Kaunas International Airport

Master Plan

Executive Summary

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1. Introduction

A comprehensive master plan of the airport should endeavour to adopt a balanced approach that considers economic, environmental and cultural aspects whereby present needs are met without compromising the ability of future generations to fulfil their own needs.

State Enterprise Lithuanian Airports (LA) is the owner and operator of the airports of Vilnius International Airport (VNO), Kaunas International Airport (KUN) and Palanga International Airport (PLQ) in Lithuania.

To be able to sustain the anticipated further growth of aviation traffic and to bring the world closer to Lithuania in the coming 30 years (until 2052), LA has initiated a project to develop master plans for the Lithuanian airports VNO, KUN and PLQ. These master plans provide guidelines for the necessary developments required to strengthen the positions of the respective airports and turn a new page in the history of Lithuanian Airports.

In November 2022, LA has engaged HaskoningDHV Nederland B.V. operating as NACO Netherlands Airport Consultants (NACO), as their airport master planner.

This Executive Summary presents the key takeaways of the final master plan report for the below topics:

- **Traffic Forecast**: Mapping the trajectory of aviation activity;
- **Passenger Terminal Building**: Enhancing the journey for travellers while accommodating growth;
- **Master Plan**: Guiding airport facilities' growth efficiently;
- **Phasing Strategy**: Sequencing development for optimal outcomes;
- **Environmental Aspects**: Embracing sustainability in expansion;
- **Financial Analysis**: Balancing investments for long-term viability.

For details on the topics in the Executive Summary, reference is made to the final master plan report.

2. Traffic Forecast

Traffic forecast approach

The general forecasting approach is illustrated in the chart on the right. The forecasts for KUN were generated using a combination of:

- **bottom-up** route-by-route forecasts for the initial years of study and over the COVID recovery period, and;
- **top-down long-term forecasts** based on a macro-economic modelling approach. As such, our forecast methodology blends a top-down macro-econometric modelling approach with a bottom-up analysis of short-term route opportunities.

To address the uncertainty related to the future air traffic development at the airport, three separate scenarios, Low, Base and High were developed.

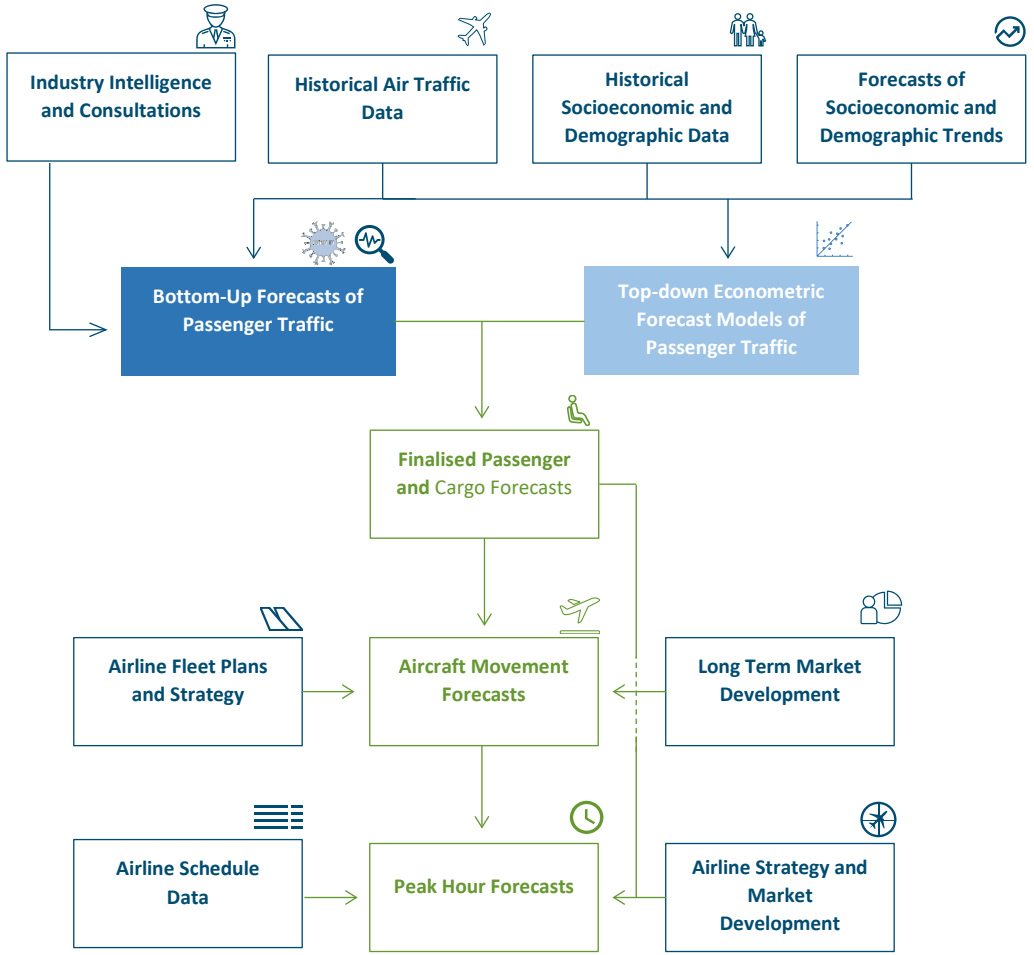

FIGURE 1 NACO FORECAST PHILOSOPHY

Commercial passenger and ATM forecast

Commercial passenger traffic at KUN is expected to increase from 1.2 million annual passengers in 2022 to the following passenger volumes in 2052:

- Low: 1.8 million, equivalent to a CAGR of 1.5%;
- Base: 2.4 million, equivalent to a CAGR of 2.4%;
- High: 3.0 million, equivalent to a CAGR of 3.3%.

Commercial passenger ATM at KUN is expected to increase from 7.3 thousand in 2022 to the following passenger volumes in 2052:

- Low: 10.3 thousand, equivalent to a CAGR of 1.2%;
- Base: 12.7 thousand, equivalent to a CAGR of 1.9%;
- High: 15.4 thousand, equivalent to a CAGR of 2.5%.

