works related to the alteration of individual sections of drainage and drainage systems or structures in the area of the proposed operation, it is not possible to identify at this stage any factors that could have a significant adverse effect on the functionality of the existing drainage system.

4.10.7 Evaluation of alternatives

Given that all the technological alternatives under evaluation are considered to be similar in the context of factors that may affect geological or hydrological conditions, there is currently no reason to consider any of the WTG models under evaluation as superior to the others. To mitigate potential impacts, guidance is provided on what to consider when starting construction of the proposed wind farm.

4.11 Waste management

This chapter assesses the impacts of wind farm construction, operation and demolition or redevelopment in the context of industrial waste management.

It is expected that municipal, construction and industrial waste will be generated during the construction of the wind farm. Municipal waste generated during the construction, operation and demolition or alteration process will be collected and temporarily stored in municipal waste containers, which are planned to be placed in temporary storage areas for machinery, equipment and materials. The collected waste will be handed over to an operator who has obtained the necessary permits for the transport and management of municipal and construction waste.

4.11.1 Legislative framework

Waste management is regulated by the waste management act (in force from 18 November 2010, as amended on 11 April 2023).

The procedure for accounting of construction and hazardous waste is determined by cabinet resolution no. 133, on the procedure for accounting waste and its withdrawal (in force from 1 July 2021).

The waste management procedure in Valmiera region is regulated by Valmiera municipal council binding regulation no. 115, on household waste management in the Valmiera region, which entered into force on 1 January 2024[105]. This regulation includes:

- the division of the territory into waste management zones;
- requirements for waste collection, including minimum frequency of collection, transport, handling, sorting and storage of household waste;
- the procedure of payments for waste management
- liability for non-compliance with this binding regulation.

4.11.2 Potential environmental impacts during construction, operation and demolition or redevelopment and mitigation measures

As mentioned in the introduction to the chapter, industrial waste is expected to be generated during the construction, operation and decommissioning or redevelopment of the wind farm.

Construction phase

[105] Household waste management in the Valmiera region (likumi.lv)

The most potentially significant impacts relate to the risk of contamination of the ground or groundwater from spills of fuel or lubricants from construction machinery during construction activities in the area of the proposed development. In areas where the likelihood of pollution is higher, i.e. where the WTG structure will be assembled, gravel and crushed stone will be used to create assembly areas of approximately 1 ha. Although the extent of such contamination may be small, if the construction work is carried out in accordance with the construction organisation procedures and using equipment and machinery in good working order, an assessment of the soil contamination will be carried out prior to the removal of the assembly areas and, if it is found that the soil is contaminated with petroleum products and cannot be used for its intended purpose without soil remediation, the contaminated soil will be transferred to a waste management company specialised in and licensed to remediate soil contaminated with petroleum products.

Operation phase

No waste is expected to be generated during the operation of the wind power plants, with the exception of waste generated during maintenance (WTG equipment that has its service life expired and needs to be replaced). Waste collection and disposal during the operation of the wind farm will be contracted out to waste management companies that have been granted permits for the management of the relevant types of waste.

Demolition or reconstruction phase

According to the information presented in Chapter 3.5, the average service life of a WTG is 25 to 30 years. After the WRG has been in operation, the structure may be completely demolished or rebuilt by dismantling the aboveground part of the WTG and installing a new WTG on the existing foundations. Manufacturers estimate that most (85–95%) of the materials used to build WTGs are reusable and only a small proportion of materials are currently not recycled but incinerated in special plants.

End-of-life metal structures and equipment resulting from the demolition or rebuilding of WTGs are recyclable and reusable. Other construction materials used (mainly concrete) are also recyclable, with the exception of WTG blades, which are made of composite materials and are considered a material group for which recycling options are currently limited. A publication produced by industry associations in 2020[106] at analyses a range of technologies available for the recycling of WTG blades, seeking the best solutions to enhance the durability of composite materials used in the construction of WTGs. Both WTG manufacturers and organisations involved in the wind energy industry are now actively looking for simple, cheap and widely applicable solutions for the reuse of polymer materials related to the wind energy industry. For example, Nordex has set a target of fully recyclable blades by 2032[107,] while Vestas and Siemens Gamesa have set a target of zero-waste WTG production by 2040[108,109.]

It is currently difficult to predict how much of the materials used to build the WTGs will be recyclable in 25 to 30 years, when a WTG is nearing the end of its service life, but the share of recyclable materials is likely to increase as the amount of recyclable materials available on the market increases and technological solutions for recycling improve.

[106] Wind Europe, Cefic, EuCIA, Accelerating Wind Turbine Blade Circularity, 2020
[107] https://www.nordex-online.com/en/sustainable-products/
[108] https://www.vestas.com/en/sustainability/environment/zero-waste
[109] https://www.siemensgamesa.com/en-int/explore/journal/recyclable-blade

The generation of waste during the construction, operation and decommissioning or redevelopment of a WTG is considered to have a direct negative impact on the environment. Given the potential amount of waste generated, the impact is considered to be minor. In the context of industrial waste, there are both primary impacts related to the storage and transport of waste, and secondary impacts related to the consumption of resources, recycling or disposal of waste. Ensuring recycling of the waste produced would have a reversible impact in terms of ensuring the circularity of the resources used, but in the context of waste that cannot be recycled, the impact would be irreversible. The environmental impact assessment has not identified the need for specific monitoring and mitigation measures if waste generated during construction, operation and demolition or redevelopment is managed in accordance with the procedures laid down in the regulatory enactments.

4.11.3 Evaluation of alternatives

Given that all the technological alternatives evaluated are considered similar in the context of waste generation and management, there is currently no reason to consider any of the WTG models evaluated as being superior to the others. To mitigate potential impacts, guidance is provided on what to consider when starting construction and operating the proposed wind farm.

4.12 Environmental risks and emergencies

This section of the report assesses in detail the accident risks associated with the operation of the WTGs, analysing also the significance of the potential consequences and the need for mitigation measures.

Having studied the available information on accidents with WTGs elsewhere in the world and recommendations from other countries, the following have been identified as potential hazards for the risk assessment of these technological installations in the environmental impact assessment:

- mechanical damage/destruction of a WTG by the spreading of debris in its vicinity;
- lubrication system faults with oil leaks;
- WTG fires;
- ice on the rotor blades of the WTGs, with subsequent falling of ice chunks in the vicinity of the plant.

Such accidents can result in risks to human health and life, as well as environmental pollution. On a wider scale, public safety could be endangered by WTG accidents that result in the separation of components from the plant and could endanger people or property in the area where they fall.

Given the location of the wind farm close to the border of Estonia, the assessment also analyses the cross-border impact of the accident risk.

4.12.1 Legislative framework

The siting of wind power plants at a safe distance from residential and public buildings in Latvia is regulated by cabinet regulation no. 16 of 30 April 2013, on general regulations for the planning, use and building of the territory. According to this regulation, in the case of wind power plants with a capacity greater than 2 MW, the distance from the boundary of the wind farm to residential and public buildings must be at least 800 m.

Taking into account that the installed capacity of the Lode wind farm will exceed 100 MW, in accordance with the provisions of article 2.3.4 of cabinet regulation no. 563 of 19 September 2017, on procedures for identifying and determining objects of increased danger, as well as for the planning and implementation of civil protection and disaster management, the wind farm will be classified as a category C object of increased danger.

Transnational collaboration on industrial accidents is governed by the convention on the transboundary effects of industrial accidents, which came into force on 27 September 2004. However, the quantities and hazards of the chemicals at the site under consideration do not meet the limits specified in this convention, and therefore the provisions of this regulation are not applicable to the proposed activity.

4.12.2 Impact assessment approach

In Latvia, there are no established procedures, principles and criteria for assessing the risk of WTG accidents. For this reason, the experience of other countries and recommendations developed in this field have been used to assess the planned situations.

The Netherlands is one of the leading countries in Europe in then asessment of industrial risks and using the results of risk assessments for spatial planning. As with any industrial facility, an accident risk assessment may be required by the Dutch authorities for the construction of a WTG. One of the accepted methods for this task is the guidelines for the risk assessment of WTGs, developed by the Netherlands Agency for Energy and the Environment in 2002 and last updated in 2020[110.] These guidelines use information on damage cases recorded in databases in Denmark, Germany, the United Kingdom and the Netherlands.

According to this method, the following basic emergencies are considered in relation to WTGs:

- breaking off a rotor blade;
- mast breakage;
- breaking off the rotor and/or nacelle.

The method developed in the Netherlands has also been used by the department for regional development, environmental planning and projects of the Belgian ministry of the environment as a basis for their own WTG risk assessment manual. Considering that the Belgian WTG risk assessment manual[111] is based on the above mentioned Dutch risk assessment principles, the Belgian manual has been used for this risk assessment.

According to the Belgian WTG Risk Assessment Manual, the same accident scenarios are analysed as in the Dutch method and the probabilities of these damage types are summarised in Table 4.12.1.

[110] Handreiking Risicozonering Windturbines (Infomil) and Handleiding Omgevingsveiligheid Module IV Specifieke rekenvoorschriften (RIVM)
[111] Vlaamse overheid, Departement Omgeving, Afdeling Gebiedsontwikkeling, Omgevingsplanning en – guidelines for the risk calculations of wind turbines (v1.1, 1 October 2019)

Table 4.12.1. Probabilities of wind power plant accident scenarios

Emergency scenario	**Probability (per year)**
Rotor blade breakage: - for normal operation (rotor rotation speed within the manufacturer's specifications); - 2 × exceeding the rotation speed	 6.2×10^{-4} 5.0×10^{-6}
WTG mast collapse	5.8×10^{-5}
Rotor and/or nacelle breakage	1.8×10^{-5}

For these accident scenarios, equations have been developed to determine the maximum exposure distance and the associated level of risk. The equations are simplified, and use assumptions such as that the effects of an accident have the same probability in all directions around a WTG. The individual risk distances are therefore defined as circular isolines around a WTG. The most important parameters taken into account in determining the overall level of risk posed by a WTG are:

- total height of the station (m);
- rotor diameter (m);
- total weight of the equipment (t);
- maximum speed of the rotor (rev/min);
- the wind speed at which the station is started (m/s);
- the wind speed at which the station is stopped (m/s).

These parameters are summarised in Table 4.12.2 for each station model considered. In all calculations, the total weight of the station is assumed as being 800 t. The calculations also assume that the gondola is 15 m long, 5 m wide and 7 m high.

Table 4.12.2. Data used in the risk assessment to characterise WTGs

Parameter	**WTG model characteristics**			
	Vestas V162-6.2	**Vestas V172-7.2**	**Nordex N163-5.7**	**Siemens Gamesa SG6.6-170**
Total height of the station (m)	247	252	246	250
Rotor diameter (m)	162	172	163	170
Mast height (m)	166	166	164	165
Maximum rotor speed (rpm)	11	11	10.5	10.3
Wind speed (m/s) at which the station is started	3	3	3	3
Wind speed (m/s) at which the station is stopped	25	25	26	25

Under certain humidity and temperature conditions, ice can form on the rotor blades of a WTG, as it can on any other object exposed to the same environmental conditions (buildings, trees, power lines, etc.). Depending on the conditions under which the ice forms, there are two types of ice:

- frost ice (formed by changes in ambient temperature);
- glaze-like ice (formed by freezing precipitation).

If the plant were to continue operating in icy conditions, this would reduce the efficiency of the WTG, increase the load on the plant and increase the noise from its operation.

The aforementioned Dutch and Belgian risk assessment manuals indicate that WTG risk assessments should also consider ice chunks and other smaller debris such as bolts falling from the equipment, but that this should be done qualitatively. This is because in the Netherlands, ice events are not frequent (assumed to be two days per year on average), and ice formation usually occurs on equipment that has been shut down. The procedures for managing the operation of WTGs also provide for automatic shutdown in the event of ice formation during operation. When the plant restarts operation, or when wind or ambient temperatures rise, ice can detach from the WTG elements and fall, posing a safety hazard to people and objects in the vicinity. In view of these considerations, the guidelines in these countries only consider ice fall for a stopped installation, and from actual observations, ice chunks are generally dispersed in the area below the rotor and up to approximately 10–15 m from it. The Dutch WTG risk assessment manual states that the risk of injury from falling ice chunks can be minimised by restricting access to the area below the WTG rotor.

Information from other international studies[112] shows that a life-threatening (1% lethality) exposure of about 40–60 J to the head, or > 80 J if delivered through the body, is dangerous to human life. For example, a car windscreen can be smashed with an energy of 140 J, while the life-threat level for occupants is 180 J.

Many factors influence the distance that a piece of ice that has become detached from a WTG can produce the above levels of exposure. The most important of these are the size and density of the flying ice particle, the height of the fall, wind speed, wind direction, rotor speed, etc. The most extensive studies and accumulated data on actual exposure distances are available in northern countries such as Canada, Norway, Sweden and Finland. Studies and publications describing methods and recommendations for assessing icefall exposure and associated risk have also been developed by the International Energy Association Wind Technology Cooperation Programme (IEA Wind TCP[113]).

As part of the environmental impact assessment, calculations have been made on the potential separation distances of ice chunks from the direct hazard of the WTG. The calculations are based on the general ballistic equations[114], as well as additional information and studies presented in a publication by Uppsala University[115], which allow the calculation of the flying distance of objects by taking into account the following factors:

- the height of the station mast;
- the rotor diameter;

[112] Bredesen, R.E., and Refsum, H.A. (2015) Methods for evaluating risk caused by ice throw and ice fall from wind turbines and other tall structures, presented at IWAIS 2015, 16th International Workshop on Atmospheric Icing of Structures, Uppsala, Sweden, June 28 – July 3, 2015

[113] IEA Wind TCP – International Energy Agency Wind Technology Collaboration Programme

[114] https://web.physics.wustl.edu/~wimd/topic01.pdf

[115] Modelling of Ice Throws from Wind Turbines. Joakim Renström. Uppsala University. 2015

- the rotor speed;
- the wind speed perpendicularly to the rotor operation direction;
- the weight and density of the ice cube;
- the density of the air and the resistance it creates;
- acceleration of free fall;
- the angle at which the body starts to move when ejected from the rotor blade.

The equations described in the literature make it possible to determine the motion of the body in the three coordinate axes x, y and z, taking into account the two main forces acting on the piece of ice when it is separated from the rotor blade: the gravity force and the aerodynamic resistance. The gravity force is always directed downwards, while the aerodynamic resistance is opposite to the movement of the ice cube in the air.

The gravity force is expressed as:

$$F_g = -mg$$

The aerodynamic resistance is expressed as: $F_D = -C_D \cdot \rho \cdot A \cdot V^2$,

where:

m - mass of the ice cube (kg);

g - acceleration due to gravity;

C_d – air resistance coefficient;

A - cross-sectional area of the ice parcel (m^2);

ρ - air density (kg/m^3);

V - relative velocity of the ice in the air (m/s).

The equations below describe the motion in three dimensions (x, y and z):

$$m \cdot \frac{d^2x}{dt^2} = -\frac{1}{2} \cdot \rho \cdot C_D \cdot A \cdot \left(\frac{dx}{dt} - U\right) \cdot |V|$$

$$m \cdot \frac{d^2y}{dt^2} = -\frac{1}{2} \cdot \rho \cdot C_D \cdot A \cdot \left(\frac{dy}{dt}\right) \cdot |V|$$

$$m \cdot \frac{d^2z}{dt^2} = -m \cdot g - \frac{1}{2} \cdot \rho \cdot C_D \cdot A \cdot \left(\frac{dz}{dt}\right) \cdot |V|$$

The relative wind speed is defined by:

$$|V| = \sqrt{\left(\frac{dx}{dt} - U\right)^2 + \left(\frac{dy}{dt}\right)^2 + \left(\frac{dz}{dt}\right)^2},$$

where U is the wind speed at height z from the ground surface.

The calculations also take into account important aspects such as the surface area of the ice parcel, the angle at which the ice parcel separates from the rotor blade (45° in the worst case scenario), the rotor rotation speed, etc.

In addition, calculations of the impact energy expected at the time of the fall of the ice parcel under consideration have been made using the following equations:

$$v_t = v_0 + a \cdot t \qquad E = \frac{m \cdot v_t^2}{2},$$

where:

v_o - initial velocity (m/s);

t - time (s);

a - overall acceleration (m/s^2);

v_t - velocity at the moment of impact (m/s);

m - body mass (kg);

E - energy at the moment of collision (J).

4.12.3 Description of the current situation

In the context of environmental risk and emergency management, it is important to identify not only the risks associated with the operation of the wind farm itself, but to identify whether there are circumstances in which the coexistence of two or more different objects may create favourable conditions for the potential for cumulative impacts. This increases the significance, magnitude and consequences of a particular hazard. In the preparation of the environmental risk and emergency assessment for the planned Lode wind farm, information on other objects of increased hazard and objects related to economic activities in the vicinity of the proposed area of operation has been assessed.

There are no sites in or near the survey area of the planned Lode wind farm that are classified as high-risk sites in accordance with cabinet regulation no. 46 of 21 January 2021, a list of high-risk sites. The nearest ones are in the city of Valmiera, about 50 km away. A more detailed description of the surrounding area is provided in Chapter 2.1.

No other objects were identified in the area of the wind farm and its immediate vicinity that could significantly alter the level of risk posed by the wind farm, nor whose activities could endanger the operation of the wind farm by increasing the likelihood of accidents in the wind farm.

4.12.4 Results of environmental risk and emergency assessments

WTG mechanical damage or breakdown

Using the approach described in Section 4.12.1 and the aforementioned Belgian calculation sheet[116], the resulting individual risk distances around stations with characteristics corresponding to the WTG parameters provided in Table 4.12.2 are summarised in Table 4.12.3.

Table 4.12.3. Individual risk distances from the WTG mast at the Lode wind farm

Individual risk level	**Calculated distance (m)**				**Restrictions according to the Belgian WTG risk assessment guidelines**
	Vestas V162-4.5	**Vestas V172-7.2**	**Nordex N163-5.7**	**Siemens Gamesa SG6.6-170**	
1×10^{-5} per year	29	30	30	32	Economic operation objects with more than 5 permanent workplaces
1×10^{-6} per year	230	248	218	225	Area with residential function
1×10^{-7} per year	248	253	247	251	Area with sensitive public infrastructure

When making calculations with the aforementioned Belgian calculation sheet, the applicable safety distances between WTGs and other significant or hazardous objects in that country have also been determined, based on the WTG exposure distances (see Table 4.12.4).

Table 4.12.4. Safety distances from the WTG at the Lode wind farm to other neighbouring objects

Object	**Calculated safety distance (m)**			
	Vestas V162-4.5	**Vestas V172-7.2**	**Nordex N163-5.7**	**Siemens Gamesa SG6.6-170**
Objects of increased hazard: - SEVESO facilities, - LNG, CNG, LPG and LNG bunkering stations, - Hydrogen filling stations, - Gas pressure regulating stations, - Aboveground pipelines for transportation of hazardous chemicals	657	721	619	642
Underground pressure reservoirs	196	197	194	196

[116] Vlaamse overheid, Departement Omgeving, Afdeling Gebiedsontwikkeling, Omgevingsplanning en – projecten, Rekenblad Windturbines (v3.1 - 24 August 2022)

Object	Calculated safety distance (m)			
	Vestas V162-4.5	Vestas V172-7.2	Nordex N163-5.7	Siemens Gamesa SG6.6-170
Underground pipelines for transportation of hazardous chemicals	220	220	219	219
Public buildings with a large number of people outdoors	605	666	567	588
Public buildings with a large number of people indoors	196	197	194	196
Main national roads	247	252	246	250

It should be noted that in Belgium and the Netherlands, the regulatory enactments provide that the distances to residential and public buildings from WTGs are determined on the basis of the risk assessment results, while cabinet regulation no. 240 of 30 April 2013 (general regulations for the planning, use and building of the territory) stipulates that for wind power plants with a capacity greater than 2 MW, the distance from the nearest planned boundary of the wind power plant and wind farm to residential and public buildings must be at least 800 m. Therefore, the distances calculated in Tables 4.12.3 and 4.12.4 from residential and public areas must only be used for the station if they are further away than 800 m.

Calculations show that in the case of the planned Lode wind farm, no WTGs are planned to be installed that could pose a risk to residential and public buildings further than 800 m away. For this reason, the location of the stations in relation to residential and public buildings, in compliance with the requirements of the regulatory enactments, provides the necessary level of protection from the risk of mechanical damage caused by the stations.

Lubrication system faults with oil leaks

A WTG is a mechanical machine that uses various lubricants and oils to lubricate its moving parts. The largest amount of oil is in the transmission in the WTG nacelle. Typical WTG gearboxes use a forced lubrication system with a pump that circulates the oil through the lubrication system. The lubrication system also acts as a transmission coolant.

According to the manufacturers of the WTG models included in the report, the amount of oil in the lubrication system of their transmissions could vary between 650 and 1,500 litres. Discharging all or even part of the oil outside the lubrication system can cause a local environmental pollution. To reduce environmental pollution in the event of oil spills, biodegradable hydraulic fluids are used in newer WTGs, especially those located in or near water bodies. To reduce the risk of environmental pollution, WTG manufacturers also pay close attention to nacelle seals, which provide additional protection against oil leaking into the mast or rotor in the event of lubrication system failures. The nacelles are also fitted with control systems that shut down the plant in the event of an oil leak, including by stopping the lubrication system pumps.

Despite the safety systems, there is a possibility of oil leaking outside the nacelle, causing environmental pollution. Oil spills can also occur in the event of a WTG failure. In this case, a distance around the station equal to the mast height can be taken as the maximum danger area. The mast heights of the WTG alternatives considered are similar, ranging from 164 m to

166 m. The maximum mast height can be taken as the maximum radius around the station within which oil contamination could be expected in the event of a station accident. Due to the potential hazard of oils to aquatic organisms and the ability of oil products to spread on the surface of water, increased attention is needed for stations located near water bodies.

There are no large bodies of water or watercourses in the study area of the proposed action. Krūmiņupīte and Veserupīte flow out of the marshes and ditches in the area and meet at Arakste to form Silupīte.

Environmental impact of a wind farm fire

The operation of existing WTGs shows that their activities may also be associated with fire risks. The structural elements and parts of a WTG made of epoxy resin and reinforced with glass fibre fabric are combustible and can spread fire. The WTG nacelle (cover housing) also houses electrical wiring and transmission, which is lubricated by lubricating fluids that can also catch fire.

The possible causes of the WTG fire have been identified as[117:]

- faults in wiring and equipment;
- mechanically caused spark;
- overheating of hot surfaces or units, e.g. due to temperature rise in the mechanical braking system;
- careless handling of fire during maintenance or repairs;
- lightning.

Information on the probability of fire in WTGs is also mixed, with publicly available sources of information indicating a probability of fire ranging from 1 fire per 15,000 WTGs to 1 fire per 2,000 WTGs per year[118,] which is based on the 2014 statistics. The statistics available in 2020 also show that the probability of a WTG fire is 1 in 2,000 WTG per year[119.] However, it should be noted that WTG fire protection and firefighting equipment is continuously being improved, and new stations are being equipped with increasingly efficient automatic fire detection and extinguishing systems.

