Vilniaus oro uostas

Vilnius International Airport Master Plan

Final Report: English Version






ALG TRANSPORTATION INFRASTRUCTURE & LOGISTICS

europraxis

September 2012

Index

6 Environmental Impacts

6. Environmental impacts

6.1 Introduction

The development of airport infrastructure touches upon several areas that need to be addressed thoroughly prior to finalising future development plans, and an assessment of the proposed infrastructure's environmental impact and integration forms an integral part of this. Climate change and the potential impact of transport and infrastructure on it have emphasised the need for sustainable growth criteria, both from a financial and social point of view, but also from an essential environmental perspective. It has been a long time since the United Nations Framework Convention on Climate Change (UNFCCC, New York 1994) and the signing of the Kyoto Protocol (1997). The summits of Nairobi (2006), Copenhagen (2009) and Mexico (2010), apart from disputes between countries on compliance with and ratification of their commitments, have shown the risks of global warming and the need to immediately implement policies and criteria to reduce the impact of human activity on global climate – and, in particular, CO_2 emissions.

The coming decades will be crucial to mitigating this risk that threatens the environmental quality of the Earth. Thus, the efforts of developed nations committed to the environment, and among these, the European Union, to which Lithuania belongs, is likely to increase. Consequently, the consideration of the environmental variable from the most strategic planning phases is not only essential, a *conditio sine qua non*, but also a way to promote the adoption of efficiency and savings proposals associated with environmental drivers, with the common goal of making aviation more sustainable.

Figure 6.1: Vilnius Airport and its vicinity (2012)
Source: Vilnius Airport

Accordingly, every environmental analysis of an airport activity should include the consideration of its local and global effects.

At a **local** level, it is necessary to consider any possible impact of the infrastructure on its immediate environment, whether this consists of residential areas, farmland or natural areas.

At **global** level, the focus will be on an airport's impact on climate in terms of the environment of the country concerned, but also assuming the responsibility it has for its potential effect on the global climate, in terms of global warming and degradation of the ozone layer.

Figure 6.2: Aerial photograph of Lithuania
Source: Sciencephotolibrary

When applying this dual-scale integration from the planning phase to the implementation of the construction projects and airport operation, the goal of improving the sustainability of the infrastructure and its territorial integration should be kept in mind as well. Ann appropriate environmental management system is certain to improve the global environment, in line with the assumption: *think global, act local*.

In order to better evaluate the environmental effects of the new Master Plan of Vilnius Airport, as well as progress the strengthening of the structure and procedures established within the framework of the European Union, the criteria used for the strategic assessment of plans and projects with regard to environmental analysis, should be in accordance with the Directive 2001/42/EC. This directive is transposed into Lithuanian legislation under Article 27 of Environmental Law. On 18 August 2004 Resolution No. 967 of the Government of the Republic of Lithuania approved the plans and programs of the Strategic Environmental Assessment Procedure (Official Gazette, 2004, no. 130-4650).

The Strategic Environmental Assessment (SEA) is a systematic and anticipatory process, undertaken to analyse environmental effects of proposed plans and programmes, and to integrate findings into decision making.

SEA includes an evaluation of likely environmental effects, and begins by determining the scope of an environmental report to support sustainable development. In adopting the SEA scheme at Vilnius Airport, it will assist the Lithuanian authorities in taking into account:

- Key environmental trends and potential constraints that may affect or be affected by the VNO Master Plan.
- Environmental objectives relevant to the VNO Master Plan.
- Likely significant environmental effects of proposed alternatives to the implementation of VNO Master Plan.
- Measures to avoid, reduce or mitigate adverse effects and enhance positive effects.
- Views and information from relevant authorities.
- Appropriate opportunities for involvement of key stakeholders and the public.

In scoping this, important issues that need to be assessed are determined, such as:

- Impact of planned operations on residential areas (noise, aircraft pollution and bird strike risk).
- Impact of development scenarios on biodiversity and protected areas.
- Impact of future development on surface and ground water.

The strategic analysis starts with the study of the current situation in environmental terms, and is based on two essential criteria: the environmental management currently carried out by Vilnius Airport; and secondly, and just as importantly, the application, scope and compliance with environment regulations, which are currently implemented across all levels involved.

As mentioned, the environmental assessment developed in this report follows the EU strategic assessment model. In this context, the analyses were conducted in parallel with the definition of the scope and purpose of the Master Plan. They study the current environmental situation of the infrastructure and assess the various alternatives formulated in the Master Plan from an environmental point of view.

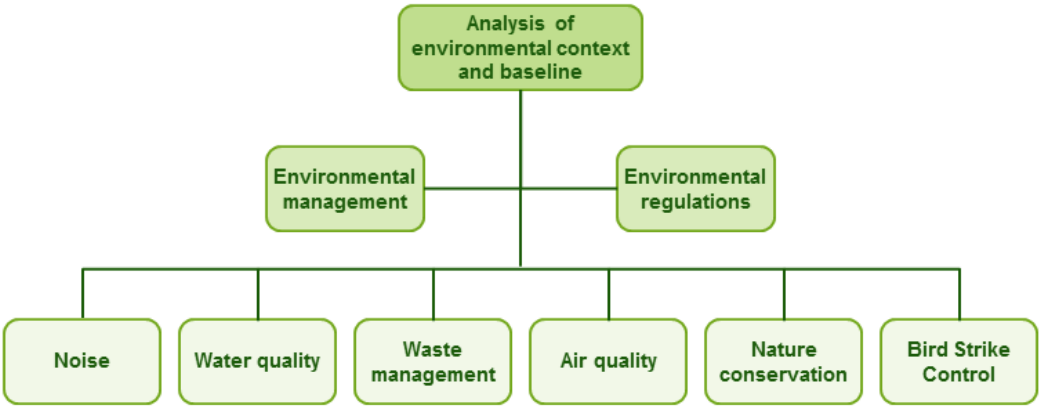


Figure 6.3: Analysis of Vilnius Airport Environmental Context and Baseline,
Source: ALG analysis

The environmental aspects considered as most significant are noise, preservation of the quality of surface water and groundwater, waste management, conservation of air quality, protecting biodiversity and minimising the risk of collision between birds and aircraft (bird strike).

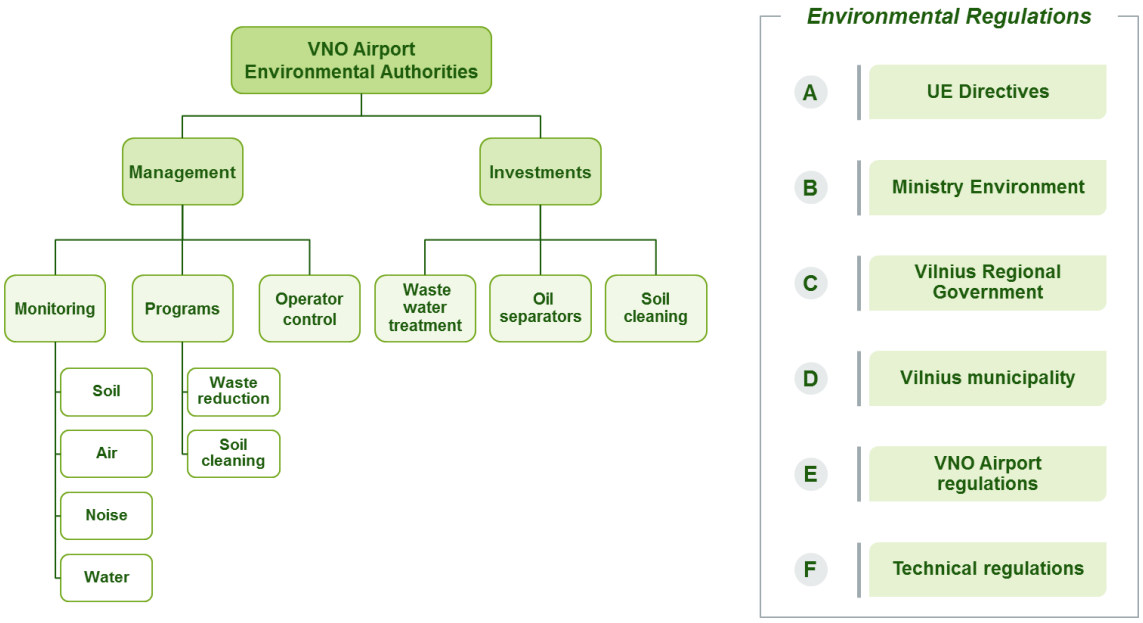


Figure 6.4: Analysis of VNO Airport Environmental management and environmental regulations
Source: ALG analysis

The development of environmental management is structured on two axes: environmental monitoring and direct action. Regarding the first issue, environmental monitoring is organised primarily into three complementary segments:

- Environmental metrics monitoring.
- Environmental improvement programmes.
- Monitoring of contractors (operators) at the airport.

The environmental aspects monitored are those typical of any airport infrastructure in a developed country: noise from airport operations, air quality, water quality (surface and underground) and, finally, contaminated soils. Each monitoring has its specific protocols, which, beyond the supervision of the airport authority itself, have been approved or validated by the environmental authorities of the state or the Vilnius region.

The airport operates two specific environmental improvement programmes: the first is to reduce waste generation, and energy and natural resources consumption, and the second is focused on the decontamination of soils located within the scope of the current fuel tanks zone. This contamination is old, according to airport sources, dating from the Soviet era and has nothing to do with the current fuel management. Both improvement programmes have the approval of national and/or regional environmental authorities, and this certifies the significant environmental commitment of the airport authority.

With regard to the monitoring of contractors, this does not differ from the process followed at major airports. In essence, documentary and operational checks of the operators, who are responsible for their own actions and the environmental impact of these, is carried out.

Direct investments in environmental actions, which can be taken by the airport, are as important. By way of example, the three most significant areas are:

- Treatment of domestic wastewater.
- Treatment of oils and hydrocarbons.
- Cleaning of soils decontaminated in the past.

Since at least 1999, Vilnius Airport has regularly carried out direct investment to improve its environmentally-related infrastructures, such as the building of purification networks and wastewater treatment. By 2015, the ongoing decontamination of soils affected by hydrocarbons discharge in the fuel tank zone will be completed and it is expected that investment will continue in order to treat surface water used for apron cleaning and therefore reduce direct discharge to the environment.

Overall, Vilnius airport is subject to a great number of environmental regulations. From technical regulations on sampling, to those at national and community levels and including those of a municipal nature, linked to the planning of the city of Vilnius, and other of a regional nature.

In light of supervision and environmental improvement functions carried out, as well the compliance with a wide range of environmental regulations, we note that Vilnius Airport maintains an environmental management system, which is proper and adequate for compliance with the requirements of the Lithuanian legal framework. In addition, to strengthen this involvement, the airport is completing the implementation of an environmental management system based on the development of the standard UNE-EN-ISO 1400, whose certification will allow progress to be made on the continuous improvement of the airport environmental management.

6.2 Environmental analysis of the current situation

In line with its size and operational volume, Vilnius Airport currently generates a *moderate* impact on the environment.

The most significant impacts are due to noise affecting residential areas located near the southern end of the runway, generated by landing and takeoff operations (1), as well as surface water pollution through the discharge of water rich in mineral salt.

The de-icing and washing of the apron, with products such as urea (CO (NH2) 2) generates significant discharges to surface water courses for the airport environment (2), involving an increase in terms of suspension and nutrients raising the risk of eutrophication (and thus the increase in phytoplankton populations, as well as decrease of levels of dissolved oxygen in water) in the water courses within the airport site.

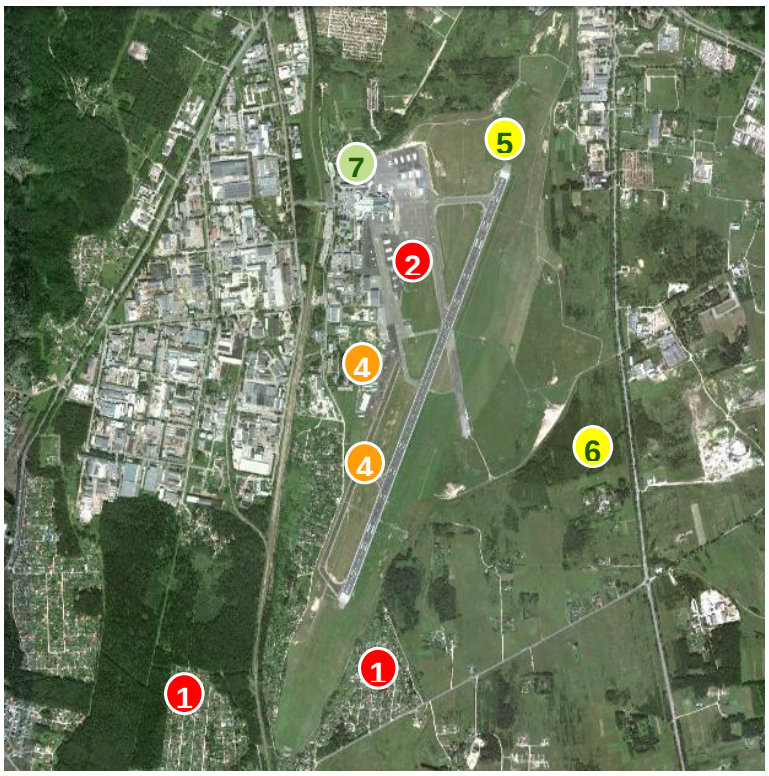


Figure 6.5: Main impacts of the current environmental management of Vilnius Airport
Source: Vilnius Airport

Other, less severe impacts, are the old soil contamination located in the current location of the fuel base (4), the emission of pollutants (mainly NO_2) by both aircraft and the apron service fleet and gases responsible for global warming (CO_2) (5) or risk of bird strike, which in 2010 reached a ratio of 3.06 collisions per 10,000 operations (6).

Impacts on biodiversity should be classified (6) at an even lower level of impact, since in the airport area no protected areas or the presence of protected flora or fauna are detected. As a counterpoint to these impacts, we have already mentioned the compliance with environmental regulations developed by the Airport and the certification in the near future of its environmental management system based on the standard UNE-EN_ISO 14001 (7).

	Airfield	Terminal Building	Terminal Area	Residential areas
Soils			Former oil pollution	
Water	Surface water organic pollution (De-icing, apron surface washing) Ground water consumption for washing surfaces (283.640 m³/yr)	Ground water consumption for drinking (55.000 m³/yr)		
Air				Gaseous pollutants (NO_2, O_3) and particulate matters emission
Fauna	Bird strike ratio (3,06 b/10000 fl, 2010)			
Flora	Eutrophication of hydrophilic habitats			
Solid waste		Non dangerous waste production (387, 5 t/yr)	Dangerous waste production (17,9 t/yr)	

Table 6.1: Summary of impacts on the current environmental management of Vilnius Airport
Source: ALG analysis

In the following paragraphs, the most significant environmental impacts currently generated by Vilnius Airport are analysed in turn.

6.3 Noise analysis

The objective of this section is to analyse the acoustic impact of airport activities on their environment, and the noise mitigation measures that can be adopted by the airport, in order to reduce its effect on neighbouring dwellings.

6.3.1 Lithuanian regulations

The analysis of the impact of the aircraft activity on surrounding populated areas is based upon a review of the current effective legal acts of the Republic of Lithuania concerning noise effects and other related issues. The following laws have been considered:

- The Law on Public Health of the Republic of Lithuania (Official Gazette, 2002, No. 56-2225)
- The Law on Aviation of the Republic of Lithuania (Official Gazette, 2000, No. 94-2918)
- The Law on Ambient Air Protection of the Republic of Lithuania, (Official Gazette, 1999, No. 98-2813)
- The Law on Land of the Republic of Lithuania, (Official Gazette, 2004, No 28-868)
- The Resolution No. 343 of the Government of the Republic of Lithuania of 12 May 1992 Regarding the Approval of the Rules for Special Land and Forest Use Conditions (Official Gazette, 1992, No. 22-652)
- The Order No. 4R-193 of the Director of the Civil Aviation Administration of 26 October 2004 Regarding the Approval of the Requirements for Airports (Official Gazette, 2004, No. 159-5838)
- The Order No. V-586 of the Minister of Health Care of the Republic of Lithuania of 19 August 2004 Regarding
- the Approval of the Rules for Establishing the Boundaries and Regime of Sanitary Protection Zone (Official Gazette, 2004, No. 134-4878)
- Noise Control Law (IX-2499), dated 10/26/2004
- Regulation on aircraft noise abatement of the Republic of Lithuania (No.134/217) of 19 April 2001
- Lithuanian Sanitary Standard HN 33:2011 “Acoustic noise, noise limit values for residential and public buildings and their environment” of 13 May 2011

6.3.1.1 Special land use and forest conditions of use

This regulation defines two Protection Zones that must be considered to regulate the civil activity in the vicinities of Lithuanian airports. They are the *Sanitary Protection Zone* and the *Aerodrome Protection Zone*:

6.3.1.1.1 Sanitary Protection Zone

The definition and legal regime for the establishment of the Sanitary Protection Zone (SPZ) are based on the following:

- The requirement to establish a Sanitary Protection Zone (SPZ) around certain activities that can pollute the human environment is established by Part 1 of Article 24 of the Law on Public Health of the Republic of Lithuania[1]. The Law on Aviation of the Republic of Lithuania[2] also establishes that the SPZ should be established for airports

[1] The Law on Public Health of the Republic of Lithuania (Official Gazette, 2002, No. 56-2225)
[2] The Law on Aviation of the Republic of Lithuania (Official Gazette, 2000, No. 94-2918)

- The SPZ is defined as a land area surrounding a stationary source of pollution wherein the special conditions specified apply (Part 18 of Article 2 of the Law on Ambient Air Protection of the Republic of Lithuania[3]).
- Special land use conditions and restrictions are set for activities in the SPZ (Part 2 of Article 4 of the Law on Land of the Republic of Lithuania[4]).
- The extent of the boundaries of the SPZ and the regime requirements, including restrictions on economic activities, are established by the Government (Part 2 of Article 24 of the Law on Public Health). Construction and reconstruction of structures, as well as economic activities in the zones of aerodrome protection and sanitary protection are also permitted in accordance with the procedure established by the Government (Part 1 of Article 10 of the Law on Aviation).

According to the Law on Land, land owners and other users within the Sanitary Protection Zone (SPZ) must comply with the special land use conditions established and fulfil the requirements set in the territorial planning documents (Part 2 of Article 21).

The following main restrictions related to the aerodrome Sanitary Protection Zone (SPZ) are established by the Rules for Special Land and Forest Use Conditions approved by the Resolution of the Government[5]:

i. It is prohibited to construct the structures of residential buildings, health care, child development and education, social care and leisure facilities, stadiums as well as the equipment of recreational facilities (parks, urban gardens, etc.) in the aerodrome SPZ.
ii. The Resolution does not specifically mention the restriction on construction of garden houses in the aerodrome SPZ. Furthermore, under the Technical Construction Regulation TCR 1.01.09:2003 “Classification of buildings according to their intended use” garden houses are included into the category of non-residential buildings (Paragraph 8.21). Therefore, construction of garden houses in the aerodrome SPZ is not directly prohibited;
iii. The construction and reconstruction of structures and economic activities in the aerodrome SPZ must be coordinated with the State Public Health Service under the Ministry of Health and the Civil Aviation Administration;
iv. Land use for specific agricultural activities (arable farming and horticultural) must be additionally coordinated with the Ministry of Agriculture of the Republic of Lithuania. In relation to garden houses, amateur horticulture activities should require coordination with the Ministry of Agriculture of the Republic of Lithuania[6];
v. Nevertheless, the legal acts do not set any specific regulation concerning the already existing constructions in the SPZ (e.g. requirement to change the purpose of existing constructions, to demolish existing constructions, etc.). Thus, it could be treated that the status and regime of already existing constructions should be determined in a stage of establishing the aerodrome SPZ, and once the SPZ is established they might continue to exist (however restrictions on reconstruction of such constructions may apply);
vi. The owners of private land within the aerodrome SPZ will have the right to apply to the organiser of the territorial planning document or its amendment regarding the losses incurred due to establishment of the aerodrome SPZ.

The Order of the Director of Civil Aviation Administration on the Approval of the Requirements for Airports[7] provides the main measures which must be planned and used in the airport SPZ:

i. Organizational and administrative, for example buildings which are under construction must be protected from noise using special windows and walls constructions with sound insulating material;
ii. Aircraft flight, for example compliance of noise abatement orders in individual flight routes through the aerodrome sanitary protection;
iii. Sonic, for example installation of sound absorbing finish in objects;

[3] The Law on Ambient Air Protection of the Republic of Lithuania, (Official Gazette, 1999, No. 98-2813)
[4] The Law on Land of the Republic of Lithuania(Official Gazette, 2004, No 28-868)
[5] The Resolution No. 343 of the Government of the Republic of Lithuania of 12 May 1992 Regarding the Approval of the Rules for Special Land and Forest Use Conditions (Official Gazette, 1992, No. 22-652)
[6] The Law on Communities of Gardeners of the Republic of Lithuania (Official Gazette, 2004, No. 4-40)
[7] The Order No. 4R-193 of the Director of the Civil Aviation Administration of 26 October 2004 Regarding the Approval of the Requirements for Airports (Official Gazette, 2004, No. 159-5838)

iv. Architecture and planning, for example performance of sound insulation requirements for buildings and rooms.

The Rules for Establishing the Boundaries and Regime of Sanitary Protection Zone approved by the Order of the Minister of Health of the Republic of Lithuania[8] establish several specific requirements, including in particular:

i. It is not allowed to use the SPZ for development of polluting objects (source of pollution), if due to this development the limits of chemical, physical, biological pollution exceeds the maximum allowable concentration (Paragraph 47);
ii. The users of the SPZ must manage the SPZ in line with economic and commercial activity limitations and take care of its afforestation, maintenance and enhancement of plantation;
iii. VNO must organize the environmental impact of pollution sources, environmental monitoring and if necessary take measures to reduce environmental pollution (Paragraph 48).