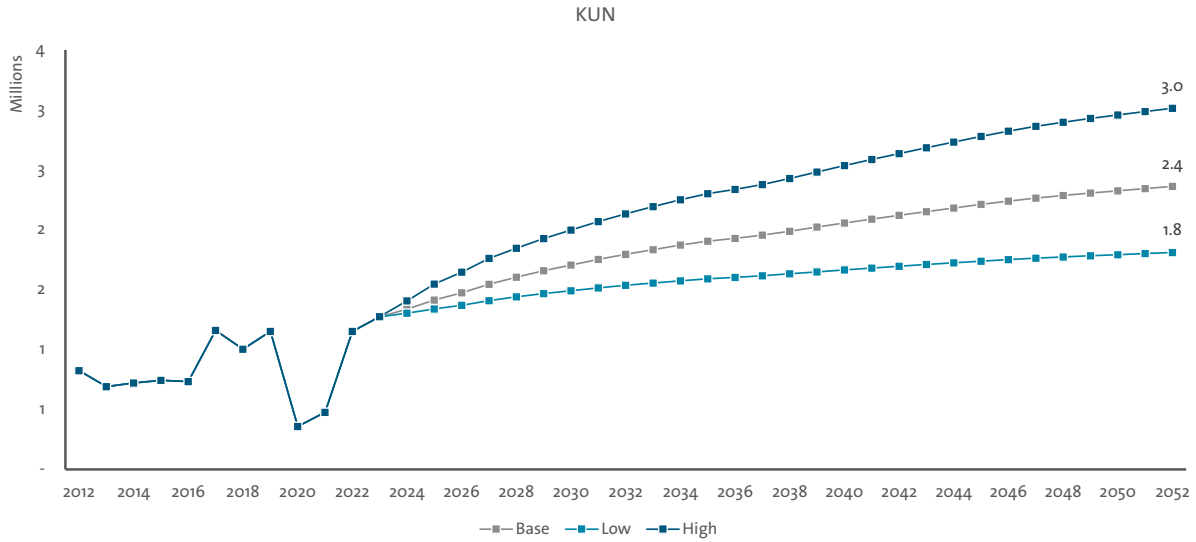

FIGURE 3 KUN PASSENGER FORECAST

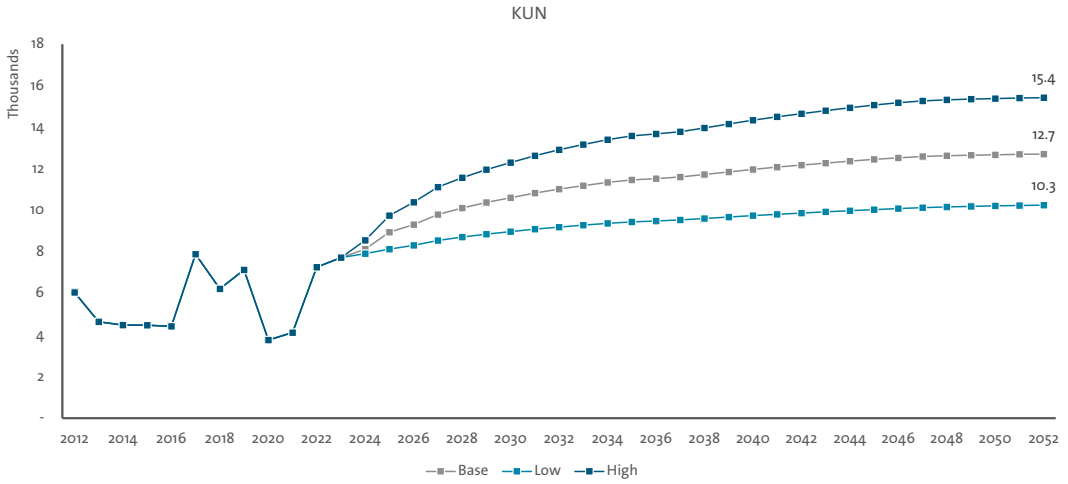

FIGURE 2 KUN COMMERCIAL ATM FORECAST

Peak hour forecast

Based on the peak hour benchmark, depending on the scenario, KUN will serve the following 30th peak hour volumes for passenger flows as well as the absolute peak for ATMs.

Low Scenario

- 1,440 total two-way passengers and 10 ATMs;

Base Scenario

- 1,570 total two-way passengers and 11 ATMs;

High Scenario

- 1,840 total two-way passengers and 13 ATMs.

TABLE 1 KUN 30TH PASSENGER PEAK HOUR FORECAST (ROUNDED TO CLOSEST 10 PASSENGERS)

	KUN	2019	2022	2032	2042	2052	2022 - 2052	2022 - 2032	2032 - 2042	2042 - 2052
Low	2-way	1,029	1,111	1,330	1,400	1,440	0.9%	1.8%	0.5%	0.3%
	Arr	709	677	810	860	880	0.9%	1.8%	0.6%	0.2%
	Dep	674	660	810	870	910	1.1%	2.1%	0.7%	0.5%
Base	2-way	1,029	1,111	1,430	1,530	1,570	1.2%	2.6%	0.7%	0.3%
	Arr	709	677	870	930	960	1.2%	2.5%	0.7%	0.3%
	Dep	674	660	870	950	990	1.4%	2.8%	0.9%	0.4%
High	2-way	1,029	1,111	1,610	1,770	1,840	1.7%	3.8%	1.0%	0.4%
	Arr	709	677	980	1,080	1,130	1.7%	3.8%	1.0%	0.5%
	Dep	674	660	970	1,100	1,170	1.9%	3.9%	1.3%	0.6%

TABLE 2 KUN ABSOLUTE ATM PEAK HOUR FORECAST

	KUN	2019	2022	2032	2042	2052	2022 - 2052	2022 - 2032	2032 - 2042	2042 - 2052
Low	2-way	8	8	9	10	10	0.7%	1.4%	0.4%	0.2%
	Arr	5	5	6	6	6	0.6%	1.4%	0.4%	0.2%
	Dep	5	5	6	6	6	0.7%	1.4%	0.4%	0.2%
Base	2-way	8	8	10	11	11	1.1%	2.5%	0.6%	0.2%
	Arr	5	5	6	7	7	1.1%	2.5%	0.6%	0.2%
	Dep	5	5	6	7	7	1.1%	2.5%	0.6%	0.2%
High	2-way	8	8	11	12	13	1.5%	3.5%	0.7%	0.3%
	Arr	5	5	7	8	8	1.5%	3.5%	0.7%	0.3%
	Dep	5	5	7	8	8	1.5%	3.5%	0.8%	0.3%

Cargo forecast

Air cargo at KUN are forecast to increase from 5 thousand tons in 2022 to:

- Low: 5.7 thousand tons in 2052, equivalent to a CAGR of 0.4%;
- Base: 11.0 thousand tons in 2052, equivalent to a CAGR of 2.6%;
- High: 16.4 thousand tons in 2052, equivalent to a CAGR of 4.0%.

Full-freighter movements will develop from 1.5 thousand in 2022 to:

- Low: 1.6 thousand tons in 2052, equivalent to a CAGR of 0.2%;
- Base: 2.2 thousand tons in 2052, equivalent to a CAGR of 1.9%;
- High: 2.7 thousand tons in 2052, equivalent to a CAGR of 2.5%.

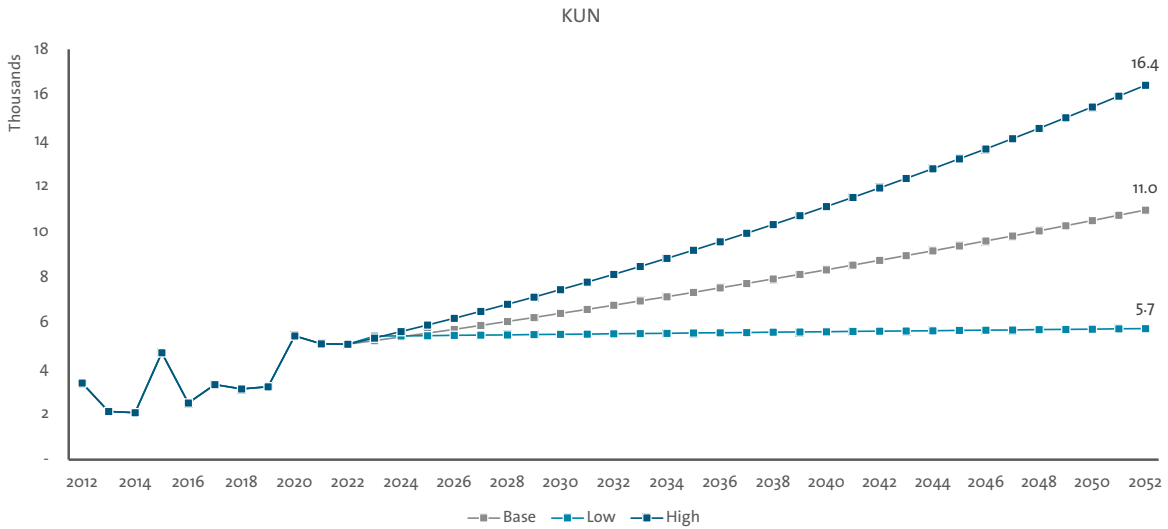

FIGURE 4 KUN COMMERCIAL AIR CARGO FORECAST (IN METRIC TONS)

General Aviation forecast

GA ATMs at KUN are forecast to increase/decrease from 1,5 thousand in 2022 to:

- Low: 1.2 thousand 2052, equivalent to a CAGR of -0.7%;
- Base: 1.6 thousand in 2052, equivalent to a CAGR of 0.3%;
- High: 2.1 thousand in 2052, equivalent to a CAGR of 1.1%.

As illustrated on the top right-hand side chart, it is anticipated that with the expected ease of military tensions in the region, the number of military of operations at the airport will decrease. This will drive the overall military ATM at the airport down between 2026 and 2028.