Despite the ability of the latest systems to effectively detect and suppress fires, the possibility of fire protection system failure remains, which could lead to further fire development. The WTG nacelle and rotor fires are difficult to suppress, because the station's height makes it impossible to extinguish the fire. None of the equipment available to the fire services is designed to work at a height of 160 m to 170 m.

As the fire develops, debris and combustion residues from the combustion of WTGs will spread to the area around the WTG, and gases from combustion will be released into the atmosphere. This means that a WTG fire will cause environmental pollution, and there is a possibility of secondary fires developing in the vicinity of the plant. To mitigate this risk, it is also intended to take into account the potential of safety distances to reduce the risk of forest

[117] CFPA-E Guideline No 22:2022 F - Wind turbines fire protection guideline
[118] https://www.windsystemsmag.com/turbines-and-fire-risk/
[119] https://www.firetrace.com/fire-protection-blog/wind-turbine-fire-statistics

fires, as indicated in the Confederation of Fire Protection Associations Europe (CFPA-Europe) guidelines on fire protection for wind turbines[120], namely to ensure a 25 m bush-free and shrub-free zone around the WTGs, which is identified in the guideline as the most effective measure to prevent secondary fires in the vicinity of the installation.

The most effective way to reduce the impact of fires is to minimise the chances of them developing and to improve the effectiveness of emergency response. The civil protection and fire safety documentation of the WTGs must include a fire response procedure that specifies the measures to be taken in the event of a fire being detected, including both notification of the services involved and the mobilisation of the necessary resources to contain and eradicate the fire.

Ice formation on the WTG rotor blades, with consequent falling of ice chunks in the vicinity of the plant

Using the method described in Section 4.12.1, the potential ice propagation distance and the intensity of the impact at the calculated propagation distance from the WTGs have been determined, corresponding to the parameters given in Table 4.12.2. Calculations have been made at the maximum operating intensity of the plant.

Observations show that in some cases, a piece of ice falling from a WTG can weigh up to 4 kg. According to the information provided in references[121], the most typical size of ice chunks observed and used in the calculations is between 0.1 and 1 kg, which is also taken into account in this assessment.

Table 4.12.5. Throw distance and power at touchdown of ice chunks at maximum operating speed

Weight of ice chunks (kg)	Vestas V162-4.5	Vestas V172-7.2	Nordex N163-5.7	Siemens Gamesa SG6.6-170
	Exposure distance (m)			
0.1	286	305	302	296
0.3	276	296	290	283
0.5	279	299	288	285
1	292	311	294	293

The following air resistance parameters have been assumed for the calculations[122]:

- air density 1.3 kg/m^3;
- air resistance coefficient of 0.6;
- ice density 800 kg/m^3;
- the wind speed at which the station is stopped (according to Table 4.12.2);
- maximum rotor speed (according to Table 4.12.2).

[120] CFPA-E Guideline No 22:2022 F - Wind turbines fire protection guideline
[121] Seifert, H., A. Westerhellweg & J. Kröning: Risk analysis of ice throw from wind turbines. DEWI, 2003
[122] Róbert-Zoltán Szász, Alexandre Leroyer and Johan Revstedt (2019). Numerical Modelling of the Ice Throw from Wind Turbines, https://www.mdpi.com/2504-186X/4/1/4/pdf-vor

The results of the calculation also confirm the information from other sources that human life could be endangered by ice chunks of 0.1 kg or more falling from the WTG. However, in the event of unfavourable conditions, the ice chunks could be sent on a trajectory that could result in them landing more than 300 m from the mast.

However, field studies show that most of the ice falling from a WTG does not follow an ideal trajectory, and is primarily dispersed in the immediate vicinity of the WTG. Research in Finland[123] indicates that 70% of ice chunks fall within 70 m of a station. A study carried out in Switzerland[124] also found that 50% of the ice was found in the area under the rotor blades. Field studies carried out by Swedish experts[125] show that 75% of the ice chunks found are distributed in the area within the rotor diameter and 1% are distributed beyond 1.5 rotor diameters. Also, recommendations issued by the Canadian Wind Energy Association[126] state that for fixed installations, the distance of the ice chunks could be up to 50 m around the installation and during ice formation, maintenance personnel in the area should be warned of the risk of ice formation.

Under Latvian climatic conditions, ice formation on wind rotor blades can occur during winter. According to the information provided in references[127], the Lode wind farm is located in a region where conditions or ice formation can occur on average from 10 to 20 days per year. This is also confirmed by the wind energy icing atlas maintained by the VTT Technical Research Centre of Finland[128], according to which the area of the proposed operation is located in a zone where ice formation is possible up to 3 per cent of the year.

Summarising the above information and calculations, it can be assumed that the area with the highest potential for falling ice hazard is the area below the rotor (for the largest rotor with a diameter of 172 m, a hazard area of 86 m radius around the installation is acceptable). Ice ejection is also possible up to 311 m from the WTG. However, taking into account the probability that the machine will operate at maximum rotational speed, the probability that the machine will be iced and the probability that the ice chunk will be ejected along the ideal trajectory, it can be assumed that the overall probability of an event resulting in an ice chunk hitting a point where a person is located is considered low, and, as indicated in the aforementioned Dutch risk assessment guidelines, only a qualitative assessment should be carried out.

Given that the distance to individual and public buildings is ensured in accordance with the regulatory requirements for spatial planning and is further than the ice throw distance, the risk to human health and life would be limited to people moving or working in the area of the proposed activity. Movement of persons not associated with the operation of WTGs is possible on roads in the vicinity of, or passing through, the area of the proposed operation. Therefore,

[123] Andersen E., Börjesson E., Vainionpää P., Undem L.S. (2011) Report – Wind Power in cold climate, WSP Environmental for Nordic Energy Research, Norway
[124] Ice throw studies, Gütsch and St. Brais, February 8, 2012 http://winterwind.se/2012/download/6b_winterwind_icethrow_cattin.pdf
[125] Göransson, B. Lundén, J., Hultin, K., Aretorn, E., Sundström, J., Odemark, Y., Montgomerie, B. (2017). ICETHROWER – ICE THROWER Evaluation and Risk Analysis Tools. Pöyry Sweden.
[126] Garrad Hassan for the Canadian Wind Energy Association (2007), Recommendations for risk assessment of ice throw and blade failure in Ontario, http://www.bape.gouv.qc.ca/sections/mandats/eole_saint-robert-bellarmin/documents/DA14_b.pdf
[127] Elforsk (2008) "Mapping of Icing for Wind Turbine Applications: A feasibility study"
[128] http://virtual.vtt.fi/virtual/wiceatla/

the ice fall distance should be used to determine the distance to roads and areas where permanent economic activities are carried out.

Safety distances

Summarising the above information on risk areas and proximity distances, the recommended safety distances, considering the station with the most distant potential for exposure (Vestas V172-7.2), are as follows:

- **86 m** – economic operation restricted zone where permanent workplaces are not recommended (based on the rotor diameter and the potential for direct exposure to accident effects in the rotor area);
- **252 m** – recommended distance from main national roads (based on the recommendations of the Belgian risk assessment guidelines);
- **311 m** – recommended distance to national and municipal roads, unless technical solutions are implemented to mitigate environmental risks (based on the furthest distance of ice fall);

By introducing technical solutions that allow the ice to thaw on the wings to mitigate the environmental risks, the distance can be reduced to:

  - 252 m from main national trunk roads;
  - 86 m from municipal roads.

- **707 m** – high-hazard restricted zone (based on the recommendations of the Belgian risk assessment guidelines);
- **800 m** – distance from residential and public buildings (based on cabinet regulation no. 240 of 30 April 2013).

The specified safety distances around a WTG in the Lode wind farm are visualised in Figures 4.12.1 and 4.12.2.

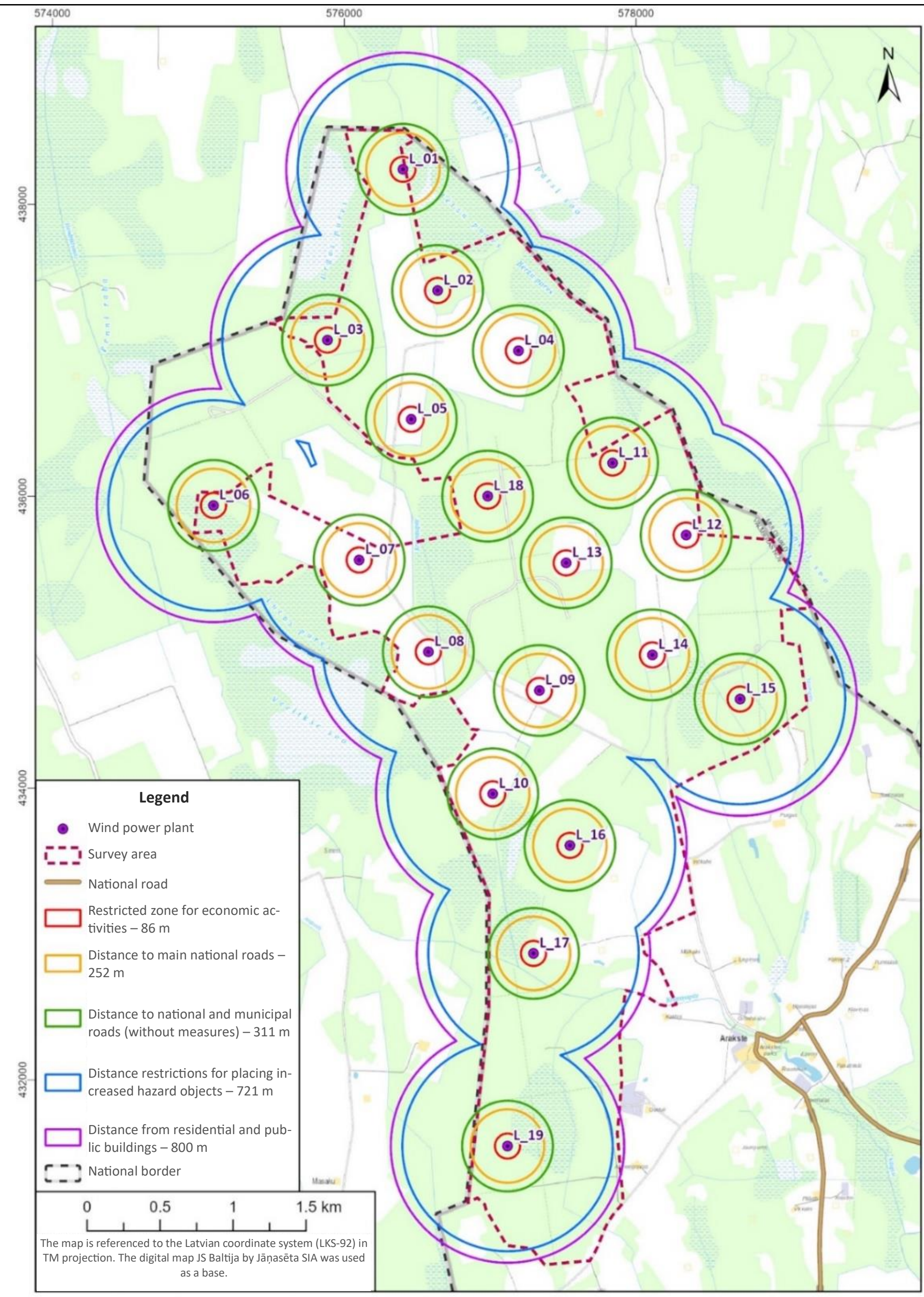


Figure 4.12.1. Safety distances around the WTGs in the Lode wind farm (basic alternative)

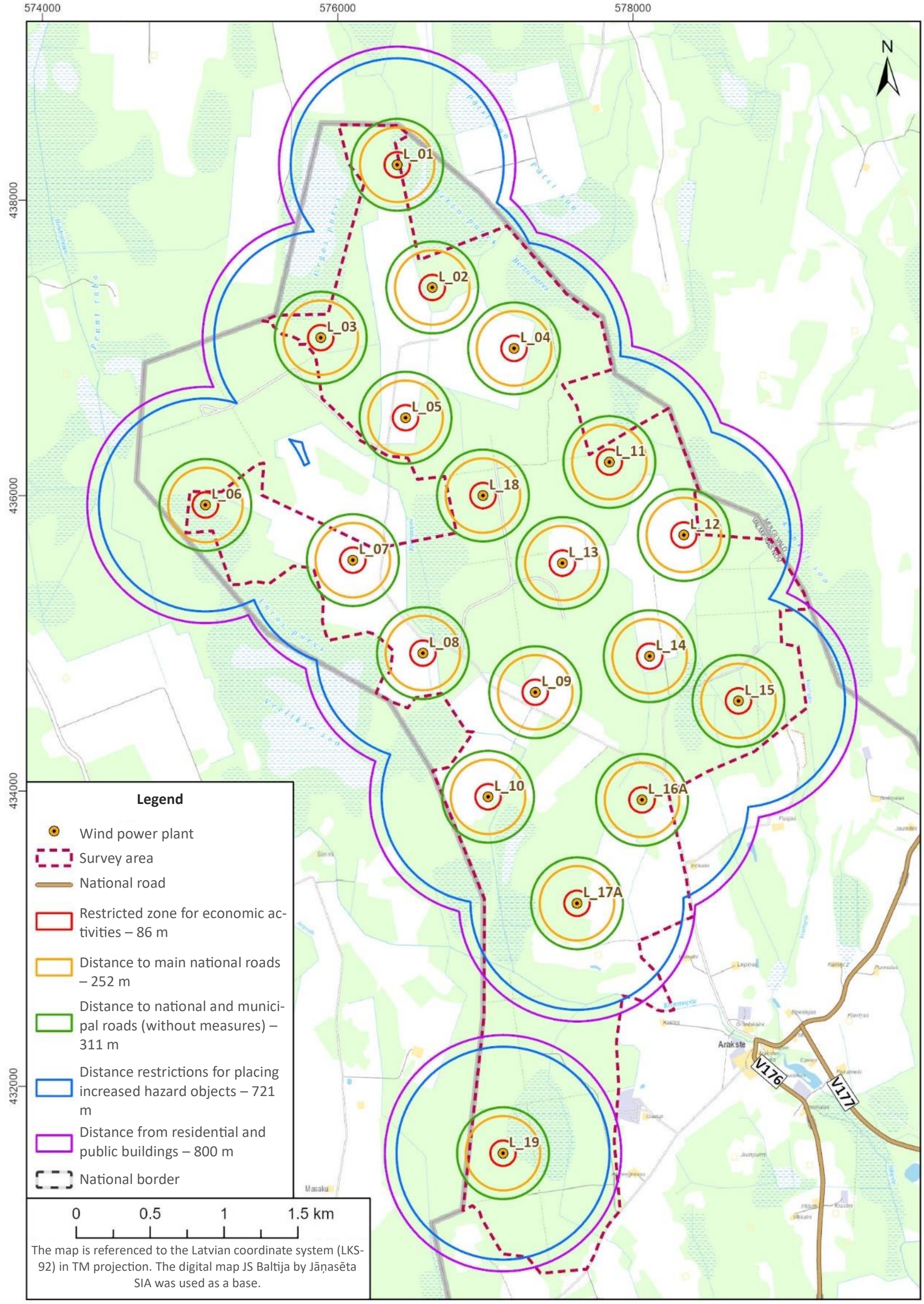


Figure 4.12.2. Safety distances around WTGs in Lode wind farm (with WTG L_16A and L_17A)

4.12.5 Mitigation measures

Modern wind turbines, including the WTG models assessed in the EIA process, are equipped with automatic vibration sensors and safety systems that shut down the plant at certain vibration levels. The system can detect both mechanical damage to the machine and icing on the rotor. Automatic shutdown is also provided for when other operating limits are exceeded, such as rotor speed. WTGs are also equipped with a smoke detection system, which also triggers an automatic safety system if it fails. WTGs are also equipped with a lightning protection system.

Given that the safety systems installed in the equipment are automatic, according to the Dutch guidelines for quantitative risk assessment[129,] such systems can prevent the development of an accident and have a probability of failure of no more than 1 in 100, which means that the use of such systems is justified to reduce the risk level of the equipment by at least two orders of magnitude. However, it is important to note that proper maintenance, regular servicing as required by the manufacturer and necessary repairs must be ensured to ensure that the level of risk does not increase during the lifetime of the equipment.

There are no residential or public buildings within 800 m of the proposed WTGs. The realisation of the WTGs L_16A and L_17A is only possible if the Inčkalni residential houses are demolished.

There are no increased hazard objects within 707 m from the proposed station locations. The potential for hazards from stations should be taken into account when proceeding with the development of the site and when planning for the siting of high-hazard facilities.

There are no national or state main roads within the estimated distance of 311 m from the WTGs. A municipal road is located closer than 311 m from the proposed location of the following stations:

- L_03 – 277 m
- L_05 – 266 m;
- L_07 – 200 m;
- L_08 – 99 m;
- L_09 – 98 m.

Taking into account the distances from the WTGs to the municipal roads as indicated above, it is justified to impose on these stations technical solutions to mitigate the environmental risks, i.e. to equip the stations with ice detection systems to ensure that the operation of the station is stopped in the event of ice being detected.

In the case of the implementation of the above mandatory measures, the recommended safety distance to local roads may be reduced to the length of the rotor wing or 86 m.

[129] Committee for the Prevention of Disasters, guidelines for quantitative risk assessment, Purple Book CPR 18E, the Hague: Committee for the Prevention of Disasters, 1999

In addition to the above, including on roads managed by the utility, it is recommended to implement one or a combination of the following solutions[130]:

- installation of a warning sign about the risk of falling ice chunks (reduces the risk by up to 10 times);
- installation of warning lights connected to an ice detection system and combined with warning signs (risk reduced by up to 100 times);
- closing access roads with physical barriers in the event of ice formation (reducing the risk by up to 100 times);
- Manual restarting of WTGs in the presence of the plant operator.

When considering the location of the proposed stations, the following are located closer than 166 m to watercourses:

- L_05 – 163 m from Krūmiņupīte;
- L_08 – 91 m from Krūmiņupīte;
- L_10 – 95 m from Krūmiņupīte;
- L_12 – 103 m from Veserupīte;
- L_17 – 123 m from Krūmiņupīte.

Given the proximity of the stations to watercourses, the emergency response planning should include appropriate actions and resources to contain and recover chemicals in the event of an accident.

According to cabinet regulation no. 563 of 19 September 2017, on a procedure for identification and determination of objects of increased danger, as well as civil protection and disaster management planning and implementation, the Lode wind farm is classified as a category C object of increased danger, for which a civil protection plan must be developed. The civil protection plan of WTGs must provide for the arrangements to be made in the event of a fire, specifying the measures to be taken in the event of a fire being detected, i.e. the timely notification of the emergency services and the mobilisation of the necessary resources to contain and eradicate the fire.

Within a distance of 86 m from the station, the movement and operation of the rotor wing does not pose a direct threat to human health and life, however, the establishment of permanent workplaces is not desirable. Information must also be provided on the conditions (ice formation) in which it is forbidden to approach the station. Employees who carry out station maintenance must be given safety instructions for station maintenance and, based on the results of a risk assessment of the working environment, be provided with the necessary personal protective equipment.

For physical protection of WTGs, it is necessary to control access to the station and provide measures to prevent unauthorised persons from entering the station.

[130] IEA Wind Task 19: International Recommendations for Ice Fall and Ice Throw Risk Assessments (2018)

The safety distances do not affect infrastructure or sensitive sites in the Estonian territory, but in case of the proposed activity, the municipality of the adjacent territory must be informed about the recommendations for the area development, taking into account the risk posed by the WTG.

4.12.6 Evaluation of alternatives

In assessing the technological alternatives for the proposed action, it should be noted that all the plant models assessed in the EIA are equivalent in the context of environmental risk management. Although the areas of impact from plant accidents as well as from ice formation are directly dependent on the size of the plant, in the context of the technological alternatives evaluated these changes are of minor importance and do not represent a significant advantage for the choice of a particular WTG model. It should be noted that the risk assessment has not identified any limiting factors that would render any of the assessed WTG sites infeasible.

4.13 Communication systems

Wind farms can affect the operation of electromagnetic and radio transmitters and receivers, causing signal interference. The most frequently cited potentially negative impacts are on air navigation equipment used for air traffic control functions, weather radars, marine navigation systems, electronic communications radio networks, terrestrial broadcasting networks[131].

4.13.1 General description of the impacts and assessment approach

Aeronautical, maritime navigation systems and meteorological radars are complex systems that are used to perform a variety of functions, such as identifying specific objects by transmitting electromagnetic signals and receiving reflected/encoded responses from the target object. Wind turbines built in the vicinity of navigation systems and radars function both as blocking devices (see Figure 4.13.1) and as large reflective objects whose reflected signals can be so strong that they can be misinterpreted and mask weaker reflected signals. It should be noted that any other high-rise structure located within the radar line of sight can have an identical effect. The radar systems currently in widespread use are not able to recognise the signals reflected by WTG.

131 I. Anguloa et al.((2014). Impact analysis of wind farms on telecommunication services, Renewable and Sustainable Energy Reviews, Volume 32, April

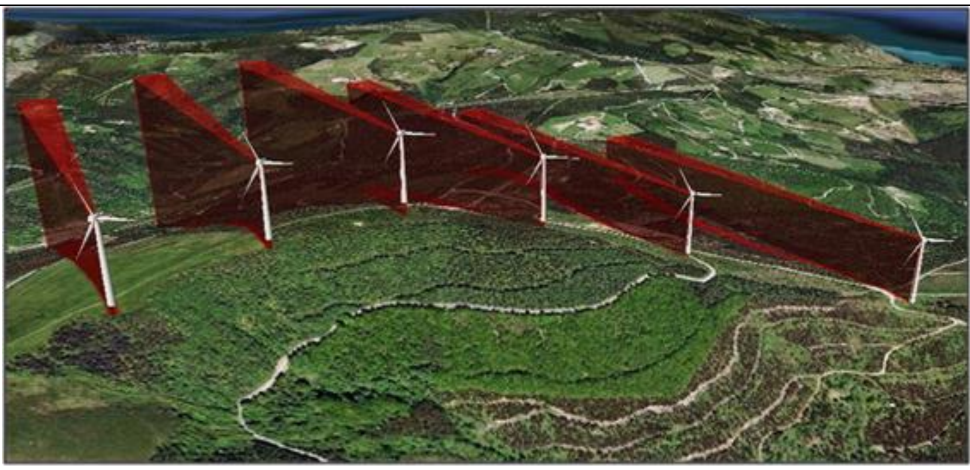


Figure 4.13.1. Example of calculations for a WTG-generated zone where a radar beam is blocked[132]

Onshore wind farms are not considered a potential threat to the operation of maritime navigation systems, but their impact on aviation safety and the operation of weather radars has been demonstrated. For example, the Spanish national meteorological agency (Agencia Estatal de Meteorología) has recorded reflections of the weather radar signal from wind farms, which are identified as precipitation zones on a day when no precipitation is observed in the radar area (see Figure 4.13.2). Although the potential impacts of wind farms have been identified, there is currently still no common methodology for assessing these impacts, which is hampered by the variety of navigation and radar systems used and the fact that the assessment method may depend on the characteristics of the wind farm site.