Part 1 of Article 24 of the Law on Public Health states that the boundaries of the SPZ shall be established when drawing up general, detailed and special plans or undertaking reconstructions of economic entities, modernisation or change of their manufacturing process, which lead to a change in the kind or intensity of a proposed economic activity. Under the Law on Land the land owner or another user shall have the right to apply to the organiser of a new or amended territorial planning document or directly to a court for reimbursement of losses incurred due to establishment of additional special land use conditions registered in the Immovable Property Register (Part 9 of Article 22). The key moments of this procedure are as follows:

i. the land owner or another user shall claim the reimbursement of losses not later than within one year after receiving a notification on establishment of additional special land use conditions in respect of the land plot;
ii. the amount of the losses incurred by the land owner or another user and the time limit for reimbursement thereof shall be settled by an agreement between the organiser of the territorial planning document (amendment of such document) and the land owner or another user;
iii. in the event the parties fail to reach an agreement, the disputes regarding reimbursement of the losses shall be resolved by a court in accordance with the procedure established by the Code of Civil Procedure of the Republic of Lithuania.

Figure 6.6: Current Sanitary Protection Zones of industrial areas around VNO
Source: Current Vilnius land use plan

6.3.1.1.2 Aerodrome Protection Zone

The objective of this Protection Zone is to determine an area around the airport, where it is not permitted to build or install infrastructures rising above specific height limits, according to their distance to the runway. Specifically, it limits the construction, reconstruction and installation of:

[8] The Order No. V-586 of the Minister of Health Care of the Republic of Lithuania of 19 August 2004 Regarding the Approval of the Rules for Establishing the Boundaries and Regime of Sanitary Protection Zone (Official Gazette, 2004, No. 134-4878)

- Air communications, high-voltage power lines, objects emitting radio waves and explosion-hazardous objects.
- Other objects which decrease airfield visibility.
- Activities or objects which can mobilize large number of birds.

Within:

- Up to 300 m away from the airfield runway axis and approach zones, regardless of its height.
- Up to 600 m, 20 m in height.
- Up to 5.1 km, 45 m in height.
- Up to 15 km, 100 m in height.

This regulation supports the *Obstacle Limitation surfaces* that must be defined in accordance with the international safety standards set by ICAO Annex 16.

6.3.1.2 Noise Control Law

This regulation establishes the legal framework for prevention of noise, noise control subjects' rights, duties and monitoring procedures. The main purpose of this law is to regulate noisy activities to protect human health and the environment from the adverse effects of noise.

It defines the noise metrics that must be assessed in order to evaluate the noise impact of any activity over humans. They are:

- Day-noise indicator (L_{day}), defined as a long-term average A-weighted sound level during day time (from 6:00 to 18:00).
- Evening-noise indicator ($L_{evening}$), defined as a long-term average A-weighted sound level during evening time (from 18:00 to 22:00).
- Night-noise indicator (L_{night}), defined as a long-term average A-weighted sound level during night time (from 22:00 to 6:00).
- Day-evening-night noise indicator (L_{den}), defined as a 24 hours A-weighted sound level, using the following formulation:

$$L_{den} = 10 \log \frac{\left(12 * 10^{\frac{L_{day}}{10}} + 4 * 10^{\frac{(L_{evening}+5)}{10}} + 8 * 10^{\frac{L_{night}+10}{10}} \right)}{24}$$

This regulation also defines the distribution of competences among the different Lithuanian authorities (ministries, counties, local governments, etc.), in order to achieve the right noise management following each jurisdiction.

Also established by this law is the necessity to draw up strategic noise maps to assess the nuisance factor of main roads, streets, railways and the airport. However, it is only compulsory to assess L_{den} and L_{night} noise indicators.

Regarding airport noise effects, it is specifically laid down that:

- Aircraft operating in the Lithuanian Republic must be certified for compliance with the aircraft noise prevention and control of the governing legislation.
- The aircraft noise monitoring system must be able to continuously monitor the noise levels during day and night for at least 3 consecutive days.

- Aviation Companies operating noisy aircraft over residential areas or natural public areas, which exceed the noise limit values, will have to help the affected entities with mitigation measures at their own expense.

- In order to protect human health and the environment, once noise limit values are exceeded, local authorities together with the Ministry of Health, have the right to temporary:

  - Restrict the activities of stationary noise sources.
  - Restrict or prohibit aircraft traffic.
  - Impose other noise mitigation measures.

6.3.1.3 Regulation on noise abatement for aircraft of the Republic of Lithuania

This regulation deploys both ICAO Annex 16 recommended practices and the EU requirements regarding noisy aircraft operational constraints. In line with EU regulations, the activity of the noisiest aircraft is restricted in the Single European Sky (SES).

This regulation defines the maximum available noise level at each measuring point for each aircraft, in accordance with its certified MTOW, taking into account any permissible excess.

The testing methodology for uniformed measurements is established both for aircraft and the airport's activity assessment. Noise control measuring points, which must be fixed at airports to evaluate aircraft noise impact, are:

- Side noise measuring point.
- Overfly noise measuring point.
- Approach noise measuring point.

The requirements of this regulation apply to all subsonic commercial aircraft submitted for airworthiness certification.

6.3.1.4 Lithuanian Sanitary Standard HN 33:2011 "Acoustic noise, noise limit values for residential and public buildings and their environment"

Lithuanian Sanitary Standards establish the noise limit values, also known as noise thresholds, for people living in residential and public buildings and their surroundings. Noise thresholds are defined for each noise indicator, for each noise source and for each land usage, following the Noise Control Law definitions.

Noise limits will be the key parameters to assess the results of the airports' activity simulation and measurement in their vicinities.

Regarding noise sources, *transport noise* refers to vehicle traffic (road, rail or air), caused by continuous or repeated number of individual sound events sourced from transport activities.

The noise from these kinds of sources (intermittent noise) in residential and public buildings and their surroundings is measured as an equivalent sound pressure level (LAeq) and maximum sound pressure level (LAmax).

The following table shows the maximum permitted noise limit values for residential and public buildings and their environment. Articles 3 and 4 set the noise limits for transport sources and industrial sources:

Art.	Item	Time frame	Equivalent sound pressure level (L_{Aeq}) dBA	Maximum sound pressure level (L_{Amax}) dBA
1	Residential buildings (houses), dwellings, public buildings, bedrooms, personal health inpatient care ward	6-18 18-22 22-6	45 40 35	55 50 45
2	Public buildings, training and (or) education facilities		45	55
3	Residential buildings (houses) and public buildings (excluding food and cultural buildings) environments affected by transport noise	6-18 18-22 22-6	65 60 55	70 65 60
4	Residential buildings (houses) and public buildings (excluding food and cultural buildings), except for the traffic calming	6-18 18-22 22-6	55 50 45	60 55 50
5	Power and culture of popular music halls of the buildings or other entertainment events, movie show time		80	85
6	Open-air concerts and dance halls of popular music and other entertainment events	6-18 18-22 22-6	85 80 55	90 85 60

Table 6.2: Maximum permitted noise limit values for residential and public buildings and their environment
Source: Lithuanian Sanitary Standard HN 33:2011

Each time frame distribution in the L_{Aeq} assessment is related to each long-term noise indicator L_{day}, $L_{evening}$ and L_{night} as previously defined. However, L_{Amax} noise indicator thresholds are far from being compatible with Air Transport activity.

Moreover, this regulation also establishes that noise mapping programmes must evaluate L_{den}, L_{day}, $L_{evening}$ and L_{night} values to meet the noise thresholds established by the following table:

Art.	Item	L_{den} dBA	L_{day} dBA	$L_{evening}$ dBA	L_{night} dBA
1	Residential buildings (houses) and public buildings (excluding food and cultural buildings) environments affected by transport noise	65	65	60	55
2	Residential buildings (houses) and public buildings (excluding food and cultural buildings) environment affected by industrial activities (excluding transport) for stationary noise sources,	55	55	50	45

Table 6.3: Maximum permitted noise limit values used for strategic noise mapping
Source: Lithuanian Sanitary Standard HN 33:2011

In contrast with "Table 6.2: Maximum permitted noise limit values for residential and public buildings and their environment", L_{den} noise indicators are included as a noise metric in the preparation of strategic noise mapping and territorial planning. It can be seen that there is no mention of the L_{Amax} noise indicator for this usage.

Furthermore, the most important conclusion to be learned from this table is that the degree of discomfort must be separately assessed, with regard to the different usage of noise sources, meaning that:

1. Aircraft noise during transportation activity (meaning during take-off, landing and overflying) must take into consideration the noise thresholds included in Article 1 of Table 6.3: Maximum permitted noise limit values used for strategic noise mapping

2. Aircraft noise during industrial activity (*i.e.* during taxiing and engine testing) must take into consideration noise thresholds included in Article 2 of Table 6.3: Maximum permitted noise limit values used for strategic noise mapping

6.3.2 Air Transport noise contours

The objective of this section is to define the limits of the Vilnius Airport Noise Affected Area. It will define the terrains where no more residential dwellings shall be built and in which mitigation measures must be adopted.

In order to guarantee that future land use plans will comply with noise regulation, the noise contours have been calculated for short, medium and long-term traffic scenarios. Subsequently, the long period average A-weighted indicators ($L_{day,}$ $L_{evening}$ and L_{night}) have been assessed using 2010 annual traffic data and 2030 and 2050 annual traffic forecasts.

The average runway usage distribution has been assessed using historical data from 2008 to 2011. During this period of time, the average runway usage has been 67% of operations for runway 20 and 33% for runway 02. It is assumed that VNO will continue operating this way in the medium and long-term scenarios.

The 24 hour average A-weighted indicator (L_{den}) has been assessed using the design day traffic, defined as the 95% busiest day. Air traffic movements during the design day have been simulated from both runway headers, in order to assess the noise impact of the busiest day, regardless of the wind direction and airport operational configuration.

Daily and annual traffic have been modelled using 4 representative aircraft in the most common traffic expected in VNO. They are:

- CL600 as representative of light jets.
- DHC8 as representative of regional turboprops.
- Boeing 737-500 as representative of C-type jets, widely used by low cost airlines.
- Boeing 757-200 as representative of long range jets.

Local environmental conditions that might have an influence on sound propagation characteristics, such as temperature or pressure, have been taken into consideration in the model. What is more, Vilnius' orographic situation has also been implemented for a tri-dimensional calculation method.

Noise contour simulation has been run using FAA simulation software *Integrated Noise Model 7.0c (*also known as INM) which is considered to be the industry standard for simulating airport noise.

The following tables show the traffic model that has been considered for each traffic scenario (annual and daily 2010-2030-2050). It meets the already presented traffic forecast:

AC SIZE	DAY	EVENING	NIGHT	TOTAL
Light jet (CL600)	3.4	0.9	0.8	5.1
Turboprop (DHC8)	23.8	6.6	5.7	36.1
C-type (B737-500)	32.4	9.0	7.8	49.3
D-type (B757-200)	1.7	0.5	0.4	2.6
Sub-total ops	**61.3**	**17.1**	**14.8**	**93.1**

Table 6.4: VNO 2010 design day traffic
Source: ALG analysis

AC SIZE	DAY	EVENING	NIGHT	TOTAL
Light jet (CL600)	4.1	1.1	1.0	6.20
Turboprop (DHC8)	28.7	8.0	6.9	43.60
C-type (B737-500)	39.2	10.9	9.4	59.50
D-type (B757-200)	2.1	0.6	0.5	3.20
Sub-total ops	**74.10**	**20.60**	**17.80**	**112.50**

Table 6.5: VNO 2015 design day traffic
Source: ALG analysis

AC SIZE	DAY	EVENING	NIGHT	TOTAL
Light jet (CL600)	4.5	1.3	1.1	6.9
Turboprop (DHC8)	32.1	8.9	7.7	48.8
C-type (B737-500)	43.9	12.2	10.6	66.7
D-type (B757-200)	2.4	0.7	0.6	3.6
Sub-total ops	**83.0**	**23.1**	**20.0**	**126.0**

Table 6.6: VNO 2020 design day traffic
Source: ALG analysis

AC SIZE	DAY	EVENING	NIGHT	TOTAL
Light jet (CL600)	6.3	1.8	1.5	9.6
Turboprop (DHC8)	44.7	12.4	10.8	67.9
C-type (B737-500)	61.0	17.0	14.7	92.6
D-type (B757-200)	3.3	0.9	0.8	5.0
Sub-total ops	**115.3**	**32.1**	**27.8**	**175.1**

Table 6.7: VNO 2030 design day traffic
Source: ALG analysis

	DAY		EVENING		NIGHT		TOTAL	
AC SIZE	Runway 02	Runway 20	Runway 02	Runway 20	Runway 02	Runway 20	Runway 02	Runway 20
Light jet (CL600)	313	624	88	173	92	134	493	931
turboprop (DHC8)	2,224	4,435	626	1,227	651	952	3,501	6,614
C-type (B737-500)	3,036	6,055	855	1,675	889	1,300	4,780	9,030
D-type (B757-200)	163	325	46	90	48	70	257	485
E-type (B747-400)	1	1	0	0	0	0	1	2
Sub-total ops	**5,737**	**11,440**	**1,616**	**3,165**	**1,679**	**2,457**	**9,032**	**17,062**

Table 6.8: VNO 2010 annual traffic
Source: ALG analysis

	DAY		EVENING		NIGHT		TOTAL	
AC SIZE	Runway 02	Runway 20	Runway 02	Runway 20	Runway 02	Runway 20	Runway 02	Runway 20
Light jet (CL600)	425	847	120	234	124	182	668	1263
turboprop (DHC8)	3,028	6,038	853	1,670	886	1,297	4,767	9,005
C-type (B737-500)	4,134	8,244	1,164	2,280	1210	1,770	6,508	12,294
D-type (B757-200)	222	443	63	123	65	95	350	661
E-type (B747-400)	1	1	0	0	0	0	1	2
Sub-total ops	**7,810**	**15,573**	**2,199**	**4,308**	**2,286**	**3,344**	**12,295**	**23,225**

Table 6.9: VNO 2015 annual traffic
Source: ALG analysis

AC SIZE	DAY		EVENING		NIGHT		TOTAL	
	Runway 02	Runway 20	Runway 02	Runway 20	Runway 02	Runway 20	Runway 02	Runway 20
Light jet (CL600)	473	944	133	261	139	203	745	1408
turboprop (DHC8)	3,392	6,765	955	1,871	993	1,453	5,341	10,089
C-type (B737-800)	4,632	9,235	1,304	2,555	1,356	1,983	7,292	13,774
D-type (B757-200)	249	496	70	137	73	107	392	740
E-type (B747-400)	1	2	0	0	0	0	1	2
Sub-total ops	**8,747**	**17,442**	**2,463**	**4,825**	**2,560**	**3,746**	**13,771**	**26,012**

Table 6.10: VNO 2020 annual traffic
Source: ALG analysis

AC SIZE	DAY		EVENING		NIGHT		TOTAL	
	Runway 02	Runway 20	Runway 02	Runway 20	Runway 02	Runway 20	Runway 02	Runway 20
Light jet (CL600)	653	1,303	184	360	191	280	1,029	1,943
turboprop (DHC8)	4,714	9,399	1,328	2,600	1,380	2018	7,421	14,017
C-type (B737-800)	6,435	12,832	1,812	3,550	1,884	2756	10,131	19,137
D-type (B757-200)	346	689	97	191	101	148	544	1,028
E-type (B747-400)	1	2	0	1	0	0	2	3
Sub-total ops.	12,149	24,226	3,422	6,702	3,556	5,202	19,127	36,130

Table 6.11: VNO 2030 annual traffic
Source: ALG analysis

Arriving and departing traffic has been modelled using straight approximation and departure tracks, with a 10% of diverging trajectories.

Each noise metric linked with Lithuanian regulation will define an internal area, which is considered as "affected" in terms of land use regulation. Most of the currently affected areas for each noise indicator are confined inside VNO terrains. However, traffic growth is likely to change this in the medium and long term scenarios. Between the indicators that must be assessed to determine the nuisance level, L_{night} and L_{den} has proved to be the most restrictive ones. Otherwise, L_{Amax} current regulation has proved to be incompatible with air transport activity.

Once all noise indicators have been simulated for each traffic scenario, it can be seen that some noise indicators are more critical in terms of territorial impact. Therefore, in order to easily understand the evolution of the noise affected area, the most critical noise indicator must be chosen.

The figures on the following pages show the noise contours simulated for each noise indicator (L_{night}, L_{den} and L_{Amax}) using 2010, 2015, 2020 and 2030 traffic. The noise limit values are marked below and the affected area has been calculated.