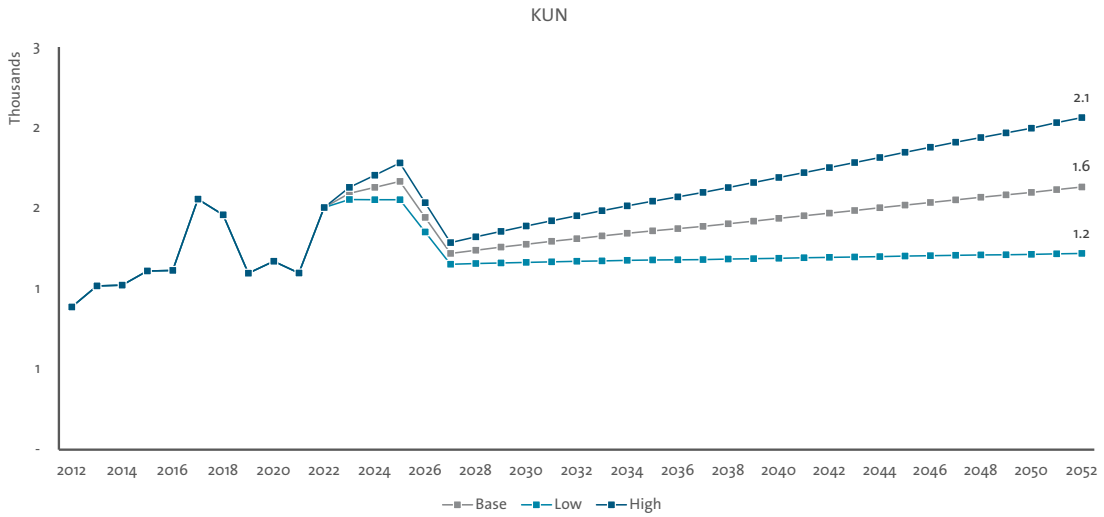

FIGURE 5 KUN GA FORECAST

3. Passenger Terminal Building

FIGURE 6 AERIAL VIEW ON THE FUTURE TERMINAL AREA

This section presents the final design proposition for the terminal building area. It outlines the facility requirements for the years 2037 and 2052 and the consequent developments required to fulfil the demand has been presented.

During the exploration phases, the gap analysis highlighted existing bottlenecks and the need for short term expansion to relieve the congestion. Security and non-Schengen gate waiting areas were noted to be the major congestion points in the existing passenger journey. Further expansion is required for the baggage handling system, border control and commercial. The expansions have been presented in functional layouts for the end phase.

Facility Requirements

The facility sizing takes into consideration the annual and peak hour figures. Based on this, the facility requirements and related waiting areas are calculated for the year 2037 and 2052. The results are presented in Table 3.

The data is used to calculate the number of required equipment and floor area of the passenger processes of the airport terminal which need to be incorporated in the terminal layout to accommodate the anticipated future demand.

TABLE 3 FACILITY REQUIREMENTS

2037			2052		
Check-in	Facilities (#)	Queueing (m²)	**Check-in**	Facilities (#)	Queueing (m²)
Conventional counters	6	180	Conventional counters	8	200
Drop-off counters	4	0	Drop-off counters	5	0
Kiosks	4	0	Kiosks	5	0
Security	Facilities (#)	Queueing (m²)	**Security**	Facilities (#)	Queueing (m²)
Boarding card control	2	30	Boarding card control	2	35
Security lanes	5	230	Security lanes	5	260
Border control outbound	Facilities (#)	Queueing (m²)	**Border control outbound**	Facilities (#)	Queueing (m²)
Manual counters	6	70	Manual counters	6	70
ABC readers	2	0	ABC readers	2	0
Border control inbound	Facilities (#)	Queueing (m²)	**Border control inbound**	Facilities (#)	Queueing (m²)
Manual counters	8	90	Manual counters	8	90
ABC readers	3	0	ABC readers	3	0
European Entry System (EES)	Facilities (#)	Queueing (m²)	**European Entry System (EES)**	Facilities (#)	Queueing (m²)
EES kiosks	5	0	EES kiosks	5	30
Baggage reclaim	Facilities (#)	Queueing (m²)	**Baggage reclaim**	Facilities (#)	Queueing (m²)
Reclaim belt length	85	340	Reclaim belt length	94	380
Min. no. of belts	2		Min. no. of belts	2	
Customs	Facilities (#)	Queueing (m²)	**Customs**	Facilities (#)	Queueing (m²)
Green channel	1	30	Green channel	1	30
Red channel	1		Red channel	1	
Inspection positions	1		Inspection positions	1	
Gate waiting	Facilities (#)	Queueing (m²)	**Gate waiting**	Facilities (#)	Queueing (m²)
Schengen	7	566	Schengen	8	1,409
Non-Schengen	5	460	Non-Schengen	6	1,099
Combined	12	0	Combined	4	2,400
Commercial		Area (m²)	**Commercial**		Area (m²)
Landside		400	Landside		500
Schengen		850	Schengen		1,150
Non-Schengen		650	Non-Schengen		750

Proposed Optimizations for 2037

This section proposes alterations in Lithuanian Airports expansion plans for the terminal building to meet the requirements for 2037 It is recommended that these optimizations are made in the current expansion plans and implemented as soon as possible.

The key areas of concern are the security filter, gate waiting area, outbound passport control, Food &Beverage (F&B) and the baggage make-up area. Figure 7 presents the capacity gap on Level L2 (Departures).

SECURITY & BOARDING CARD CONTROL

Four security lanes are required to meet the demand until 2037. It is recommended that a part of the void (4 grids) is closed to accommodate one extra security lane. The security filter should also be shifted by 1 grid to accommodate the new equipment and additional queuing space.

PASSPORT CONTROL – OUTBOUND

It is recommended that the current area allocated for the outbound passport control is expanded into the non-Schengen lounge to add 2 manual counters and 20m2 of queuing space. For this, 50m2 of the non-Schengen lounge will need to be relocated.

GATE WAITING AREA

Additional 201m2 of Schengen and 103m2 of non-Schengen gate waiting area is required to fulfil the demand up to 2037. To accommodate this demand, it is recommended that the Schengen and non-Schengen F&B is relocated to Level 3 (entresol). A swing gate waiting area of 150m2 has also been introduced to meet the demand.

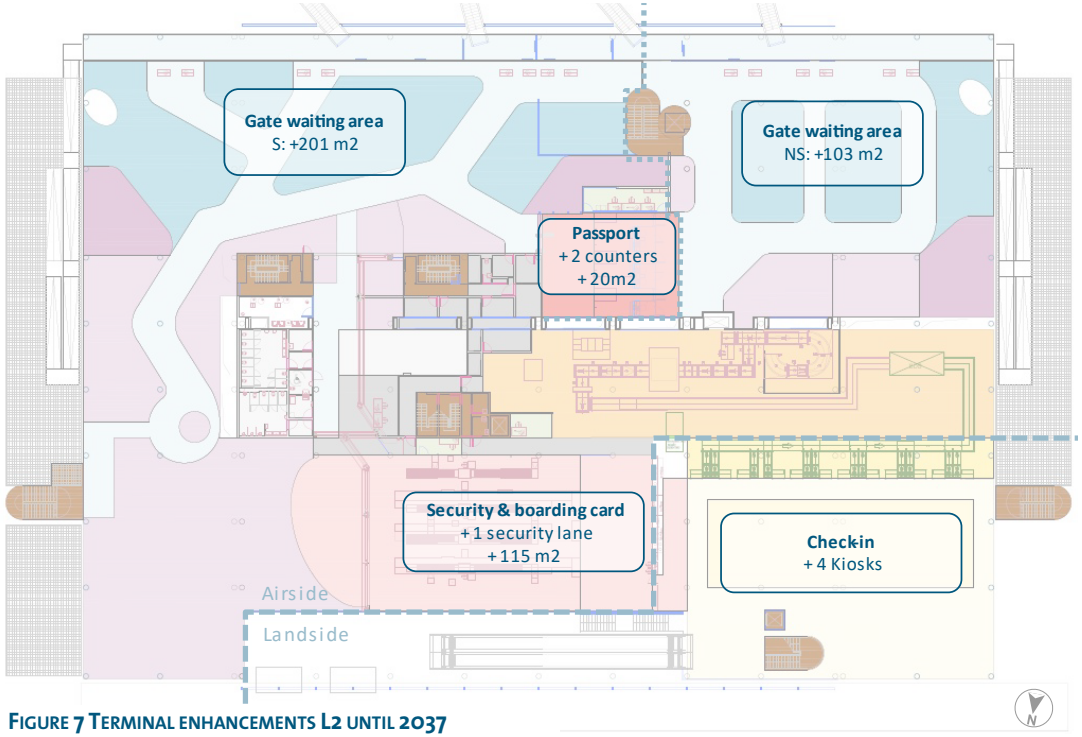

FIGURE 7 TERMINAL ENHANCEMENTS L2 UNTIL 2037

LEVEL 1 -BAGGAGE HANDLING AND ARRIVALS FLOW

An additional baggage carousel is required to meet the projected demand for baggage make up from 2027 to 2037. This can be added to the west of the existing carousel. To ensure the non-Schengen arrival flow remains uninterrupted, it is recommended that the current arrival corridor for is retained. This will enable smooth operations during the construction phase of the non-Schengen Pier.