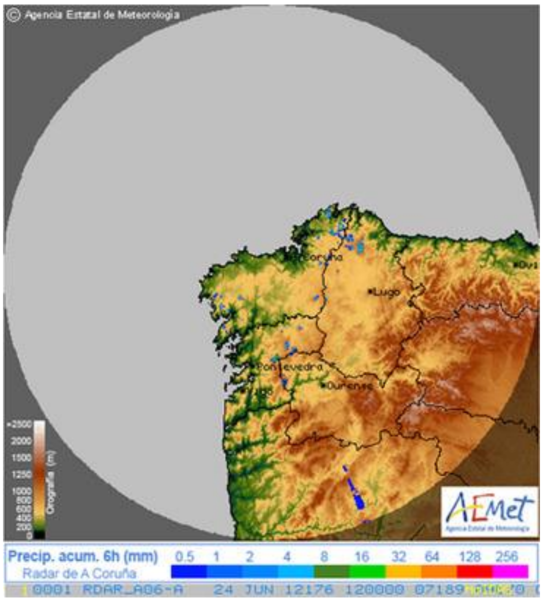


Figure 4.13.2. Meteorological radar image, with most of the blue areas being WTG wind farms (source: the Spanish state meteorological institute, Agencia Estatal de Meteorología (http://www.aemet.es))

132 De la Vega, D., et al. Software tool for the analysis of potential impact of wind farms on radiocommunication services. Proceedings of the 2011 IEEE international symposium on broadband multimedia systems and broadcasting (BMSB), 2011.

Also in the context of other devices transmitting radio signals (radio, television, mobile communications, MW/RRL radio relay antennas, etc.), there is a possibility that the operation of wind turbines could cause signal interference to radio communication systems. Studies suggest that wind farms can block, fragment and reflect signals from these communication systems. Although, in contrast to aeronautical equipment used for air traffic control functions, the increase in the height of wind farms is more likely to be positive, under certain conditions the impact of wind farms on the quality of communications can still be significant.

4.13.2 Description of the existing situation, possible impacts and mitigation measures

The nearest meteorological radars to the territory of the proposed activity are the radar operated by the Latvian Centre for Environmental Geology and Meteorology (LVGMC) installed in the territory of Riga Airport and the radar operated by the Estonian Environment Agency in Sürgavere[133.] The World Meteorological Organisation (WMO) and the European Meteorological Services Network (EUMETNET) recommend that certain distances from the weather radar should be observed, where the construction of wind farms should be avoided (up to 5 km for C-band and 10 km for S-band radars), or the construction of wind farms should be coordinated with the owner of the weather radar (up to 20 km for C-band radars and 30 km for S-band radars[)134,135.] However, more recent studies suggest that the upper limit for C-band radars, i.e. 20 km, should be increased, as impacts can be observed at greater distances[136.] The Latvian Centre for Environmental Geology and Meteorology has also acknowledged that, given the current station sizes, impacts on radars could be observed at greater distances. The two radars in Latvia and Estonia are located more than 100 km from the planned wind farm. Taking into account the spacing of the weather radars in relation to the proposed wind farm, the technical characteristics of the weather radars, the topography of the site and the height of the proposed wind farms, the proposed WTGs are not expected to have a significant impact on the performance of the radars.

The European Organisation for the Safety of Air Navigation (EUROCONTROL), taking into account the International Civil Aviation Organisation (ICAO) guidance on the regulation of construction in restricted areas around air navigation facilities used for air traffic management functions[137,] has developed guidance for air navigation service providers and wind farm developers on the need and procedures for assessing the impact of WTGs on navigation systems. The guidelines define four zones in the vicinity of a primary surveillance radar (PSR) and a secondary surveillance radar (SSR) where the impact of wind turbines should be assessed (see

133 https://www.eumetnet.eu/wp-content/themes/aeron-child/observations-programme/current-activities/opera/database/OPERA_Database/index.html

134 Finnish Meteorological Institute, EUMETNET OPERA PROGRAMME (2004–2006) – Operational programme for the exchange of weather radar information, Final report, 2007

135 Tristant P. (2006). Impact of wind turbines on weather radars band. World Meteorological Organization. CBS/SG-RFC 2006/Doc. 3.1.

136 VINDRAD. Project report v1.0, A tool for calculation of interference from wind power stations to weather radars, 2011

137 European guidance material on managing building restricted areas: 3rd edition, International civil aviation organisation, 2015

Table 4.13.1). As shown in Table 4.13.1, the position of the WTGs within the radar's field of view is also an important aspect for air traffic surveillance radars.

Table 4.13.1. Assessment areas for WTG impacts on primary and secondary surveillance radars

Zone	Description	Impact assessment condition
Zone 1	0–500 m from the radar	Safety zone for PSR and SSR installations, in which construction of WTGs would not be allowed
Zone 2	500 m – 15 km from the radar and within its Position Sight Range (PSR), 500 m – 16 km from the radar and within its surveillance surveillance range (SSR)	Detailed assessment area for PSR and SSR radars, in which the construction of WTGs is not allowed unless a detailed impact assessment is carried out, the results of which demonstrate that no significant adverse effects on radar performance are expected and agreed with the air navigation service provider(s).
Zone 3	Beyond a distance of 15 km, but not exceeding the radar's area of visual range within the radar's maximum range	Simple engineering assessment area for PSR radars
Zone 4	Within the radar's maximum range outside its visual range or outside the radar's maximum range	Acceptable area for PSR and SSR radars where no assessment is required

The closest radar systems to the area of the proposed operation that are used for air traffic management functions are the PSR system installed at Riga Airport, located more than 100 km from the planned wind farm, as well as three SSS systems in Ērgļi (more than 30 km from the planned wind farm), Riga (more than 100 km from the planned wind farm) and Martna in Estonia (more than 200 km from the planned wind farm).

In accordance with ICAO guidelines, the impact of the WTGs planned to be constructed closer than 15 km to radio navigation and landing aids, such as very high-frequency omnidirectional range stations (VOR), instrument landing systems (ILS), on these air navigation systems must be assessed by identifying the significance of the impact and the interference caused to the operation of the system. WTGs situated further should not have an impact on radio navigation and landing aids. There are no radio navigation and landing aids within 15 km of the planned wind farm.

As part of the EIA process, the initiator of the proposed activity has consulted VAS Latvijas gaisa satiksme on the construction of the planned wind farm in the parish of Lode, in the municipality of Valmiera. In its preliminary assessment, *VAS Latvijas gaisa satiksme* has concluded that the planned wind farm will be located more than 16–17 kilometres from LGS radio navigation and radiolocation aids and will not have a significant adverse impact on civil aviation radio navigation or radiolocation facilities (see Annex 12).

Airspace surveillance radar systems are also used by the National Armed Forces. Lockheed Martin AN/TPS-77 radars are used for airspace surveillance at the radio-technical observation posts of the National Armed Forces of Latvia in Čalas (~240 km from the area of intended activity), Lielvārde (~140 km from the area of intended activity) and Audriņi (~200 km from the area of intended activity). The NAF also uses TPS-77 MRR mobile radars. AN/TPS-77 radars are also used at all Lithuanian observation posts — Antaveršis, Degučia and Ceikiškės, as well as at the observation post in Estonia (Kellavere). Thales Ground Master 403 radar equipment is also used at the observation posts in Estonia (Levalopme and Otepaa). Both the Locheed Martin TPS-77 series and the Thales GM400 series radars are equipped with solutions that ensure their efficient operation in the immediate vicinity of WTG farms[138,139]. Based on the above, it can be concluded that the planned wind farm will have no impact on the airspace surveillance functions performed by the Armed Forces.

Studies carried out on the impact of WTGs show that the construction of wind farms can affect the quality of TV and radio broadcasting, as well as the quality of mobile broadcasting. Studies suggest that WTGs can block, fragment and reflect the signals emitted by this communication equipment. This interference is considered to be insignificant in areas where the signal quality is good, but may be significant in areas on the periphery of the range of the broadcasting equipment. The ITU, which has carried out a number of studies on the impact of WTGs on the quality of TV broadcasting, including digital terrestrial television, has found that there may be some interference in the vicinity of wind farms, but most of it is insignificant. Significant problems are mostly observed in areas where the quality of the broadcast signal is low. In the area of the planned wind farm and its vicinity, free (see Figure 4.13.3) and pay (see Figure 4.13.3) terrestrial TV broadcasting and radio broadcasting are provided by transmitters installed in Valmiera and Cesvaine, located more than 50 km away from the Lode wind farm study area. The assessment of the available information on the quality of radio and TV broadcasting in the vicinity of the area of intended activity indicates that the quality of broadcasting in the areas surrounding the planned wind farm is currently good.

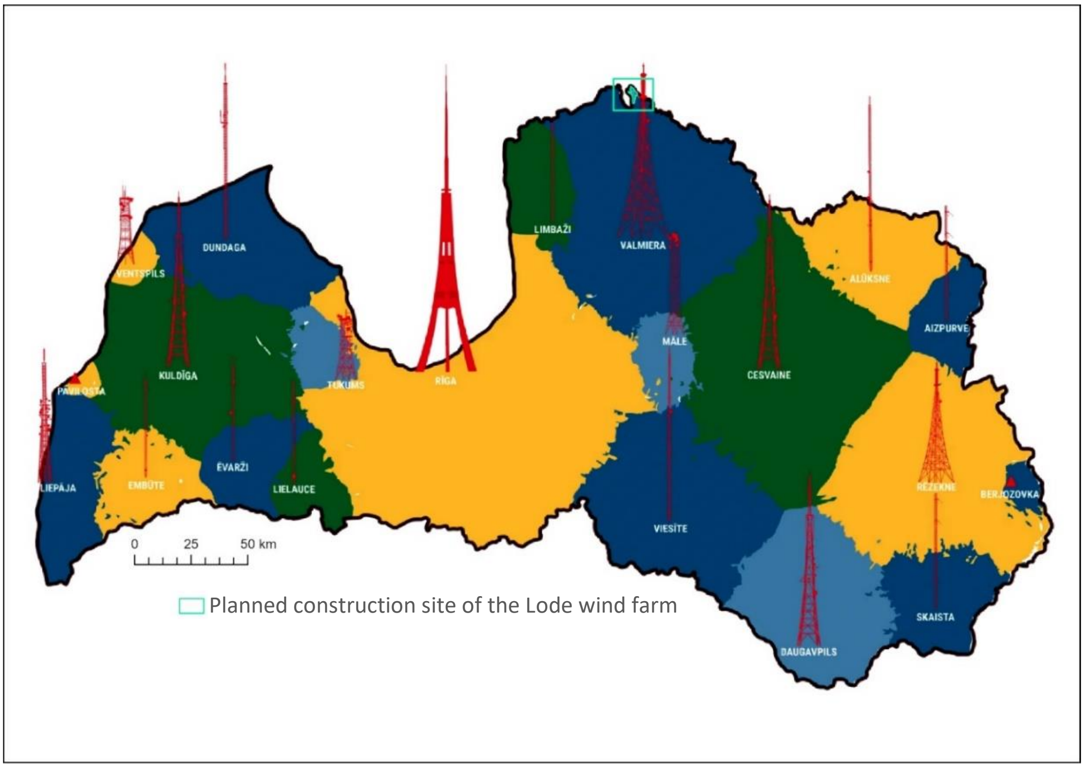


Figure 4.13.3. Free terrestrial television broadcasting network (LVRTC)

138 https://www.lockheedmartin.com/en-us/products/ground-based-air-surveillance-radars.html

139 https://www.thalesgroup.com/en/ground-master-400

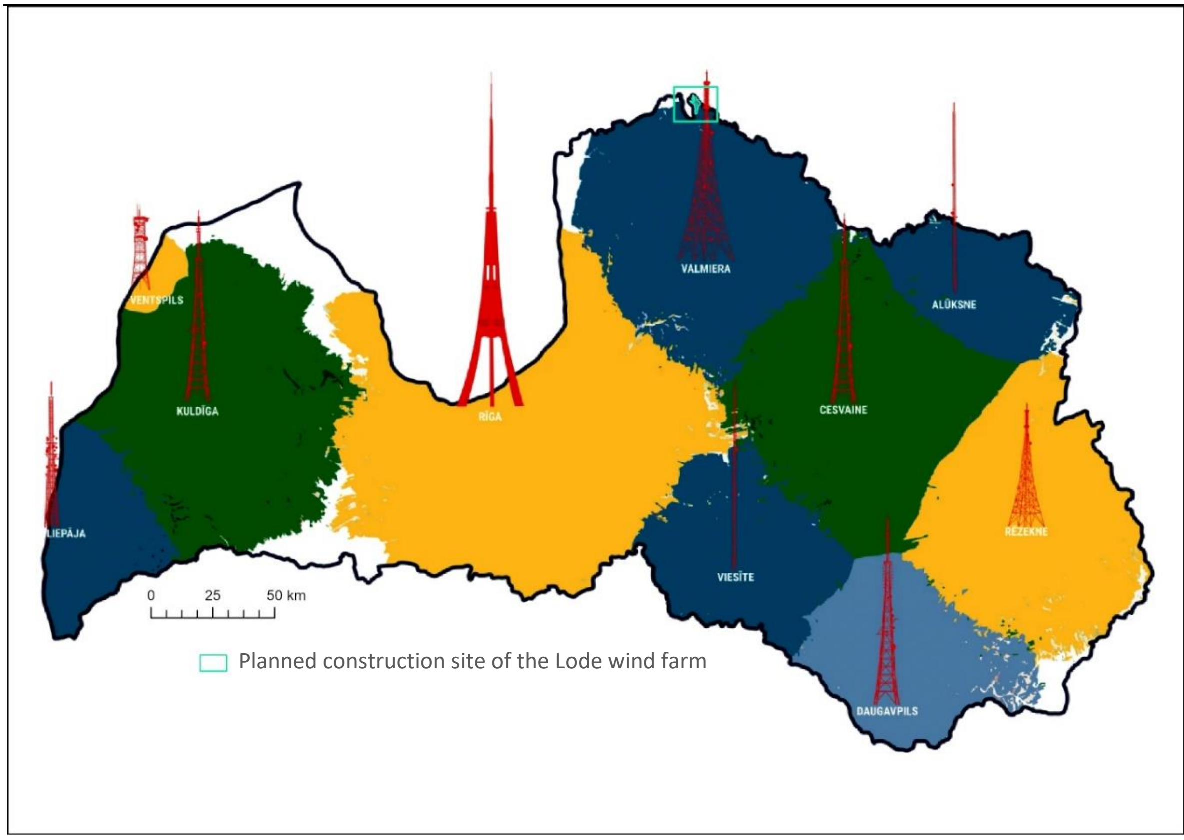


Figure 4.13.4. Pay terrestrial television broadcasting network (LVRTC)

The quality of mobile communications, including mobile Internet traffic, could be significantly affected by WTGs in areas with poor quality of communications. Looking at the information published by the largest Latvian mobile operators — *LMT*, *Tele2*, *Bite* — on the quality of communications in the vicinity of the area of intended activity, it can be seen that both 3G and 4G mobile Internet is provided in the territory of the planned wind farm and its periphery, with communications available from several transmitters built in the vicinity of the area of intended activity. It should be noted that the quality of communications provided by all operators in the area of intended activity varies from variable to good, which is largely determined by the location of the transmission towers and the topographical characteristics of the area. The height of transmitters and receivers is an important aspect to be taken into account when assessing the potential impact of the intended activity on the quality of mobile or radiolink communications. The towers on which mobile transmission equipment is located in the vicinity of the area of intended activity are mostly relatively low, lower than the bottom of the planned WTG wing. Thus, the most important part of the WTG that can fragment the communication signal will be higher than the line connecting the communication tower to the service recipient.

Although issues of communication quality are not directly related to environmental impacts, if, after the construction of the wind farm, a reduction in the quality of communication and broadcasting signals is detected due to the operation of the WTG, measures to improve the signal quality should be implemented, the technical solutions of which should be determined on a case-by-case basis.

According to the informative report of the Ministry of Defence "On the development of wind farms in Latvia and operational needs of the defence sector", the Lode wind farm is located in a zone where its construction is permissible and supported without the application of compensatory mechanisms.

4.13.3 Evaluation of Alternatives

In assessing the technological alternatives for the intended activity, it should be noted that all the plant models assessed in the EIA are equivalent in the context of environmental risk management. Although the areas of impact from plant accidents as well as from icing are directly dependent on the size of the plant, in the context of the technological alternatives evaluated, these changes are of minor importance and do not represent any significant advantages for the choice of a particular WTG model. It should be noted that the risk assessment has not identified any limiting factors that would render any of the assessed WTG construction sites infeasible.

4.14 Socio-economic Aspects

This section analyses the socio-economic situation in the vicinity of the intended activity, describing the current situation in terms of population, employment level, economic activity, business indicators, tourism offer and agricultural sector indicators. The main objective of the assessment is to ensure that no significant adverse effects are expected from changes in the use of the territory or impacts on any sensitive uses, and to assess potential impacts on other socio-economic aspects.

4.14.1 Assessment Approach

There are no uniform guidelines in Latvia for assessing socio-economic impacts in EIAs and mitigating potential impacts. The assessment therefore draws on guidance on socio-economic impact assessment in EIA developed in other countries[140,141,142,] as well as examples of good practice[143,144.] The purpose of the assessment is to identify and assess the impact of the intended activity by analysing available information on relevant socio-economic aspects and providing a qualitative assessment.

Various sources of information have been used to describe the current socio-economic situation, including data from the Central Statistical Bureau (*'CSB'*), regional development planning documents, State Employment Agency data, Food and Veterinary Service data, as well as other sources. In the absence of detailed information on future development scenarios, the assessment is based on the analysis of historical data and trends. Given that the intended activity also has a potential cross-border impact on part of Estonian territory, Estonian statistics from the *Eesti statistik*[145] database have also been considered.

[140]https://www.researchgate.net/publication/274254726_Social_Impact_Assessment_Guidance_for_Assessing_and_Managing_the_Social_Impacts_of_Projects
[141] https://reviewboard.ca/file/1024/download?token=1DDLP3jP
[142] https://group.vattenfall.com/uk/contentassets/c66251dd969a437c878b5fec736c32aa/best-practice-guidance---final-oct-2020.pdf
[143] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010101/EN010101-000229-Document%20Ref%206.11%20LC%20ES%20CH11%20SOCIO.pdf
[144] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010112/EN010112-000547-6.3.3_AyM_ES_Volume%203_Chapter3_Socio-economics_Final.pdf
[145] https://www.stat.ee/

The socio-economic impact of the intended activity will depend on a number of factors, including the distance of the affected site from the area of intended activity, the sensitivity of the socio-economic aspect, its current characteristics and development trends.

In defining the potentially affected socio-economic aspects, these are considered in three spatial impact zones: the zone in the immediate vicinity of the area of intended activity, the zone of local impact and the zone of regional/national impact (see Table 4.14.1). Potential cross-border impacts are also considered in the context of this intended activity.

Table 4.14.1. Spatial impact groups

Area of impact	Description	Potential impact on socio-economic aspects
Cross-border impacts	Potential socio-economic impacts in cross-border areas within the area of influence of intended activity	- Social services and infrastructure (health care, education, social services) - Site accessibility - Natural areas - Recreational opportunities - Economy and employment (including agriculture and tourism) - Hunting, berry picking, mushroom picking
Regional/national level	Regional and national level of impact. The purpose of the wider impact area analysis is to consider the overall impact of the intended activity on the economy on a regional and national scale	- Economy and employment - Changes in environmental quality - Impact on climate change
Local level	The administrative division for the municipality of Valmiera describes the changes that will affect the population and local economy of the region	- Economy and employment (including agriculture and tourism) - Social services and infrastructure (health care, education, social services) - Site accessibility - Natural areas and recreational opportunities
Area of direct impact (local level)	Areas in the immediate vicinity of the area of intended activity (within a radius of 2 km from the intended activity)	- Social services and infrastructure (health care, education, social services) - Site accessibility - Natural areas - Recreational opportunities - Economy and employment (including agriculture and tourism) - Hunting, berry picking, mushroom picking

A description of the socio-economic aspects and the associated stakeholders or beneficiaries is provided in Table 4.14.2.

Table 4.14.2. List of socio-economic aspects and related affected parties

Socio-economic aspect	Affected parties
Social services (e.g, education, health)	Users of social services
Natural areas and recreational opportunities	Users of natural areas and recreational services
Immovable properties, the purpose of use of which is residential	Local residents
Economic operators (including farms, tourism service providers)	Company owners and employees
Employment opportunities	Labour force

The sensitivity of the affected parties is classified as high, medium or low, providing a qualitative assessment based on pre-defined criteria. The evaluation criteria are shown in Table 4.14.3.

Table 4.14.3. Criteria for assessing sensitivity

Sensitivity	Criteria
High	The affected party has limited capacity to react and adapt to changes
Medium	The affected party has the capacity to respond and adapt to changes at least partially
Low	The affected party has the capacity to respond and adapt to changes, without resulting in a significant impact on their current situation or development prospects

In order to assess the significance of the potential effects of the intended activity, both the sensitivity of the affected parties and the extent/scale of the potential impacts are taken into account (see Table 4.14.4). The extent and scale of the impacts have been assessed taking into account the following factors:

- the scale of the potential impact;
- the spatial distribution of the impact;
- the duration and reversibility of the impact;
- the capacity of the local economy to absorb or adapt to the impact.

To assess the impact, a qualitative assessment is provided, covering the type of impact and the assessment of the significance of the impact according to pre-defined criteria. The following terms are used to describe the type of impact:

- Unfavourable: negative impact on a socio-economic aspect or affected party;
- Insignificant: negligible or minor impact on a socio-economic aspect or affected party;
- Favourable: positive impact on a socio-economic aspect or affected party.

Where favourable or unfavourable impacts are identified, they are assessed in terms of their significance, i.e:

- Minor: small, temporary or very local impact. Not considered significant;

- Medium: limited impact (in terms of scope, duration or spatial impact) that can be considered significant;
- Significant: a significant impact (in terms of scope, duration or spatial impact) that is more than of local significance (e.g. a significant change with regard to the existing situation or a wide area of impact);
- Substantial: a large and widespread impact of more than local significance. In the case of unfavourable effects, it should be considered as an exclusion factor.

Table 4.14.4. Assessment of the significance of the impact

Sensitivity of affected partied / **Scope and scale of impact**	**High**	**Medium**	**Low**
Large	Substantial unfavourable/favourable impacts	Significant unfavourable/favourable impacts	Medium unfavourable/favourable impacts
Medium	Significant unfavourable/favourable impacts	Medium unfavourable/favourable impacts	Minor unfavourable/favourable impacts
Low	Medium unfavourable/favourable impacts	Minor unfavourable/favourable impacts	Insignificant impacts
Insignificant	Minor unfavourable/favourable impacts	Insignificant impacts	Insignificant impacts

A combination of quantitative and qualitative approaches is used to assess socio-economic impacts. For example, the assessment of the impact on the local economy is based on the analysis of the existing situation and expert opinion on the potential impact of the intended activity, while the assessment of the impact on the employment level (especially at national and regional level) is based on calculations made in other projects. The assessment of the impact on social services analyses information on the existing infrastructure, including the availability and accessibility of services. Similarly, impacts on natural areas and recreational opportunities are based on the analysis of the existing situation and expert assessment of the likely impacts of the intended activity.