Figure 6.7: L_{den} 2010 noise contours and affected area
Source: ALG analysis

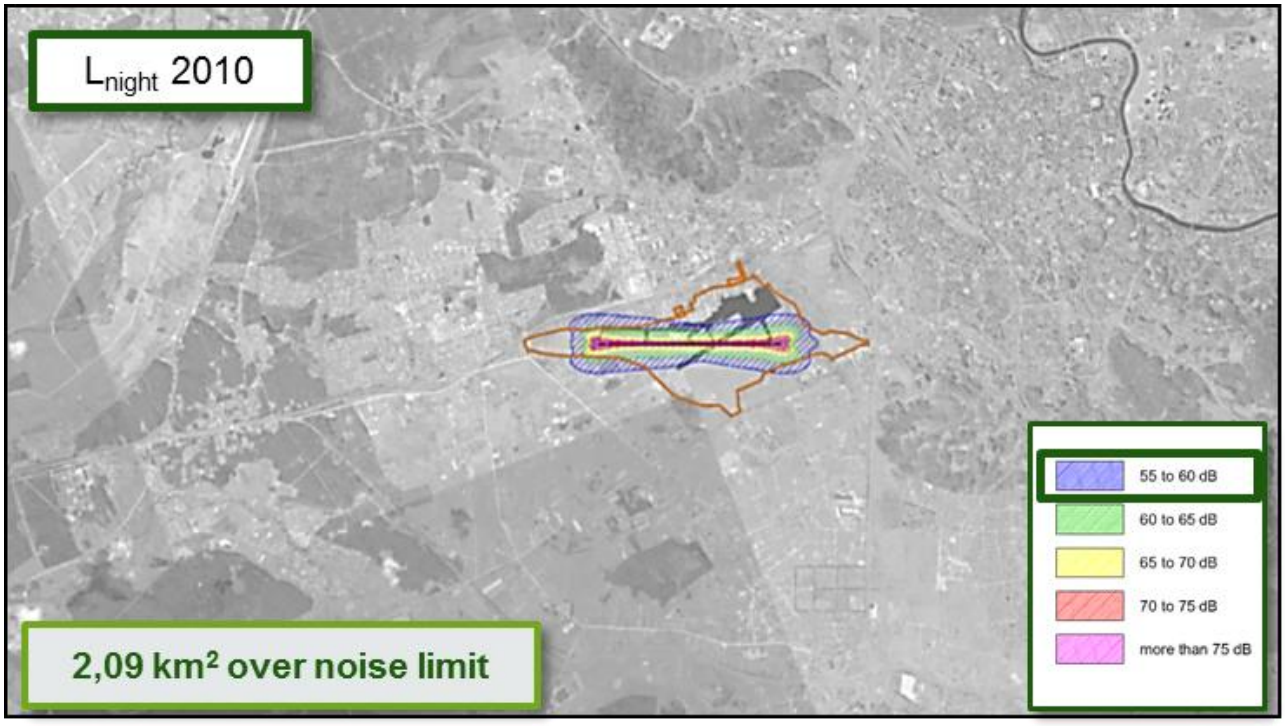


Figure 6.8: L_{night}2010 noise contours and affected area
Source: ALG analysis

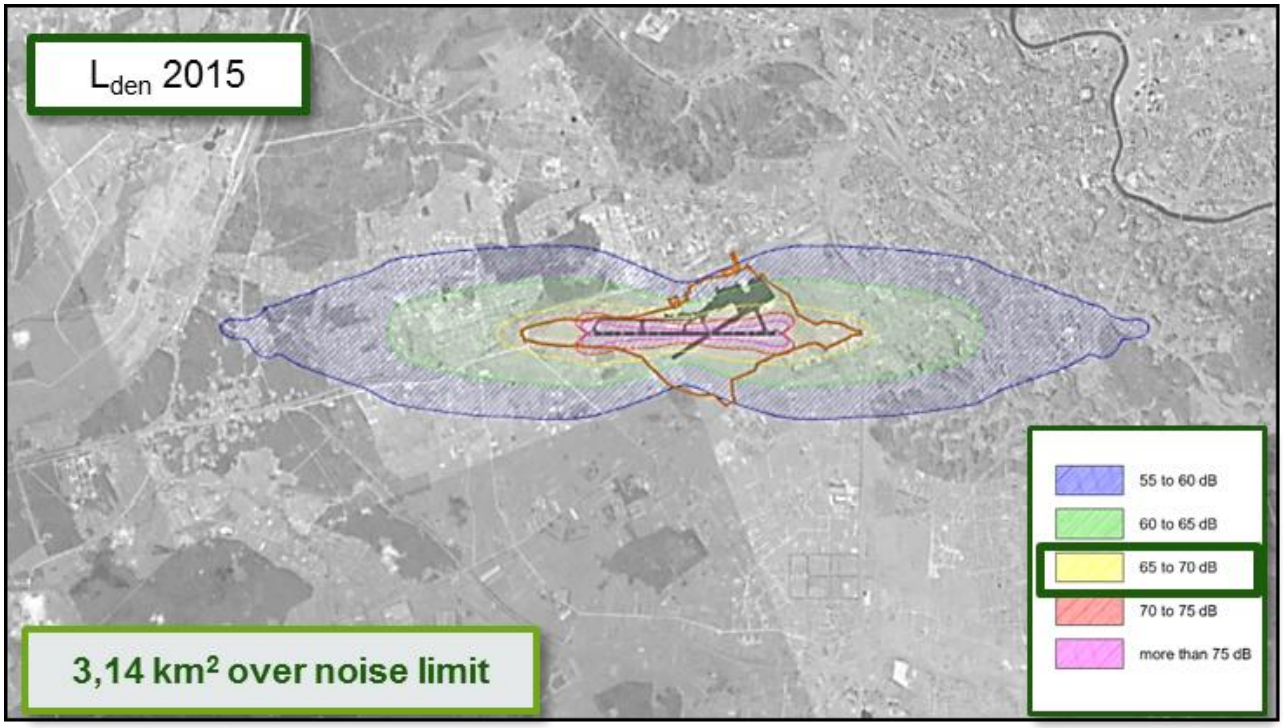


Figure 6.9: L_{den} 2015 noise contours and affected area

Source: ALG analysis

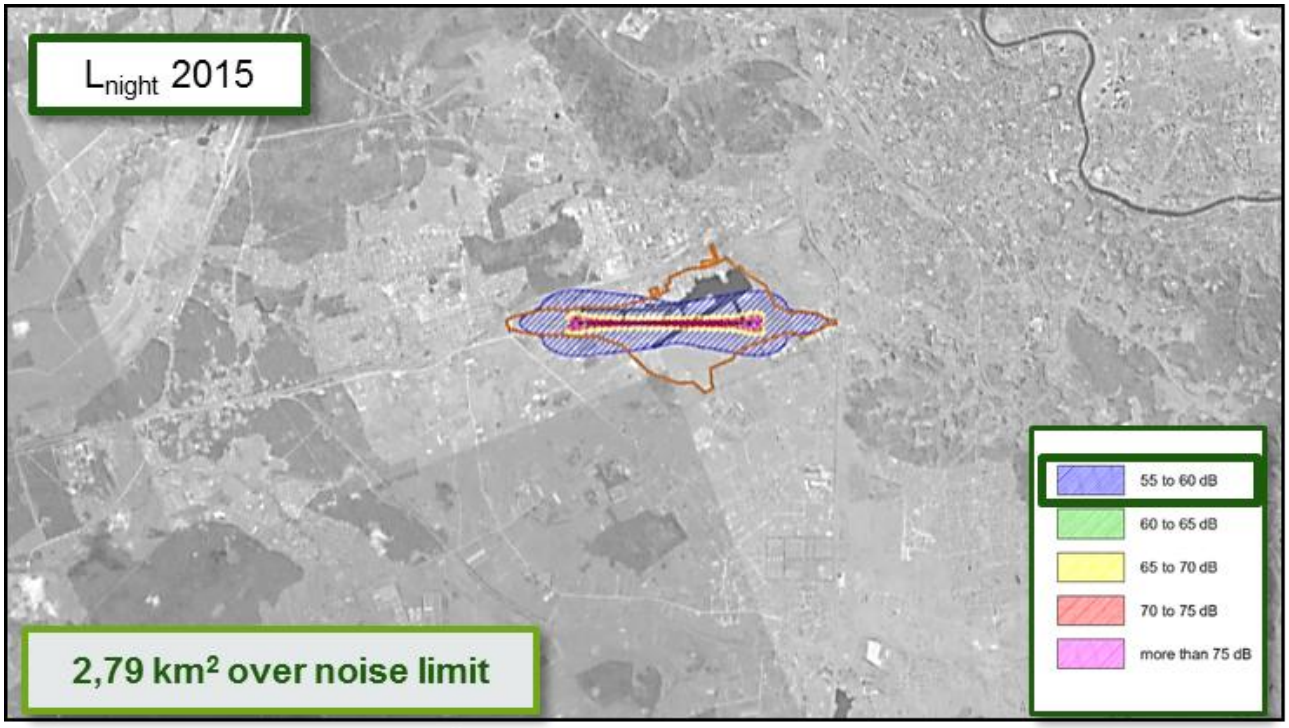


Figure 6.10: L_{night}2015 noise contours and affected area

Source: ALG analysis

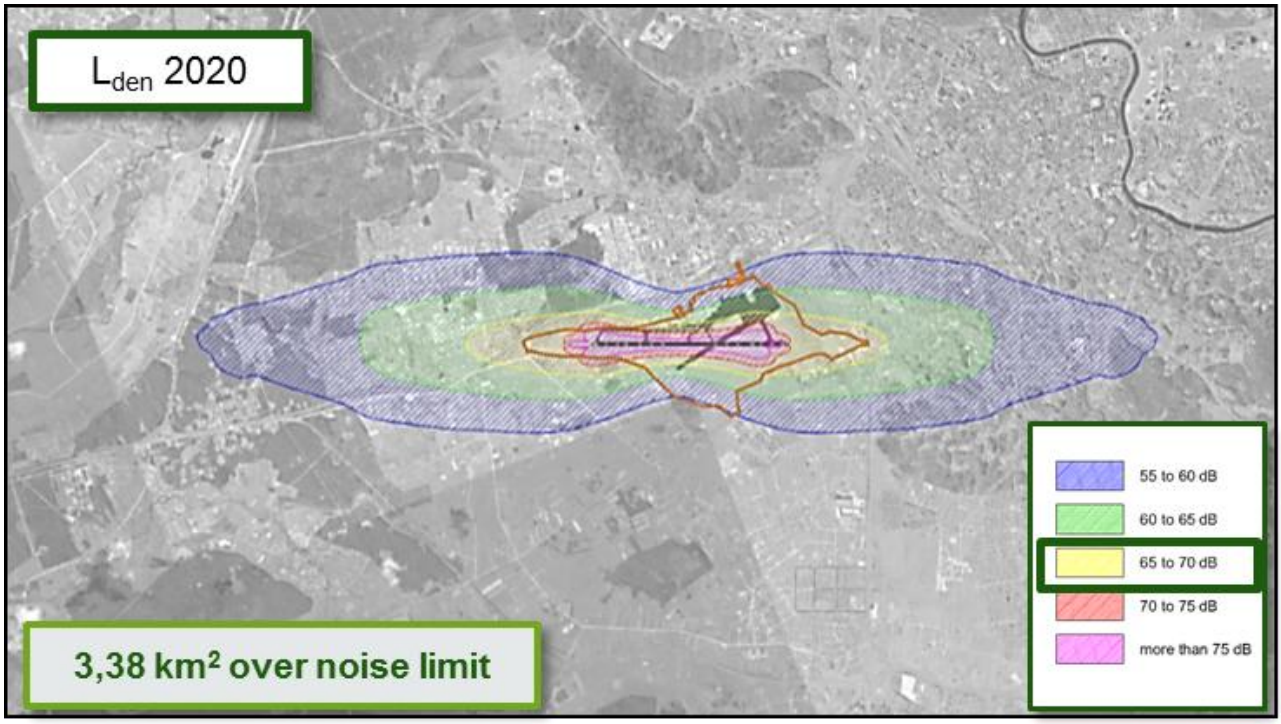


Figure 6.11: L_{den} 2020 noise contours and affected area
Source: ALG analysis

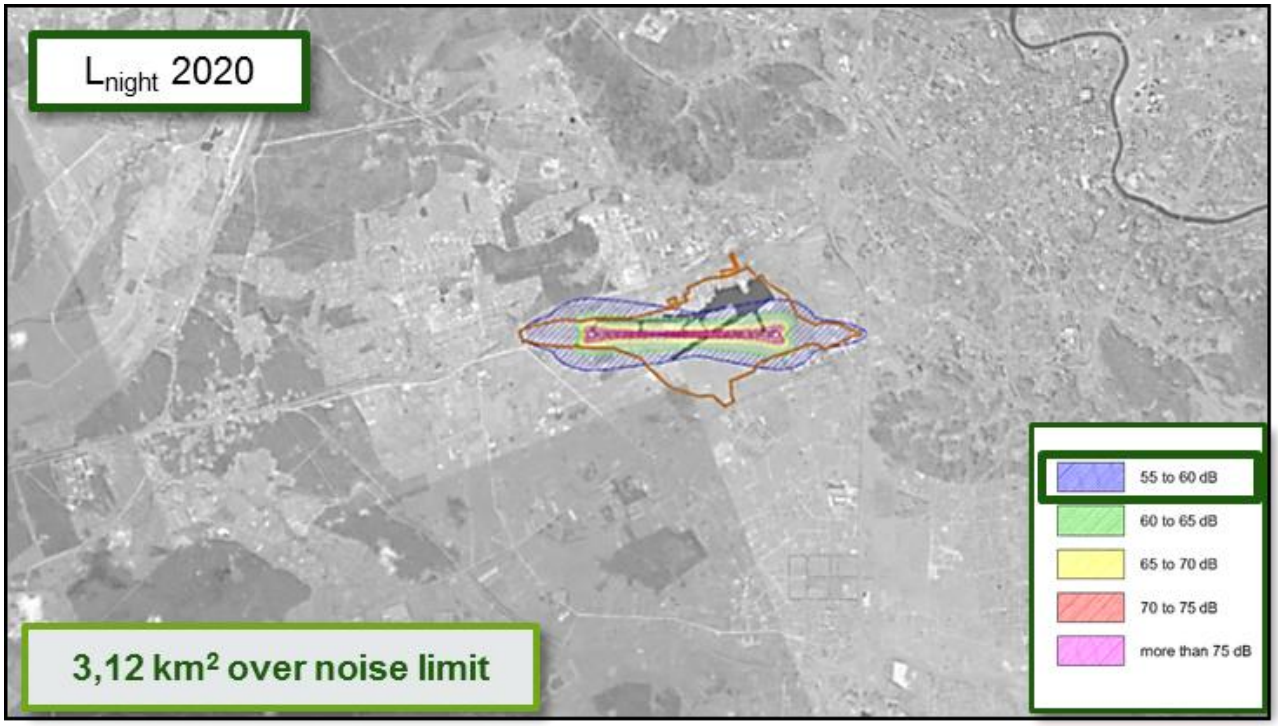


Figure 6.12: L_{night} 2020 noise contours and affected area
Source: ALG analysis

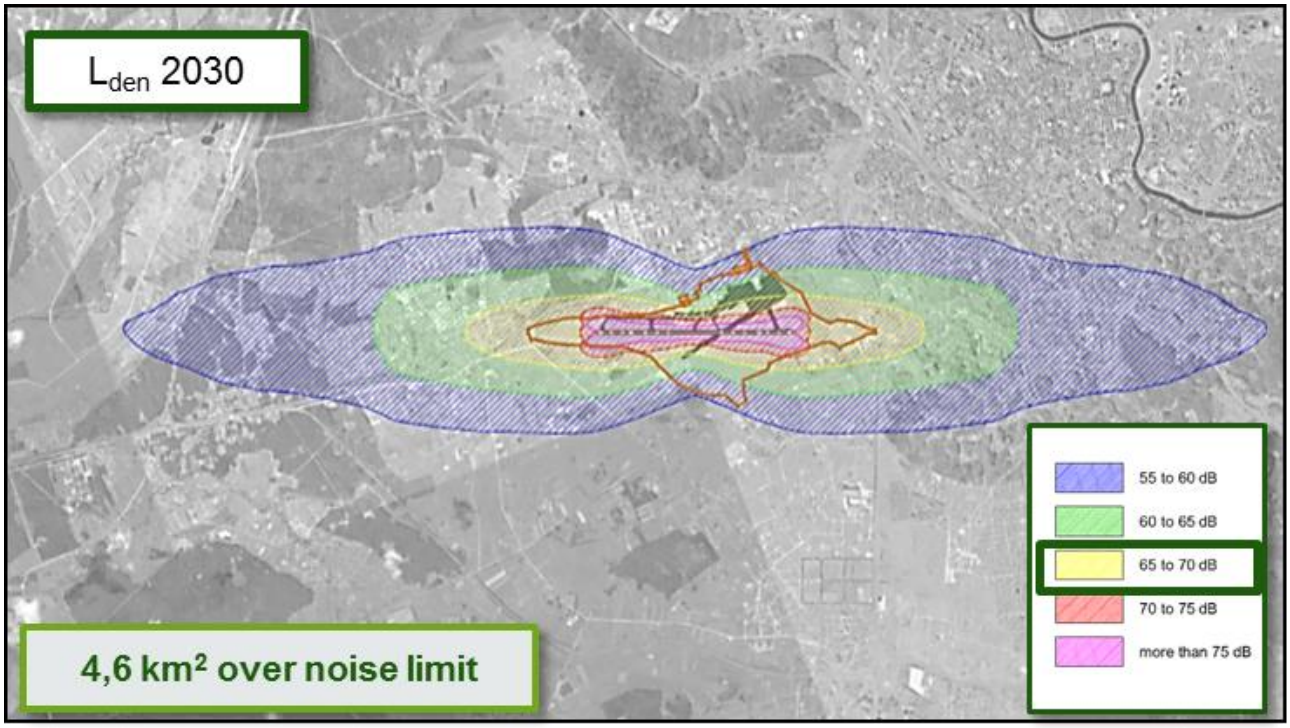


Figure 6.13: L_{den} 2030 noise contours and affected area
Source: ALG analysis

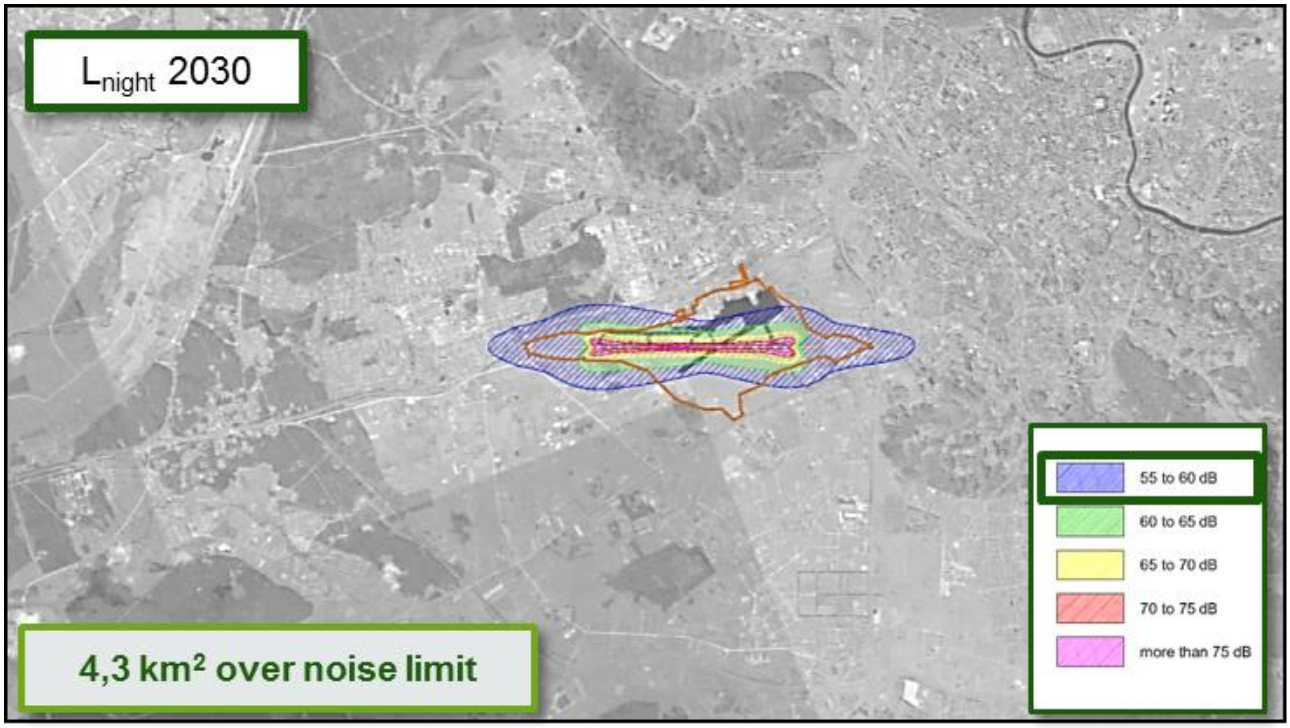


Figure 6.14: L_{night} 2030 noise contours and affected area
Source: ALG analysis