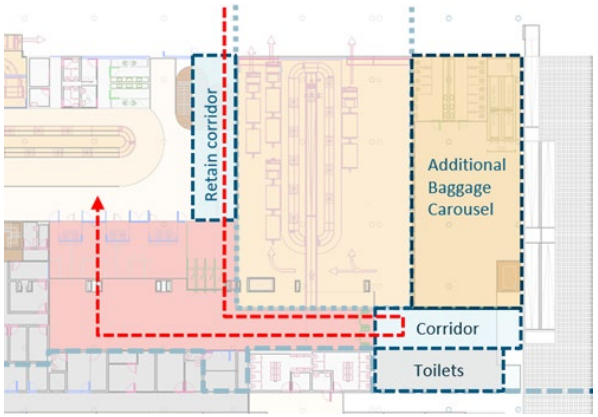

FIGURE 8 PROPOSED ARRIVAL FLOW UNTIL 2037

Functional layouts 2052

In response to Lithuanian Airports ambitions and the demand for additional gate waiting area Schengen and non-Schengen Piers have been introduced for the end phase of the Master plan (2052). The piers enhance the passenger experience significantly and allow for additional commercial space in the Terminal.

Level 1 (ground floor)

Figure 10 presents the functional zoning plan of the ground floor (Level 1) for the year 2052. It integrates the arrival flows from the Schengen and non-Schengen Piers to the baggage reclaim areas.

The ground floor of the non-Schengen pier is designed as the arrival route which connects to the terminal through a corridor leading into the inbound passport control.

The Schengen passengers transfer from Level 2 to the baggage reclaim on Level 1 through a new vertical transport section, introduced on the eastern façade of the building.

FIGURE 9 IMPRESSION OF THE PIERS

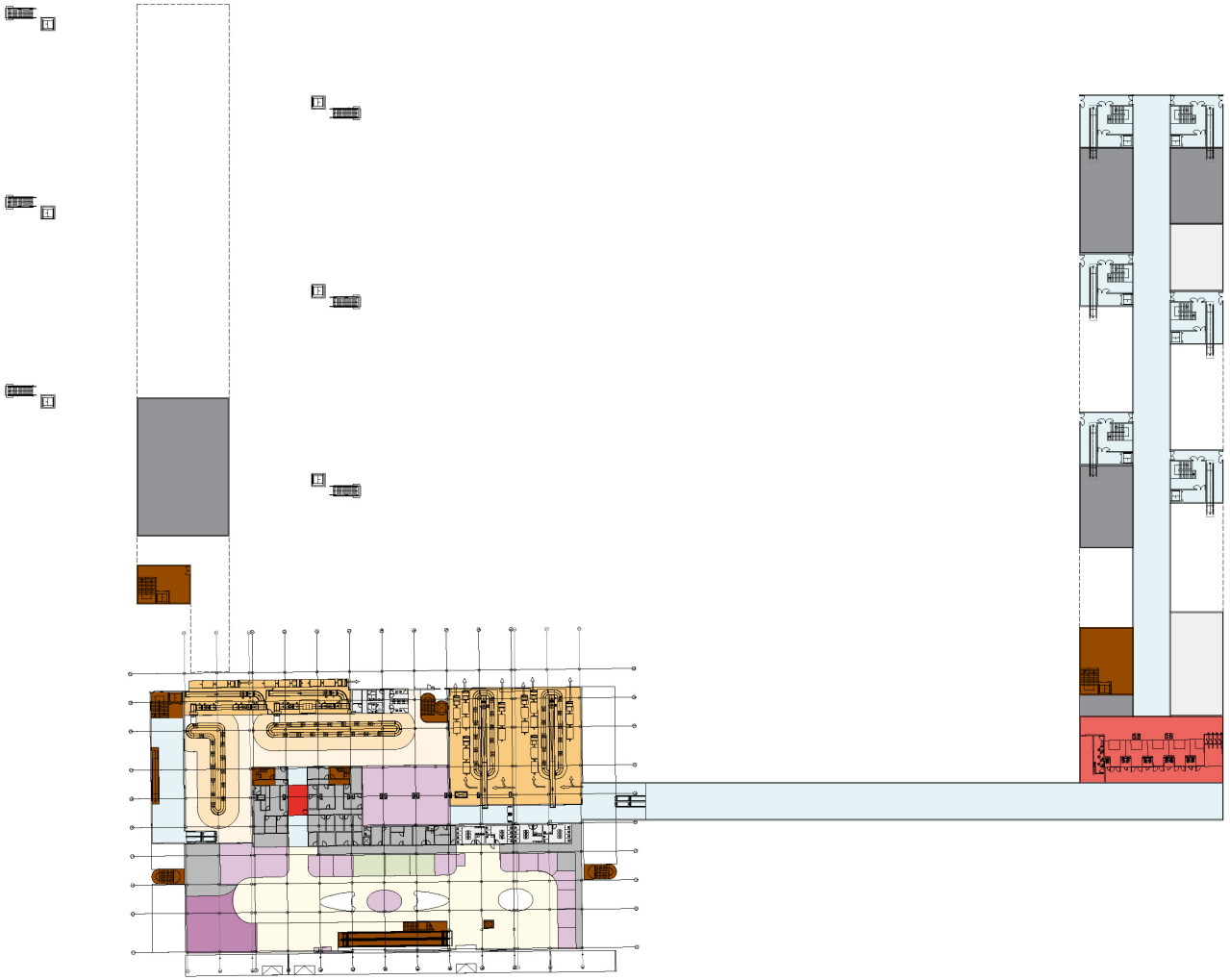

FIGURE 10 PROPOSED FUNCTIONAL LAYOUT LEVEL 1 (GROUND FLOOR)

Level 2 (First floor)

Figure 11 presents the functional layout of Level 2 for the year 2052. It includes the departure processors and flow. The Schengen pier also accommodates arriving passengers, because departing and arriving Schengen passengers are allowed to mingle.

SECURITY AND CHECK IN

To accommodate the demand for 6 security lanes in 2052, it is proposed that this filter is shifted towards the eastern façade. This will allow for the required expansion with minimal demolition and relocation of adjacent spaces.

GATE WAITING AREAS SCHENGEN

The gate waiting areas have been reorganised to meet the end phase demand. For the Schengen the call-to-gate gate waiting concept has been adopted to optimize the layout and the size of the pier. A common gate waiting area of 653 m² has been provided on L2. Smaller areas of approx. 120 m² per gate have been provided in the pier to allow the passengers to dwell and queue before boarding. The passengers walk out into the apron through a bridge and vertical transfer to avoid crossing the front of stand road on the ground level.

GATE WAITING AREAS NON-SCHENGEN

The non-Schengen gate waiting has been organised conventionally by allocating 220 m² of gate waiting area per gate in the pier. The passengers will use the vertical transfer within the pier to access the ground floor and then the aircraft.

COMMERCIAL AREAS

902 m² of commercial area has been provided on the airside of the Terminal area and an additional 488 and 938.2 m² has been provided in the Schengen and non-Schengen pier respectively.