The results of the assessment should take into account the uncertainties inherent in long-term forecasts of economic and social developments, emphasising, inter alia, that the assessment of the existing situation is based on publicly available data, its quality and level of detail, and that expert judgement has been used to assess the potential impacts of the intended activity in situations where quantitative assessments or appropriate assessment guidelines are not available.

Given that the socio-economic impacts of wind farms in Latvia have not been extensively studied, the information contained in this report is largely based on the results of studies carried out in other countries.

4.14.2 Socio-economic Impact of the Intended Activity on a Regional and National Scale

In assessing the socio-economic impact of the intended activity on a regional and national scale, the positive impacts include investments in the economy, an increase in the number of directly and indirectly related jobs, an increase in the potential for economic activity, an increase in the supply of energy on the market, the potential to reduce carbon dioxide emissions, and a contribution to the national energy policy objectives.

Attracting investments is an important factor in the development of the national economy, and the construction of wind farms contributes to economic growth as much to attracting investments as any other investments. According to the statistics published by the Bank of Latvia, the stock of direct investments in Latvia has increased gradually over the past 15 years (see Figure 4.14.1). In the last four years, the investment surplus in the sector of professional scientific and technical services has increased sharply — from EUR 268 million in 2019 to EUR 5,279 million in Q3 2023. In addition, the investment balance amounted to EUR 3,798 million in the finance and insurance sector, EUR 3,330 million in the real estate operations sector, and EUR 3,280 million in the wholesale and retail trade; repair of motor vehicles and motorcycles sector . In the energy, gas and heat supply sector, the investment balance amounted to EUR 891 million [146].

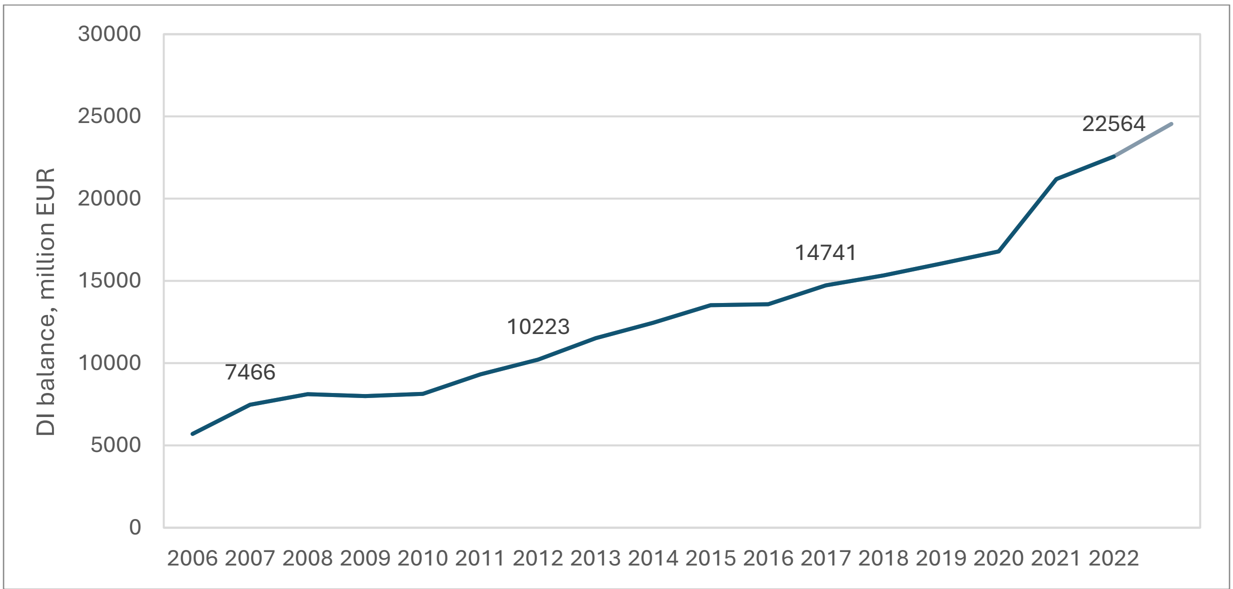


Figure 4.14.1. Changes in the balance of direct investments

The total investments in the case of the Lode wind farm are expected to be around EUR 450 million. Therefore, the planned construction of the wind farm should be seen as a significant investment in the energy sector of Latvia compared to the amount of investments in recent years.

An important aspect to take into account when assessing the impact of the intended activity on the national economy is not only the total amount of investments, but also the job growth

[146] https://statdb.bank.lv/lb/Data.aspx?id=131

associated with the investments. In the context of employment, the intended construction of the wind farm is linked to the creation of workplaces both during the construction process and during operation. The additional labour demand will be related to the construction and operation of the wind farm itself, as well as to indirectly related activities such as mining of mineral resources for road construction, concrete production, and transport.

Increasing the amount of energy produced in Latvia can also be seen as a potential benefit for society, which can potentially affect the price of electricity for consumers. In Latvia in 2023, electricity production totalled to 6,150 million kWh, of which 3,795 million kWh were produced by hydroelectric power plants, 2,040 million kWh by cogeneration plants and 269 million kWh by wind power plants[147.] Referring to the Electricity Market Overview prepared by *Augstsprieguma tīkls AS*, the year 2023 is estimated to have the highest amount of electricity produced from renewable energy resources in the last 13 years, reaching 77.5% of the total amount of electricity produced in the country. While electricity prices in Europe in 2023 have been relatively lower compared to previous years, the Nordic countries have maintained the lowest price levels due to a higher share of generation from renewable energy resources[148.] In view of this situation, the Ministry of Economics believes that increasing electricity capacity is a key priority for Latvia to achieve its energy security and independence goals, and that higher electricity prices reduce the competitiveness of Latvia's economy compared to Northern European countries and reduce the inflow of investments into industry; therefore, it is essential for Latvia to increase the installed electricity capacity to reduce electricity prices and boost competitiveness. Latvia plans to increase the share of renewable energy resources in electricity generation by increasing the installed capacity of wind power plants and solar photovoltaics in line with the capacity of the Latvian electricity transmission grids and developing large-capacity wind farms (at least 800 MW), generating an additional 1,600 GWh of wind energy per year[149.]

The initiator of the intended activity expects that the total energy output from the 19 wind turbine generators in the planned wind farm could range from 375 to 594 GWh of electricity per year. The construction of the wind farm will not have a significant impact on the price of electricity in Latvia, as the scale of the intended activity in the context of the *NordPool* region is assessed as negligible; however, any project that involves the installation of new electricity capacity may in the long term contribute to an increase in supply on the market, which could potentially affect the price paid by consumers for electricity use. Overall, the planned construction of the Lode wind farm will contribute to achieving Latvia's national targets for electricity generation from renewable energy resources and climate neutrality.

As the energy produced by WTGs has the potential to replace electricity generated by combustion processes, the construction of WTGs and the use of the energy produced thereby are expected to reduce CO_2 emissions to the atmosphere, thus reducing the impact of the energy sector on climate change. As shown by the calculation results in Section 4.10, the greenhouse gas emission reductions associated with the introduction of new electricity generation

[147] https://stat.gov.lv/lv/statistikas-temas/noz/energetika/tabulas/enb010m-elektroenergijas-razosana-imports-eksports-un?themeCode=EN

[148] https://www.ast.lv/lv/electricity-market-review?year=2023&month=13

[149] On proposals for draft act no. 1509/Lp13, stipulating amendments to the act on protection zones, Ministry of Economics (available at: https://titania.saeima.lv/LIVS13/SaeimaLIVS13.nsf/0/A2A3417067663BCCC225888C002B39EF?OpenDocument)

technologies and the transfer of the electricity generated thereby to the grid can amount to ~130 t CO_2 eq/year. At the same time, by replacing gas (and in some cases creating an alternative to biomass combustion), the electricity generated by WTGs will have a positive impact on air quality, contributing to the achievement of the targets set in the National Action Plan to Reduce Air Pollution 2020–2030.

Accordingly, on a regional and national scale, the impact of the intended activity is assessed as ***significantly beneficial*****.**

4.14.3 Socio-economic Impact of the Intended Activity on a Cross-border, Domestic and Local Scale

Description of Administrative Areas

The new administrative boundaries of the municipality of Valmiera entered into force on 1 July 2021, uniting the towns of Valmiera, Beverīna, Burtnieki, Kocēni, Mazsalaca, Naukšēni, Rūjiena and Strenči. The municipality comprises 26 parishes, including the parish of Lode. The administrative centre of the municipality is the city of Valmiera. The total area of the municipality of Valmiera is 2,947.9 km^2, while the parish of Lode occupies 63.8 km^2 of the total area of the municipality, making up 2.2% of the total municipality's territory. 50% of the municipality's territory is covered by forests, while 33% is agricultural land. In the southern part of the municipality runs the main national road A3 Inčukalns-Valmiera-Estonia border (Valka) and the railway line Riga-Valka.[150]

Population and Characteristics

The total population of the municipality of Valmiera at the beginning of 2023 (on 1 January 2023) according to the data of the Central Statistical Bureau is 50,464 (Figure 4.14.2), with approximately 0.6% of the municipality's population resides in the parish of Lode.

At the beginning of 2023, 67% of the population of Valmiera Municipality live in urban (densely populated) areas[151,] and 33% in rural (sparsely populated) areas. However, when looking at the parish of Lode, 100% of the population lives in rural areas, which is due to the fact that the largest settlements in this parish are villages. In general, the population of both Valmiera municipality and the parish of Lode tends to decrease. In 2023, the population density in the municipality of Valmiera was 18 people per 1 km2, compared to 5 people per 1 km^2 in the parish of Lode.

[150] Local government of the municipality of Valmiera. 2022. *Valmiera municipality sustainable development strategy 2022–2038* Available at https://www.valmierasnovads.lv/content/uploads/2022/11/ilgtspejigas_att_strat_valmieras_nov.pdf
[151] https://data.stat.gov.lv/pxweb/lv/OSP_PUB/START__POP__IR__IRS/IRS051/

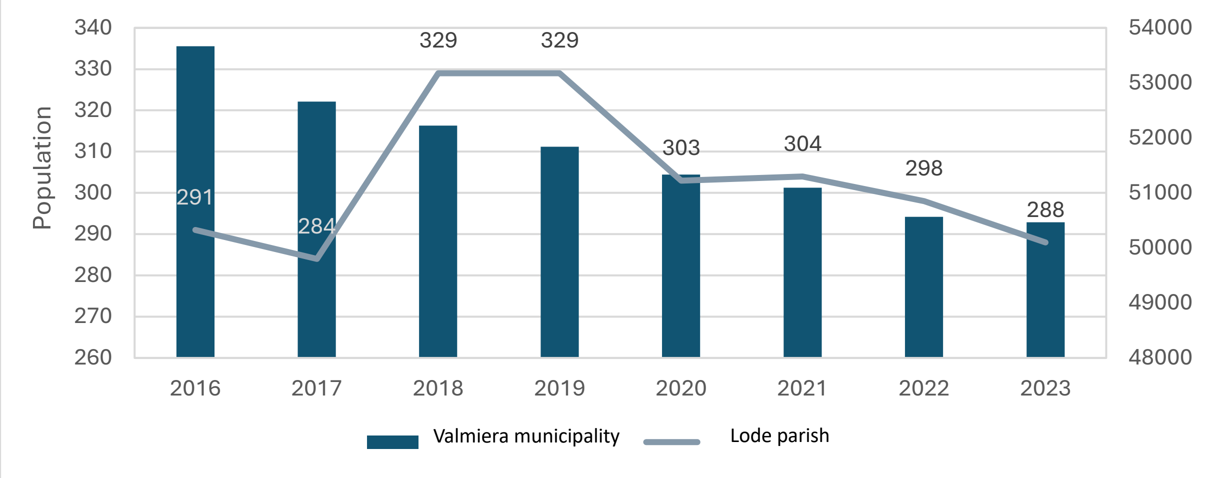


Figure 4.14.2. Population changes in Valmiera municipality and the parish of Lode[152]

Due to the intended activity being located in the border area, the part in Estonia, Viljandi county (municipality) and the parish of Mulgi, which borders the parishes of Ipiķi, Vilpulka and Lode in Latvia, are considered. Viljandi county covers an area of 3,422 km2[153], which is about 475 km2 larger than Valmiera municipality. According to Estonian statistical data, the population of Viljandi county was estimated at 45,411 inhabitants in 2022 (Figure 4.14.3), while Mulgi parish has about 15% of the county's population.

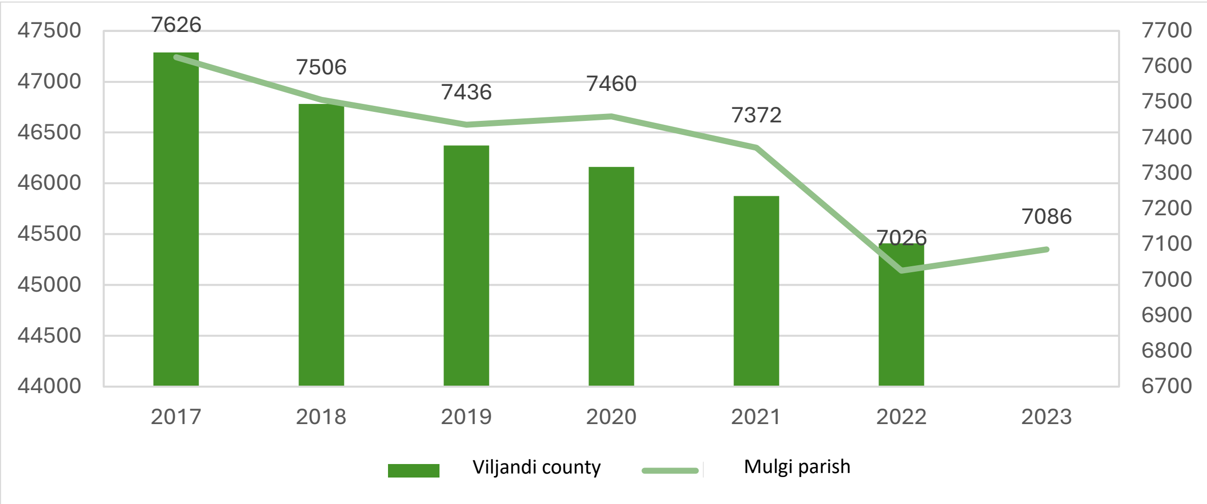


Figure 4.14.3. Population changes in Viljandi county and Mulgi parish[154]

<u>*Local economy and employment*</u>

Based on the Central Statistical Bureau (CSB) data on the share of jobseekers in Valmiera municipality in the 2011–2022 period (Figure 4.14.4), it is seen that the unemployment rate in general has more than halved since 2011. In 2019, the unemployment rate was at its lowest,

[152] https://data.stat.gov.lv/pxweb/lv/OSP_PUB/START__POP__IR__IRD/RIG010/
[153] https://andmed.stat.ee/en/stat/rahvaloendus__rel2011__rahvastiku-paiknemine__elukoht-ja-soo-vanusjaotus/RL006
[154] https://andmed.stat.ee/en/stat/rahvastik__rahvastikunaitajad-ja-koosseis__rahvaarv-ja-rahvastiku-koosseis

followed by a slight increase in the share of jobseekers. In general, the changes in the unemployment rate in Valmiera municipality are in line with the trends in the country [155] (Figure 4.14.4).

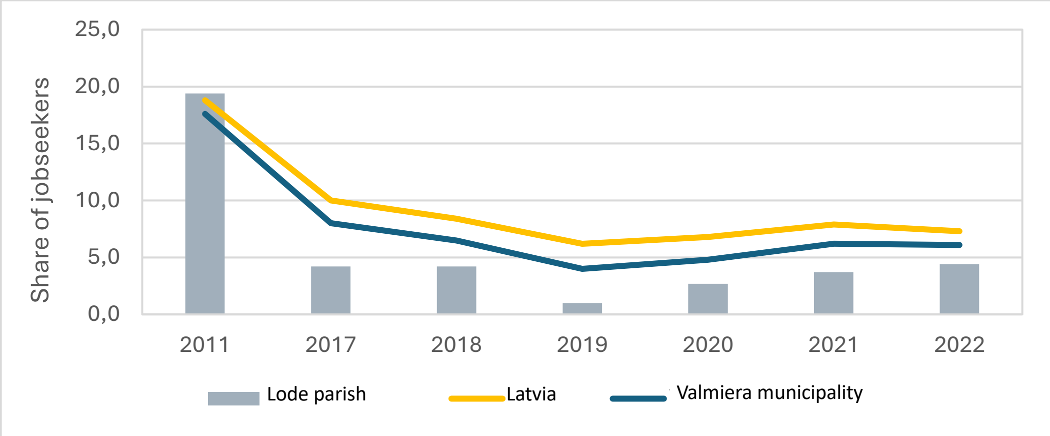


Figure 4.14.4. The share of jobseekers and unemployed persons (%) in Valmiera municipality and the parish of Lode among economically active population aged 15 to 74

According to the data of the State Employment Agency[156] on the unemployment rate in municipalities (situation on 31 January 2023), 674 unemployed people, or 3.8% of the working age population, were registered in Valmiera Municipalities, while the national unemployment rate was 4.6%. Of all the registered unemployed in Valmiera municipality, women make up more than half (54%), while men make up 46%, and the highest number of unemployed by age group is from 60 years and over (100 registered unemployed persons). Looking at the data by duration of unemployment, in Valmiera municipality the largest share (76%) of registered unemployed people have a status of up to 6 months, while 17% of unemployed people have a duration of between 6 and 12 months, followed by 6% of unemployed people with a status of between 1 and 3 years, while 3 years and more are registered in 1% of cases.

Estonian statistical data (Figure 4.14.5) show that the national trends are also noticeable in Viljandi county and Mulgi parish. In Viljandi county in 2023, the total number of registered unemployed reached 1,359, of which 49.7% are women and 50.3% men, while among both sexes the highest number of registered unemployed is in the 25–54 age group.

[155] https://data.stat.gov.lv/pxweb/lv/OSP_PUB/START__EMP__NBBA__NBB1/RIG090/

[156] https://www.nva.gov.lv/lv/2023gads

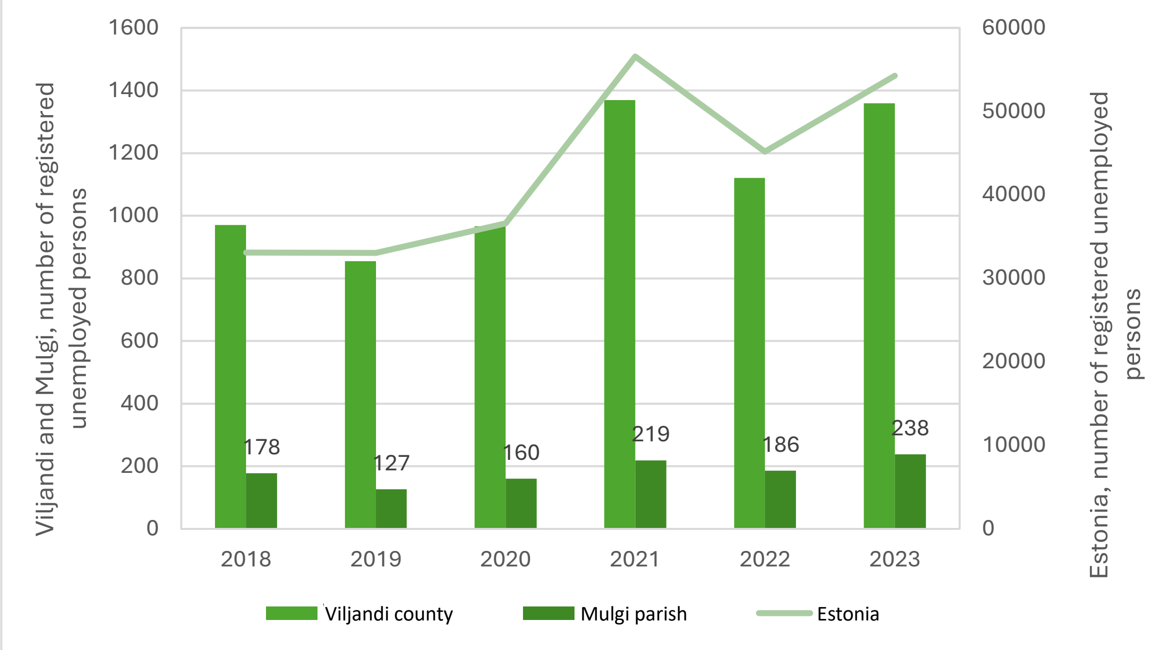
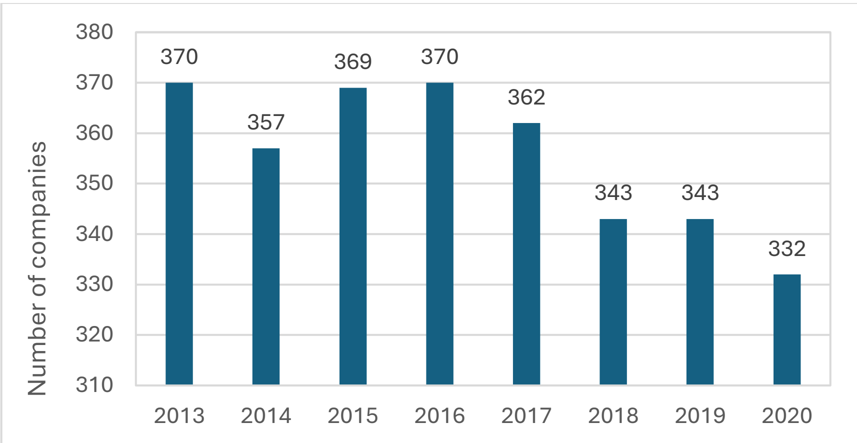


Figure 4.14.5. Number of registered unemployed persons in Estonia, Viljandi county and Mulgi parish[157]

According to the CSB data on economically active companies in municipalities before the administrative territorial reform (hereinafter referred to as 'ATR') in 2021, Rūjiena municipality, which includes the territory of the parish of Lode, is considered. Between 2013 and 2020 (Figure 4.14.6), the total number of economically active companies in Rūjiena municipality was 332[158]. In Rūjiena municipality, there was a steady decrease in the number of registered companies from 2016 to 2020. In contrast, after the ATR, the territory of the parish of Lode was annexed to Valmiera municipality (including the town of Valmiera), which, according to the CSB data, significantly exceeds the number of economically active companies in 2022[159] — 2,494, with the majority of them representing the market sector.