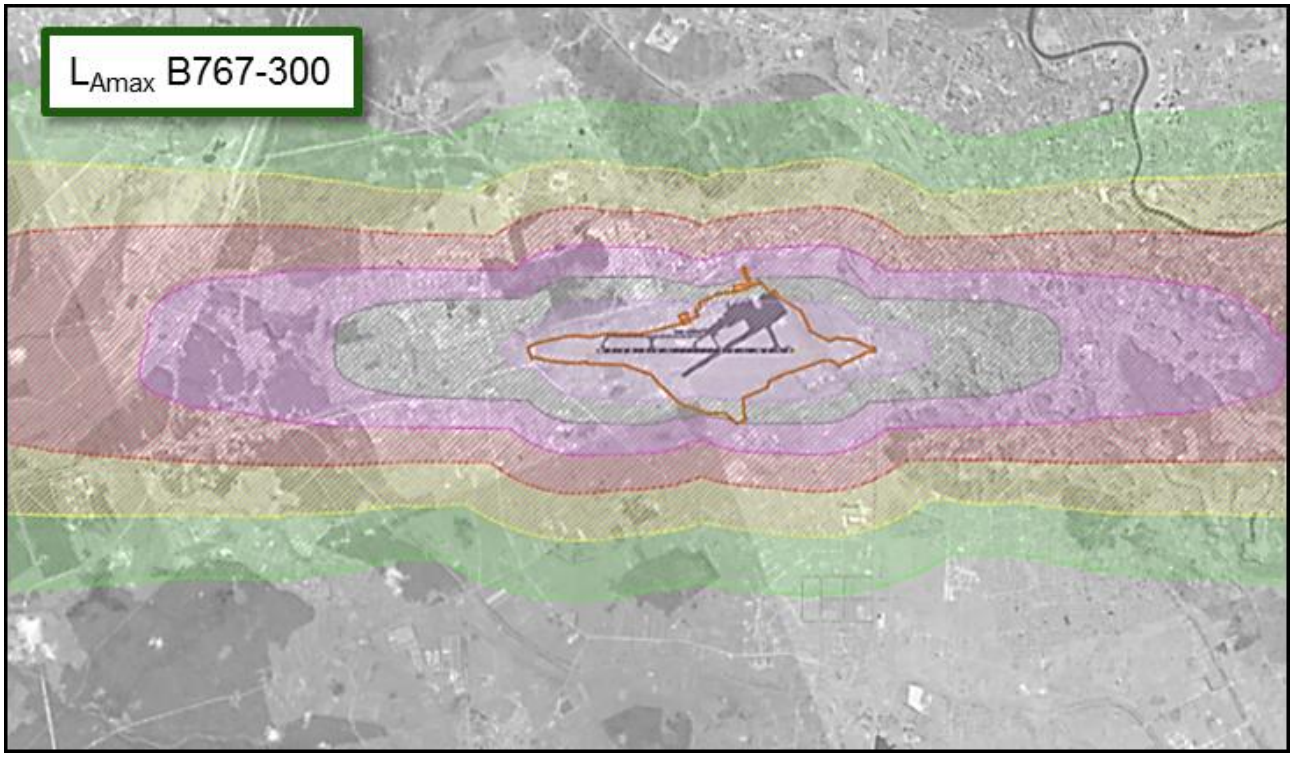


Figure 6.15: LA_{max} B757-200, currently operating in VNO
Source: ALG analysis

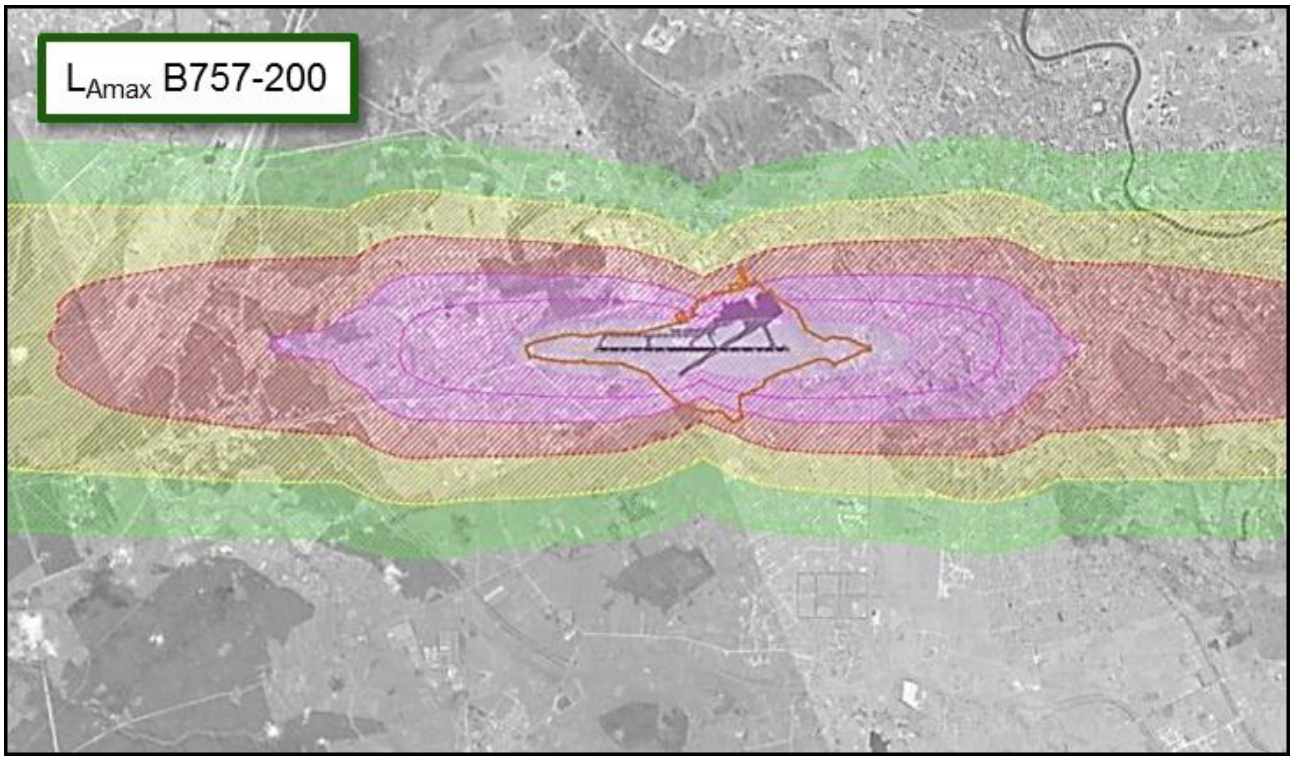


Figure 6.16: LA_{max} B767-300, expected to operate in 2020
Source: ALG analysis

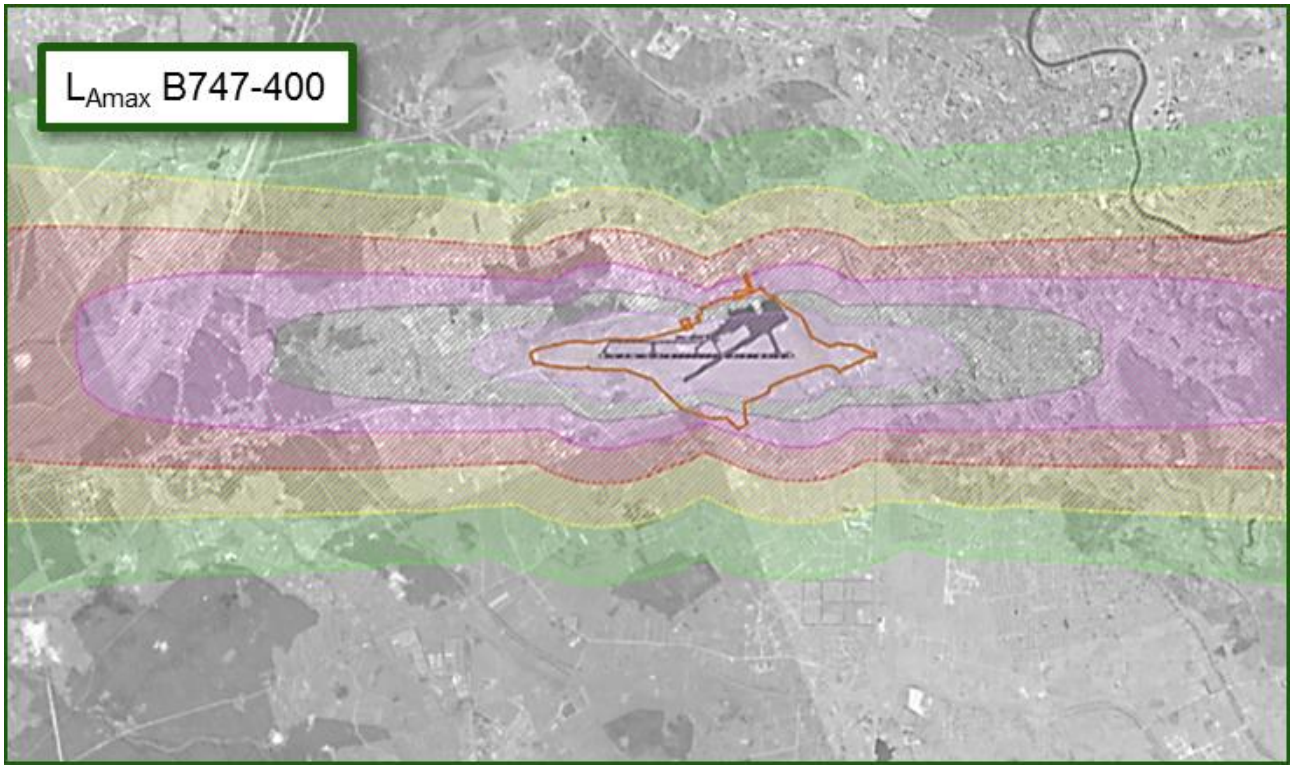
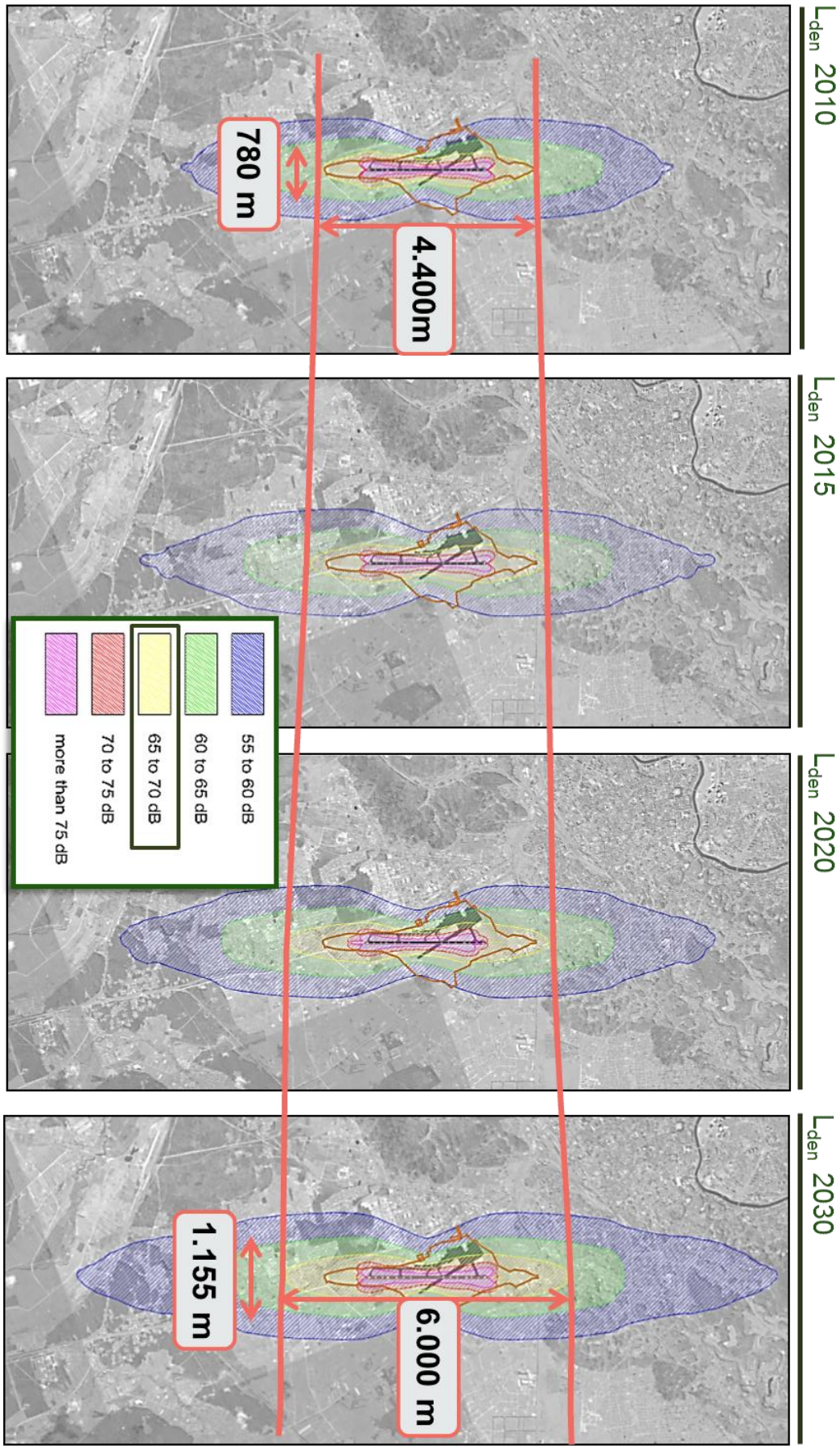


Figure 6.17: LA_{max} B747-400, expected to operate in 2030
Source: ALG analysis

It can be seen that L_{den} noise contour for its limit value includes an affected area bigger than L_{night} or any other noise indicator. From now on, L_{den} will be considered as the reference parameter to assess the evolution of noise affected territories in the vicinities of VNO.

The following figure shows the evolution of L_{den} noise indicator from 2010 up to 2030. The dimensions of the area outside of limit values are also defined.


Lden 2010
780 m
4.400m
Lden 2015
55 to 60 dB
60 to 65 dB
65 to 70 dB
70 to 75 dB
more than 75 dB
Lden 2020
Lden 2030
1.155 m
6.000 m

Finally, based on the previous noise contour analysis, the Noise Affected Area regarding air transport noise has been defined in line with traffic forecasts for the next 20 years.

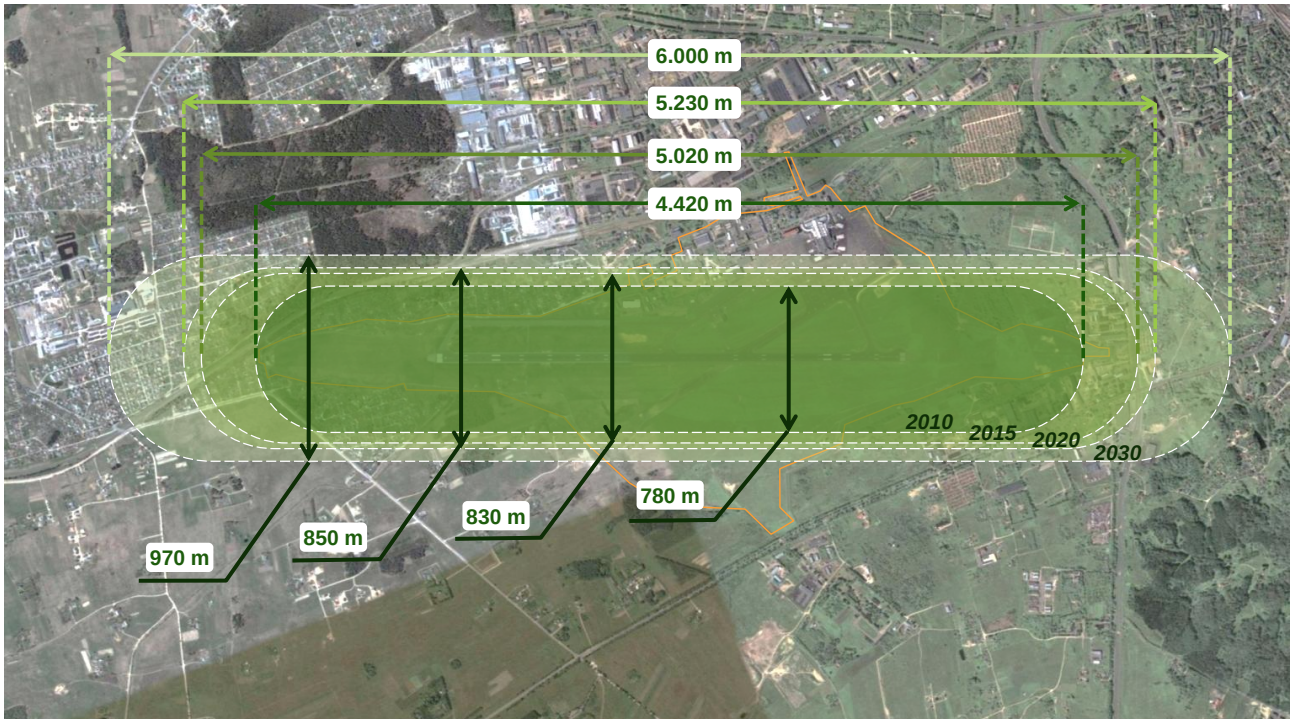


Figure 6.18: Noise Affected Areas regarding Air Transport noise
Source: ALG analysis

Once the Air Transport noise affected areas have been defined, they can be contrasted with the current land usage in the vicinities of the airport. This comparison will yield the environmental effect of VNO in terms of affected dwellings. The following figure shows in red the current residential neighbourhoods within the VNO Noise Affected area:

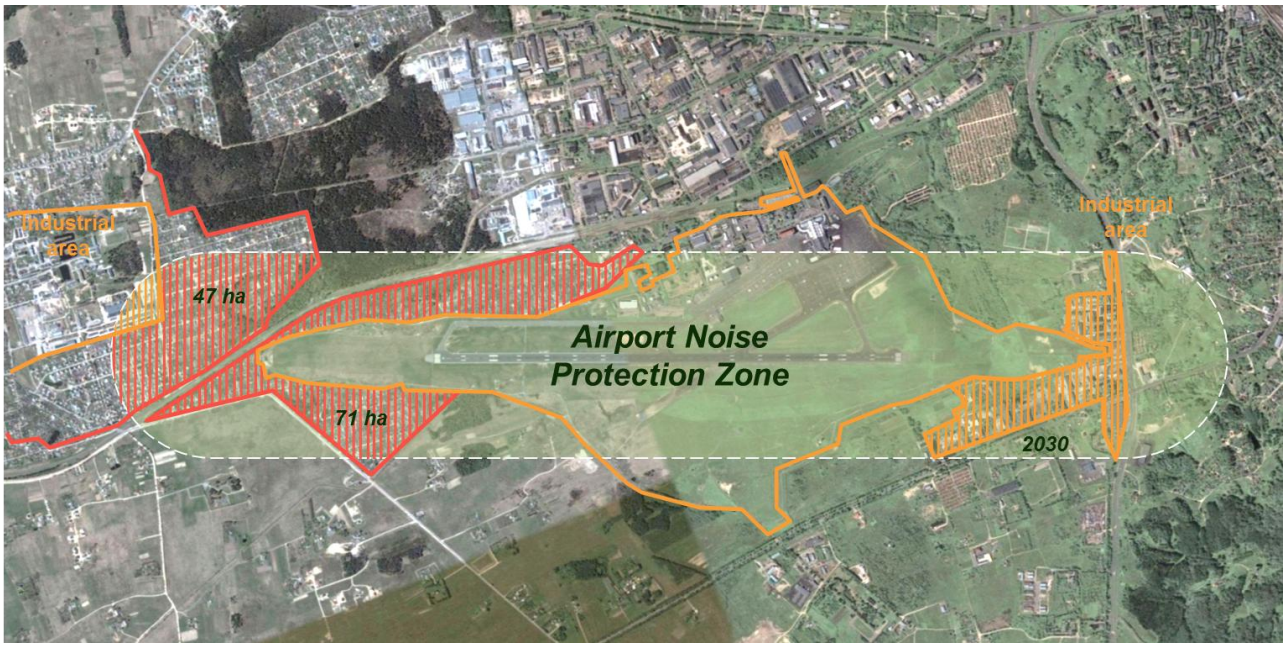


Figure 6.19: Residential areas within VNO Noise Affected Area
Source: ALG analysis

As can be seen, a larger number of inhabitants in Vilnius will be affected by air transport activity. Therefore, mitigation measures for these will be adopted. Specifically, over 900 dwellings (≈120ha.) will be affected in 2030, according to the forecast traffic development.

Alternatively, the number of affected inhabitants would be reduced by 50% by transferring all the airport operations to the proposed new second runway (currently safeguarded in the Territorial Plan), even though this would affect a new residential area that has never been affected by noise before.

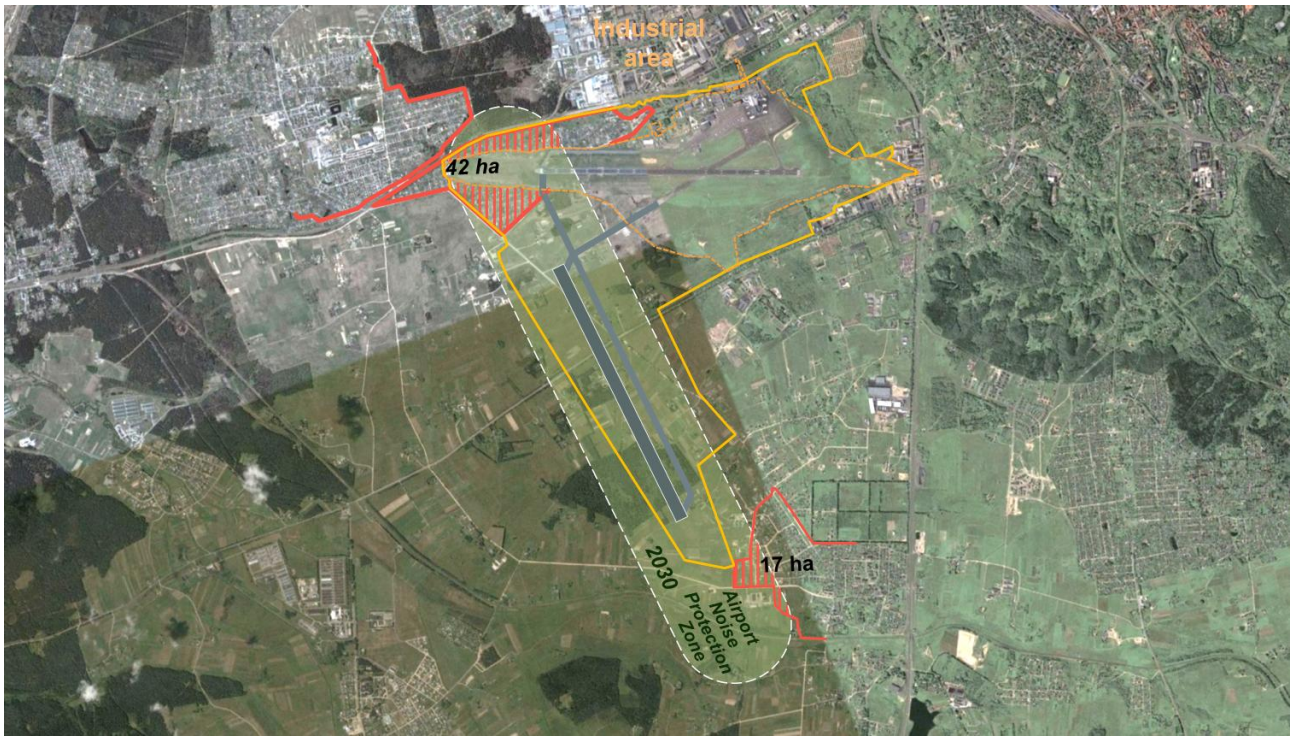


Figure 6.20: Residential areas within VNO Noise Affected Area by transferring airport activity to the 2nd runway
Source: ALG analysis

However, if both runways are used, there will be new affected areas without a great reduction in the number of the population affected. There would only be a net reduction in the number of affected inhabitants if the current runway was closed. However this is not a practical or desirable option as it would be sub-optimal in terms of cross wind operations. Following a multi-criteria analysis the proposed new second runway is not recommended by this Master Plan and it is proposed that it should be removed from the future Territorial Plans.

Mitigation measures must be adopted on the current affected dwellings while trying not to increase the affected area. Some measures that could be adopted by VNO in order to reduce its impact upon the neighbourhood include:

- Limiting the night time operations.
- Restricting the aircraft types used in each time frame.
- Defining a preferential runway configuration.
- Defining approach and departure noise mitigation procedures.
- Promoting soundproofing works on the affected dwellings.
- Controlling the fulfilment of these mitigation measures.

6.3.3 Industrial noise contours

This chapter will define the limits of the VNO Sanitary Zone and the incompatibility of the airports' activity with the residential land uses.

The industrial noise associated with the airport's activity has been assessed following the same criteria as transport noise. Firstly, noise from aircraft taxiing has been considered as industrial noise. Therefore, it must be assessed separately from landing and take-off noise.

Aircraft taxiing nuisance has been modelled based on taxi sound-power levels and guidelines issued in the scientific magazine "Applied Acoustics, No.7", dated July 2009, by C. Asensio (Applied Acoustics department of the Polytechnic University of Madrid).

The A-weight filter has been applied to third octave band distribution of the published sound power levels. Propagation of aircraft taxi noise along taxiways has been modelled as a cylindrical propagation from a lineal source, where the noise flow is related to the traffic through the taxiways and the aircraft average taxi speed.

Forecast traffic has been modelled from the most common aircraft currently operating in VNO, in terms of their noise specifications:

- CL-600 as a representative light/medium jet.
- DCH-8 as a representative turboprop.
- B737 as a representative commercial C-type jet.
- B757 as a representative commercial D-type jet.
- B747 as a representative commercial E-type jet.

Noise indicators L_{den}, L_{day}, $L_{evening}$ and L_{night} have been assessed using the 2030 annual traffic forecast, though $\mathbf{L_{night}}$ has proved to be the most critical parameter. The figure below shows taxi noise L_{night} contours for 2030 traffic.

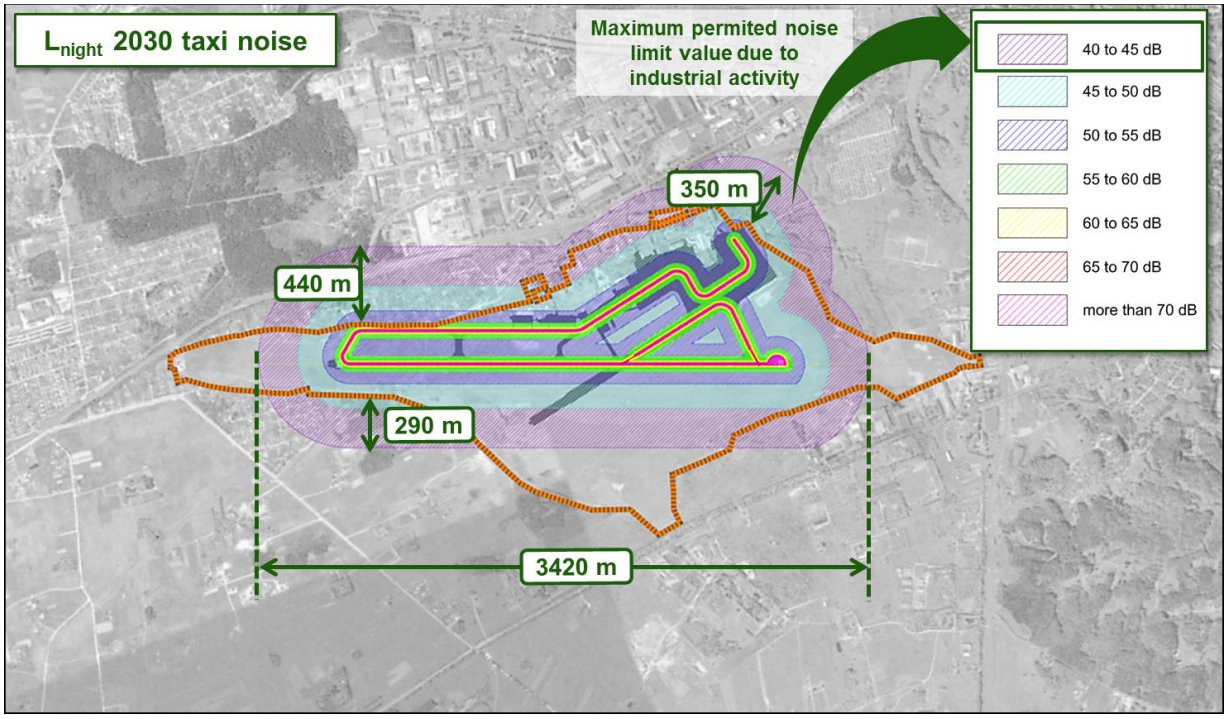


Figure 6.21: L_{den} contours from taxi noise, 2030 traffic forecast
Source: AGL analysis

It can be seen that noise from aircraft taxiing draws an approximate 300 m contour around the airport border for a total affected area that is 3,400 m long. Additionally, industrial areas around VNO have their own noise affected areas related to other industrial activities.