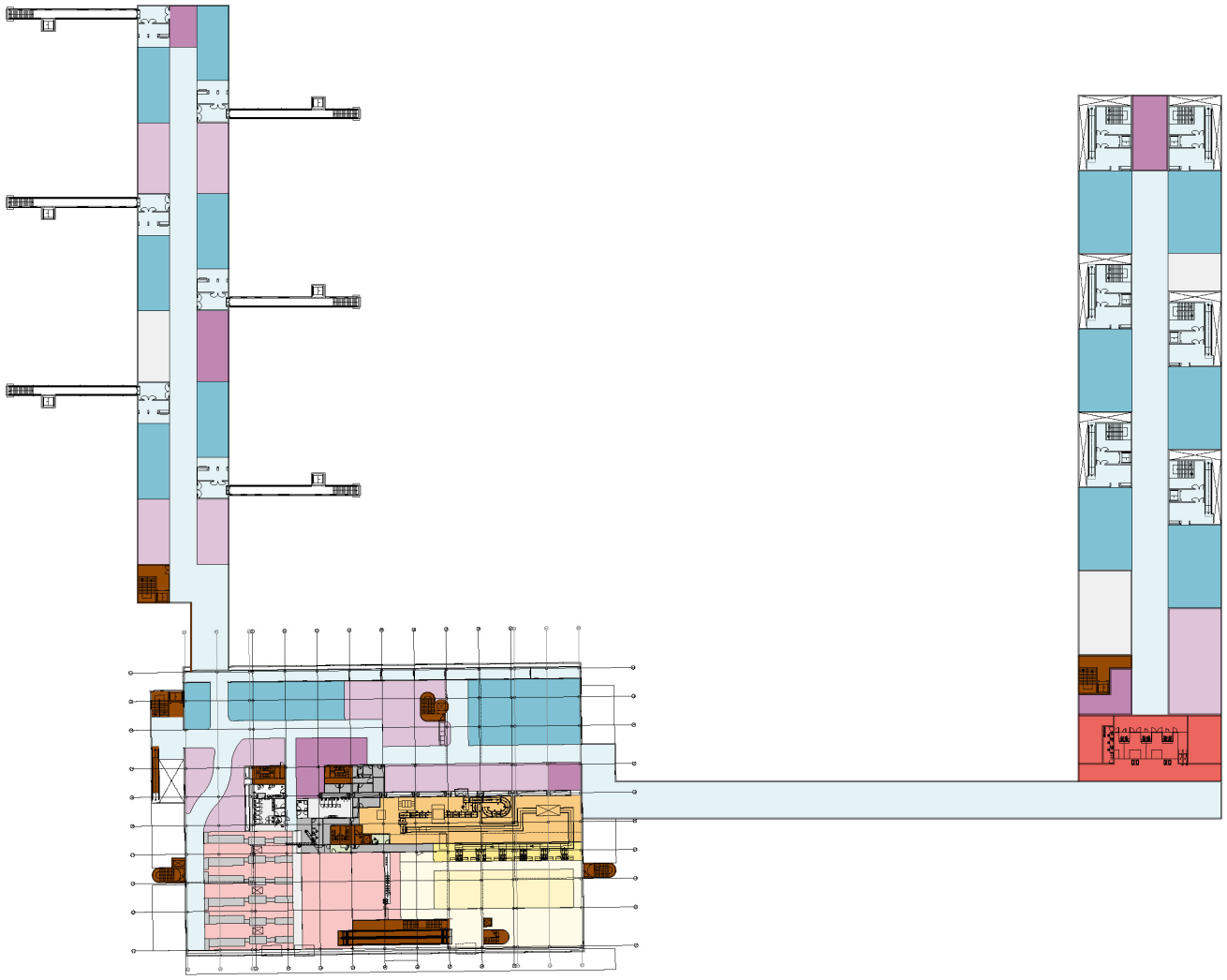

FIGURE 11 PROPOSED FUNCTIONAL LAYOUT LEVEL 2 (FIRST FLOOR)

Level 3 (Entresol)

The entresol or Level 3 consists of back of house areas and F&B.

The 240 m² of F&B in the Schengen area is connected to L2 via the new vertical transfer on the east façade.

Further the 192 m² on the western side can be developed as an airline lounge and/or VIP lounge. The existing vertical transportation core (stairs and lift) connect directly to the apron on the ground floor. If required, VIP could be transferred to the aircraft by car.

FIGURE 12 IMPRESSION OF THE NON-SCHENGEN PIER

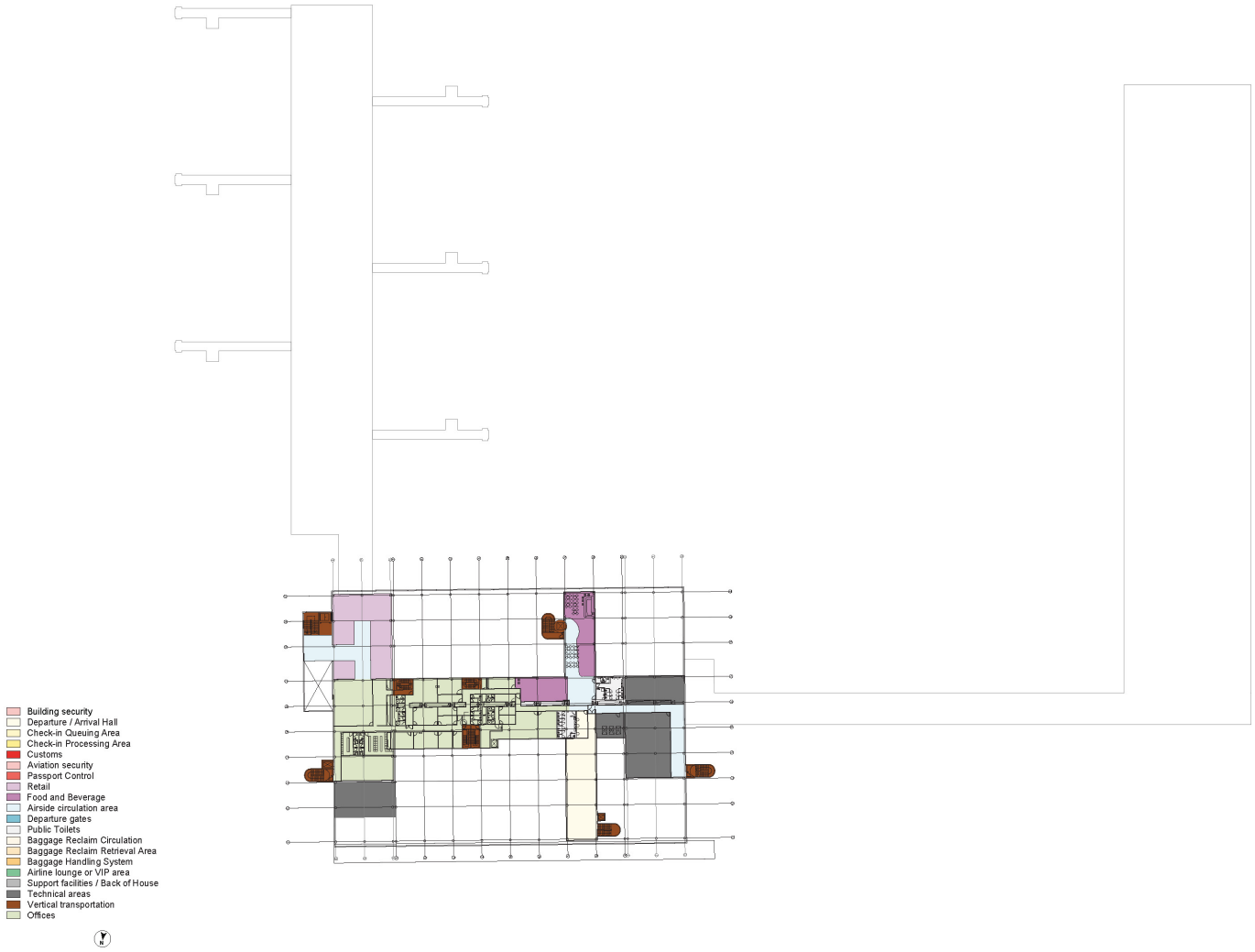

FIGURE 13 PROPOSED FUNCTIONAL LAYOUT LEVEL 3 (SECOND FLOOR)

Optional future expansion

There is a possibility to expand the terminal area towards the non-Schengen pier as shown Figure 14. The area can be used for gate waiting and commercial areas, serving both Schengen and non-Schengen passengers.

However, before undertaking this development it is essential to assess the facility demand for the future years, business case for the commercial area and the potential impact on airside operations.