[157] https://andmed.stat.ee/en/stat/sotsiaalelu__tooturg__tooturu-uldandmed__aastastatistika/TT4645
[158] https://data.stat.gov.lv/pxweb/lv/OSP_PUB/START__ENT__UZ__UZS/UZS010/
[159] https://data.stat.gov.lv/pxweb/lv/OSP_PUB/START__ENT__UZ__UZS/UZS011/

Figure 4.14.6. Economically active companies in the territory of Rūjiena municipality before the ATR in 2021[160]

According to the CSB data on the economically active companies in the market sector in the municipalities by company size groups, in 2022 Valmiera municipality (after the ATR) had a total of 2,348 registered companies, where 83 companies employ 1–9 employees and 36 companies 10–19 employees. The total number of companies in which the number of employees increases from 20 to 49 decreases to 22, while 14 companies have 50 to 249 employees. No company fits into the category of 250 or more employees[161].

In 2022, there were 85 economically active companies registered in Valmiera municipality per 1,000 inhabitants, 39 of which were merchants[162]. Comparing the situation in Valmiera municipality to the national average indicators, it can be concluded that the number of active companies in Valmiera municipality is lower than in Latvia (85 in Valmiera municipality and 93 in Latvia as a whole), and the number of merchants is relatively lower than the national average indicator (39 in Valmiera municipality and 53 in Latvia as a whole). Compared to the category of other companies, Valmiera municipality (46 companies) exceeds the average international of Latvia as a whole (40 companies).

In dividing the number of active companies by type of activity in 2022[163] throughout the territory of Valmiera municipality (after the ATR), the largest number of companies was registered in the agriculture, forestry and fisheries sector, totalling to 960 companies, which are represented by the following:

- 813 companies — crop and livestock production, hunting and related auxiliary activities;
- 136 companies — forestry and logging;
- 11 companies — fisheries.

According to Estonian statistical data, Viljandi county in 2021 had 3,275 registered active companies, most of which (1,522 companies) employ 1 to 4 employees, with the next largest category of companies by number of employees being those with no employees (1,388 companies). The situation is relatively similar for the number of companies with 5 to 9 employees, which makes a total of 176 companies, and for the number with at least 10 employees, which is 189 companies[164].

Considering the areas of activity of active companies in Viljandi county, in 2021 the most common type of business was construction (563 companies); respectively, the next sector was represented by wholesale and retail trade related to the repair of cars and motorcycles

[160] https://data.stat.gov.lv/pxweb/lv/OSP_PUB/START__ENT__UZ__UZS/UZS010/
[161] https://data.stat.gov.lv/pxweb/lv/OSP_PUB/START__ENT__UZ__UZS/UZS031/
[162] https://data.stat.gov.lv/pxweb/lv/OSP_PUB/START__ENT__UZ__UZS/UZS041/
[163] https://data.stat.gov.lv/pxweb/lv/OSP_PUB/START__ENT__UZ__UZS/UZS031/

[164] https://andmed.stat.ee/et/stat/majandus__majandusuksused__ettevetluse-demograafia/ER061U/table/tableViewLayout2

(511 companies). The third most common type of business by number was professional scientific and technical activities, with 382 companies[165].

Agriculture and Forestry

According to the latest available data (on 1 January 2023)[166], Valmiera municipality is mostly covered by forest, 147,455 ha, accounting for 50% of the total territory of the municipality. The second most common type of land use is agricultural land (arable land, orchard, meadow, pasture), accounting for 33% of the total territory of the municipality. Most of the agricultural land is arable land, 69,443 ha, which accounts for 24% of the territory of Valmiera municipality. More detailed information on the number and types of agricultural companies active in the municipality is provided in the sub-section on the local economy and employment.

Information on the number of registered livestock in Valmiera municipality is compiled using information from the agricultural data centre (ADC; see Table 4.14.5).

Table 4.14.5. Number of registered livestock in the parish of Lode in Valmiera municipality on 1 January 2023

Territory	**Animals**	**Cattle**	**Pigs**	**Sheep**	**Goats**	**Horses**	**Poultry**	**Rabbits**	**Fur-bearing animals**	**Bee colonies**	**Aquaculture**	**Other species**
Lode Par.	1,542	766	1	133	2	9	253	29	0	349	0	0
Valmiera Mun.	51,621	20,174	964	4,116	235	659	17,030	1,496	1,475	5,222	11	239

According to the food and veterinary service registers on 14 February 2024, Valmiera municipality has no registered organic farming companies in Lode parish[167].

Tourism Infrastructure

For the assessment, information on the tourism sector in both Latvia and Estonia has been collected, where in the Latvian part information sources such as the websites of Valmiera municipality[168] and Valmiera tourism information centre[169] have been used, while in the Estonian part tourism sites have been looked at on the official tourism information website[170] for cultural sites, activities, catering services and accommodation within 10 km of the research area, and information publicly available on OpenStreetMap and dodies.lv maps has also been used. The location of the accommodation places was obtained from websites such as *Google Maps,*

[165] https://andmed.stat.ee/et/stat/majandus__majandusuksused__ettevetluse-demograafia/ER051U/table/tableViewLayout2

[166] State Land Service, https://www.vzd.gov.lv/lv/zemes-sadalijums-zemes-lietosanas-veidos?utm_source=https%3A%2F%2Fwww.google.com%2F

[167] FVS — Organic farming companies registered with control authorities, the list updated on 14.02.2024: https://registri.pvd.gov.lv/cr/dati?q=Re%C4%A3istr%C4%93tie+biolo%C4%A3isk%C4%81s+agricul-ture%C4%ABbas+on%C5%86%C4%93mumi

[168] https://www.valmierasnovads.lv

[169] https://visit.valmiera.lv

[170] https://www.visitestonia.com/lv

Airbnb.com and *Booking.com*[171]. *The research area of the planned wind farm is close to cultural and historical sites, as well as places of sightseeing and recreation. The closest points of sightseeing to the area of the intended activity are shown in Figure 4.14.7. More detailed information on them is provided in Sections 4.6 and 4.7 of the Report.*

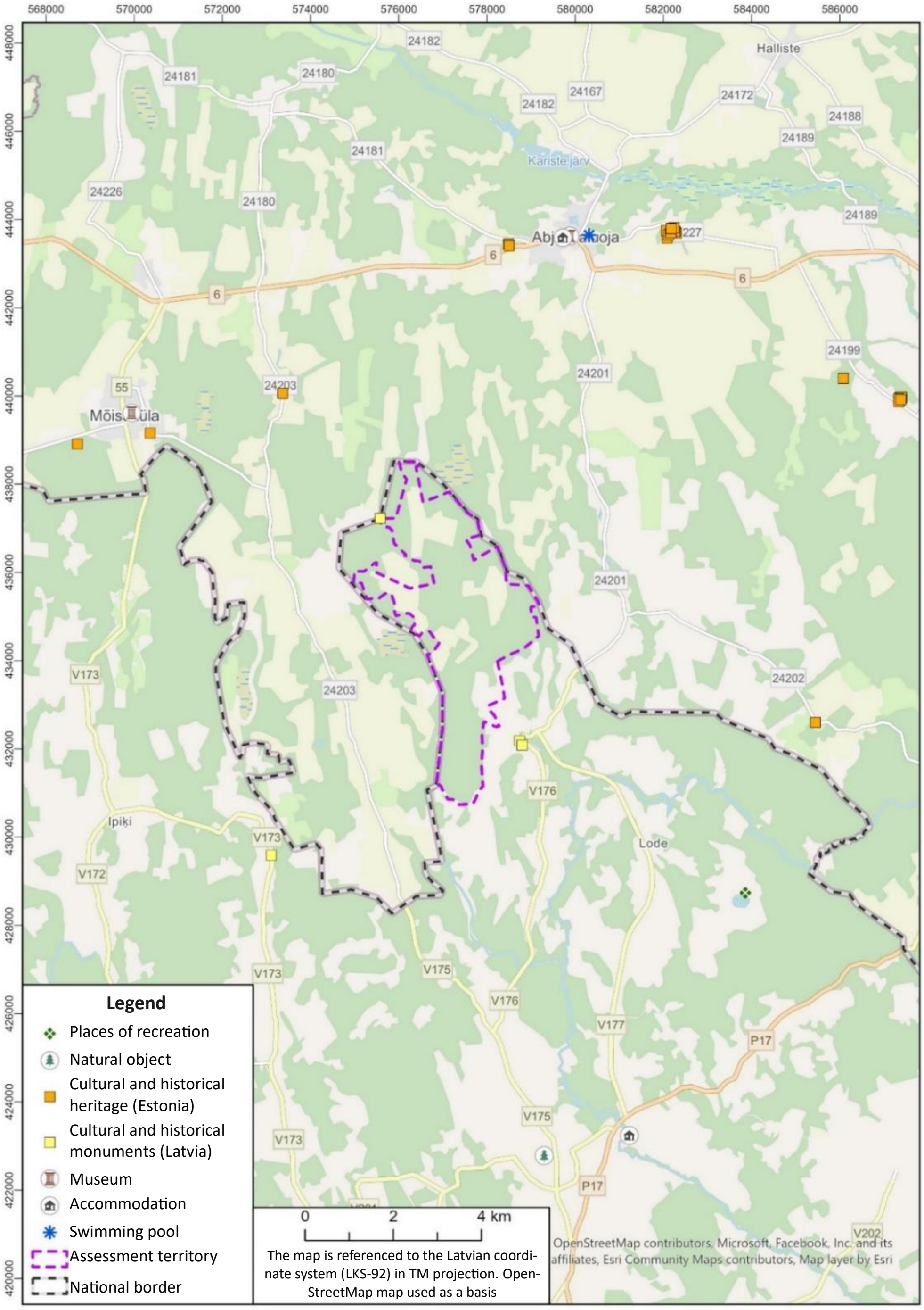


Figure 4.14.7. Tourist attractions in the vicinity of the area of intended activity

According to the CSB data on hotels and other tourist accommodation places in Valmiera municipality for the 2022–2023 period[172], there have been no significant changes in the number

[171] Information accessed on 20 February 2024
[172] https://data.stat.gov.lv/pxweb/lv/OSP_PUB/START__NOZ__TU__TUV/TUV050m

of accommodation places (see Table 4.14.6), but the number of rooms and beds has increased over the year. The number of people served in Valmiera municipality has almost doubled — the number of local guests has increased and the number of foreign guests has increased six-fold. Overall, the end of January 2023 is assessed positively, as the number of overnight stays has almost doubled, and the number of overnight stays by foreign guests, which increased about five times in Valmiera municipality, also stands out.

Table 4.14.6. Hotels and other tourist accommodation in Valmiera municipality (after the ATR in 2021)[173]

	End of January 2022	End of January 2023
Number of accommodation places (end of period)	33	39
Number of rooms (end of period)	328	401
Number of beds (end of period)	974	1,173
Persons served	1,188	2,490
Local guests served	1,061	1,705
Foreign guests served	127	785
Overnight stays	2,243	4,559
Overnight stays by local guests	1,985	3,026
Overnight stays by foreign guests	258	1,533

For comparison of Valmiera municipality, Table 4.14.7 shows Viljandi county, which surpasses Valmiera municipality in terms of characteristics presented in the tables, i.e. the number of registered accommodation places in the Estonian county in 2022 is 26 places higher and the number of rooms is almost twice as high as in Valmiera municipality. There is a significant difference in the number of persons served and the number of overnight stays, more specifically, in 2022, the number of persons served in Viljandi county is 54 times higher, exceeding 60,000 persons, while the number of overnight stays exceeds 100,000. This is mainly due to the significantly different areas of Valmiera municipality and Viljandi county.

Table 4.14.7. Hotels and other tourist accommodation in Viljandi county in 2021 and 2022[174]

	2021	2022
Number of accommodation places	54	59
Number of rooms	612	645
Number of beds	1,795	1,933
Persons served	50,472	64,145
Overnight stays	89,239	104,847

The nearest tourist accommodation to the area of intended activity is approximately 6 km from the research area (Figure 4.14.7), therefore impacts on such tourist accommodation places are expected to be insignificant:

[173] https://data.stat.gov.lv/pxweb/lv/OSP_PUB/START__NOZ__TU__TUV/TUV050m
[174] https://andmed.stat.ee/en/stat/majandus__turism-ja-majutus__majutus/TU110/table/tableViewLayout2

- An accommodation place and an inn in Estonia 6.06 km from the research area called 'Mulgi Kõrts';
- The guest house 'Koņu dzirnavas' is located in 8.32 km from the research area.

According to the CSB data on economically active companies by their main areas of activity[175], in 2022 the total number of accommodation and catering companies in Valmiera municipality was 42, with 21 accommodation companies and 21 catering companies registered.

Conformity of the intended activity to the spatial planning of local governments

Information on the conformity of the area of intended activity to the local government spatial plan is provided in Section 3.1.

4.14.4 Impact on Socio-economic Aspects during Construction

A description of the works is provided in Section 3.4. During the construction of the Lode wind farm, local residents may experience temporary disturbances due to construction noise, vibrations and traffic impacts from construction machinery and vehicles. Visual landscape changes are expected. Temporary changes in air quality (e.g. disturbances related to construction dust) may also occur. However, all disturbances, with the exception of landscape changes, are transitory and temporary. While the impacts of the construction process cannot be prevented, they can be significantly reduced through planning and organisation of construction works. Before construction works start, the customer, the contractor and the relevant local authority must plan works and mitigation measures in good time and inform residents, traffic participants and other involved parties.

Road traffic restrictions will apply to the construction sites and the road and street network in their vicinity. The intended activity may not result in any denial of access to any property or site within the respective area of works. In order to ensure access to properties and sites and the possibility to bypass or cross the construction or reconstruction work area, traffic organisation schemes will be prepared during both the development of the technical design and the execution of the works, taking into account the working methods and technologies used by the contractor.

The construction works may affect public safety and/or the perception of public safety. Construction sites must be duly fenced off to prevent public access.

Overall, taking into account the duration, scope and spatial distribution of the impact and the number of people affected, ***minor unfavourable impacts*** on the accessibility of the area and the quality of life during construction are expected. At the same time, it should be noted that the construction of the wind farm can have a positive impact on the economy and employment levels in the short term, including by creating new construction jobs, as well as promoting specific knowledge and skills development opportunities in the short and long term. In this respect, the impact is assessed as a ***minor favourable impact***.

4.14.5 Impact on Socio-economic Aspects during Operation

During the operation of the Lode wind farm, a number of socio-economic impacts are expected, which will be analysed in this subsection.

[175] https://data.stat.gov.lv/pxweb/lv/OSP_PUB/START__ENT__UZ__UZS/UZS031/

Local economy and employment

During the operation period of the wind farm, labour demand is expected to be relatively low at the local level, i.e. the number of new jobs planned will be small compared to the national level. The sensitivity of the affected parties is assessed as low, the magnitude and scale of the impact — as low, and consequently ***minor favourable impacts*** are expected***.***

Impact on Local Infrastructure

The changes to the road infrastructure resulting from the intended activity, as well as the extent of the impacts, are described in Section 3. Overall, it can be concluded that the impact of the intended activity on infrastructure during construction will be temporary and insignificant, while the impact during operation will be rather positive, given that the intended activity is related to the improvement of access roads and the construction of new road sections. It is expected that the construction of the wind farm could lead to an increase in traffic volumes in the national road network and the municipal road network in the vicinity of the area of intended activity, as well as temporary traffic restrictions during the transportation of WTGs (see more in Section 3). No traffic restrictions are planned during the operation of the wind farm.

The construction or operation of the wind farm is also not expected to affect the operation of other infrastructure objects, such as electricity supply systems, water supply, or have a direct impact on other economic activities in the vicinity of the planned wind farm. It is expected that the construction work organisation plan will be agreed with all users of the territory in order to avoid, as far as possible, the imposition of restrictions that could prevent other economic activities from taking place in the vicinity of the WTG construction sites. During the operation of the wind farm, it is not envisaged that restrictions on the above-mentioned economic activities outside the WTG construction sites have to be imposed.

During the operation of the Lode wind farm, no impacts on access to social services, sports, recreational and cultural services are foreseen, which may be negatively affected by the barrier effect. At the same time, it should be noted that the new access roads built during the construction of the Lode wind farm and the reconstruction of existing roads have the potential to improve access to these services.

Overall, the sensitivity of the affected parties is assessed as low at the local level and medium at place-specific level, and the magnitude and scale of the impact as low. Accordingly, the impact is assessed as a ***minor favourable impact***.

Agriculture, Forestry, Hunting Resources

In Latvia, no studies have so far been carried out to analyse the impact of WTGs on livestock, forest animals and beekeeping. A survey of scientific studies in other countries shows that relatively little similar studies have been carried out elsewhere. Some media have published on the negative effects of WTGs on farm animals and insects, but the authors have not tested the hypotheses put forward in the publications using scientifically accepted methods.

There are no livestock sheds in the area of the planned wind farm, nor is the territory used for livestock grazing, nor are there any organic farms. Information on the number of livestock registered in Valmiera municipality is summarised in Section 4.14.3.1.

Scientific studies examining the impact of wind farms on beekeeping have been carried out in Poland[176]. One study compared the health, activity and productivity of bees in populations located inside and outside a wind farm over two years. The results of the study show that the presence of wind farms does not affect bee populations. Similarly, a report published in 2018[177] shows that no significant differences can be identified when comparing the population size and species diversity of different pollinators, including bees, inside and outside wind farms. A 2020 report commissioned by the European Commission found that the development of wind farms could have negative impacts on pollinators through habitat loss, degradation and fragmentation associated with the construction of wind turbines[178]. These negative impacts can be mitigated through post-construction rehabilitation measures and other support for biodiversity in the wind farm area.

In analysing the potential impacts of wind turbines on livestock and wildlife, some studies have shown that noise from wind turbines can affect communication between animals, affecting their reproduction. Stressful noise can also contribute to an increase in cortisol levels, making animals more susceptible to infections and diseases. Such impacts depend on the distance of the habitat from the wind farms[179]. In 2013, a study was published by a group of Polish scientists on the effects of WTGs on weight gain and cortisol levels in domestic geese *Anser anser f. domestica*[180]. The study showed that the average cortisol level was significantly higher in geese kept 50 m from the WTG (34.12 ng/mL (week 17)) than in geese kept 500 m from the WTG (12.61 ng/mL (week 17)). It was also found that the weight gain was higher in geese kept 500 m from the WTG (8.31 kg (week 17)) than in geese kept 50 m from the WTG (7.45 kg (week 17)). The authors of the study point out that there are significant differences in the individual scores of the test group birds, suggesting an individual-specific response to the stressor. The authors attribute the increased cortisol levels and reduced weight gain to the noise from the WTGs. The study does not indicate normal cortisol levels and weight gain, which limits the ability to assess the potential role of stressors. It should be noted that the wind generation technologies available in 2013 were significantly different from those envisaged for the intended activity. Based on the information of the state environmental service on animal camping sites for which a category C permit has been issued[181] in accordance with cabinet regulation no. 1082, on procedures by which polluting activities of category a, b and c will be declared and permits for the performance of category a and b polluting activities will be issued[182], three category C polluting activities have been identified in the vicinity of the wind farm assessed within the distances specified in the study: three animal camping sites within approximately 1.6 km from the research area.

[176] Karwan, D., Wpływ farmy wiatrowej na wartość użytkową pszczoły miodnej, 2018
[177] Pustkowiak S, Banaszak-Cibicka W, Mielczarek ŁE, Tryjanowski P, Skórka P. The association of windmills with conservation of pollinating insects and wild plants in homogeneous farmland of western Poland. Environ Sci Pollut Res Int. 2018;25(7):6273-6284. doi:10.1007/s11356-017-0864-7
[178] https://solar-ew.nl/wp-content/uploads/2021/02/Arcadis_EnergyGuidance_SolarEnergyWorks_A4_05_11_compressed.pdf
[179] Hansen, C. & Hansen, K. Recent Advances in Wind Turbine Noise Research, 2020
[180] Mikolajczak et al., Preliminary studies on the reaction of growing geese (Anser anser f. domestica) to the proximity of wind turbines, Polish Journal of Veterinary Sciences Vol. 16, no. 4, 2013
[181] https://registri.vvd.gov.lv/piesarnojoso-darbibu-vietu-karte accessed 20 April 2024.
[182] https://likumi.lv/ta/id/222147-kartiba-kada-piesakamas-a-b-un-c-kategorijas-piesarnojosas-darbibas-un-izsniedzamas-atlaujas-a-un-b-kategorijas-piesarnojoso-da

Taking into account the small loss of agricultural land, the expected low impact on livestock and the spatial distribution of the expected impacts, the impact of the intended activity on agriculture is assessed as ***insignificant.*** Similarly, impacts on forestry and hunting resources are assessed as ***insignificant.***

Tourism infrastructure

The planned wind farm has the potential to have negative impacts on economic activities related to tourism and recreation. Currently, it is relatively difficult to predict the economic impact of the planned wind farm on nearby recreational facilities, as there is a lack of such studies in Latvia and Estonia. Studies carried out in other European countries and around the world show that:

- in studies where visitors to recreational facilities were surveyed before the planned wind farms were built, some visitors indicated that they would not visit the recreational facilities after the wind farms were built;
- studies analysing the possible decrease in the number of customers for recreational services after the construction of wind farms have not shown that the construction of WTGs has had a significant negative impact on the turnover of recreational facilities[183].

In some cases, the results of the studies indicate that tourists with prior knowledge of wind turbines would be willing to pay more to live with a view of a wind farm during their recreation and rated the development of wind farms positively[184,185,186.] There are also studies of residents living in close proximity to wind farms who have created new and unique uses for wind farm infrastructure and who are positive about this type of development[187.] At the same time, the results of other studies[188,189,190] indicate that where nature- and landscape-based tourism is particularly important for the local economy, the development of wind farms can become a competing type of land use. Summarising the results of the studies, it can be concluded that factors such as the existing use of the area of intended activity (undeveloped environment or economically developed area), the visibility of wind farms, the distance to and number of wind

[183] Polecon Research, The Impact of Wind farms on Tourism of New Hampshire, 2013; C. Aitchison, Torism impact of wind farms, The University of Edinburgh, 2012; V. Braunova, Impact study of wind power on tourism on Gotland, Uppsala University, E.Tverijonaite et al., How close is too close? Mapping the impact area of renewable energy infrastructure on tourism, 2022.

[184] S. Trandafir, How Are Tourists Affected By Offshore Wind Turbines? A Case Study Of The First U.S. Offshore Wind Farm, 2020

[185] T.Smythe, Beyond the beach: Tradeoffs in tourism and recreation at the first offshore wind farm in the United States, 2020

[186] T. Broekel & C. Alfken, Gone with the wind? The impact of wind turbines on tourism demand, 2015

[187] C. E.Pavlowsky & T. Gliedt, Individual and local scale interactions and adaptations to wind energy development: A case study of Oklahoma, USA, 2021

[188] A. D. Sæþórsdóttir & R. Ólafsdóttir, Not in my back yard or not on my playground: Residents and tourists' attitudes towards wind turbines in Icelandic landscapes, 2020

[189] L. Voltairea & O.P. Koutchade, Public acceptance of and heterogeneity in behavioural beach trip responses to offshore wind farm development in Catalonia (Spain), 2020

[190] T. Broekel & C. Alfken, Gone with the wind? The impact of wind turbines on tourism demand, 2015

farms, the level of knowledge and awareness about the impact of wind farms and renewable energy in general play an important role in people's perception of wind farms[191,192,193].