Once the industrial noise affected areas has been defined, they can be compared to the current land usage in the vicinity of the airport. The following figure shows the current residential neighbourhoods within VNO Sanitary Zone, indicated in red:

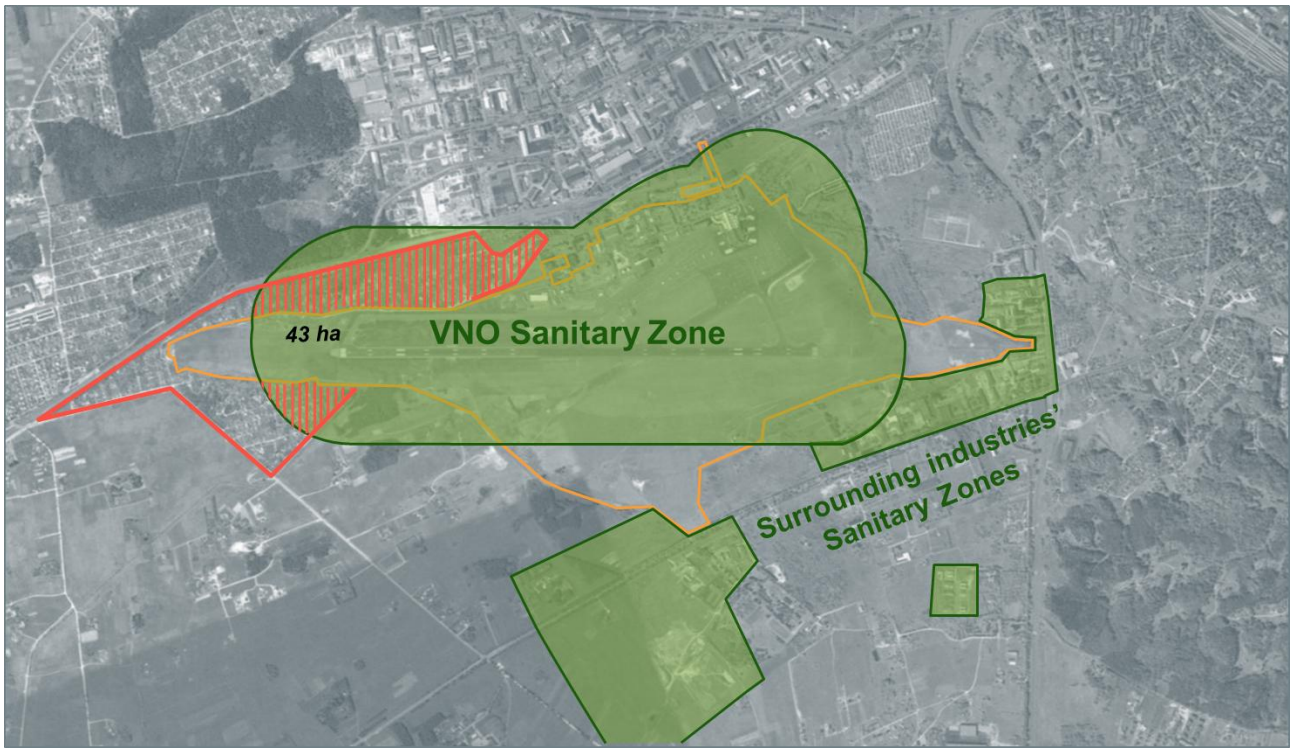


Figure 6.22: Residential areas within VNO Sanitary Zone
Source: ALG analysis

Residential building within the Sanitary Protection Zone (over 300 dwellings) must be subject to the restrictions of the Sanitary Zone. However, most of these affected dwellings have not been declared as permanent residential buildings and are classified as "garden houses".

The legal requirements concerning the aerodrome SPZ mainly cover the restrictions for planning and construction of new residential buildings or reconstruction of existing residential buildings within the SPZ. The legal acts do not set any specific regulation concerning the already existing constructions in the SPZ (e.g. requirement to change the purpose of existing constructions, to demolish existing constructions, etc.). Thus, it could be treated that the status and regime of already existing constructions should be determined in a stage of establishing the aerodrome SPZ, and once the SPZ is established they might continue to exist (however restrictions on reconstruction of such constructions may apply).

The legal restrictions are specifically applicable for residential houses and may not be applied in full to garden houses. Nevertheless, once the aerodrome SPZ is determined the gardener activities should require coordination with the Ministry of Agriculture of the Republic of Lithuania[9], as explained previously in section 6.3.1.1.1 iv of this document.

The owners of private land within the aerodrome SPZ will have the right to apply to the organiser of the territorial planning document or its amendment regarding the losses incurred due to establishment of the aerodrome SPZ.

[9] The Law on Communities of Gardeners of the Republic of Lithuania (Official Gazette, 2004, No. 4-40)

Figure 6.23: Residential areas within VNO Sanitary Zone by transferring airport activity to the 2nd runway
Source: ALG analysis

Regarding the potential option of the proposed second runway (currently safeguarded in the Territorial Plan), there is no benefit in terms of the effects on the Sanitary Zone in transferring operations to a 2nd runway, because aircraft would still taxi to and from the terminal. Even if departures and landings were carried out on the 2nd runway, aircraft would be forced to taxi through the current taxiways and thus expand the Sanitary Zone.

As stated previously, following a multi-criteria analysis the proposed new second runway is not recommended by this Master Plan and it is proposed that it should be removed from the future Territorial Plans.

6.3.4 International benchmark

Finally, an international benchmark study has been prepared to show different measures adopted by European airports to reduce air traffic noise impact on the population. The most important points of this benchmark are exposed below:

Regarding noise abatement procedures:

- Runway preferential uses reduce the average long-term noise impact on the non-preferential header. This measure has been adopted by airports that have an important urban concentration around one of their runway headers. Barcelona and Linate are examples of this practise.

- *Standard Instrument Departure* (SID) and *Standard Terminal Arrival Route* (STAR) procedures can force aircraft to manoeuvre in accordance with a desired trajectory in order to avoid overflying residential areas. Paris Orly and Barcelona have adopted this kind of measure.

- Special gliding and climbing paths can be defined in order to reduce the length of the noise affected area, such as in the case of London City Airport.

Otherwise, regarding L_{Amax} noise indicator:

- Lithuania is the only assessed country that defines the L_{Amax} threshold under 70 dB.
- Some countries, such as Norway, Germany or Switzerland, establish different noise limit values depending on the noise source and they are more permissive with air transport L_{Amax} noise.
- Other countries such as Denmark, Finland or France, do not define a maximum noise limit indicator used for noise impact assessment.

6.3.5 Conclusions regarding noise assessment

Finally, the most important conclusions drawn from the noise assessment are summarised below:

- The number of affected inhabitants due to aircraft noise is likely to rise with traffic over the next few decades.
- In the medium-term, the number of adjacent houses within the nuisance limit values will increase up to 900 dwellings.
- VNO should begin taking mitigation measures on these dwellings. Operational procedures and soundproofing works would be the most effective actions to carry out.
- Otherwise, the future airport development could be limited by social pressure and the general negative perception of the airport's activity.
- In terms of healthcare, most affected dwellings within the Sanitary Protection Zone are not currently declared as permanent residential dwellings; potentially they can maintain their status as "garden houses".
- The owners of private land within the aerodrome SPZ will have the right to apply to the organiser of the territorial planning document or its amendment regarding the losses incurred due to establishment of the aerodrome SPZ.
- The number of affected dwellings within the Noise Protection Zone could be reduced by transferring all the operations to the 2nd runway. However, new residential areas would then be affected. In any case, the 2nd runway is considered to be sub-optimal in term of cross wind minimization. If both runways remain in use, there will be no benefit in terms of the number of affected inhabitants.
- Following a multi-criteria analysis the proposed new second runway is not recommended by this Master Plan and it is proposed that it should be removed from the future Territorial Plans.

In summary, the adoption of mitigation measures by VNO needs to be implemented in order to maintain the correct social perception of the airport's activity.

6.4 Soils polluted through hydrocarbon contamination

The current fuel base of Vilnius Airport stands on an old facility designed for the same purpose during the Soviet occupation (1944-1990), which is responsible for the hydrocarbon discharges that still remain and locally affect the surface layers of soil in the facility.

Figure 6.24: Location area of fuel and water collection wells
Source: Vilnius Airport

This situation was addressed by the current Lithuanian airport authority, which has a monitoring programme underway for groundwater close to the surface, where the pollution episode is concentrated (up to 6 metres depth, approximately) and has programmed active decontamination of the area for the triennium 2012-2015. Both actions are supervised by the Lithuanian environmental authorities, and have been developed in full compliance with the regulatory framework of the country. The compounds detected through the monitoring include aromatic hydrocarbons, benzene and other petroleum products and toxic metals such as lead, zinc or chromium. It can be said that the current fuel base is a safe facility that operates according to Lithuanian legislation on safety and environment, without producing new hydrocarbon discharges in soils or surface water courses of the airport environment.

The biggest risk of residual contamination is the transfer to deeper levels of the aquifer or the three wells for drinking water catchment, which are very close to the contaminated area. The closest well to the area with higher levels of contamination is 1/889, according to monitoring reports prepared by the airport.

6.5 Impact on surface water and groundwater

Along with the noise in residential areas, water is the medium most affected by the normal operation of the airport. Discharges and extractions are the cause of this impact. The framework Water Directive 2000/60/CE is the reference that should guide the adoption of measures for sustainable consumption of this precious resource.

6.5.1 Surface water

The cleaning of the apron and de-icing treatment of aircraft are responsible for the contamination of the surface water courses of the airport. The effluent water of these actions is discharged to the drainage network that empties into natural water courses. Discharge volumes are quite significant: for instance, in 2010, 283,640 m³ of water from the aquifer located at the airport was used to clean the apron. In the case of de-icing, there is no specific area for this treatment and there are up to three areas, not specially equipped, where aircraft de-icing is carried out. The material used for the de-icing is a derivative of propylene glycol, while urea is used to clean surface. The result of these applications is, as mentioned above, the discharge of mineral nutrients into the water, increasing the risk of eutrophication and the decimation of the hydrophytic flora of the airport environment.

Figure 6.25: De-icing works in the Airport of Vilnius
Source: Vilnius Airport

To improve this situation, the airport is planning to replace the urea with less polluting salts (potassium acetate) and to reorganise the drainage system to separate the cleaning run-off water and direct it to the treatment network managed by Vilnius municipality. With the simple implementation of these measures, the airport will significantly reduce the pollution load in its surface water, and indirectly, in the hydrophytic vegetation of its environment.

6.5.2 Groundwater

The airport bases its water consumption on the exploitation of its aquifer, with a well system having extraction points located at an approximate depth of 100 metres. Extractions in 2010 amounted to 55,000 m³ of water for domestic use and 283,640 m³ for other purposes. This consumption not only affects the quantitative status of water reserves, but also generates an increase in levels of manganese and dissolved iron, as detected by the monitoring programme developed by the airport itself.

6.6 Environmental assessment of alternatives

The technical, urban and environmental conditioning factors make it advisable to consider an assessment of time scenarios of the solution proposed by the Master Plan, instead of evaluating different alternatives.

6.6.1 Scenario 1. Short term

The Master Plan development proposals for the short term will not generate a sizeable environmental impact, since they focus on areas already transformed and their scope is very moderate. The development of the terminal building will involve a reorganisation of areas already built or currently being improved, within the limits of the airport perimeter and promoting consolidation instead of the separation of the uses contained within these functional areas.

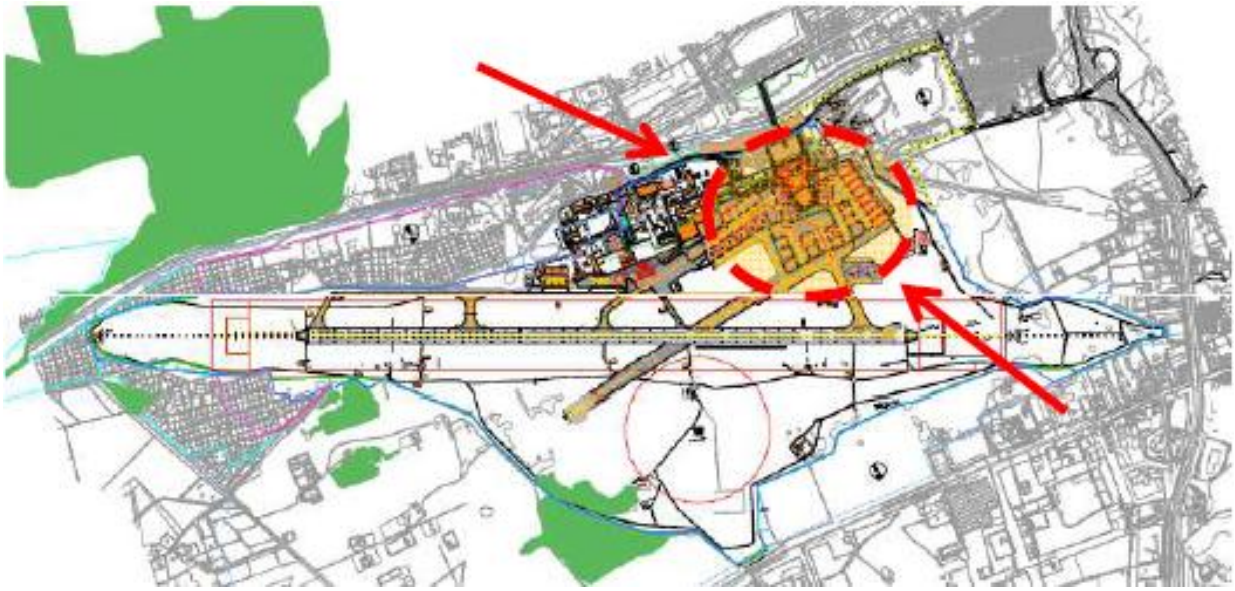


Figure 6.26: Location of the most relevant impacts of the scenario 1
Source: ALG analysis

The environmental impact of the scenario is temporary and will be focused on the construction phase: consumption of materials and natural resources (energy and water), production of waste and emission of pollutants into the air by trucks transporting building materials.

The proposal is considered as environmentally satisfactory since it improves previously developed areas.

6.6.2 Scenario 2. Medium Term

The runway extension and resulting aircraft operation (mainly take-offs) will generate a permanent impact: the increase of noise in residential areas near the southern header of the runway.

To go ahead with the extension, corrective measures will have to be taken, such as the soundproofing of homes. Additionally, Vilnius Airport should analyse the feasibility of expropriating the areas closest to the header of the runway, as well as the application of noise abatement procedures in order to reduce the overall noise impact.

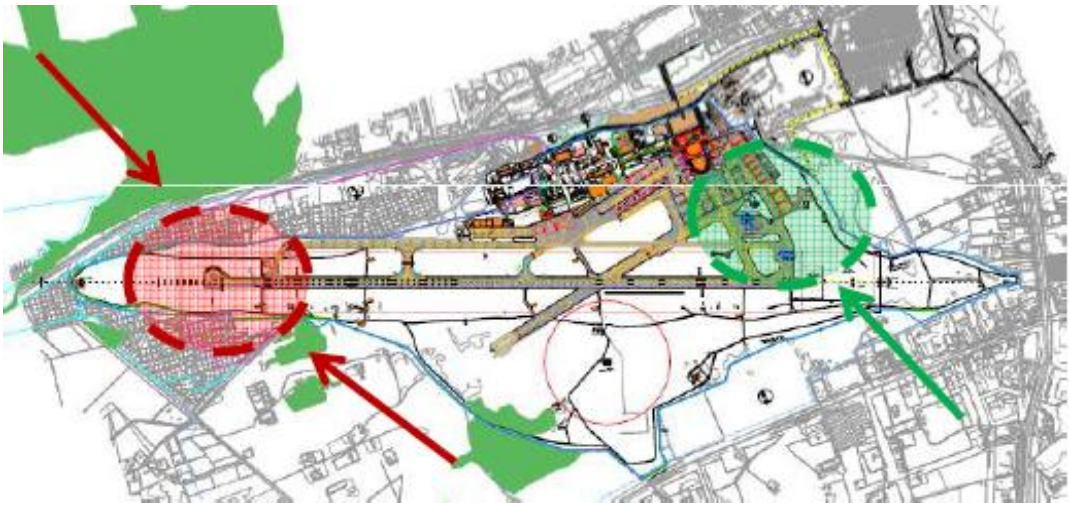


Figure 6.27: Location of the most relevant impacts of the scenario 2
Source: ALG analysis

In contrast, enabling a de-icing zone in the vicinity of the north header of the runway will lead to a triple environmental improvement: the concentration of equipment for the de-icing activity, as well as controlled management and treatment of wastewater produced by this activity.

6.6.3 Scenario 3. Long term

In practice, this scenario means a consolidation of the previous one. There are no significant differences between both scenarios. The proposal reaffirms the runway extension and structures more interior spaces in areas previously transformed in the terminal environment, the airfield and the services and industry zone.

The relocation of the fuel tank area is an environmental improvement: moving away from the runway and the water catchment wells will reduce potential environmental and safety risks. And additionally, it will be an opportunity to remove any contaminated soil that may survive in the scope of action.

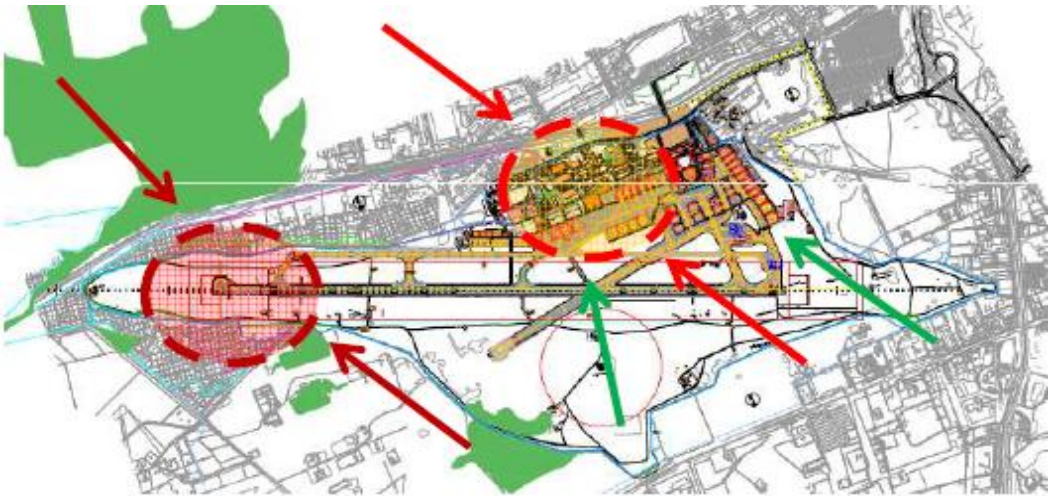


Figure 6.28: Location of the most relevant impacts of the scenario 3
Source: ALG analysis

The impacts of this scenario are temporary and are specified in the construction phase: consumption of materials and natural resources (energy and water), generation of waste and the emission of pollution to the atmosphere by vehicles transporting materials.

6.6.4 Maximum development possible

In the very long term, in a scenario involving the maximum development of infrastructure, growth proposals would involve new permanent impacts: construction (and operation) of a taxiway to provide aircraft access to the south header of the runway and the new logistics park located on the other side of the same runway.

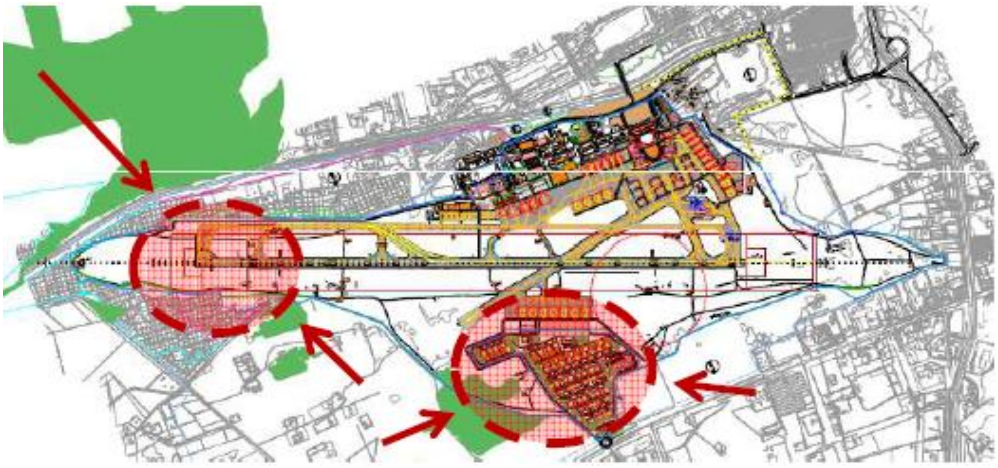


Figure 6.29: Location of the most relevant impacts of the scenario 4.
Source: ALG analysis

In the case of the taxiway, the impact will be caused by the access of aircraft, which are likely to increase noise levels in residential areas of the SN. As regards the logistics park, its construction will have impacts such as change of land use and the breaking of the principle of infrastructure consolidation on one side of the runway, which will lead to increased vehicle traffic, emission of contaminants, etc. However, the logistics park construction would not involve transforming the state of the nearby national forest.

Whilst the impacts of this scenario are significant, they are not critical. However, it would be advisable to adopt additional measures to improve the environmental balance of the Master Plan

6.7 Environmental analysis of the development considered in the Master Plan

Having earlier analysed the current situation of the main environmental aspects, the analysis then focuses on the expected evolution of these issues within the development framework of the Master Plan and the corrective and protective measures that should support it.

6.7.1 Natural resource consumption and waste generation

The infrastructure development will lead to a parallel growth in these aspects, so adopting efficiency, economy and minimisation criteria is necessary. In the case of energy consumption, for example, it is expected that consumption in scenario 3 (5.5 million passengers) will almost triple current consumption (a 265% increase) and drinking water consumption and waste generation will behave similarly.