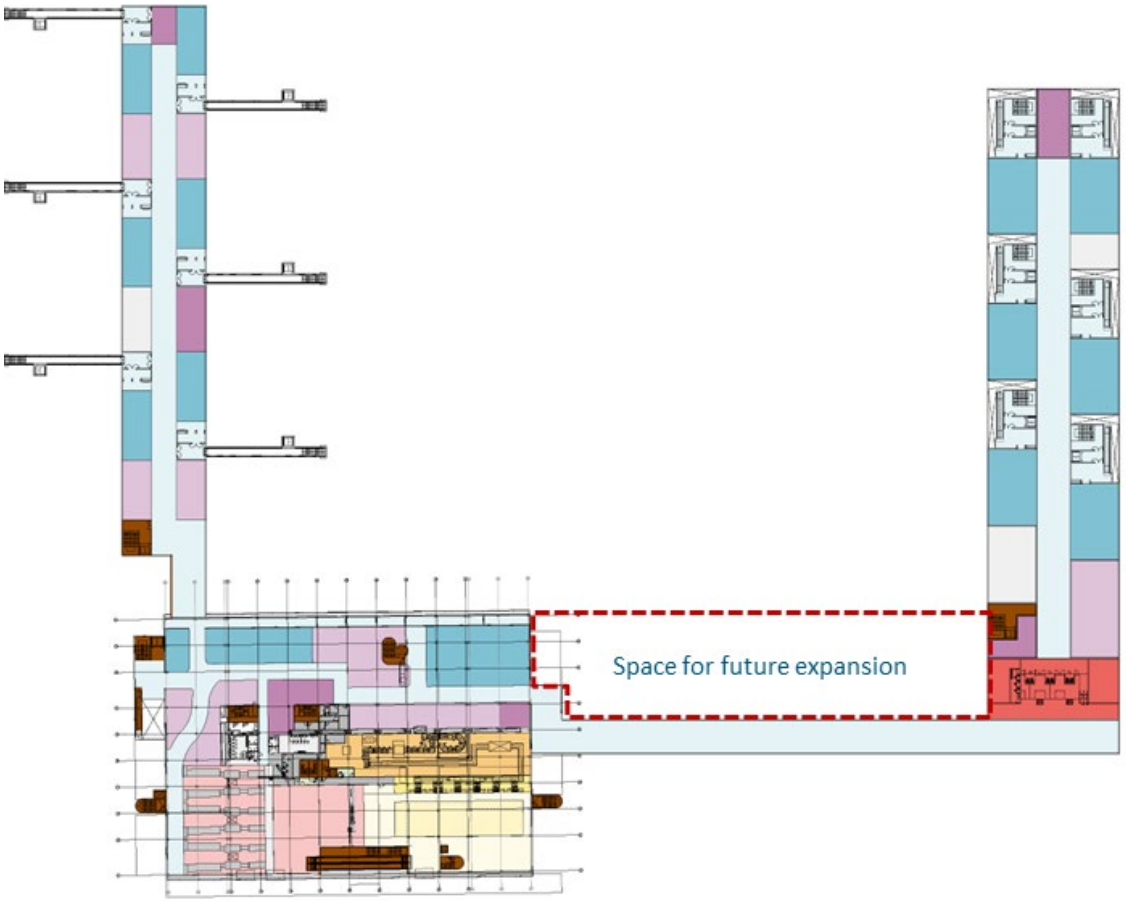

FIGURE 14 RESERVATION FOR FUTURE EXPANSION GATE WAITING AND COMMERCIAL AREA

FIGURE 15 AERIAL IMPRESSION OF THE MASTER PLAN

4. Master Plan

This section outlines the strategic and required developments for the airport. First the critical airside infrastructure (runway, taxiways, aprons) is discussed, followed by the support facilities at the airport. In the end, the landside accessibility of the airport is discussed. The sizing of all infrastructure and facilities is based on the high scenario from the traffic forecast.

Airside

The existing runway at KUN (08-26) has a total length of 3,250 meters. The runway has sufficient length and capacity for the forecasted traffic growth. Hence, no changes are foreseen for the runway, nor for the navigational aids. The Air Traffic Control (ATC) tower is planned to be replaced by a digital (camera) tower for remote control. The taxiway systems will efficiently be expanded and adjusted to provided adequate access to the respective aprons for different sizes of aircraft (see Figure 16).

As a result, the north-eastern corner of the airport is compliant for aircraft up to ICAO code C, whereas most of the other taxiways are compliant for ICAO code E aircraft. The GA/FBO apron can be accessed by aircraft up to ICAO code B.

The following aircraft parking stands are provided:

- Commercial passenger apron: 12 code C;
- Cargo apron*: 4 code C, 1 code D;
- MRO apron*: 2 code B, 57 code C, 11 code E;
- GA apron: 4 code B, 1 code C;
- Military apron: 2 code C, 2 code E;
- De-icing*: 4 code C, 1 code E.

* *not all used simultaneously*

De-icing fluid is collected at the de-icing stands and transported to VNO.

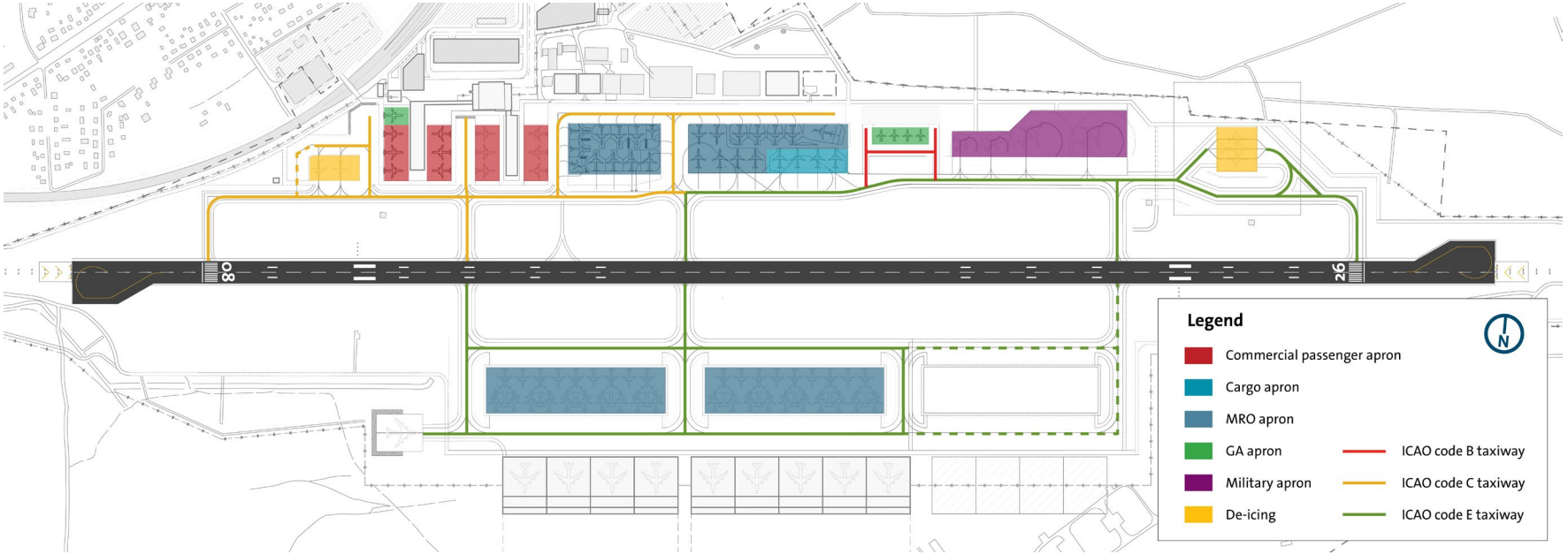

FIGURE 16 TAXIWAYS AND APRONS

Cargo facilities

The existing cargo area (1a in Figure 17) provides both landside-to-airside cargo as well as landside-to-landside cargo. Hence, not the entire terminal capacity is used for air cargo. As a result, the airport faces capacity limitations. Therefore, LA is planning to lease out a new cargo plot of 20 ha (1b in Figure 17). The new area has direct landside access as well as direct airside access.

Given the size of the existing cargo plot and cargo terminal building, in combination with the new planned cargo plot and its size, it is concluded that the existing and planned facilities are sufficient for the master planning horizon (2052).

Aircraft Maintenance (MRO) facilities

In the near future, the Maintenance, Repair and Overhaul (MRO) area north of the runway (2a in Figure 17) reaches a capacity of 15 narrow body bays. The area cannot be further expanded at its existing location. Provided the remaining demand for further growth, a new MRO is planned south of the runway (2b in Figure 17). Within the new MRO area), the aircraft maintenance hangars are planned linear to allow for development and detailed sizing upon demand within the allocated zone. The capacity of the aircraft maintenance hangars depends on the required aircraft sizes and ways of parking of aircraft in the hangars but can in total go up to 9 wide body bays, 18 narrow body bays, or a mix of those. Besides, an engine run-up bay is planned in the area.