Insignificant impacts on tourism infrastructure are expected due to the small magnitude and scale of the impact, as well as the location of accommodation and tourist facilities in the vicinity of the planned activity, which is likely to be related to the Latvian-Estonian border and historical development.

Impact on Real Estate

The analysis of the impact of the intended activity on real estate is based on two aspects: the preservation of the residential or public function of the real estate and the expected impact on real estate prices.

In accordance with cabinet regulation no. 240 of 30 April 2013, on general regulations for the planning, use and building of the territory, the construction of wind turbine generators is not allowed closer than 800 m from residential and public buildings. According to the information available in the information system of the state cadastre of immovable properties on the main type of use of the building, there are no residential and public buildings in the study area of the planned Lode wind farm. Similar restrictions applied to the retention of potential future residential or public functions within a certain distance of the WTGs. However, the binding regulations of the municipality of Mulgi in Estonia do not set minimum distances from the WTGs to residential or other areas.

Another potentially negative aspect of the impact of wind farms that is being studied is the impact on property values. Analysing the studies carried out so far on the impact of wind farms on property values, it should be noted that no such studies have been carried out in Latvia so far, therefore the assessment is based only on the results of studies carried out in other countries. Most of the studies carried out abroad are based on the quantitative analysis of changes in property values, using retrospective analysis methods, mainly analysing the relationship between the distance and property value, and between the view and property value. The results of the studies show that the construction of wind farms does not have a negative impact on the value of agricultural land, forestry land and land for industrial development, which is largely due to the fact that the construction of wind farms does not affect the use of this type of property, which is considered to be an important factor in determining the market price. The construction of wind farms has the potential to affect the value of properties whose primary use is residential.

[191] V. Westerberg et al, Offshore wind farms in Southern Europe – Determining tourist preference and social acceptance, 2015
[192] B. Frantál & J. Kunc, Wind turbines in tourism landscapes: Czech Experience, 2011
[193] D. L. Bessettea & S. B.Millsb, Farmers vs. lakers: Agriculture, amenity, and community in predicting opposition to United States wind energy development, 2021

A number of studies[194,195,196,197,198,199,200,201] do not find a statistically significant impact of wind farms on the market value of real estate in the residential segment of the market. At the same time, the authors of other studies[202,203,204,205,206,207,208,209] have found statistically significant correlations between the construction of wind farms and the depreciation of the market value of real estate in the residential segment of the market. Although the authors of the studies seem to come to different conclusions, it can be argued that the construction of wind farms in the vicinity of residential properties does not increase the market value of those properties. The analysis of the results of the studies carried out did not identify any study that found a positive change in the market value of real estate immediately after the construction of wind farms. The results show that there are a number of specific factors that can influence the market value of real estate in the vicinity of a wind farm — distance to the wind farm, height of the WTG, number of visible WTGs, quality of the landscape near the wind farm, quality of the real estate, total number of wind farms in the region, public attitudes towards wind energy projects and other factors.

Although the number of studies on the impact of wind farms on real estate market values is relatively large and the studies mostly use comparative quantitative analysis methods, it is not possible to predict from the studies the impact of operations on housing market values in the

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[194] Sims, S., Dent, P., Oskrochi, R., Modelling the Impact of Wind Farms on House Prices in the UK. International Journal of Strategic Property Management, 12, 2008

[195] Laposa, S., Mueller, A., Wind Farm Announcements and Rural Home Prices: Maxwell Ranch and Rural Northern Colorado. Journal of Sustainable Real Estate, 2, 2010

[196] Canning, G., Simmons, L. J., Wind energy study - Effect on real estate values in the municipality of Chatham-Kent, Ontario. Consulting Report prepared for the Canadian Wind Energy Association, Ontario, Canada, 2010

[197] Hoen, B., Wiser, R., Cappers, P., Thayer, M., Sethi, G., Wind Energy Facilities and Residential Properties: The Effect of Proximity and View on Sales Prices Authors. Journal of Real Estate Research, 33, 2011

[198] Hoen, B., Wiser, R., Cappers, P., Thayer, M., Sethi, G., The impact of wind power projects on residential property values in the United States: A multi-site hedonic analysis, 2014

Lang, C., Opaluch, J., Sfinarolakis, G., The Windy City: Property Value Impacts of Wind Turbines in an Urban Setting. Energy Economics, 44, 2014

[199] Urbis Pty Ltd, Review of impact of wind farms on property values, 2016

[200] Hoen, B., Atkinson-palombo, C., Wind Turbines, Amenities and Disamenities: A Study of Home Value Impacts in Densely Populated Massachusetts. Journal of Real Estate Research, 38, 2016

[201] Castleberry, B., Greene, J., Wind power and real estate prices in Oklahoma. International Journal of Housing Markets and Analysis, 11, 2018

[202] Sims, S., Dent, P., Property stigma: wind farms are just the latest fashion. Journal of Property Investment and Finance, 25, 2007

[203] Heintzelman, M., Tuttle, C., Values in the Wind: A Hedonic Analysis of Wind Power Facilities. Land Economics, 88, 2011

[204] Gibbons, S., Gone with the wind: Valuing the visual impacts of wind turbines through house prices. Journal of Environmental Economics and Management, 72, 2015

[205] Sunak, Y., Madlener, R., The impact of wind farm visibility on property values: A spatial difference-in-differences analysis. Energy Economics, 55. 2016

[206] Dröes, M., Koster, H., Renewable energy and negative externalities: The effect of wind turbines on house prices. Journal of Urban Economics. 96. 2016

[207] Eichholtz, P., Kok, N., Langen, M., Clean Electricity, Dirty Electricity: The Effect on Local House Prices. SSRN Electronic Journal, 2017

[208] Frondel, M., Kussel, G., Sommer, S., Local Cost for Global Benefit: The Case of Wind Turbines, 2019

[209] Holm, P., Tyynilä, J.. Impact of wind power on residential property prices (Tuulivoima -vaikutus asuinkiinteistöjen hintoihin), 2021

vicinity of the planned wind farm. The range of changes in real estate market values identified in the studies is very wide. As mentioned above, a large number of studies do not find a link between the construction of WTGs and the market value of real estate. One of the most comprehensive studies carried out in Europe[210], which analysed housing prices in the vicinity of wind farms in the Netherlands between 1985 and 2019 (around 290,000 transactions valued), found that housing prices in areas within 2 km of a wind farm fell by an average of 1.6%. A study carried out in the UK[211] found that the market value of real estate in areas within 2 km of a WTG decreased by around 5–6%, and in areas within 2-4 km of a WTG by less than 2%. A study carried out in Germany[212] found that in areas where WTGs were very close to residential houses (closer than 2 km), WTGs were visible from the central part of the building's courtyard or where WTGs created a significant contrast in the landscape and the number of visible WTGs was at least 8, property prices could decrease by up to 17.9%. One of the studies carried out in Sweden[213] found a strong and statistically significant effect of distance to wind turbines on property values. In particular, the value of dwellings in the immediate vicinity of WTGs was reduced by up to 20% in some cases, by 9–14% at a distance of 2–4 km from WTGs, with no value reduction at a distance of 6–8 km.

Some researchers suggest that the impact of WTGs on the market value of real estate could be sporadic, affecting only specific properties that are mainly used for recreation or have cultural and historical value. The results of a study carried out in Greece[214] on real estate price developments on two relatively similar and relatively small islands, Euboea and Cephalonia, where a large part of real estate was used for recreational purposes, show that the location of WTGs can also influence the market price. In Cephalonia, where the total installed capacity of WTGs is higher but the wind farms are compact, no statistically significant change in real estate market values could be identified over the last 10 years, while in Euboea, where the plants are spread over a wider area in several small groups, a statistically significant decrease in real estate market values can be observed in areas up to 2 km away from the WTGs.

Several studies analysed have found that the impact of WTG wind farms on real estate values is more likely to be a deterrent to the growth of real estate values than a direct depreciator. This is shown, for example, by a study carried out in Australia[215], which also analysed re-sales and concluded that real estate values depend to a large extent on the overall demand in the region, as well as on other market fluctuations that are not directly related to WTGs. Factors such as access to services and transport, economic growth and employment in the region, as well as changes in legislation can have a more significant impact on real estate values.

Although the almost 20% change in property market values identified in a study carried out in Sweden[216] in areas with significant visual impact is obviously very significant, looking at the Central Statistical Bureau data on dwelling price indices in Latvia over a 10-year period (see

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[210] Dröes, M., Koster, H., Wind turbines, solar farms, and house prices. Energy Policy, 155. 2021
[211] Gibbons, S., Gone with the wind: Valuing the visual impacts of wind turbines through house prices. Journal of Environmental Economics and Management, 72, 2015
[212] Sunak, Y., Madlener, R., The impact of wind farm visibility on property values: A spatial difference-in-differences analysis. Energy Economics, 55. 2016
[213] (Westlund, Wilhelmsson, The Socio-Economic Cost of Wind Turbines: A Swedish Case Study, 2021
[214] Skenteris, K., Mirasgedis, S., Tourkolias, C., Implementing hedonic pricing models for valuing the visual impact of wind farms in Greece. Economic Analysis and Policy, 64, 2019
[215] Urbis Pty Ltd, Review of impact of wind farms on property values, 2016
[216] Westlund, Wilhelmsson, The Socio-Economic Cost of Wind Turbines: A Swedish Case Study, 2021

Figure 4.14.8), it should be concluded that other socio-economic factors in the country have a much more significant impact on property market values.

A long-term study was published in 2024[217], which estimated real estate changes in the US before the announcement of the intention to build WTG farms, after the announcement and up to 10 years after the construction of the wind farms. The results of the study show that for dwellings located within a 1-mile (1.6 km) radius of the WTG farms, price decreases were observed after the announcement of the construction plan, but within 10 years of the construction of the wind farm the price level increased and reached the regional average price. The impact on housing prices is much smaller for properties within a 1–2 mile radius of the WTG farms, and insignificant for properties further than 2 miles from the wind farms.

The House Price Index is a quarterly indicator that reflects changes in the prices of housing purchased by people on the free market. The House Price Index covers all house purchases, regardless of the purpose and future use of the property. The House Price Index covers transactions between households on the one hand and traders, state or local government institutions on the other hand, as well as between two or more households. According to data collected by the Central Statistical Bureau, the value of housing prices in Latvia can fluctuate by 33% even within one quarter, but the direction and range of fluctuations largely depend on the economic growth rate in the country and other factors.

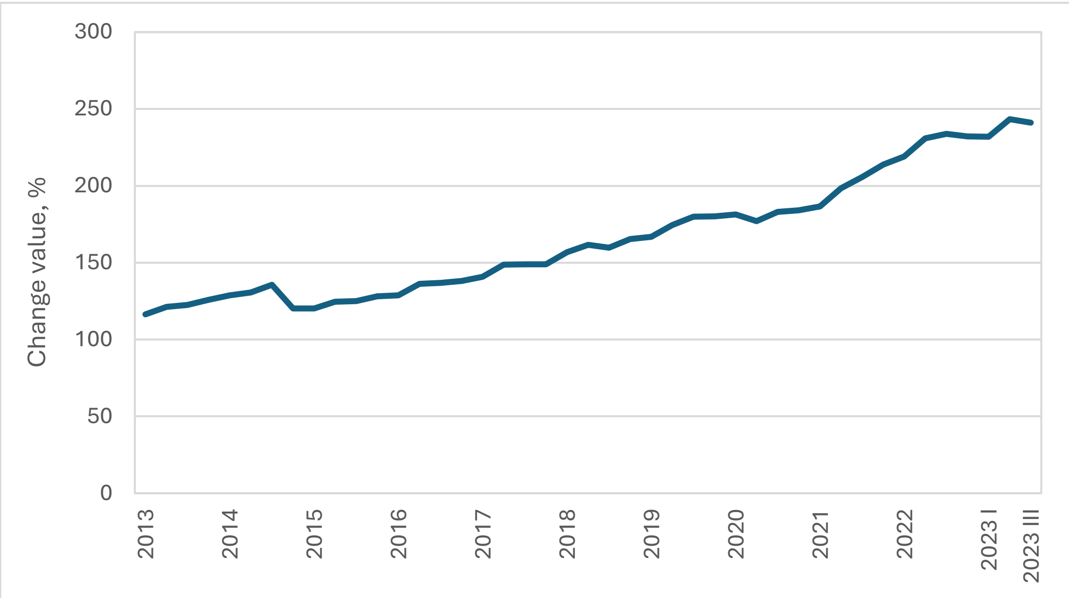

Figure 4.14.8. Changes in the value of the House Price Index (reference period — 2013)[218]

Accordingly, it is likely that the implementation of the intended activity may reduce the market value of properties in the vicinity of the wind farm. Although it is not possible to assess quantitative indicators for describing the significance of the impact in Latvia on the basis of the

[217] Eric J. Brunner, Ben Hoen, Joe Rand, David Schwegman. 2024. Commercial wind turbines and residential home values: New evidence from the universe of land-based wind projects in the United States, *Energy Policy*, 185, 2024, 113837, ISSN 0301-4215. Available at: https://doi.org/10.1016/j.enpol.2023.113837
[218] https://stat.gov.lv/lv/statistikas-temas/valsts-ekonomika/paterina-cenas/tabulas/pci050c-majokla-cenu-indekss-un-parmainas

available information, even if the magnitude of the changes under the worst-case scenario identified in studies of other countries is assessed, it is to be concluded that the potential impact of construction of the planned wind farm on the market value of properties in the vicinity of the intended activity will be comparable to the magnitude of changes in the market value of properties in the residential segment of the market caused by other processes in the country.

Hence, overall, the impact on property values in the immediate area of influence is assessed as ***moderate unfavourable***, and at the local level as ***minor unfavourable***. The impact on the maintenance of the real estate function is assessed as ***moderate unfavourable*** and, at the local level, as ***minor unfavourable***, given that the designated use within 800 m of the proposed WTGs is agricultural land or forest territory.

Compensation to the Local Community

It should be noted that according to the amendments to the act on electricity markets, for the operation of a wind turbine generator, if its installed capacity is equal to or greater than one megawatt, the installer or owner of the WTG will be required to make an annual payment to the local community for the discomfort caused by the wind turbine generator for the total installed capacity of each unit, starting from the moment the respective unit is put into operation. For the local community, 100 per cent of the compensation for the inconvenience caused by the wind turbine generators will be paid into the local government budget in whose territory the electricity generation facility is located or will be installed. The procedure for the use of these funds by the local government and the purposes for which they are to be used must be determined by the local government by means of binding regulations. The amount of compensation will be determined in the cabinet regulations, which will be developed and adopted on the basis of the new amendments to the act on electricity markets. As stated in the annotation to the amendments[219], the local government can use the funds from the payment for the operation of the wind energy equipment, for example, for:

- reducing energy poverty in the respective municipality;
- supporting municipal infrastructure projects (e.g. roads, outdoor lighting, greening and nature protection projects);
- educational purposes; informing the public about renewable energy, climate change, energy efficiency and environmental protection matters;
- competitively and prioritised electricity generation equipment installed in the immediate vicinity for the following purposes: investment support for renewable energy generation equipment for private individuals and businesses, energy efficiency projects, support for energy communities, support for active users and self-producers of renewable energy in the affected area.

Local governments and regional populations will directly benefit financially from the compensation, contributing to a better quality of life and increased ability to pay. This in turn can boost local consumption, improve the local business environment and have a positive impact on the market values of properties.

[219] Annotation to the draft of amendments to the act on electricity markets: https://titania.saeima.lv/LIVS13/SaeimaLIVS13.nsf/0/02418148FD9D269FC225881C0049D340?OpenDocumet

Cross-border impacts

The Lode wind farm also includes associated infrastructure (a cable line) in the territory of Estonia, but its environmental impact will be assessed separately. Overall, the intended activity (i.e. wind turbine generators in the Latvian territory) is expected to have similar impacts on socio-economic aspects and affected parties on a local and place-specific level in Estonia as described in this section for the Latvian territory, i.e. no significant negative impacts on socio-economic aspects are expected.

4.15 Other Impacts

4.15.1 Vibrations

Similarly as in any other mechanical equipment, vibrations during the operation of a WTG are caused by the imbalance and friction of rotating parts. The main sources of vibration in a WTG are the generator, gearbox and bearing systems. The vibration of these rotating parts can also cause the nacelle and tower to vibrate. At high wind speeds, the level of vibration can be increased by imbalances in the WTG parts due to wind pressure and turbulent flows. Mitigating and controlling vibrations caused by the mechanical parts of a WTG has been one of the most important research areas for WTG engineers in recent decades. The search for new solutions continues today, with WTG operators being the main initiators of such studies, as vibration-induced equipment damage can significantly increase the operating costs of WTGs. The vibrations generated by the WTG structures have a direct impact on the vibration levels that will be experienced in the vicinity of the WTG.

In order to reconcile the wishes of the users of the WTGs with modern technological possibilities, the first guidelines in the world (VDI 3834 “Messung und Beurteilung der mechanischen Schwingungen von Windenergieanlagen und deren Komponenten - Onshore-Windenergieanlagen mit Getrieben”, March 2009) were approved in Germany in 2009, setting vibration limits for the mechanical parts of WTGs. In 2015, these guidelines were updated to extend the thresholds also with regard to WTGs with a rated capacity of more than 3 MW. These guidelines and the limit values set are taken into account by all major WTG manufacturers when developing new WTG designs and by WTG operators. The permissible limits for vibration velocity and acceleration as defined in VDI 3834 are shown in Figure 4.15.1.

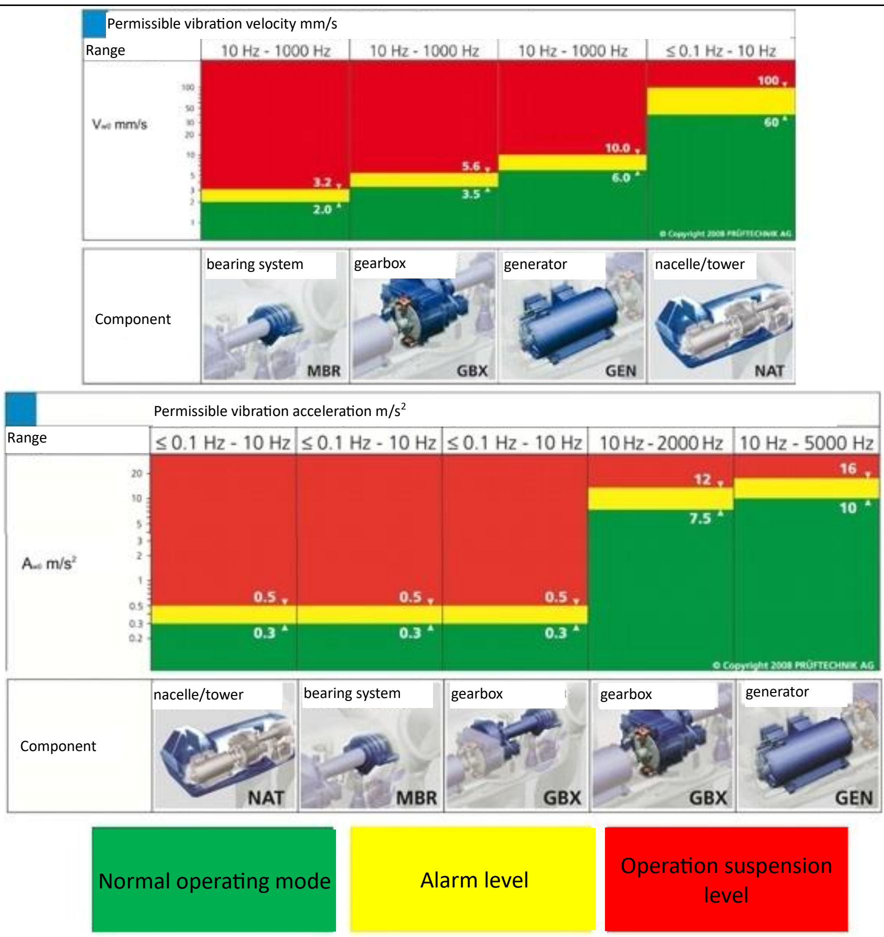

Figure 4.15.1. Permissible vibration levels of mechanical parts of a WTG according to VDI 3834

Vibrations from WTGs have not been studied in Latvia, and relatively few studies have been carried out in other countries. Most of the studies carried out so far have analysed solutions to mitigate vibrations caused by the mechanical parts of WTGs to prevent damage to WTGs due to vibrations, and only a few studies have analysed the effects of vibrations in the vicinity of WTGs.

In 2013–2015, a study by the Baden-Württemberg Ministry for the Environment, Measurement and Nature Protection also measured vibrations alongside low-frequency sounds from WTGs. The measurements were taken at the Nordex N117 WTG on a 140.6 m high mast, operating at rated power. According to the measurement results, the vibration acceleration at the station (on the station's base plate) exceeded 1 m/s^2, but the vibration level decreased rapidly while moving away from the station. At a measurement point at 285 m from the station, the vibration acceleration was slightly higher than 0.01 m/s^2, which was insignificantly higher than the level observed during the period when the WTG was switched off. Similar measurement results were obtained in a study carried out in Canada where vibration measurements at different distances from a WTG were carried out at a 2.3 MW WTG in an 88-unit wind farm. Again, this study shows that vibration acceleration levels can be high in the immediate vicinity of the WTG, but at a distance of 300 m from the WTG they are no higher than 0.01 m/s^2. Similar levels of vibration from WTGs have also been found in a study analysing the impact of WTGs on the operation of seismological equipment.

The level of vibration caused by WTGs and their impact on nearby areas in Latvia are not limited by regulatory limits. Until 30 June 2010, the vibration limit values were laid down in cabinet regulation no. 341 of 25 June 2003, on regulations on permissible values of vibration in residential and public buildings (hereinafter referred to as cabinet regulation no. 341). No new legislation setting vibration limit values has been issued since 30 June 2010, when the said cabinet regulation expired. Cabinet regulation no. 341 set lower vibration limit values for operating theatres and wards in medical and rehabilitation institutions (nighttime hours), where the weighted vibration acceleration could not exceed 0.028 m/s^2. In residential premises, the weighted vibration acceleration could not exceeded 0.04 m/s^2 at night and 0.07 m/s^2 during the day.

A comparison of the results of vibration measurements at WTGs with the vibration limit values in force in Latvia until 30 June 2010 shows that vibration levels caused by WTGs in their immediate vicinity are higher than the limit values, while vibration levels at a distance of 300 m from WTGs are significantly lower than the lower limit value applicable to operating theatres and wards of medical and rehabilitation institutions (night period). Although there are currently no studies on the vibration levels of the WTG models assessed in this EIA, given that the limit values for the mechanical parts of WTGs are set independently of the power of WTGs, there is no reason to believe that the vibration levels from the planned wind farm in Valmiera will be significantly higher and pose a threat to public health. In other words, the impact on public health caused by vibrations from WTGs is assessed as minor.