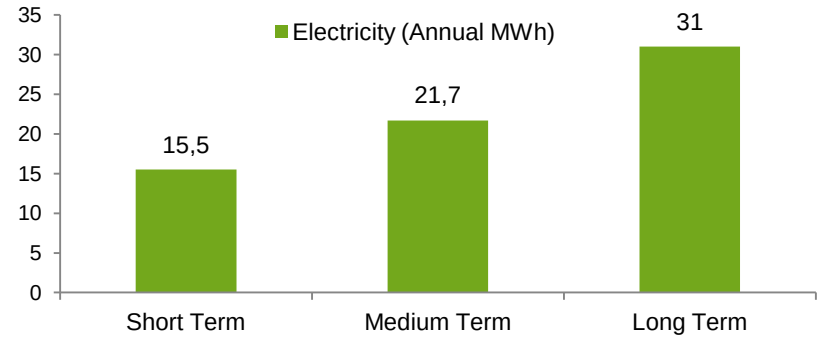


Chart 6.1: Forecast of energy consumption in scenarios 1, 2 and 3
Source: ALG analysis

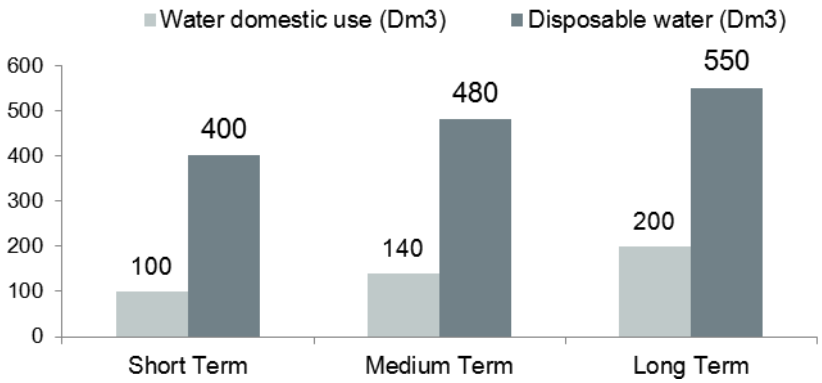


Chart 6.2: Forecast of drinking water consumption and wastewater generation in scenarios 1, 2 and 3
Source: ALG analysis

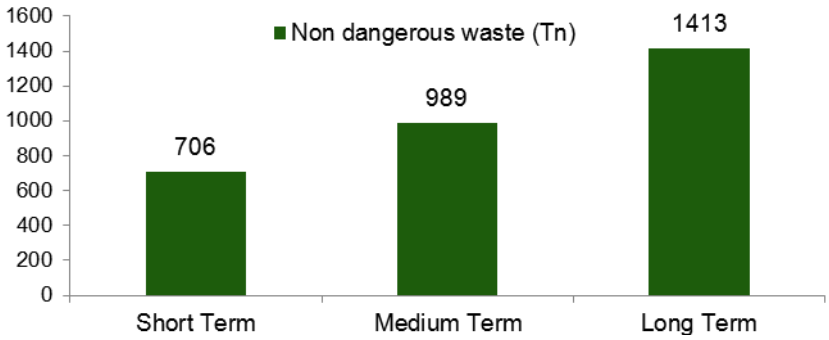


Chart 6.3: Forecast of non-hazardous and solid waste generation of the scenarios 1, 2 and 3
Source: ALG analysis

As mentioned, the future development should give priority to the adoption of energy systems which emphasise energy saving and efficiency. The environmental management system will significantly help in this task, as well as in the minimisation of waste production. The gradual introduction of renewable energy sources would be very attractive in terms of improving the environmental balance of the airport and reduce its overall carbon footprint.

6.7.2 Consumption of water resources

While the airport does not plan to increase the volume of water extraction immediately, it is undeniable that the growing development is likely to increase the consumption of water, and therefore also the extraction of water from the current well system. This greater consumption will have an effect on the quantitative status of the aquifer, and also increase the levels of iron and manganese dissolved in the water. In the medium term, it would be advisable to combine the use of well water with the use of water supplied from the municipality of Vilnius. This measure not only has environmental advantages in terms of quantitative and qualitative conservation of water resources, but will also lead to an improvement in the security of supply, using the already existing connection to the municipal supply networks.

In relation to extracted water consumption, we note that in the short-term the airport plans to substitute the urea used for the apron cleaning for potassium salts, which are less pollutant, and the review of the airfield drainage system will redirect cleaning water to purification treatment.

In the medium term, the Master Plan envisages the designation of an area (facilities) for the specific development of de-icing. This measure will allow handler operators to provide better and faster service to air carriers, as well as controlled management and treatment of generated effluent water. The de-icing consumption (Propylene glycol) reached 350 tons in 2010 and presumably could reach 650 tonnes in 2030. All these measures should allow a reduction in water pollutant discharges, as well as a significant reduction of their pollution load, and therefore the risk of eutrophication of the environment.

As an additional improvement, the airport could consider creating green filters with hydrophytic vegetation such as reed beds to reduce the organic load of water from surface drainage. This measure would also allow the creation of attractive habitats for wildlife.

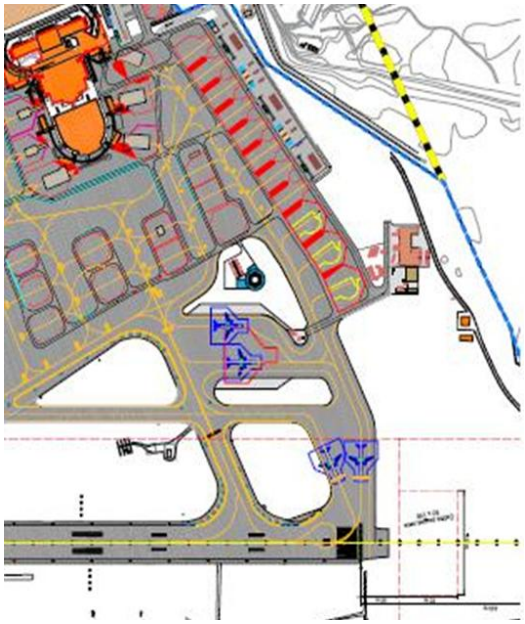


Figure 6.30: Projected location of the de-icing area
Source: ALG analysis

6.7.3 Impact on air quality

In relation to the gas emissions of the entire Vilnius Airport infrastructure, the airport carries out its common activity via an environmental authorisation from the Ministry of the Environment of the Republic of Lithuania. Based on the size and volume of its operations, we consider the airport emissions to have a moderate level in absolute terms.

However, the fight against climate change and pollution of the atmosphere is one of the fundamental principles of the environmental policies of the European Union, as demonstrated by e.g. the international treaties signed by the Member States, such as the Kyoto Protocol or the Directive 2008/50/EC on air quality. As a consequence, the adoption of measures for the progressive reduction of emissions, at least in relative terms, is highly recommended given the expected increase in air traffic that will accompany the development of the Master Plan.

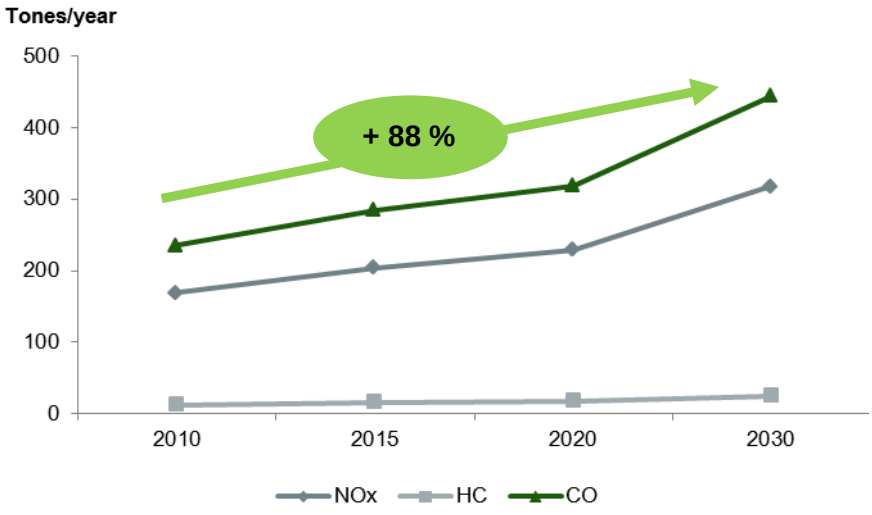


Chart 6.4: Modelling of pollutant gas emissions before the various scenarios of the Master Plan (LTO cycle) 1
Source: ALG analysis

At this point, it should be noted that there is a significant impact from gas emissions (NO_2, HCC and CO mainly) produced by the apron service fleet, which uses vehicles with old engines and consumes fossil fuels exclusively. The progressive replacement of this fleet is strongly recommended, leading to the use of more efficient motor vehicles which use bio fuels and less pollutant energies, such as electricity.

In parallel, in the medium term, the airport could develop actions to reduce emissions of NO_2, the most important pollutant generated by aircraft during their taxiway movements and during approach and take-off.

1LTO cycle: includes all activities near the airport that take place below the altitude of 3,000 ft. (1,000 m). These therefore include taxi-in and out, take-off, climb-out and approach landing.

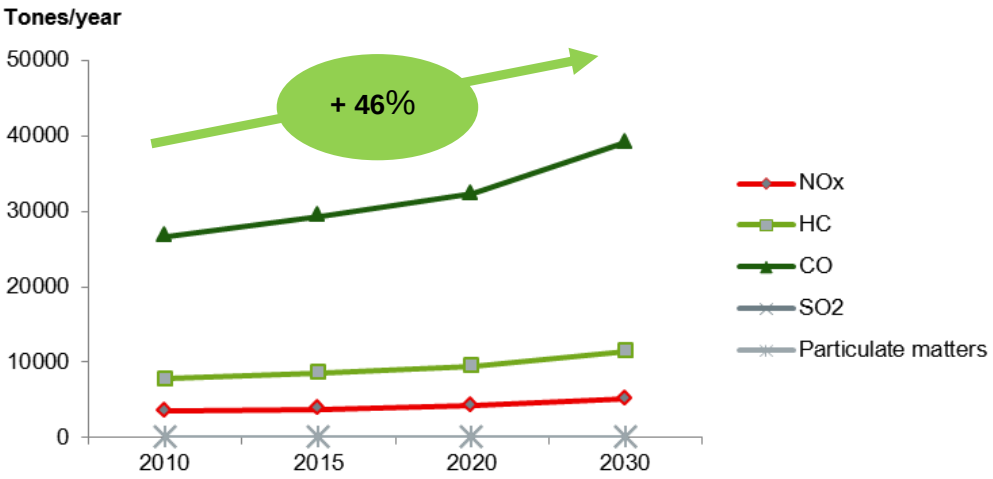


Chart 6.5: Modelling of emissions and pollutant gases from the ground fleet
Source: ALG analysis

In this regard, to combat climate change, the airport could improve its environmental commitment by carrying out an inventory of emission-generating activities to estimate its carbon footprint and start the airport carbon accreditation process.

At the local level, for the purpose of estimating emission levels, we recommend the installation of an automatic station for monitoring air quality in the area of the airfield.

6.7.4 Impact on waste generation

The execution of construction projects that make up the Master Plan of Vilnius Airport will generate a large volume of solid waste, mainly non-hazardous and recyclable (paper, plastic and glass), but also chemical waste, as well as waste water and emissions to the atmosphere (noise, dust and compounds). The operators (construction companies) will be responsible for the proper management of their own waste and the organised treatment of this should not be an issue. In any case, the airport should supervise this management, being supported by its environmental management system. We recommend the creation of a technical office in order to manage the implementation of the Master Plan and, among other things, monitor the compliance with the various environmental regulations including waste management.

As regards the operational phase, a progressive increase is also expected in the production of waste (in 2030, 848 tons of non-hazardous and 37 of hazardous). In any case, the management of the waste generated today (405.9 tons in 2010) is correct and should not involve greater problems in the future, regardless of the advisability of introducing measures for monitoring and minimising the quantities produced.

As mentioned earlier, the management and waste minimisation policies of the airport are correct. After a comparative analysis with airports with comparable traffic such as Strasbourg (France) and Oulu (Finland), we believe there are some possibilities for the adoption of policies to keep reducing waste production, especially non-hazardous waste. In the case of hazardous waste this consideration is also valid, although

some factors related to the climatic conditions of the airport (like the need to apply de-icing treatment) affect the possibilities for improvement.

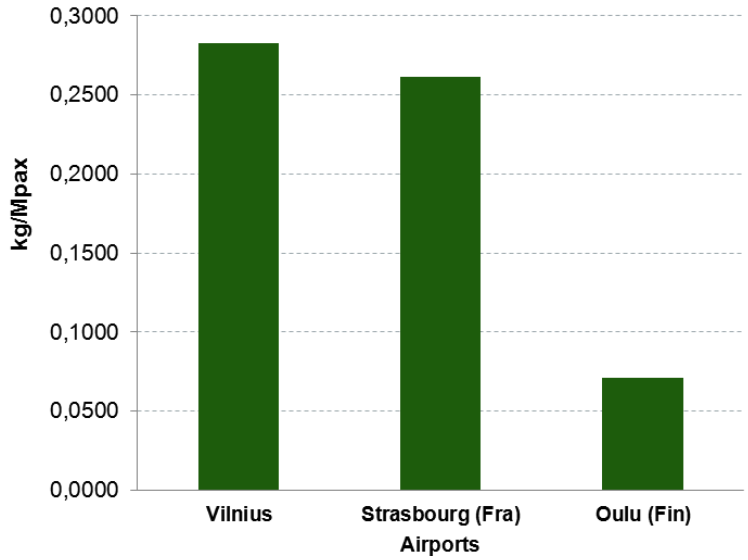


Chart 6.6: Comparison of production of non-hazardous waste among Vilnius, Strasbourg and Oulu, 2010
Source: ALG analysis

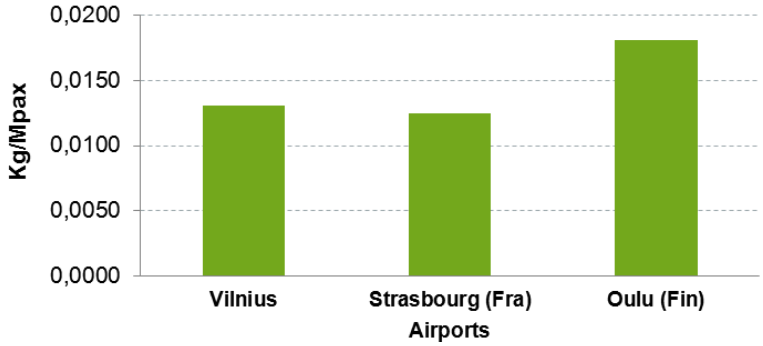


Chart 6.7: Comparison of production of hazardous waste among Vilnius, Strasbourg and Oulu, 2010
Source: ALG analysis

6.7.5 Other impacts

Other impacts, such as electromagnetic fields, ionizing radiation, biological pollution, vibration, light and heat have also been reviewed. Of all of these, the most significant are the vibrations caused by overflying aircraft in residential areas near the south header of the runway.

The figure below shows the impact matrix developed:

	Significant Impact
	Moderate Impact
	Slight Impact

	Airfield	Terminal Building	Terminal Area	Residential areas
Electromagnetic	Radars (Surveillance/ > Approach and surface) (OP) --	Scanner boarding lounges (OP) -	High voltage supply system (OP) -	Radars (Surveillance/ > Approach and surface) (OP) --
Ionising radiation		Screening devices (OP) -		
Biollogical pollution	Eutrophic water discharges favor the development of invasive vegetation (nitrophilous) in waterways, of low ecological value (OP) --			
Vibration	During Infrastructure Construction (CP) -	During Infrastructure Construction (CP) -		Aircraft overflight in closest areas (Sanitary zone) (OP) ---
Light	Airfield Lighting Systems (OP) (visual and birdstrike) -	Building , parking and access lighting design (OP) -		Airfield views in the closest areas (Sanitary zone) (OP) -
Heat		Energy supply design (OP) -	Energy supply system (OP) -	

CP: Construction phase. OP: Operation phase

Table 6.12: Matrix of impacts
Source: ALG analysis

6.8 Impact on residential areas of the activities planned in the Master Plan

6.8.1 Most environmentally friendly proposals for development options

Based on the analysis of proposals for the development of the Master Plan and its environmental impact, options have been provided, outlining how the environmental impact of its implementation can be reduced. Organised by scope of actions, the proposals are:

Airfield:

- Continue the use of the current runway.
- Concentrate development on one side of the runway (consolidation principle).
- Should there be a requirement in the future to extend the runway due to the development of traffic and long distance routes, then this particular project should involve an environmental impact assessment.

Terminal Building

- Base the design on spaces which have already been transformed.
- Develop the terminal building in moderate dimensions.

Terminal Area:

- Reorganisation of space and uses.
- Relocation of the fuel tank area.
- Reconsider whether building a new logistics park on the other side of the runway is suitable or not.

Furthermore, it should be noted that the development of the Master Plan will not affect areas included in the Natura 2000 network and protected by the Directive 92/43/EC, so the adoption of compensatory measures is not necessary.

6.8.2 Identification of compensatory measures to reduce adverse environmental impacts

Corrective and protective measures are structured according to the environmental aspects identified.

Noise

- Residential areas: Home soundproofing works.
- Aeronautical operation:
    - Establishing operational procedures to reduce noise.
    - Limiting night time operations.
    - Restricting operations of noisiest aircraft types.

Water

- Surface water courses: water treatment systems (de-icing area and cleaning of apron surfaces)

- Groundwater: Reduction in the use of water catchment wells, combined with the use of water from the municipal supply networks to limit the impact on the ground water levels[10].

Air quality

- Progressive renewal of apron service fleet (electric vehicles)
- Programme to reduce NO2 emissions by aircraft.
- Start the process for obtaining the Airport Carbon Accreditation.

Fauna and flora

- Increase the monitoring of risk of bird strikes[11].
- Restoration of habitat with conservation purposes (reed green filters[12]).

Energy

- Adoption of energy systems that promote savings and energy efficiency.
- Progressive introduction of renewable energies.

[10] Refer to previous explanation in section 6.7.2 Consumption of water resources
[11] Note a project to monitor bird strikes is currently being implemented
[12] Note with reference to previous section 6.7.2 Consumption of water resources, reed beds can act as green filters to reduce the organic load of water from surface drainage and also create an attractive habitat to relocate wildlife.

6.9 Public relations proposals

In line with European best practices on airport management, the opening of a permanent building for the communication and dissemination of knowledge on social and environmental measures has been put forward.

The dissemination of the airport development plans shall focus on neighbouring communities and all stakeholders involved. Any action or communication that can be disclosed should be directly delivered to the community by Vilnius Airport, using the airport facilities to set up a permanent meeting point. The presence of all the social agents and stakeholders in the discussion spaces will improve the understanding and the credibility of the airport activities and the new airport development works.

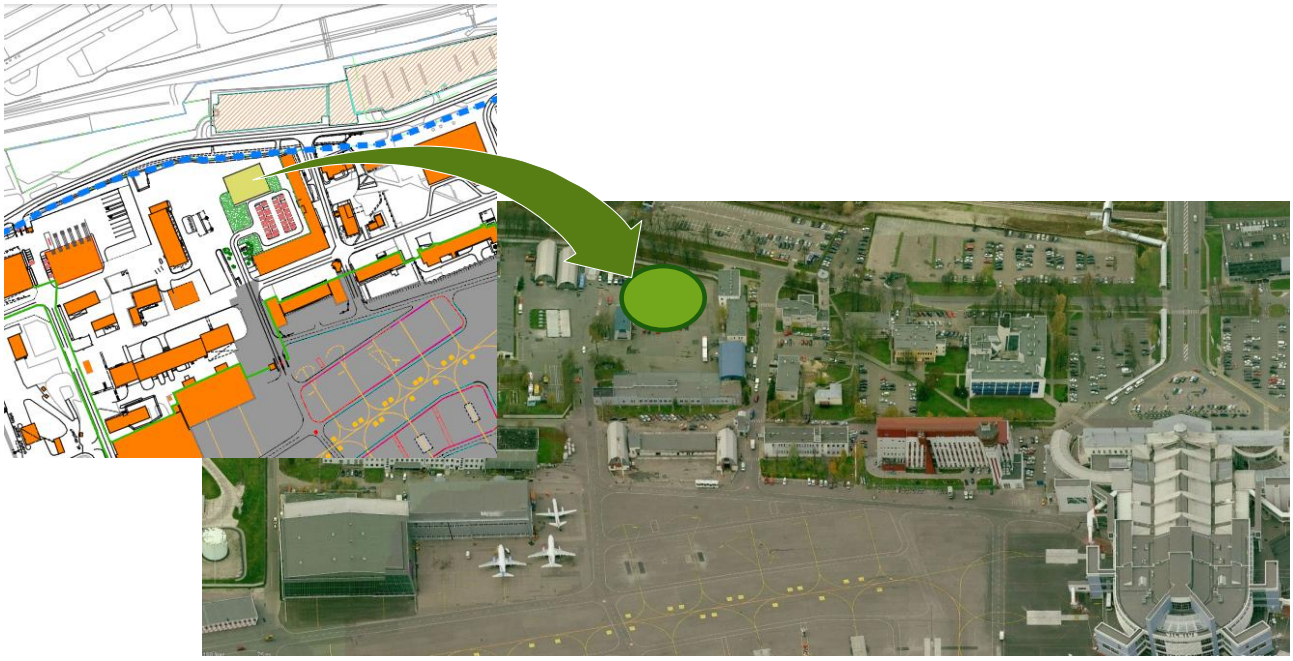


Figure 6.31: Projected location for the airport new Green building
Source: ALG analysis

This new Green Building of Vilnius Airport (1,200 m^2) is intended to be an office and meeting room centre that will permit a series of particular activities:

- Monitoring of the airport's environmental impacts.
- Communication centre for the press, media & the community.
- Meeting point for EU committees and stakeholders.
- Public information and service centre.

This last function – public information and service centre – is intended to receive and attend to all the information requests and complaints related to environmental nuisances: noise, odours, etc. This service will register all complaints and give a formal answer to them in an appropriate procedure. Attention to the public will be provided within normal working hours whilst complaints at other times should also be recorded and responded to.