In front of the new MRO facilities an MRO apron is planned. Given the flexible nature of the MRO

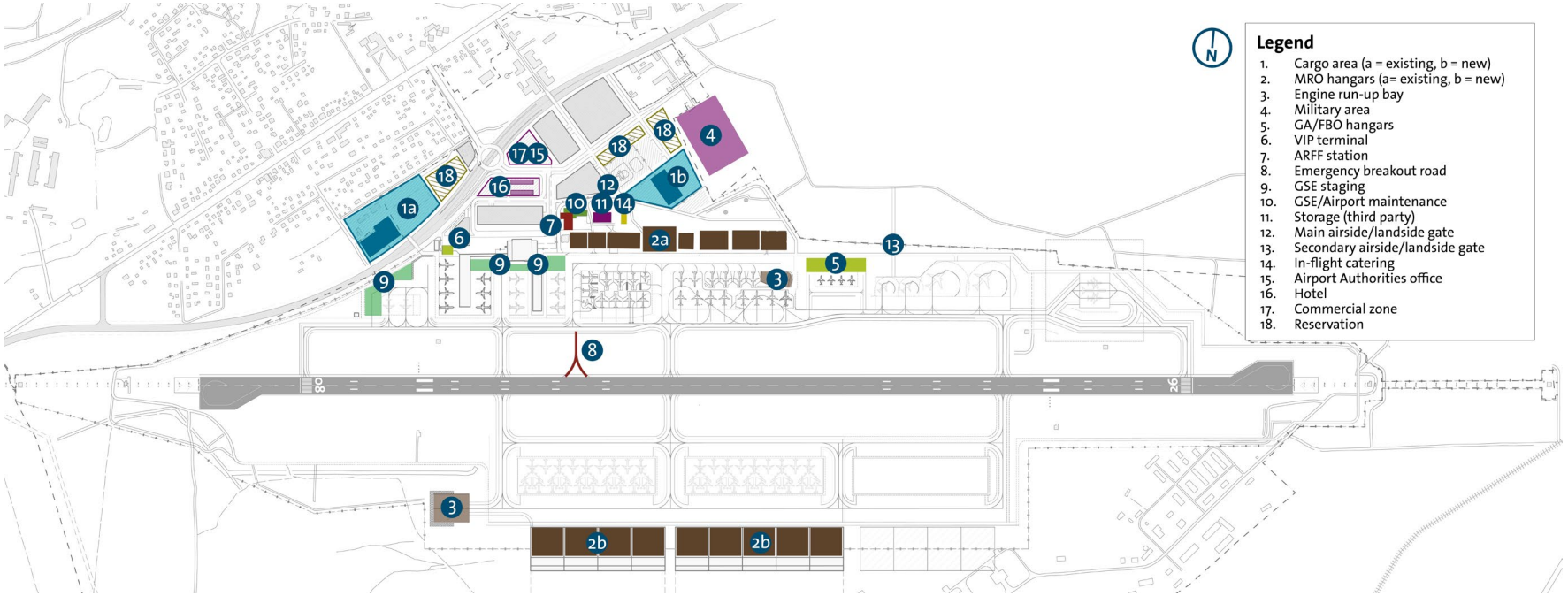

FIGURE 17 SUPPORT FACILITIES

facilities, also the apron is planned to be flexible and optimized for usage by both narrow body and wide body aircraft.

A landside connection to the MRO area is planned to be connected to the A6, as well as to the free economic zone.

On the east side, a strategic reservation is included to develop 4 more wide body MRO bays (or 8 narrow body bays), as well as an apron expansion.

Military, General Aviation, and VIP facilities

The existing military facility at the airport is not changed within the master plan. However a reservation for a segregated military apron is included to host 2 code C and 2 code E aircraft.

A GA/FBO facility is included in the master plan. The facility can be developed as a combination of hangars for up to four code B aircraft and a GA/FBO terminal. Moreover, the master plan includes a space reservation for a VIP terminal including conference room adjacent to the passenger terminal building. The facility can be developed to meet the specific needs and requirements of its distinguished guests. Alternatively, space is reserved within the passenger terminal building for a VIP lounge.

Airport support facilities

The airport has several facilities that support the operations.

EMERGENCY FACILITIES

The existing Aircraft Rescue and Firefighting (ARFF) station has sufficient capacity to host the minimum of three ARFF vehicles that are required for the airport. However, the by ICAO defined response times for emergency situations cannot be met. Therefore, a breakout road is planned to provide easier and faster access to the runway from the ARFF station.

GSE FACILITIES

The Ground Support Equipment (GSE) fleet requires sufficient parking space. Several central parking areas are reserved in the passenger terminal area (see Figure 17). Within the staging areas, also charging facilities for electrified GSE (eGSE) is available.

Although main GSE maintenance activities are outsourced to third parties off-airport, attached to the ARFF station a vehicle storage and maintenance building is present where (minor) repairs to the GSE fleet can be performed.

AIRPORT MAINTENANCE

Maintenance activities of the airport are outsourced to third parties. However, within the ARFF station, airfield maintenance equipment is located, as well as a small workshop. Spare parts for e.g. airfield lighting are stored here. In this building, currently, snow removal equipment is also stored. The building is already planned to be expanded north of the existing building.

East of the ARFF building a shed is currently present. The shed is planned to be demolished and the land will be leased out to third parties for storage of goods.

AIRSIDE/LANDSIDE GATES

The main airside/landside gate is slightly relocated to provide more queueing space on both landside and airside. The relocation also enables separate airside and landside access to the fuel farm, thereby optimizing the operations as fuel trucks don't have to go through the airside/landside gate for each operation.

A secondary airside/landside gate is planned to provide efficient access to the GA/FBO area and the military apron.

IN-FLIGHT CATERING

An in-flight catering services facility is present at KUN (see Figure 17). The company Global Travel Supply provides in-flight catering services to the airport's main carriers. The facility has sufficient capacity up to the master planning horizon (2052).

COMMERCIAL FACILITIES

North of the terminal, the hotel is located. As a result of the reconfiguration of the landside road system, the current hotel plot needs to be adjusted. It however is ensured that the hotel's plot size remains as in the existing situation. Within the foreseen plot, the hotel can grow from 90 hotel rooms to over 200 rooms in the future (upon demand, depending on the number of floors).

North of the hotel area, a commercial area of 8,000 m2 is planned. The area can be used for the development of (for example) offices, additional hotels or conference buildings. Within the plot, also the airport authority office is planned. By the development of the non-Schengen pier, the existing ON-building requires to be relocated.

Additionally, within the airport landside area, three plots are allocated as 'reservation'. These zones can be used for development of commercial facilities upon demand.

Landside accessibility

The master plan prepares the landside area for the future development of the new municipality road (a "sunken road" crossing the area), which has significant impact on the area as shown in Figure 18. A new route to/from the kerb is developed, as well as several new parking lots. Parking lots P5 and P6 are temporary to allow for the development of the multi-story carparks (MSCP):

- P1: 2 levels MSCP (840 bays)
- P2: 4 levels MSCP (1,475 bays)
- P3: 2 levels MSCP (615 employee bays, 210 car rental bays)
- P4: at grade (700 bays)
- P5: at grade (165 bays)
- P6: at grade (200 bays)
- VIP: at grade (25 bays)
- T/B: Taxi/Bus buffer at grade

In the final situation (2052), a total of 3,015 parking bays for passengers is available.

On the south side of the runway, a landside connection to the new MRO area is planned to connect the area to the A6, as well as to the free economic zone.