4.15.2 Exposure to Electromagnetic Fields

Electromagnetic fields are generally not sensed by the sensory organs, and low-level electromagnetic fields do not immediately result in unfavourable effects on human health. At the current level of scientific development, it is not clearly known whether such effects on human health exist at low levels of electromagnetic fields, but if they do, the high latency period may make it difficult to attribute any effects unambiguously to exposure to low-level electromagnetic fields that occurred at some earlier time, excluding other possible causes of the effects.

The widespread use of electricity in many areas of modern life (industry, transport, households, etc.) and the associated generation and transmission of the necessary electricity, fixed and various wireless communication, radio, TV and radar applications, as well as medical diagnostics and therapies using various types of electric, magnetic and electromagnetic fields, have added to the electric, magnetic and electromagnetic fields always present in the environment around us (the Earth's magnetic field — (in Latvia approximately 51 μT), natural electric fields, which, although quasi-static, can vary by several orders of magnitude (from 200–500 V/m on a normal day when the sun is sometimes obscured by clouds, to 20 kV/m or more during thunderstorms), cosmic magnetic storms, cosmic radio waves, infrared and ultraviolet radiation and visible light, cosmic and terrestrial ionising radiation). Living things, including humans, also generate electric and magnetic fields, but their intensity is usually low.

People realised that electromagnetic radiation of very high energy could be dangerous soon after the practical use of electricity began, first with the use of X-ray machines and radioisotopes. Therefore, safety requirements first emerged specifically for the part of the electromagnetic spectrum that carries more energy — ionising radiation.

Since 1 November 2018, cabinet regulation no. 637 of 16 October 2018, on regulations on the assessment and limitation of exposure of the population to electromagnetic fields, has been in force in Latvia. It transposes the restrictions set out in European Council Recommendation 1999/519/EC of 12 July 1999[220] (hereinafter referred to as 1999/519), which in turn is based on the ICNIRP guidelines of 1998[221] (hereinafter referred to as ICNIRP98). It should be noted that, for several years, both the Ministry of Health and the authorities under its authority and supervision have, prior to the entry into force of cabinet regulation no. 637 of 16 October 2018, used the European Council Recommendation 1999/519/EC of 12 July 1999 to assess the impact of various sources of electromagnetic fields on the population, for example in connection with the construction and commissioning of mobile communication base stations.

Within the framework of this EIA process, an assessment of the electromagnetic radiation associated with the intended activity has been carried out, including a comparison of the calculated radiation levels with the limit values and target values for the protection of public health specified in cabinet regulation no. 637 of 16 October 2018, on regulations on the assessment and limitation of exposure of the population to electromagnetic fields. According to the said regulation, the numerical value of the electromagnetic field target value for the population for a magnetic field arising from the voltage at the frequency of 50 Hz is 100 µT.

Calculations using the FEM method (referenced in LVS EN 50499 "Procedure for the assessment of the exposure of workers to electromagnetic fields") show that the actual magnitudes of the external fields would have to be significantly higher for the induced body currents to reach the limit values. Hence, the real external field actually needed to achieve a root mean square of current density of 2 mAm/m^2 in a human, which corresponds to the threshold value, is 360 µT. Accordingly, for 50 Hz, the limit value of 2 mA/m^2 would not be exceeded even if the target values for the magnetic field were exceeded more than 3 times.

The flux density (induction) of a magnetic field is mainly determined by the strength of the current flowing through the wires and the distance to them. The flux density of a magnetic field for a single (infinitely long, straight) conductor can be calculated using the Biot-Savart-Laplace law, based on a simplified formula:

$$B = \frac{\mu_0}{2\pi} * \frac{I}{r}$$

By decomposing the Bio-Savar-Laplace formula into a Taylor series, the first term in the series can be considered as equal to zero, and the magnetic field generated by underground cables at 1 m above the ground level will depend mainly on the depth of the cable, the amperage, the spacing of the phase wires and their relative positions. If the wires are arranged in an equilateral triangle, it is:

$$B(r) = \left(\frac{3}{2}\right)^{0.5} * \frac{\mu_0}{2\pi} * I_v * \frac{d}{r^2},$$

where μ_0 is the magnetic constant $(4\pi \cdot 10^{-7} H/m)$, π is the pi number, I_v is the current flowing through the wire, d is the distance between the conductors of the individual phases, and r is the distance from the wire.

The WTG models assessed within the EIA process are very similar in terms of technology, i.e. they have a generator, a transformer and mechanisms for monitoring and controlling the

220 European Council Recommendation 1999/519/EC of 12 July 1999 on the limits of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz)

221 International Commission on Non-Ionizing Radiation Protection (1998). Guidelines for limiting exposure in time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz). Health Phys. 74, 494-522.ICNIRP

operation of the unit built into a nacelle located at least 150 metres above the ground, and depending on the WTG model, they can be equipped with a 20 kV, 30 kV, 34.5 kV or 40 kV transformer.

The following main sources of electromagnetic fields are likely to arise from the construction of the wind farm and the associated underground cabling to the 110 kV substation:

1) **Power generator and transformer.** Given that the power generator and the voltage step-up transformer, irrespective of the WTG model, will be located in the WTG nacelle at a height of more than 150 m and surrounded by an electrically conductive enclosure, the electric field will be well shielded and is considered insignificant from the point of view of potential impact. In the vicinity of the WTG, the magnetic field at the ground level will be low because the power generator and the step-up transformer are located far from the ground surface (in a nacelle, at least 150 m high) and the magnetic field induced in the windings of the power generator and transformer decreases in proportion to the cube of the distance.
2) **Power cable from the nacelle to the base of the WTG tower.** Based on the WTG specifications indicated in Table 3.2.1, the maximum possible current in the cable will be around 360 A. Given that the WTG tower will use shielded three-core cables, the magnetic field due to the maximum current at a distance of 20 cm from the cable will not exceed 3 to 9 µT, depending on the distance between the cores of the cable. Given that no persons will be permanently present in the immediate vicinity of the WTGs, i.e. there are no dwellings or other facilities in the area where residents, employees or visitors would be required to stay permanently, such magnetic field values are considered to be of minor significance. At a distance of 5 m from the cable, the magnetic field flux level could be between 0.12 and 0.37 µT, depending on the internal geometry of the cable used, in case the voltage is only 20 kV, and if a higher voltage is used, the magnetic field flux density will decrease.
3) **Underground cable network from the WTG to the substation.** Shielded three-core cables are planned to be used. Thus, with a current of 360 A and a cable burial depth greater than 1 metre, the lowest possible magnetic field will be ensured as the different phases of the same system will be in the optimal so-called triangular configuration for reducing the magnetic field. The size of the field will depend on the current flowing and the depth of cable embedment, while the magnitude of the current is directly related to the voltage used. As there is virtually no electric field on the outside of shielded three-core cables, the use of voltages higher than 20 kV is a simple but effective way to reduce the magnetic field above the cable routes. At 20 kV at 1 metre above ground with a cable burial depth of 1 metre, a flux density of up to 5 µT is expected in the magnetic field.

The following tables will show the calculated values of the magnetic field directly above the cables at a height of 1 m above the ground level, depending on the distance between the individual phase conductors, the depth of burial of the cables, and at distances of 10 m, 20 m and 30 m from the cable line.

The calculations in Table 4.15.1 are for a single 20 kV cable from the WTG to the substation carrying 360 A current, corresponding to 7.2 MW of Vestas EnVentus, with a 20 kV step-up transformer. According to the calculations, the flux density of the magnetic field at 1 metre above the ground level is 20 times lower than the set target value. If the WTG is equipped with a higher voltage transformer, or if WTG models with lower rated power are used, the flux density in the magnetic field will be lower.

Table 4.15.1. The magnetic field flux density at 1 m the above ground level for underground cables from the WTG to the wind farm substation *(depending on cable depth and at a distance of 10 m, 20 m and 30 m from the cable, WTG rated power 7.2 MW, current 360 A (if the WTG is equipped with a 20 kV transformer))*

Cable depth, m	Magnetic field flux density, µT, if the distance between the phases is:					
	0.05 m	0.08 m	0.10 m	0.12 m	0.15 m	0.20 m
0.7	1.526	2.441	3.051	3.662	4.577	6.103
0.8	1.361	2.177	2.722	3.266	4.082	5.443
1	1.102	1.764	2.205	2.645	3.307	4.409
1.2	0.911	1.458	1.822	2.186	2.733	3.644
1.5	0.705	1.129	1.411	1.693	2.116	2.822
2	0.490	0.784	0.980	1.176	1.470	1.960
2.5	0.360	0.576	0.720	0.864	1.080	1.440
3	0.276	0.441	0.551	0.661	0.827	1.102
at a distance of 10 m	0.044	0.071	0.088	0.106	0.132	0.176
at a distance of 20 m	0.011	0.018	0.022	0.026	0.033	0.044
at a distance of 30 m	0.005	0.008	0.010	0.012	0.015	0.020

Table 4.15.2 shows the calculations for a single 20 kV cable from the wind farm to a 110 kV substation carrying a current of 5,100 A, which is the worst case and technically not feasible, but even in this case the flux density at 1 metre above the ground is 1.6 times lower than the set target value. If 3 separate 20 kV cables are used, the flux density of each individual cable will be 3 times lower.

Table 4.15.2. The magnetic field flux density at 1 m the above ground level for underground cables from the wind farm to a 330 kV substation *(depending on cable depth and at a distance of 10 m, 20 m and 30 m from the cable. Voltage 20 KV, current 5,100 A, situation where the wind farm operates with a maximum rated power of 102 MW and the WTG is equipped with a 20 kV transformer)*

Cable depth, m	Magnetic field flux density, µT, if the distance between the phases is:					
	0.05 m	0.08 m	0.10 m	0.12 m	0.15 m	0.20 m
0.7	21.613	34.581	43.226	51.872	64.839	86.453
0.8	19.278	30.845	38.557	46.268	57.835	77.114
1	15.615	24.985	31.231	37.477	46.846	62.462

Cable depth, m	Magnetic field flux density, µT, if the distance between the phases is:					
	0.05 m	**0.08 m**	**0.10 m**	**0.12 m**	**0.15 m**	**0.20 m**
1.2	12.905	20.649	25.811	30.973	38.716	51.621
1.5	9.994	15.990	19.988	23.985	29.982	39.976
2	6.940	11.104	13.880	16.657	20.821	27.761
2.5	5.099	8.158	10.198	12.237	15.297	20.396
3	3.904	6.246	7.808	9.369	11.712	15.615
at a distance of 10 m	0.516	0.826	1.032	1.239	1.549	2.065
at a distance of 20 m	0.142	0.227	0.283	0.340	0.425	0.567
at a distance of 30 m	0.065	0.104	0.130	0.156	0.195	0.260

The calculation in Table 4.15.3 corresponds to the worst-case scenario where the current from the wind farm flows to the substation through a single 40 kV cable. In this case, the current in the underground cable could reach 2,550 A, which is a technical challenge, but even in this case the flux density of the magnetic field at 1 metre above the ground is 3.2 times lower than the set target value.

4.15.3. The magnetic field flux density at 1 m the above ground level for underground cables from the WTG farm to a 110 kV substation (depending on cable depth and at a distance of 10 m, 20 m and 30 m from the cable. Current 2,550 A (corresponds to the situation where the WTG is equipped with 40 kV transformers, the current flows from the WTG farm to a 330 kV substation, the wind farm has a rated generation capacity of 102 MW)

Cable depth, m	Magnetic field flux density, µT, if the distance between the phases is:					
	0.05 m	**0.08 m**	**0.10 m**	**0.12 m**	**0.15 m**	**0.20 m**
0.7	10.807	17.291	21.613	25.936	32.420	43.226
0.8	9.639	15.423	19.278	23.134	28.918	38.557
1	7.808	12.492	15.615	18.739	23.423	31.231
1.2	6.453	10.324	12.905	15.486	19.358	25.811
1.5	4.997	7.995	9.994	11.993	14.991	19.988
2	3.470	5.552	6.940	8.328	10.410	13.880
2.5	2.549	4.079	5.099	6.119	7.648	10.198
3	1.952	3.123	3.904	4.685	5.856	7.808
at a distance of 10 m	0.258	0.413	0.516	0.619	0.774	1.032
at a distance of 20 m	0.071	0.113	0.142	0.170	0.212	0.283
at a distance of 30 m	0.032	0.052	0.065	0.078	0.097	0.130

The magnetic field flux density values have been calculated assuming that the separate phases in the underground cable are arranged in a triangular configuration. If the separate phases were aligned in a plane on the same level, the magnetic field flux at 1 m above the ground would be about 1.4 times higher if the plane was parallel to the ground.

In addition, it should be noted that in real life, WTGs will not be operating at maximum power all the time, so the magnetic field flux density levels will not always reach those obtained from the worst-case calculations. However, it should be stressed that in any case the target values set out in cabinet regulation no. 637 of 16 October 2018, on regulations on the assessment and limitation of exposure of the population to electromagnetic fields, will not be exceeded, as shown by the calculations of different situations presented above, and if the depth of the cables was at least 1 m, they would not reach even half of the target values. It is important to note that these regulations state that a person can be exposed to such a magnetic field for 24 hours a day without harmful health effects. No residential development and no continuous presence of persons is foreseen in the area of the wind farm, in the immediate vicinity of WTGs and above the planned cable network of WTGs. Persons carrying out servicing and maintenance works in the vicinity of WTGs are subject to occupational exposure limits that are higher than those for the general public.

The electromagnetic fields that will be generated if the wind farm project is implemented to its maximum extent are not considered likely to have significant effects on public health in general and on the health of people living in the vicinity of the wind farm and using the roads along the underground cable routes. Such electromagnetic fields also do not interfere with the operation of various equipment, including specific medical equipment/devices that support human functions and which are manufactured with a high degree of protection against magnetic fields.

5 PARTICIPATION OF THE PUBLIC

In accordance with the act on the management of the spread of the COVID-19 virus (effective from 10 June 2020 to 31 December 2023), an initial public consultation on the EIA process was held (remotely) from 18 September to 11 October 2023.

The announcement on the initial public consultation was published in the newspaper *Liesma* on 15 September 2023, in the September issue of the Valmiera municipality newsletter no. 9 (27), published on 18 September 2023, as well as on the websites of the Valmiera municipality local government, the Environment State Bureau and the report's author: Estonian, Latvian & Lithuanian Environment, SIA. The property owners (possessors) whose properties are located in or adjacent to the research area of the wind farm have been individually informed about the initial public consultation of the intended activity.

The initial public consultation meeting on the intended activity was held remotely via an online videoconference *on 2 October 2023 at 18:00*. A total of 33 participants attended the initial public consultation meeting.

The attendees became acquainted with the information on the main objectives of EIA, which include identifying impacts, assessing them, identifying alternative solutions and mitigating or eliminating the impacts assessed. As well as on the criteria for selecting the location, number of WTGs, size and possible layout of the planned wind farm. The participants of the meeting were provided with information on the expected impacts during construction, including the use of local roads, the possibility for the hunters' group to use the wind farm area, and the impacts during operation, including the amount of real estate tax, the noise level of the substation, the benefits of the wind farm for the local government, the surrounding community and local residents, such as the nuisance payment to the local government, etc.

During the initial public consultation, no emails were received to the email address of the activity initiator.

6 LIMITING FACTORS FOR THE INTENDED ACTIVITIES AND SOLUTIONS TO MITIGATE ENVIRONMENTAL IMPACTS

This section summarises the information on limiting factors, potential significant impacts and mitigation solutions, as analysed and described in detail in Section 4.

6.1 Factors Limiting the Intended Activity

The EIA report has identified limiting factors for the intended activities, which determine the feasibility of the activities at the selected sites.

The area of the planned wind farm includes land units where energy production enterprises or facilities may not be constructed. Likewise, the regulations on the use of territory and its development[222] stipulate that a free-standing installation, such as a wind turbine generator, will be located on a plot of land so that the distance to the boundary of the plot of land is not less than the maximum height of the installation, so in order to implement the construction of the planned Lode wind farm, a local plan and new regulations on the use of territory and its development for the local plan area will be drawn up, changing the permitted territory use to one that allows the construction of wind turbine generators and removing or changing the conditions regarding the defined distances to the boundary of the land plot.

In accordance with paragraph 163 of cabinet regulation no. 240 of 30 April 2013, on general regulations for the planning, use and building of the territory, when planning the location of WTGs with a capacity of more than 2 MW, the distance from the nearest planned WTG and the boundary of the wind farm to residential and public buildings must be at least 800 m.

The construction of WTG L_16A and L_17A as an alternative to WTG L_16 and L_17 is allowed if the house known as Inčkalni (cadastral designation 96680010088) is agreed for demolition and cancellation of entries in the cadastre and the land register.

The limiting factors for the intended activities are related to the construction of WTG L_01. According to the current planning, the construction of WTG L_01 site will affect the site of the protected *Orobanche pallidiflora (O.reticulata*). According to the experts' assessment, the construction of the above-mentioned development site is not supported. It is recommended that the development site be relocated to the south outside the *Orobanche reticulata* location.

The assessment of environmental aspects related to the impact of the intended activity on public health (environmental noise, flickering) has revealed that the choice of certain technological alternatives may lead to changes in the state of the environment that do not comply with the environmental quality threshold values determined in Latvia or used in this environmental impact assessment process and borrowed from the regulations of other countries. Although technological solutions are available to mitigate these impacts, the refusal to

[222] TUDR, § 25.1.3

implement mitigation measures would be considered as a limiting factor for the implementation of the intended activity.

The initiator should also take into account the need for mitigation measures for ornithofauna, bats, biotopes of EU importance and other natural values, as well as landscape and cultural-historical values in the case of the construction of certain WTGs. More information on the quantitative indicators of impact and mitigation solutions is provided in Section 4 of the Report. Information on potential significant impacts and associated mitigation measures is summarised in Table 6.1.2 of this Report.

It should be noted that the potential locations for WTGs are indicative, according to the currently available information, and may be adjusted within the boundaries of the indicated property during the development of the construction design. In such a case, it should be ensured during the design phase that the proposed changes do not affect the identified natural values and, in cases where the chosen solution differs from the one assessed in this Report, a reassessment of the impacts on the aspects that depend on the change of location, such as calculations of the timing of the flickering effect, identification of the affected built-up areas and the development of shutdown regimes for the WTGs. Changes to the location of WTGs and a reassessment of the impacts associated with these changes may identify additional limiting factors to the implementation of the changed design.

6.2 Potential Substantial Impacts and Mitigation Solutions

This section of the Report summarises information on the likely substantial or significant impacts and mitigation measures that will be required or recommended as a result of implementing the intended activity. Environmental impact mitigation measures are classified into two groups:

- measures to meet requirements set out in legislation and guidelines or by authorities, measures for public safety, or measures to avoid, mitigate or compensate for significant or substantial impacts. These measures should be considered as measures without the implementation of which the intended activity would not be permissible;
- recommendations for impact mitigation based on expert judgement, but not set out in legislation or guidelines.

Information on potential substantial impacts and associated mitigation measures is summarised in Table 6.1.2 of the Report, distinguishing between measures applicable to the construction period and measures applicable to the operation period of WTGs. This table also provides an assessment of the significance of the residual impacts using the criteria in Table 6.1.1. In determining the significance of impacts, environmental and social considerations arising from the requirements of legislation, policy and development planning documents, guidelines and environmental protection principles, as well as the public interest in the context of the environmental aspects assessed, were taken into account.

Table 6.1.1. Assessment scale of the significance of the impact

Impact	Description
Insignificant impact	No qualitatively or quantitatively measurable changes in the state of the environment are expected, or the potential event has a low level of risk. Such impacts are identified in the text of the Report but are not assessed in this section.
Minor unfavourable impact	Qualitatively or quantitatively measurable small and/or temporary changes are expected in the level of resource consumption, in the state of the environment or in the context of certain socioeconomic factors, which do not overall prevent the achievement of the target values or threshold values for environmental quality set out in legislation.
Minor favourable impact	Qualitatively or quantitatively measurable small and/or temporary changes are expected in the level of resource consumption, in the state of the environment or in the context of certain socio-economic factors, which have an overall favourable effect on the environment and/or society.
Significant unfavourable impact	Qualitatively or quantitatively measurable changes of significant magnitude or scale are expected in the level of resource consumption, in the state of the environment or in the context of certain socio-economic factors, which may result in the non-achievement of the target values or guidelines for environmental quality set out in legislation or guidelines.
Significant favourable impact	The intended activity will result in significant quantitatively or qualitatively measurable improvements in the level of resource consumption, in the quality of the environment or in the context of certain socio-economic factors compared to the baseline situation.
Substantial unfavourable impact	Environmental quality limit values set out in legislation in the field of the environment will be violated. **Such an impact should be considered as an exclusionary factor.**
Substantial favourable impact	The intended activity will result in substantial quantitatively or qualitatively measurable improvements in the level of resource consumption, in the quality of the environment or in the context of certain socio-economic factors. The environmental quality target values set out in legislation and guidelines will be met.

The initiator of the intended activity has familiarised itself with the mandatory measures to mitigate environmental impacts identified by experts and institutions, as well as the measures whose implementation results from the provisions of legislation or institutions, and intends to fully implement the mandatory measures and assess the feasibility of the recommended measures in the implementation of the intended activity. In the context of noise impact mitigation, the initiator of the intended activity has not yet chosen which of the possible mitigation measures to implement, but is committed to implementing measures to ensure that the limit values set out in legislation or recommendations (low-frequency noise) are met. The construction or operation of the planned wind farm is not expected to result in significant or substantial impacts through the implementation of environmental impact mitigation measures.