6.10 Conclusions of the environmental assessment

Vilnius Airport is responsible for a moderate impact on the environment. This conclusion applies equally to the current situation and the scenarios developed for the implementation of the new Master Plan. The most significant conclusions of the environmental aspects are:

- Noise generated by aircraft operation is the most significant impact in residential areas near the airport, followed by mineral nutrient pollution of surface water of the infrastructure environment. In both cases, the airport is already developing suitable actions to reduce the effects.
- The airport operates under strict compliance with the environmental legislation of the Republic of Lithuania. Additionally, the authorities are implementing a standard-based environmental management system. The certification of this is imminent and it will result in a significant improvement in the commitment to managing the infrastructure in a more sustainable way.
- Earlier pollution due to discharges of hydrocarbons in the fuel tanks area has limited effects and will be decontaminated in the coming years (2012-2015).
- The future development of the airport will most likely lead to an increase in the consumption of energy and natural resources (such as water).
- The number of residents affected by noise is also likely to grow as traffic operating from the airport increases. In the medium term, the number of residences within the area suffering significant discomfort from noise is expected to reach 1,000.
- The emission of products into the atmosphere is forecast to increase, contributing to local environmental pollution and global warming. Since this is one of the key areas of the environmental policy of the European Union, it would be advisable to adopt actions to reduce the impacts generated.

Recommendations for the future: to grow in a sustainable manner

The Master Plan proposes progressive and efficient infrastructure development. The criteria for the future management of the airport should prioritise the efficient use of resources and greater environmental and territorial integration. The certification of its environmental management system will undoubtedly make the achievement of these goals more feasible.

Noise: VNO should carry out measures to mitigate noise impact on residential areas near the Southern header that will be affected by higher levels of noise. The most effective actions would be adopting noise abatement procedures and the soundproofing of homes.

Water: The airport should continue to adopt measures to treat wastewater produced in the apron cleaning and de-icing work. In the medium term, it would be highly advisable to combine well water extraction with the supply from municipal networks of Vilnius.

Air quality: The airport can greatly enhance its commitment in this area. It would be advisable, for example, to start the necessary studies to reduce NO_2 emissions from aircraft operation and the gradual modernisation of the apron service fleet.

Biodiversity: Although the risk of bird strike collisions is currently low, it would be advisable to start monitoring the potential risk from this area to better devise mitigating procedures.

7 Airport Land Use Plan

7 Airport land use plan

In earlier chapters the implications (limitations and opportunities) of the current territorial planning of the municipality of Vilnius for the future development of the Airport have been analysed. After evaluating the different improvement options and evaluating the territorial and environmental impacts of the different development alternatives (for the passenger terminal, for the industrial and services area and for the airfield), the next step was to prepare a land use proposal compatible with the territorial plans and the currently valid legislation.

The objective of this proposal will be to align the planning of land uses within and in the immediate surroundings of Vilnius Airport with the development in the short, medium and long term of the infrastructure and the expected increase in air traffic.

In the preparation of the land use proposal, the aim is to find a solution to the space requirements that has the minimum effect (or with none at all) on the forested areas surrounding the airport.

7.1 Airport land use considering current traffic

Currently, Vilnius air traffic generates acoustic impacts from aircraft noise that effect the surrounding areas and which require the implementation of projection zones and potential mitigation measures for the population affected.

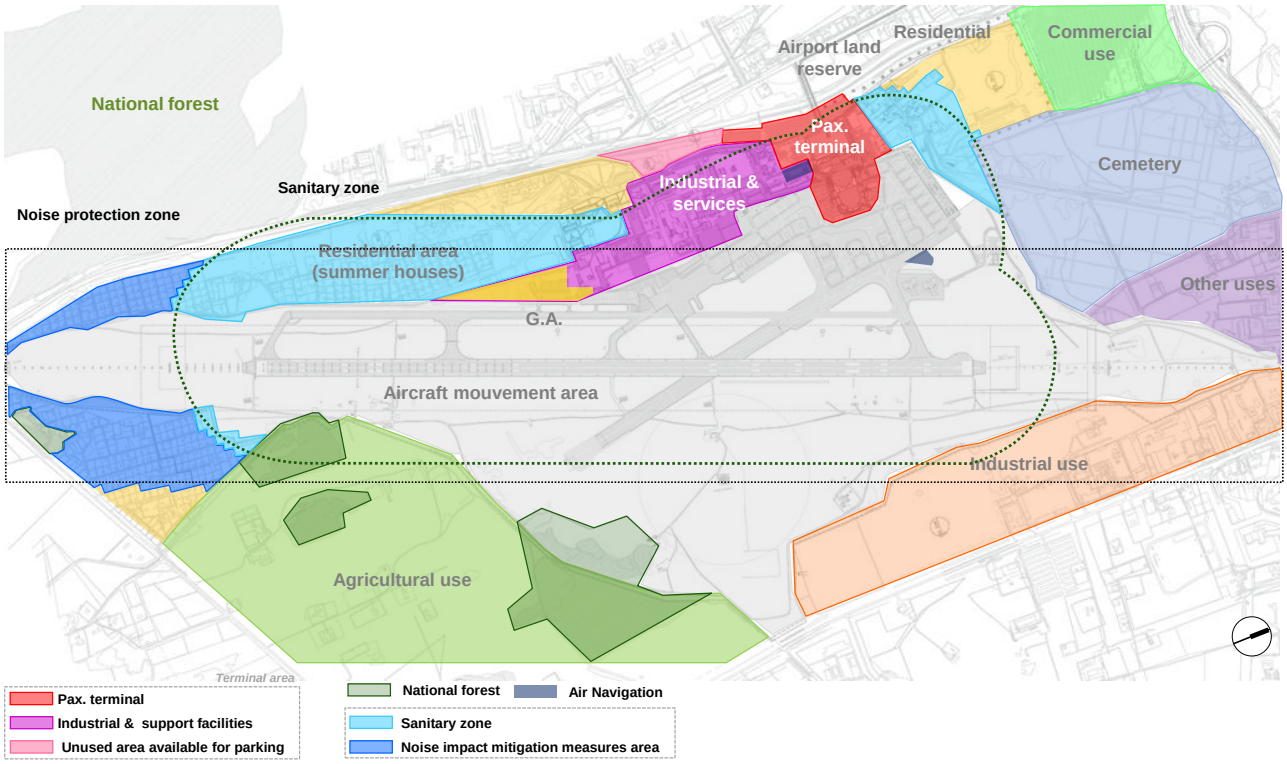


Figure 7.1: Current airport land use with Sanitary Protection Zone and Noise Protection Zone
Source: ALG elaboration

All land plots in the Sanitary Protection Zone (SPZ) Area and the Noise Protection Zone (NPZ) Zone must receive mitigation measures to ensure the health levels set by Lithuanian regulation are reached, based on the declared uses of the land. As well, within the SPZ, neither the construction of new housing units nor the re-zoning of land for residential purposes is permitted.

As can be seen in the figure above, at present a large part of the area affected by the SPZ is not considered as a permanent residential area but rather as "Garden Houses".

Nevertheless, there are housing units affected north of the terminal (see figure 6.10 on page 13) which are considered to be in permanent residential areas (27 homes).

Within the current NPZ, there are no permanent residences (all those that are located within this area fall into the category of "Garden Houses").

Within the analysis of the conditioning factors affecting the General Territorial Plan (GTP) for the municipality of Vilnius, it is noted that the Plan rejects the future growth of these residential areas adjacent to the Airport and recommends against their conversion into areas of permanent residence, or the construction of any type of internal infrastructure, in the "Garden House" areas that currently fall within the current or future SZ and NPZ.

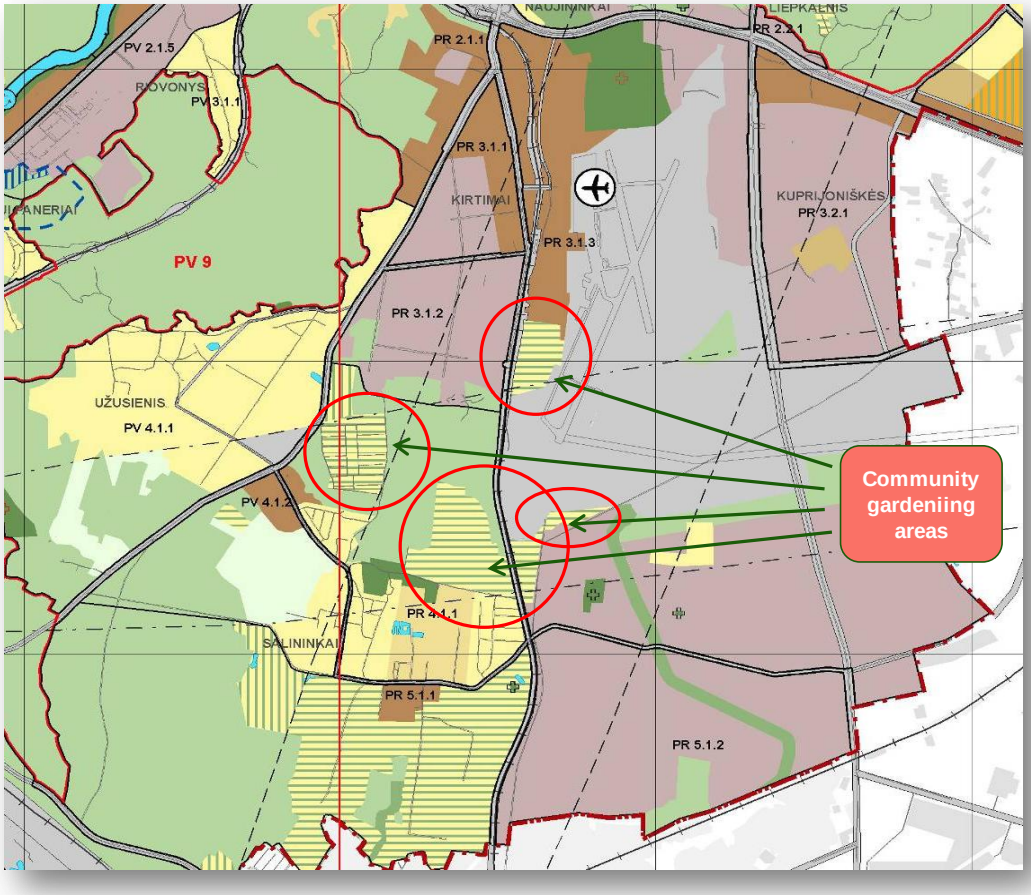


Figure 7.2: GTP Zoning: Residential areas around the Airport precinct
Source: General Territorial Plan of Vilnius Municipality (2015)

On the other hand, in the Airport surroundings there are three declared industrial areas, two to the north and northeast of the runway, in process of being established, and another west of the terminal area, already well established – as well as two additional areas planned (labelled as “Other areas of industrial development” in Figure 7.3) that will provide new sites for development and which could represent an opportunity for attracting activities related to aviation.

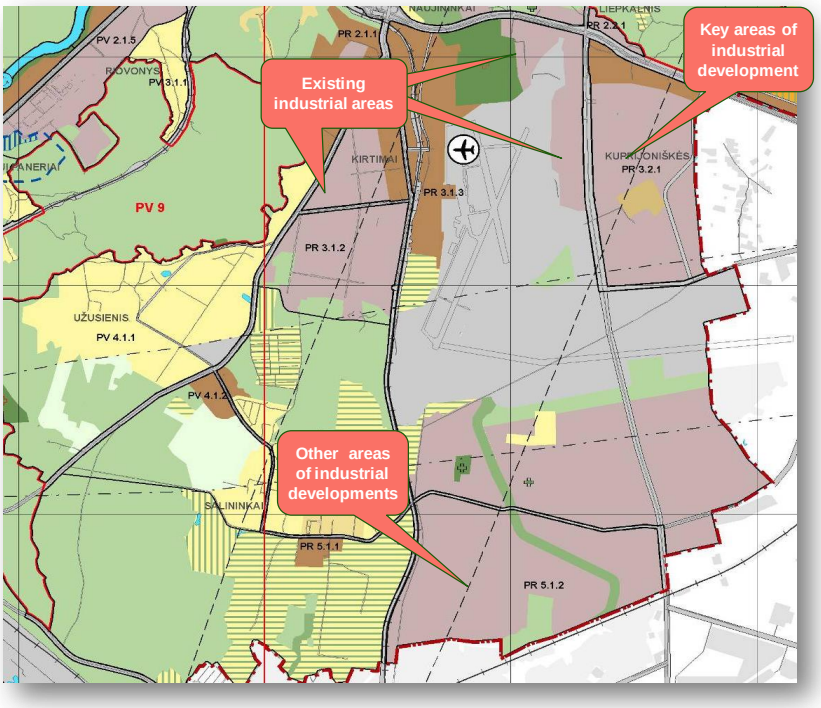


Figure 7.3: GTP Zoning: Industrial areas around the Airport precinct
Source: General Territorial Plan of Vilnius Municipality (2015)

Lastly, the land reserved in the GTP for forest areas and for the cemetery area beside the current Airport area represent new limitations, endorsed by the territorial plan, on future expansion of the land affected by the airport in these areas.

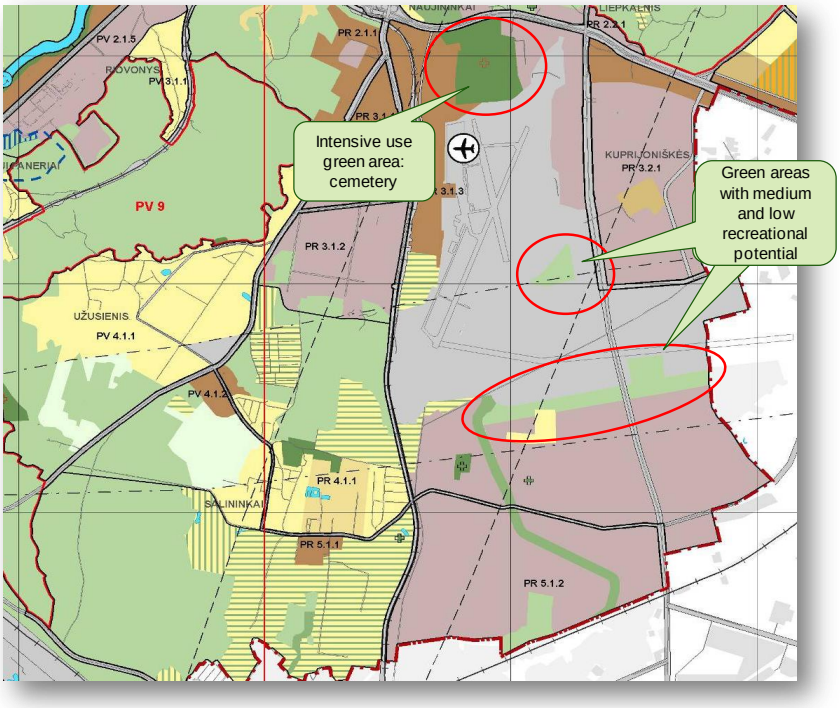


Figure 7.4: GTP Zoning: Green areas
Source: General Territorial Plan of Vilnius Municipality (2015)

For the current situation, as well as for the short, medium and long term scenarios and beyond, described in the following sections, the hypothesis used has been that conditioning factors stated in the current territorial plan (which is only valid until 2015) will in principle be maintained with respect to the regulation of the areas of permanent and non permanent residence, and regarding the protection and the land areas reserved for forest and cemetery areas.

Nevertheless, the territorial plan will need to be adapted and to incorporate the uses foreseen in the vicinity of the airport, the limitations imposed by the Aerodrome Protection Zone defined in Lithuanian legislation on special land use and forest uses (No. 343).

The objective of this protection area is to determine an area around the airport, in which a ban is placed on the construction or installation of infrastructures exceeding specified heights depending on their distance from the runway.

In this respect, limits are placed on the construction, reconstruction and installation of:

- Air communications, electrical high tension lines, object that transmit radio waves and objects which present a danger of explosion
- Other objects which reduce visibility of the landing runway
- Activities or objects that can attract large numbers of birds, such as landfills, livestock, farms, etc.[1]

All of this applies to the areas within the following distances:

- Up to 300 m from the runway axis of the aerodrome and the approach areas, regardless of height
- Up to 600 m, 20 m height
- Up to 5.1 km, 45 m height
- Up to 15 km, 100 m height

These norms support the limiting surface areas which must be defined in line with the international safety regulations laid down by the ICAO.

These areas are defined around the airport infrastructure and above the limits listed it is prohibited to introduce any obstacle which could put aircraft in danger during their manoeuvres of take-off, landing and over flight.

The following figure shows the plan of obstacle limitation surfaces defined for the airport of Vilnius. The heights listed are in relation to sea level. The reference height of the airport is laid down as 197 m above sea level.

[1] As stated in article 16.3 of Resolution No. 343 on “Special and forest land use conditions” approved by the Government of the Republic of Lithuania in 12th May 1992.

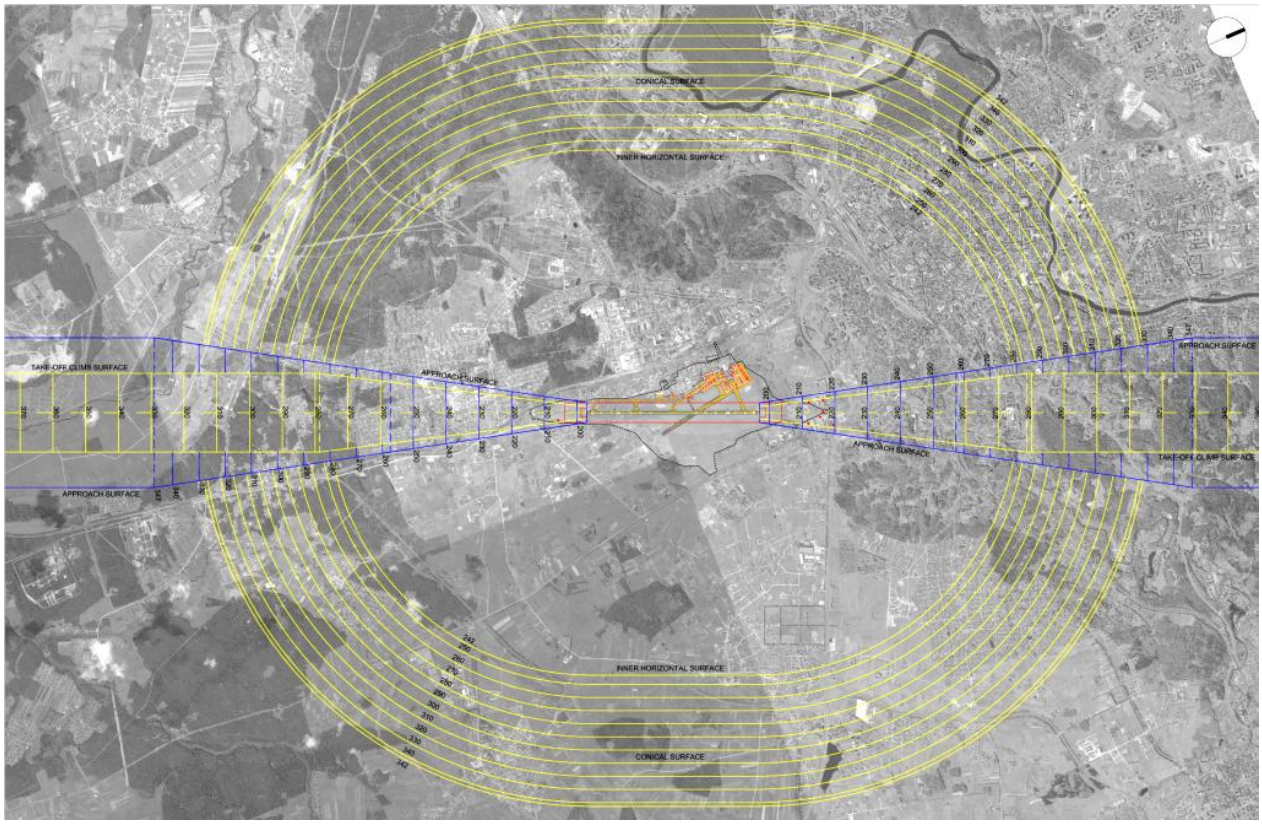


Figure 7.5: Vilnius airport Obstacle Limitation Surfaces
Source: ALG elaboration

7.2 Airport land use 2015-2020

Before 2020 the increase in traffic will cause an increase in the land areas affected by the airport noise. With the foreseen increase in the noise footprint, there will also be an increase in the total surface and the number of housing units affected by the Sanitary Protection Zone (3 ha and between 3 to 5 additional housing units included) as well as in the "garden houses" sites at the west of header 02.

With respect to the Noise Projection Zone, this will in the short term reach some homes located on the other side of the railway, to the southeast of the airport, also considered as Garden Houses.

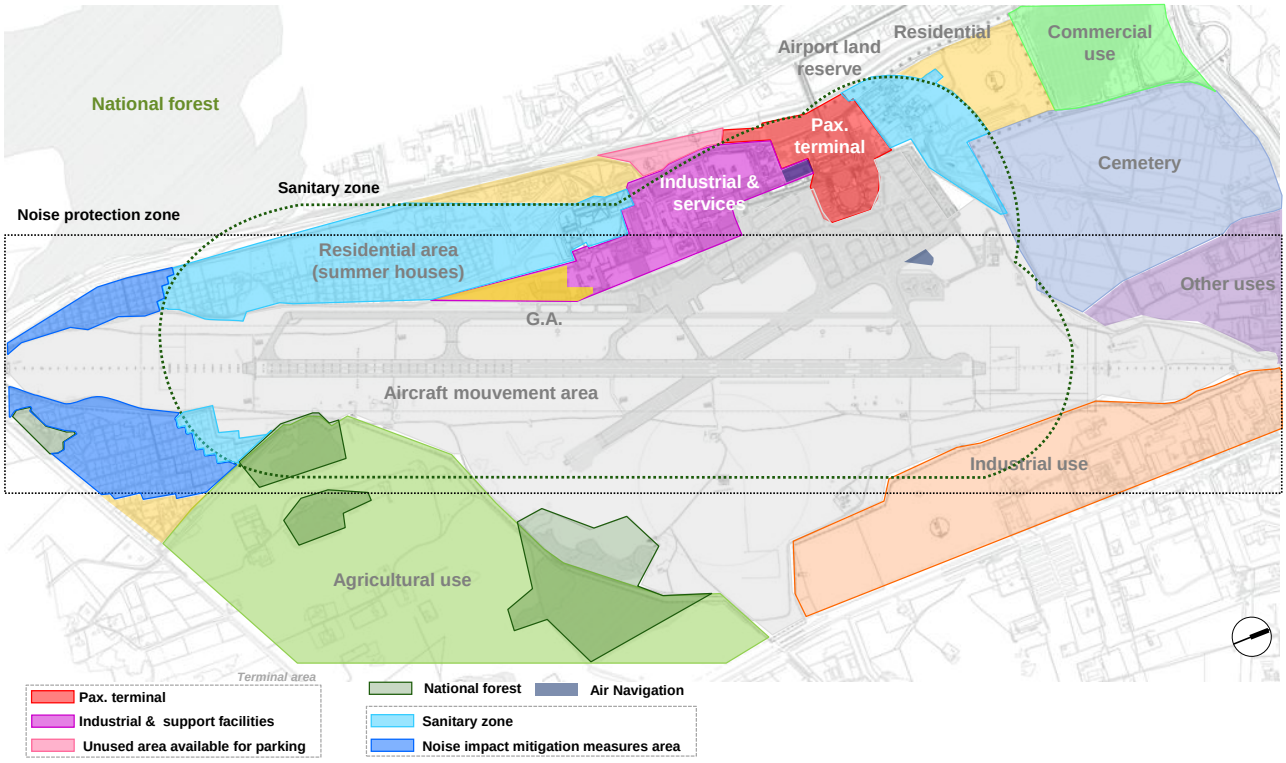


Figure 7.6: Short term airport land use with Sanitary Protection Zone and Noise Protection Zone
Source: ALG elaboration

In this period it is planned, around the year 2018, to begin the expansion of the terminal building with a new pier to the north of the current terminal.

With respect to accesses, the construction of a highway running from the location of the current cemetery and the new commercial development area to the terminal area is planned.

7.3 Airport land use 2020-2025

In the medium term, the extension of the airfield and the development of facilities associated with aviation support activities are planned.

There will be a progressive increase in the number of land plots affected by the SPZ (until it reaches 37-40 housing units)

With respect to the NPZ, the traffic forecasts mean that an increase in the acoustic impact on a large number of housing units south of the railway (to the south of the airport) can be expected. The majority of these are classed as garden houses with the exception of 72 residential homes.

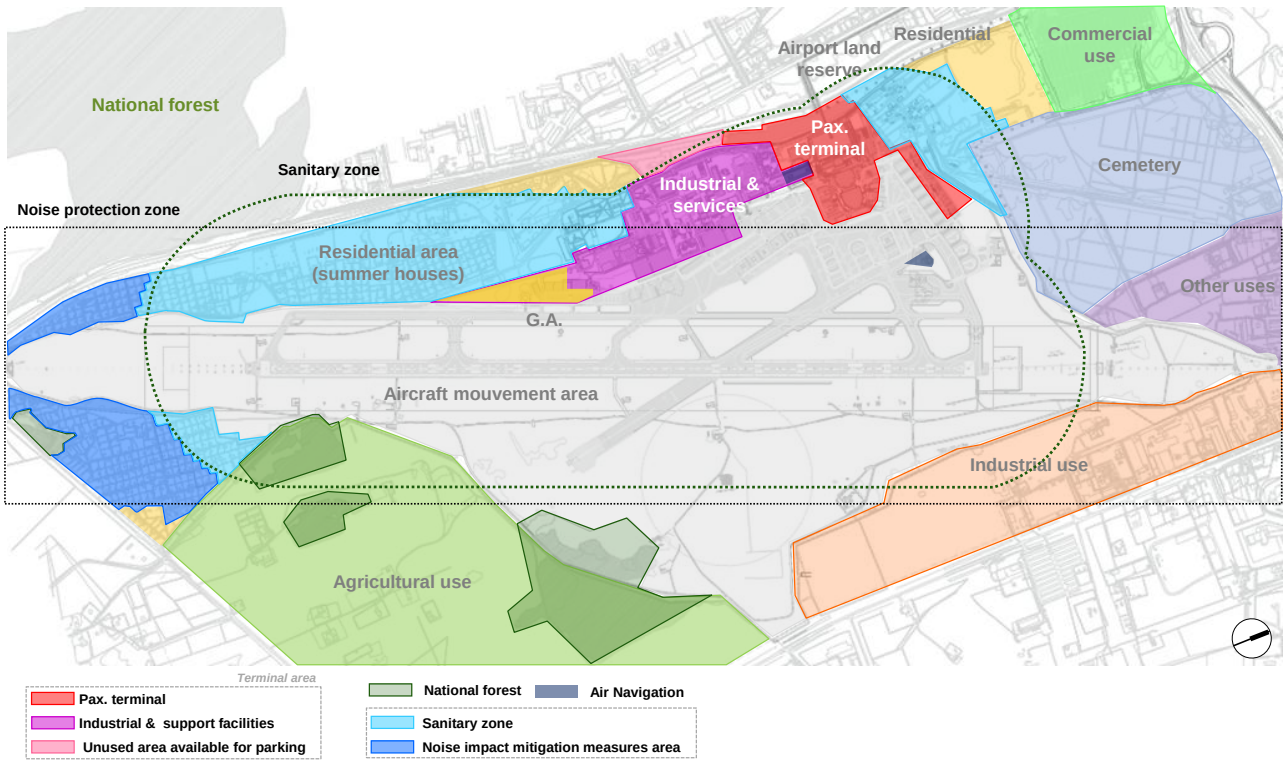


Figure 7.7: Medium term airport land use with Sanitary Protection Zone and Noise Protection Zone
Source: ALG elaboration

Along the length of this period, the entry into operation of the extension of the terminal building is planned, with a new pier north of the current terminal.

This extension will be within the current limits of the airport perimeter, and so it will not cause new land use effects beyond those already foreseen in the General Territorial Plan.

7.4 Airport land use 2025-30

In the long term, a 200m extension of the runway is proposed to reduce the operational limitations on long-haul aircraft. This runway extension will bring with it an expansion of the NPZ since the aircraft that land on runway 02 will do so 200m closer to the current "Garden Houses", and as a result the noise footprint will extend further to the south of the airport, affecting 95-100 residences and almost 900 garden houses. Operational limitations for long-haul aircraft due to the length of the current runway are described in detail in Section 4.2. *Runway length* within Chapter 4. *Future Needs*.

In this period the expansion is also proposed of the passenger terminal building with a new pier to the south of the current terminal.

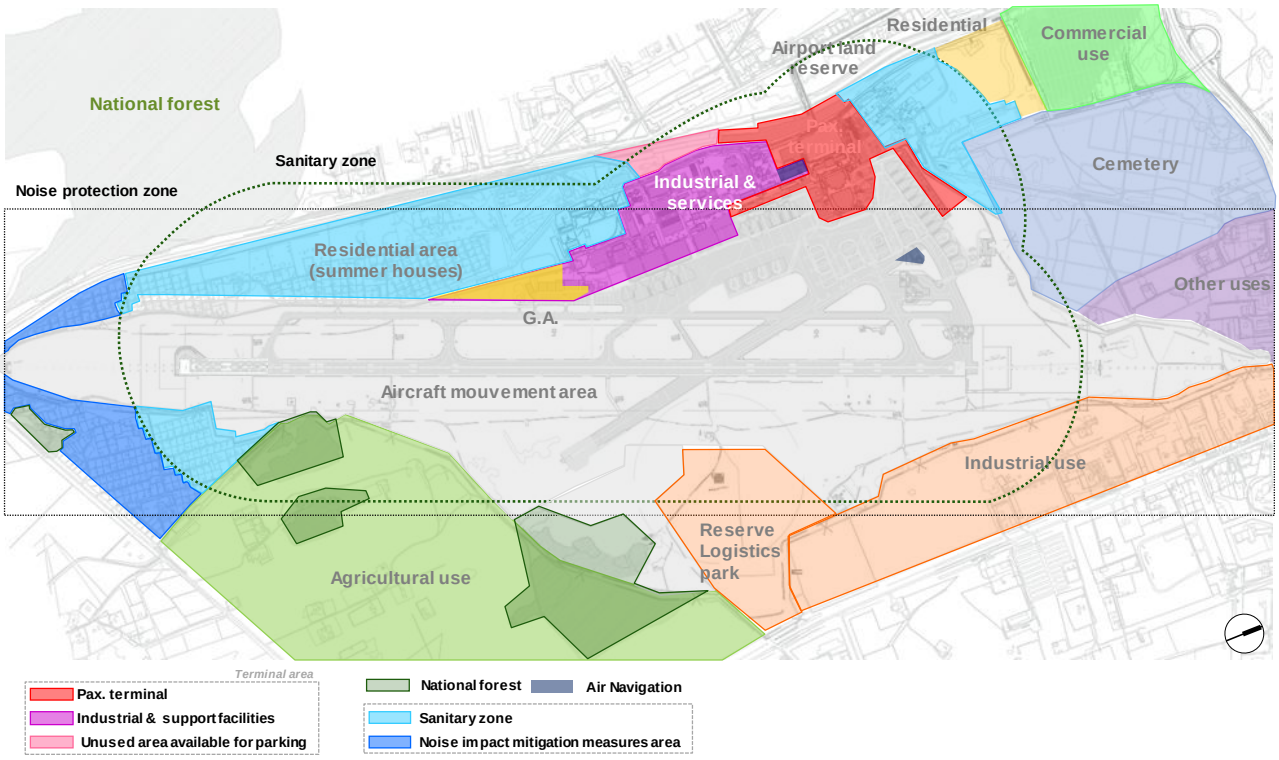


Figure 7.8: Long term land use with Sanitary Protection Zone and Noise Protection Zone
Source: ALG elaboration

As with the first extension of the terminal building, this second extension, as well as the 200m extension of the runway will take place within of current airport boundaries and as such will conform with the currently valid general territorial plan.

With respect to the growth of the logistics areas, the development of the existing industrial area to the east of the runway is planned, sharing accesses with the future logistical park of the airport, as well as with the future economic activities area planned in the GTP (see figure 6.2) further to the east of these logistical-industrial areas.

7.5 Airport land use far beyond 2030

In the very long term, the extension of TWY F is planned together with its border strip up to the new header for runway 02, moved 200m from the current header. This action will only be possible through expropriation of the first row of land plots located to the west of header 02. This expropriation will enable the perimeter fence to be moved, thus guaranteeing the obstacle free distance required by the ICAO regulations.

Beyond 2030, it is also proposed to use a space for a new terminal area on the other side of the runway (to the east) with new accesses, within the future logistical park of the Airport.

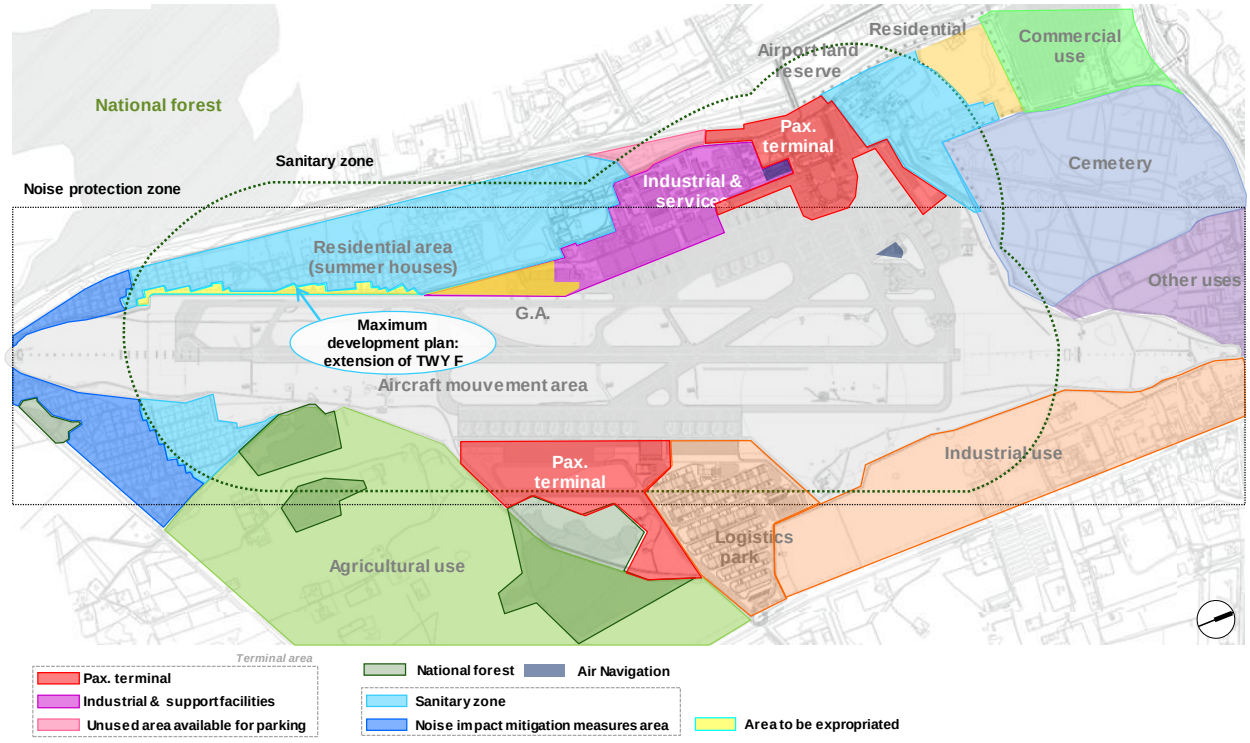


Figure 7.9: Very long term land use with Sanitary Protection Zone and Noise Protection Zone
Source: ALG elaboration

The following table summarises the distribution of areas in the long term associated with each element of the Vilnius Airport system.

Pax terminal area	Industrial & services	Aircraft area	Logistics park
32.1 ha	19.3 ha	209.5 ha	22.2 ha

Table 7.1: Surface distribution according to Vilnius Interim Master Plan
Source: ALG elaboration

7.6 Summary of effects on residential dwellings

The following table shows the evolution of the plots affected by the progressive increase in air traffic in Vilnius, and the resulting increase in noise.

Affected dwellings	Current situation	Short term	Medium term	Long term
Noise Protection Zone	Total: 370 Non-*summer houses*: 0	Total: 515 Non-*summer houses*: 0	Total: 765 Non-summer houses: 72	Total: 940 Non-*summer houses*: 95
Sanitary Zone	Total: 200 Non-*summer houses*: 27	Total: 278 Non- *summer houses*: 30	Total: 292 Non- *Garden Houses*: 32	Total: 340 Non- *summer houses*: 37

Table 7.2: Summary of dwelling and garden houses within Sanitary Zone and Noise Protection Zone
Source: ALG elaboration

The residences affected by the NPZ in the medium term belong to the land plots to the south of the airport, beyond the railway.

The residential plots affected by the SPZ are detailed in the following figure:

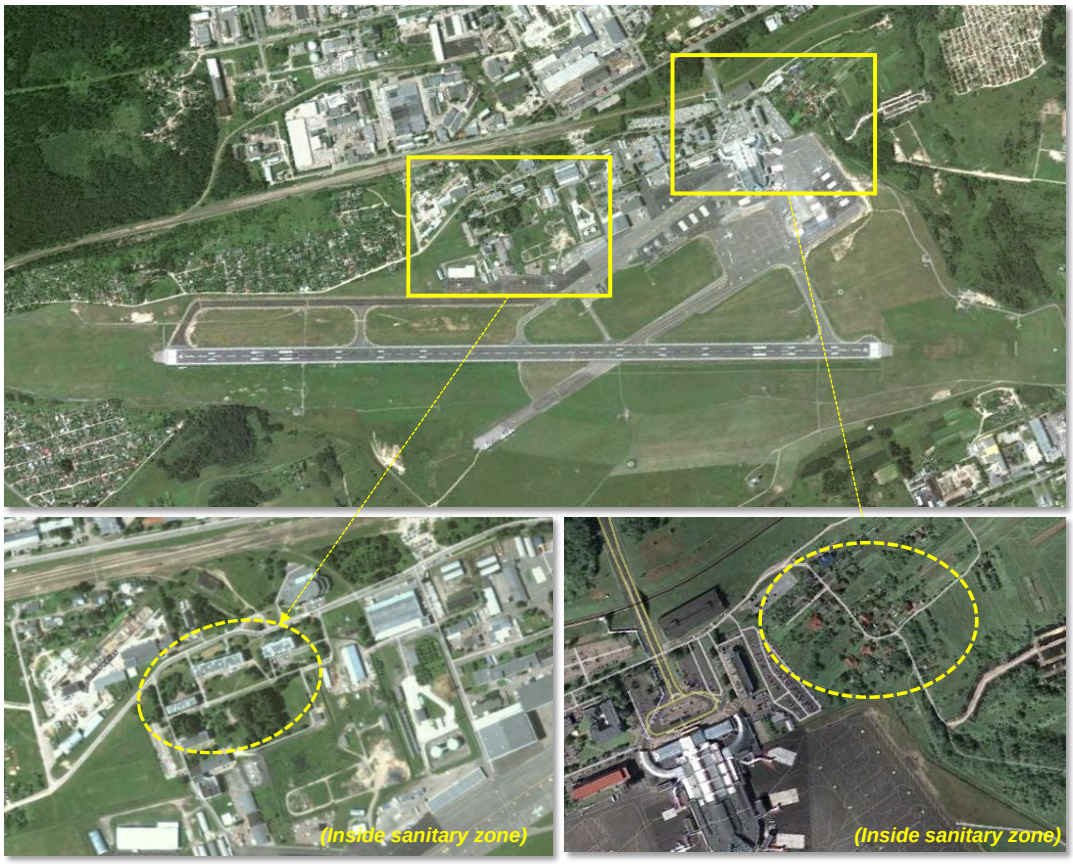


Figure 7.10: Residential dwelling inside Sanitary Protection Zone
Source: ALG analysis

7.7 Terminal Area land use plan

Below, details are shown of the organisation of the land areas within the airport proposed to meet the criteria for access to the apron. Thus, the definition of three lines of building is proposed as part of the terminal area.

The first line of the terminal area is reserved for:

- The passenger terminal, taking into account the construction of new boarding piers both to the north and south
- The industrial areas which will accommodate MRO activities and support the aircraft, that is, which need to have apron access
- The new air freight terminal
- The general aviation installations
- The Fire Fighting and Rescue facilities (building, vehicles, deposits and support facilities)
- The runway and taxiway de-icing facilities (de-icing liquid storage and vehicle parking area)

These areas and activities are described in detail in Chapter 5. *Development Options*.

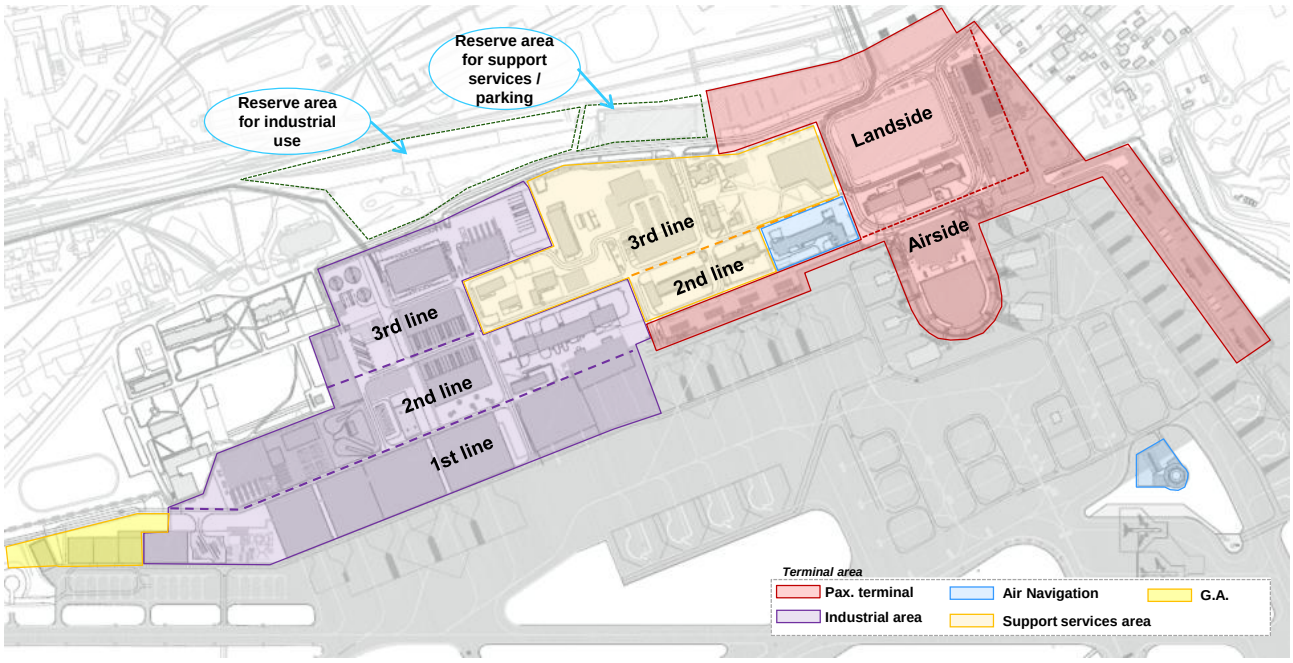


Figure 7.11: Terminal Area Layout regarding apron proximity
Source: ALG elaboration

The second line must accommodate industrial and aviation support activities that may require occasional access to the airfield. Examples of these activities are the logistics facilities for reception and distribution of cargo, catering services and other support activities for MRO and cargo. The above activities are described in detail in Chapter 5. *Development Options*.

The third line is used for the location of administration offices for airlines, and logistics and airport operators. Restaurants, banks, car parks and other auxiliary services are also located in this area.

Additionally, the reservation of the land plots between the railway and the terminal area is proposed. These plots could be of interest for the development of industrial activity or for a future car park extension.

The following table shows the future distribution of areas dedicated to each activity within the Vilnius terminal area:

Industrial area	Support services area	Passenger terminal area
13.5 ha	**5.8 ha**	**12.18 ha**

Table 7.3: Terminal area surface distribution
Source: ALG elaboration

Robert Appleton

rappleton@alg-global.com

www.alg-global.com

BARCELONA
Tánger 98, 3ª planta
08018 Barcelona (España)
Tel: (+34) 93 430 4016
Fax: (+34) 93 363 0623
alg@alg-global.com