Table 6.1.2. Measures to mitigate or eliminate environmental impacts and assessment of residual impacts

Aspect	Reference to the Report section	Brief description of the impact	Mitigation measure	Mandatory (M) or recommended (R) measure	Time of implementation	WTG number to which the measure applies	Residual impacts after implementation
Noise	4.1.5.	Noise impact caused by the operation of WTGs on residential areas	Recommendation for the choice of technological alternatives. At the planned wind farm, it is recommended to construct WTGs whose level of impact on nearby residential areas does not exceed the noise levels recommended by the World Health Organization guidelines.	M	Construction stage	All	Minor unfavourable impact
		Noise pollution caused by the substation	To ensure that the emission limit values set out in Section 4.1 of the Report are met when selecting a substation solution	M	Construction stage	-	Minor unfavourable impact
Flickering	4.2.4.	Disturbances caused by the flickering effect from WTGs in residential areas	Discontinuation of flickering-causing WTGs during periods when the respective WTG may cause flickering in residential areas, ensuring compliance with the impact target values set out in the Report	M	Construction stage — re-calculation of the flickering effect time has to be carried out if the chosen solution differs from those assessed.	All	Minor unfavourable impact

Aspect	Reference to the Report section	Brief description of the impact	Mitigation measure	Mandatory (M) or recommended (R) measure	Time of implementation	WTG number to which the measure applies	Residual impacts after implementation
					Operation stage — ongoing		
Impact on plants and biotopes	4.3.5.	Impact on plants and biotopes — *Orobanche pallidiflora* site	– Construction must be planned without disturbing the identified site, at least 100 m south of the originally intended location – The embankment of the WTG construction site must be constructed without any attenuation ditches; – The locally excavated soil must be used to reinforce the edges of the construction site.	M	Construction stage	L_01	Substantial unfavourable impact
			No movement of machinery or other activities will be permitted to the south of the amelioration ditch located along the planned access road in block 708, lot 4	M	Construction stage	L_03	Minor unfavourable impact
		Impact on the protected	Construction without the construction site drainage	R	Construction stage	L_03	Minor unfavourable impact

Aspect	Reference to the Report section	Brief description of the impact	Mitigation measure	Mandatory (M) or recommended (R) measure	Time of implementation	WTG number to which the measure applies	Residual impacts after implementation
		forest biotope 9010*	No road widening is allowed affecting the landfill site of biotope 9010*	M	Construction stage	L_08	Minor unfavourable impact
		Impacts on potentially protected trees	Prevention of potential negative impacts aimed at damaging the tree canopy or root system	M	Construction stage	L_04	Minor unfavourable impact
			For the access solution and the widening of the existing road at the junction with the new access road, a solution that preserves the roadside oaks should be chosen	R	Construction process	L_16	Minor unfavourable impact
		Impact on the protected forest biotope 91D0*	The location of the WTGs, the construction site and the access roads will be provided with embankments, without the construction of new ditches and without the drainage of the site. To create dams at the ends of ditches at biotope 91D0*	R	Construction process	L_19	Minor favourable impact
		Impact on protected plant sites	No movement of machinery, stacking of materials and other construction-related activities are allowed, including in	M	Construction process	All	Minor unfavourable impact

Aspect	Reference to the Report section	Brief description of the impact	Mitigation measure	Mandatory (M) or recommended (R) measure	Time of implementation	WTG number to which the measure applies	Residual impacts after implementation
			the protected species sites identified in the cartographic material of the Report				
		Impact on plants and biotopes	Large-sized (>25 cm) fallen trees and harvested ecological trees in clearings in the area of WTG construction sites, new access roads and power transmission cable routes should be moved to the nearest forest stand. Fallen trees and trunks of felled ecological trees must be moved, as far as possible without disarticulation	R	Construction stage	All WTGs, access roads, cable route	Minor unfavourable impact
			Moving large stones (>4m^3) with lichens and mosses growing on them, keeping the orientation of the stone towards the sky	R	Construction stage	All WTGs, access roads, cable route	Insignificant impact
		Impact on the biotope 9080*	– in the area of biotope 9080*, felled trees must be placed in a stand outside the cut-through; – machinery is only allowed to be moved by the planned cut-through.	M	Construction stage	Cable route in Ipiķi Parish	Minor unfavourable impact

Aspect	Reference to the Report section	Brief description of the impact	Mitigation measure	Mandatory (M) or recommended (R) measure	Time of implementation	WTG number to which the measure applies	Residual impacts after implementation
		Restricting the spread of invasive species	No soil movement is allowed from these sections to avoid the spread of invasive species.	M	Construction stage	Cable route in Ipiķi Parish, also in construction areas in Lode parish if invasive plants are found	Favourable impact
Impact on bat populations	4.4.4.	Risk of bat mortality	Stopping or not starting up wind turbines from 1 June to 30 September after sunset until sunrise if: 1) the wind speed at the height of the nacelle is 5 m/s or less; 2) the air temperature is above +6°C; 3) the amount of precipitation does not exceed 1 mm/h.	M	Operation stage — operating restrictions to be revised in line with monitoring results	All	Minor unfavourable impact
Impact on ornithofauna	4.5.4.	Noise disturbance to 'forest' bird species	Deforestation for the construction of the WTG farm should be carried out outside	M	Construction stage	All	Minor unfavourable impact

Aspect	Reference to the Report section	Brief description of the impact	Mitigation measure	Mandatory (M) or recommended (R) measure	Time of implementation	WTG number to which the measure applies	Residual impacts after implementation
			the bird nesting season (1 August to 1 March)				
			WTGs to be equipped with aerodynamically enhanced wings (*serrated trailing edges*)	R	Construction stage	All	Minor unfavourable impact
		Threats to diurnal birds of prey in their foraging areas	To introduce solutions that make WTG wings more visible to birds, provided they do not have a significant impact on the quality of landscape	R	Operation stage	All	Minor unfavourable impact
		Threat of loss of Black Stork foraging habitat	To refuse from the construction of WTGs within 500 m buffer zone from the river, WTG L_17A to be implemented in preference	R	Construction stage	L_17	Minor unfavourable impact
		Decrease in habitat quality (noise pollution) for the European Kestrel, white-backed woodpecker, lesser	During the period 1 March to 1 July, in the mornings one and a half hours before and up to five hours after sunrise and in the evenings two hours before and up to one and a half hours after sunset to keep the station switched off provided that the wind speed is less than 5 m/s.	R	Operation stage	L_02	Minor unfavourable impact

Aspect	Reference to the Report section	Brief description of the impact	Mitigation measure	Mandatory (M) or recommended (R) measure	Time of implementation	WTG number to which the measure applies	Residual impacts after implementation
		spotted woodpecker, grouse					
		Decrease in the quality of the priority protection area of White-backed Woodpecker (noise pollution)	Restriction of WTG operations and human activity (during construction and maintenance) during the nesting season from March through June	R	Construction stage, Operation stage	L_01, L_03	Minor unfavourable impact
		Threats to lesser spotted eagle and kestrel populations (risk of collision)	To install and use equipment for automatic flight detection, identification of flying birds and automatic stopping of the WTG for birds (at least lesser spotted eagle, hen hawk, gull, sea eagle, golden eagle, osprey, black stork, white stork, mouse kite) covering the whole territory of the wind farm or at least 1.5 km radius around each WTG	M	Operation stage	All	Minor unfavourable impact
		Threats to owl species (habitat loss, noise pollution)	Placement and maintenance of at least 10 nest boxes in and around the planned wind farm area, with artificial nesting	M	Construction stage (until the commencement of construction works)	-	Minor unfavourable impact

Aspect	Reference to the Report section	Brief description of the impact	Mitigation measure	Mandatory (M) or recommended (R) measure	Time of implementation	WTG number to which the measure applies	Residual impacts after implementation
			sites in suitable biotopes and around observation sites (with signs of nesting)				
			Placement and maintenance of at least seven boxes for the barn owl in and around the planned wind farm area, with artificial nesting sites in suitable biotopes and around observation sites	M	Construction stage (until the commencement of construction works)	-	Minor unfavourable impact
			Restriction on the operation of WTGs at wind speeds below 5 m/s	M	Operation stage	L_11, L_18	Minor unfavourable impact
		Risk of loss of quality (fragmentation) of bird habitats	For electricity supply and communication, to lay buried cable lines along roads	R	Construction stage	All	Minor unfavourable impact
		Reduction in bird habitat area	To maintain forests of equivalent conditions in the WTG area without any form of logging	R	Construction stage, Operation stage	L_02, L_03	Minor favourable impact
		Impacts on the lesser spotted eagle micro-	The cable line must be located at least at the crown projection distance of the outermost growing trees from the boundary of the micro-reserve area	M	Construction stage	Cable route	Insignificant impact

Aspect	Reference to the Report section	Brief description of the impact	Mitigation measure	Mandatory (M) or recommended (R) measure	Time of implementation	WTG number to which the measure applies	Residual impacts after implementation
		reserve ML 3099	Construction works in and along the buffer zone must be carried out between 1 September and 29 February	R	Construction stage		
		Risk of collisions	To not enclose WTGs and infrastructure elements. If a fence is needed, it should be as low as possible and visible to birds	R	Construction and operation stages	All WTGs and substation	Minor unfavourable impact
			The first section of the WTG mast at 20 m height must be painted dark (surrounding shades: green/brown; with a gradual transition from dark to light)	M	Operation stage	All	Minor unfavourable impact
			To introduce solutions that make WTG wings more visible to birds, provided they do not have a significant impact on the quality of landscape	R	Operation stage	All	Minor unfavourable impact
			WTGs must be equipped with automated bird detection and identification systems (e.g. cameras) capable of identifying large bird species and, if necessary, momentarily reducing the rotor speed or stopping it completely. The following species should be recognised: lesser spotted eagle, hen hawk,	M	Operation stage	All	Unfavourable impact

Aspect	Reference to the Report section	Brief description of the impact	Mitigation measure	Mandatory (M) or recommended (R) measure	Time of implementation	WTG number to which the measure applies	Residual impacts after implementation
			gull, sea eagle, golden eagle, osprey, black stork, white stork, common buzzard.				
Landscape and visual impact	4.6.7.	Changes to the landscape and visual impact on the overall landscape	Light (white) colour of WTG wings	M/R	Construction stage	All	Minor unfavourable impact
			To use single-colour illumination for signal lighting	M	Construction stage	All	Minor unfavourable impact
			To ensure the protection of valuable trees by consulting a certified arborist during construction on the measures to be taken during the construction process, as well as preparing the alignment of supply routes	M	Construction stage	All	Insignificant impact
			To choose delivery routes that eliminate the need for extensive roadside clearance. Temporary diversion routes should be created where possible to minimise the potential felling or cutting of trees, groups of trees, rows or avenues.	M	Construction stage	All	Minor unfavourable impact

Aspect	Reference to the Report section	Brief description of the impact	Mitigation measure	Mandatory (M) or recommended (R) measure	Time of implementation	WTG number to which the measure applies	Residual impacts after implementation
			In forest lands and roadsides, artificial reforestation is recommended to reduce the direct impact of the WTG structures on close-up views	R	Construction stage	All	Minor unfavourable impact
Cultural and historical heritage	4.7.3.	Destruction of archaeological sites and artefacts	Before the start of construction works, the wind farm area must be surveyed by a professional archaeologist to check for archaeological sites in the areas of WTGs and utilities	M	Construction stage (construction design stage)	All	Insignificant impact
		Uncovering the remains of soldiers killed in action	Earthworks must be stopped at the respective site and the police and the Association "Committee of the Brethren Cemetery" (bkkomiteja@apollo.lv) must be notified immediately if human remains are found. The contractor must ensure that the exhumation of the remains of the soldiers is carried out under the supervision of an expert.	M	Construction stage (construction work stage)	All	Insignificant impact
Air quality	4.8.5.	Disturbance caused by dust pollution	Record all complaints received about foaming and/or air quality, identify their causes and implement corrective actions	R	Construction stage	All (including transportation routes)	Insignificant impact

Aspect	Reference to the Report section	Brief description of the impact	Mitigation measure	Mandatory (M) or recommended (R) measure	Time of implementation	WTG number to which the measure applies	Residual impacts after implementation
			Record all emergencies resulting in increased foaming and/or air pollution and the actions taken to address the impact	R	Construction stage		
			Carry out regular inspections of construction sites and assess the implementation of anti-foaming measures	R	Construction stage		
			Identify and provide sufficient water for the construction site and haul road wetting	R	Construction stage		
			Ensure that road surfaces are wetted or treated with anti-dust material in the event of complaints from residents about dust nuisance *To be implemented for foaming in favourable weather conditions, on gravel roads*	R	Construction stage		
			Prioritise the use of asphalted roads for transport, gravel roads only where justified, including where there are no alternative transport routes.	R	Construction stage		

Aspect	**Reference to the Report section**	**Brief description of the impact**	**Mitigation measure**	**Mandatory (M) or recommended (R) measure**	**Time of implementation**	**WTG number to which the measure applies**	**Residual impacts after implementation**
		Engine emissions from construction machinery	To not allow engines to idle — switch off engines when not in operation	R	Construction stage		Insignificant impact
Environmental risks and accidents	4.12.5	Environmental risks and emergency situations	Developing and implementing a civil protection plan	M	Construction stage Operation stage	All	Insignificant impact
		WTG Mechanical damage or breakdown	Automatic process control and monitoring	M	Operation stage	All	Insignificant impact
		Lubrication system faults with oil leaks	Leak detection systems	M	Operation stage	All	Insignificant impact
		Environmental impact of a wind farm fire	Automatic fire detection and extinguishing systems	M	Operation stage	All	Insignificant impact
		Icing on WTG rotor blades	WTGs must be equipped with ice detection systems to ensure that they are stopped when icing is detected	M	Operation stage	L_03, L_05, L_07, L_08, L_09	Minor unfavourable impact

Aspect	Reference to the Report section	Brief description of the impact	Mitigation measure	Mandatory (M) or recommended (R) measure	Time of implementation	WTG number to which the measure applies	Residual impacts after implementation
			In addition to the above (including on roads managed by the utility), it is recommended to implement one or a combination of the following solutions: To install warning signs about the risk of falling ice chunks; To install warning lights connected to the ice detection system and combined with warning signs; To close access roads with physical barriers in the event of icy conditions; To resume the operation of WTGs manually, with the plant operator present	R	Operation stage	L_03, L_05, L_07, L_08, L_09	Minor unfavourable impact
Contamination of soil and groundwater	4.10.6.	Fuel or lubricating oil spills during construction (temporary storage areas for equipment and materials	Assessing the level of soil contamination before dismantling the sites and deciding on the future use of the removed soil	R	Construction stage	All	Insignificant impact
			For WTGs located closer than 166 m to watercourses, the emergency response planning should include appropriate actions and resources to contain and	M	Construction stage, Operation stage	L_05, L_08, L_10, L_12, L_17	Insignificant impact

Aspect	**Reference to the Report section**	**Brief description of the impact**	**Mitigation measure**	**Mandatory (M) or recommended (R) measure**	**Time of implementation**	**WTG number to which the measure applies**	**Residual impacts after implementation**
		and WTG construction sites)	recover chemicals in the event of an accident.				
Impact on amelioration systems	4.10.6.	Amelioration system functionality	To develop a project for the realignment of amelioration systems	M	Construction stage (construction design stage)	All	Insignificant impact
			Where existing and planned roads cross open watercourses, new culverts should be built or the need to rebuild existing culverts should be assessed	M	Construction stage (construction design stage)	All	Insignificant impact
Communication systems	4.13.2.	Communication and broadcast signal quality	If, after the construction of the wind farm, a reduction in the quality of communication and broadcasting signals is detected due to the operation of the WTG, measures to improve the signal quality should be implemented, the technical solutions of which should be determined on a case-by-case basis.	M	Operation stage	All	Insignificant impact

Aspect	Reference to the Report section	Brief description of the impact	Mitigation measure	Mandatory (M) or recommended (R) measure	Time of implementation	WTG number to which the measure applies	Residual impacts after implementation
Socio-economic aspects	4.14.5.	Discomfort caused by WTGs	To make a payment to the local community to compensate for the discomfort caused by WTGs for the total installed capacity of each unit (in accordance with the act on electricity markets)	M	Operation stage	All	Significant favourable impact

7 COMPARISON OF ALTERNATIVES TO THE INTENDED ACTIVITY

The EIA considers site alternatives and technology alternatives. More detailed information on these are given in Sections 3.1 and 3.2. Section 3.3 of the EIA Report provides the rationale for the choice of alternatives. As part of the environmental impact assessment process, a full assessment has been carried out for 19 potential WTG sites, details of which are provided in Section 4.

7.1 Assessment of Site Alternatives

Taking into account the previous experience in planning wind farms in Latvia, where it has been found that the initial definition of different alternatives for the location of WTGs, with the assessment of each alternative as the only possible solution, is not a rational solution. The EIA process may identify circumstances that require changes to the originally envisaged alternative or alternatives, leading to derivative solutions (e.g. "Augstkalni", "VPSP", "SELP' wind farms). Comparing two or more alternatives can often lead to the conclusion that the best solution in the context of nature and environmental protection is none of the alternatives in their entirety, but the selection of certain stations or solutions from more than one of the evaluated alternatives and combining them into a final solution (e.g. wind farms "Vērgale", "SELP").

During the environmental impact assessment of the Lode wind farm, the developer defined the initial possible locations of WTGs, which were primarily submitted to the assessment by nature experts. The nature experts' assessment was preferred because, based on past experience, it is their assessment that can have the most significant impact on the location of WTGs, while physical impacts — noise, flickering, environmental risk — are mainly mitigated not by relocating WTGs but by implementing technological measures to reduce or eliminate impacts. Up to the time of preparation of the EIA report, different baseline options for the location of individual WTGs and infrastructure have been analysed, mainly related to the avoidance of specially protected biotopes, biotopes, protected species sites and other natural values.

The assessment process started with a larger number of WTGs than those assessed and analysed in detail in Section 4 of the Report, discarding at an early stage those WTGs for which implementation is not feasible based on expert conclusions of significant negative impacts that cannot be mitigated by appropriate measures or compensated for.

The option evaluated in the EIA report and the other alternatives considered for the location of the WTGs are presented in Section 3.3 of the Report.

Although this approach has avoided a number of potential conflicts in the context of nature conservation in the first place, even the basic solution chosen is not ideal (see for example the section on impacts on ornithofauna for more details). The selected baseline alternative includes the construction of up to 19 WTGs in the research area. Table 3.1.3 summarises the aspects assessed in the context of the site location alternatives, while a brief assessment of the alternatives is provided in the specific sections at the end of the EIA report. Table 6.3.1 summarises information on measures to mitigate or avoid environmental impacts.

7.2 Assessment of Technological Alternatives

Four different models of WTG have been analysed as part of the environmental impact assessment process, in addition to different types of wing or rotor blades. It is only worth comparing the residual impacts of a technological alternative after the implementation of impact mitigation measures, which are considered a prerequisite for the implementation of the intended activity.

Although the size of the WTG may also play an important role in the context of landscape protection, environmental risks, impacts on communication systems and impacts on bird and bat populations, all the technological alternatives assessed are considered to be equivalent or not significantly different in the context of these impacts.

The most important differences attributable to the choice of technological alternative relate to the physical impacts on public health, namely noise and flickering effects from the WTGs. Noise impacts are also considered significant for ornithofauna.

No single technological alternative has been identified during the environmental impact assessment process as a limiting factor for the implementation of the intended activity, recognising that not all stations available on the market have been assessed and that the initiator of the intended activity has the right to choose a newer station model not included in this assessment as long as its impacts do not exceed the environmental quality thresholds specified in this assessment, and that even for a potentially worse alternative, technological solutions to mitigate impacts are available. The initiator of the intended activity must take into account the conclusions of the environmental impact assessment process, the conditions set for the implementation of the activity and must select a technological alternative that ensures compliance of the intended activity with the national environmental quality standards or threshold values assessed in this Report.

8 CONDITIONS FOR THE SUBSEQUENT MONITORING OF THE INTENDED ACTIVITY IN THE CONTEXT OF THE ENVIRONMENTAL IMPACT

As part of the environmental impact assessment process, the potential impacts of the planned wind farm have been assessed. Impacts such as flickering effects, noise pollution, safety risks, impacts on biotopes and protected plant species can be predicted with a high degree of accuracy by assessing the scale of the intended activity and using calculation methods. Unfortunately, it is practically impossible to assess the exact impact of the planned wind farm on ornithofauna and bat populations, therefore the impact of the planned wind farm on the abovementioned animal groups should be assessed in the future by monitoring and, if necessary, introducing additional mitigation measures not specified in this Report. A detailed monitoring programme should be developed before the beginning of the construction, but after the final WTG locations and designs have been selected. The monitoring programme should be approved by the Nature Conservation Agency.

Impact on bats

Bat monitoring is ensured in the first and second year after the wind turbines are operational. The methodology is developed and the monitoring is carried out by a bat expert certified by the Nature Conservation Agency according to the site specifics. The monitoring methodology includes:

- acoustic monitoring with ultrasonic detectors on the ground and automatic ultrasonic detectors installed in the nacelles of at least four turbines to continuously record bat activity at least from 1 April to 31 October. Automatic detectors must be installed on one turbine in the forest, one in the open field and two in woodland habitats;
- counts of dead bats at least for those turbines where acoustic monitoring takes place (the number of turbines to be monitored may be increased where possible). Searches for dead bats should be carried out by trained searchers, together with monitoring of the effectiveness of the search and the timing of the disappearance of the carcasses.

To facilitate the search for dead bats, a vegetation-free ground surface should be established within a radius of at least 50 m around the wind turbines foundations or grass should be cut regularly during the monitoring period. Turbines to be installed in the forest do not need creation of a 50 m strip of land in addition to clearing the forest.

Ornithofauna impact monitoring

Considering that the assessment of any impact of the wind farm on bird populations is a forecast with some degree of uncertainty, it is important to monitor the actual impact through a comprehensive monitoring programme. A detailed monitoring programme should be developed involving ornithologists, applied statistics experts and representatives of other stakeholder groups after the final selection of the turbine locations and design, but before the commencement of the construction work. The programme must be approved by the Nature Conservation Agency.

Although a detailed monitoring programme should be developed and approved by the Nature Conservation Agency before the construction begins, its basics can already be outlined now.

1. Beginning of pre-construction monitoring

Considering that the wind farm construction may begin several years after the approval of the construction concept, monitoring should be initiated at least one year before the beginning of the construction in order to update information on the actual situation on and around the wind farm site. Pre-construction monitoring should provide up-to-date data on both the bird species nesting on the wind farm site or in its immediate vicinity, and bird activity during autumn and spring migration. Considering that the northern part of the proposed wind farm will be a special area of conservation, mainly grassland, which may be an important breeding area for corncrakes, special attention should also be paid to this species during pre-construction monitoring.

2. Monitoring during construction

The wind farm and related infrastructure construction can take several years. Monitoring should also be carried out during the construction of the wind farm, paying particular attention to changes in the occurrence of species that are sensitive to disturbance from economic activities. In this process, it is very important to properly document any changes caused by the construction process itself.

3. Monitoring during operation of the wind farm

After the wind farm is built, monitoring must be carried out for at least six years. The monitoring period is indicative, and if signs of impact are identified that can only be qualitatively assessed over a longer period of time, the Nature Conservation Agency has the right to extend the monitoring period. The proponent of the proposed activity should accept that monitoring may reveal that the actual impact of the wind farm is more significant than originally anticipated and that additional measures not foreseen in this EIA report are required to mitigate or compensate for them.

Records of dead birds by the turbines must be kept after the WTGs become operational. Since many dead birds are collected by various predators and scavengers (foxes, ravens, etc.) before they are found, it is useful to place trail cameras (automatic cameras) by four or five outermost WTGs to record any predator visits even during the night. Combining this information with the dead bird remains (feathers) records would provide reasonably good information on the species affected.

WTGs must be equipped with automatic collision detectors. When assessing the impact of WTGs (on bird mortality), the data recorded by these detectors should be compared with the number of birds found and identified dead and the conditions under which they were found.

Due to the lack of studies on the impact of sound generated by wind farms on white-backed woodpeckers, monitoring of this species should be carried out to assess the impact of WTGs due to noise and disturbance. This includes surveying bird behaviour and adapting the operation of the WTGs based on the observation data.

Monitoring measures for the Eurasian pygmy owl in affected habitats should be envisaged. Monitoring of the use of nest boxes placed in and around the wind farm for Eurasian pygmy owls and barn owls should be ensured.

Noise from WTGs can also have an adverse effect of drowning out the mating song of the common snipe. It is advisable to monitor this species and to record any changes during monitoring.