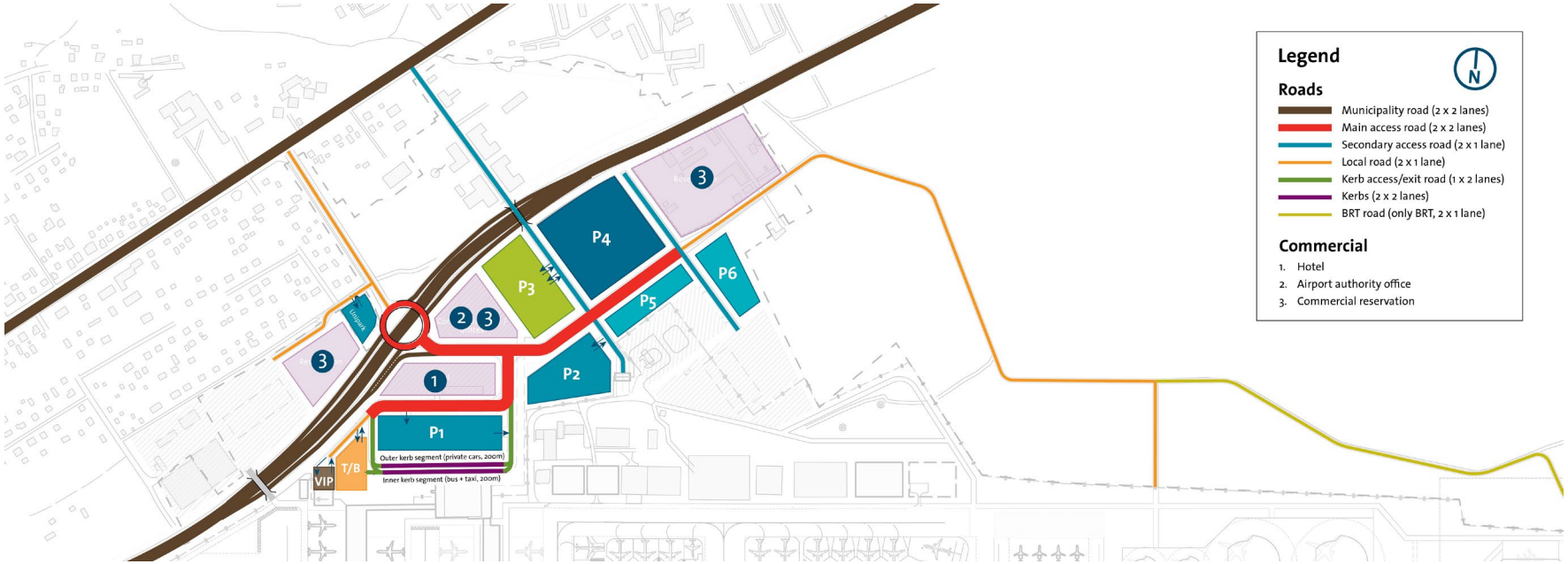

FIGURE 18 LANDSIDE ACCESSIBILITY

By 2032, a station along the Rail Baltica railway will be located southeast of the airport. Given the initially expected low demand of passengers travelling between the rail station and the airport, and to prevent disinvestments, a Bus Rapid Transit (BRT) is proposed as solution to connect the Rail Baltica station with the KUN terminal building. A BRT is a high-comfort bus connection by maximizing the use of a dedicated bus lane. This solution provides the possibility to, if in the future required, be upgraded to pods or an APM system.

Utilities

WATER

The main source of water supply for Kaunas International Airport is currently provided by UAB Giraitės vandenys (Giraitės water), and this potable water is used for various purposes, including food preparation, drinking, cleaning, irrigation, toilet flushing, firefighting, aircraft lavatories, and de-icing fluid dilution.

The average water consumption per passenger was estimated to be 19 litres per day. This forecasted demand does not include water needed for firefighting, irrigation, aircraft lavatories, and de-icing, which can potentially be supplied with non-potable water. It is recommended that groundwater be used to meet these non-potable water demands. The master plan includes spatial reservations for future expansion, including areas for groundwater treatment, potable water storage, and firewater based on forecasted future demands.

WASTEWATER

Wastewater at KUN is handled by UAB Giraitės vandenys. The master plan estimates future wastewater production to be a percentage of the potable water demand as well as the wastewater from the aircraft on a peak day. UAB Giraitės vandenys will be able to handle the additional flow expected to be generated by Kaunas airport with the additional upgrades. The current wastewater distribution and treatment philosophy should be maintained for the forecasted horizon.

SOLID WASTE

Solid waste at Kaunas Airport is collected and handled by the airport operator, with a central point designated for waste disposal. For hazardous waste management, a state-owned company called JSC "Toksika" handles toxic waste activities. Forecasted solid waste production is estimated to be 0.24 kg of waste per passenger per day on average. Additional infrastructure for solid waste handling should be developed in response to demand, including more garbage trucks and storage space.

DRAINAGE

It can be assumed that the surface runoff will not increase significantly since there will be minimal upgrades to the hardened area. Downpipes will be installed for the new facilities to be connected to the existing storm water drainage network.

ELECTRICAL POWER SUPPLY

The current bulk electricity demand for Kaunas airport is under 1 MW. However, by 2052, projections estimate a demand of 15.2 MW, incorporating a significant estimate of at least 10 MW for both land and airside electric vehicle charging systems. The airport primarily sources its electricity from three traditional power plants, complemented by a cogeneration plant introduced in 2020 and a hydroelectric power plant, together boasting a combined capacity of over 1800 MW. Even though this collective power output supports a substantial national load, it's evident that the anticipated year 2052 demand for the airport can be sufficiently accommodated by the existing power supply infrastructure.

The airport has an intense network of underground medium voltage distribution cabling serving various facilities within the airport. To accommodate the envisioned expanded airport masterplan layout, it is essential to consider carefully re-arranging the airport's medium voltage distribution network to ensure they remain unaffected by the construction process. Such adjustments might entail redirecting the medium voltage network around the airport's boundary, relocating, safeguarding, or even lowering pertinent services. This approach not only reduces potential risks but also enhances the successful implementation of the masterplan.

AVIATION FUEL

There are several fuel operators at Kaunas airport including Baltic Ground Services BGS, RSS Motors, and Naftelf. Fuel is supplied to the airport by trucks from the bulk storage facility. The fuel storage and supply facility covers an area of approximately 9,000 m^2. Reports suggests that the facility has a storage capacity of 600 m^3. There's also a petrol station for GSE owned by Lithuanian Airports.

The existing fuel setup involves trucks crossing public areas, which is suboptimal for safety and efficiency.

The forecasted demand suggests that by 2052, the airport will require around 2100 m^3 of fuel storage capacity for a 10-day supply. For future planning, an additional 1500 m^3 of fuel storage is recommended to meet the demands of 2052.

The European Commission Green Deal recently enacted legislation that sets specific targets for the mandatory implementation of electric recharging and hydrogen refuelling infrastructure.

SOLAR FARM OVERVIEW

A solar farm is planned across four sites within the airport on approximately 37,000 m^2. Preliminary analysis, using the PVsyt software, suggests these sites can produce peak power outputs ranging from 400 kW in winter for up to 5 hours, and as much as 2 MW in summer for up to 8 hours. The system's top capacity is projected at 7.36 MWp, given a fixed tilt angle of 30° without shading.

The most substantial energy demands are seen in December and January, which aligns with the lowest PV plant output. Despite this, there is still potential to integrate the PV output into the airport's power system, primarily targeting peak shaving and EV charging. It's crucial to adapt and synchronize EV charging to off-peak times or during the PV plant's maximum output. There's a chance of producing excess energy during 5-8 hour periods, offering an opportunity to redirect this surplus to the main power grid or consider storage alternatives, such as MW-scale hydrogen storage.

SOLAR GLARE ASSESSMENT

Forge Solar tool was used to study solar glare effects at KUN. It was noted that runway 08 experiences significant solar glare from April to late October, mainly between 18:00 and 20:00, presenting potential operational concerns. However, RWY 26, the main arrival path, seems largely free from glare effects.

HEATING AND COOLING

Heating is the most demanding energy requirement for KUN airport The proposed airport expansion will result in a substantial increase in both electrical and heating requirements. To effectively cope with this escalating energy demand, we have recommended cogeneration as a practical and optimal choice. Therefore, it is strongly recommended that the airport thoroughly explores the implementation of this solution to meet its evolving energy needs. By adopting cogeneration technology, the airport can efficiently generate electricity and heat simultaneously, maximizing the utilization of resources while ensuring a reliable and sustainable energy supply for its expanding operations.

TELECOMMUNICATIONS

The airport has a vast underground telecommunication network, but its layout doesn't follow master planning principles. For the airport's optimal development, a utilities master plan is essential. This plan should outline servitudes and zoning for infrastructure, especially telecommunications. Establishing clear guidelines will help future airport expansions, simplify utility management, and optimize resource usage. All infrastructure should align with the latest telecommunications industry standards and codes, including the BICSI TDMM, Outside Plant Design Reference Manual, ANSI/TIA—568E series, IEEE standards, NEC, and local building regulations.

5. Phasing Strategy

The main objective of the KUN master plan is to reserve space. Space is required to safeguard future development flexibility and expansion in the short and in the long term. The purpose of the phasing strategy is to guide these developments in the most efficient way. This phasing strategy prevents that short-term developments will obstruct long term developments and at the same time reduces the risk of over-investment and over-capacity by a stepwise approach.

The phasing strategy is divided in the following four phases:

- Phase 1 2023-2027 (1.8 MAP)
- Phase 2 2028-2032 (2.1 MAP)
- Phase 3 2033-2042 (2.6 MAP)
- Phase 4 2043-2052 (3.0 MAP)

While some facilities and infrastructure such as apron expansion can be phased as they are related to aircraft movements it can be more economical to build the facility or infrastructure in one step rather than phased. Therefore some developments have been planned to be constructed in one phase instead of multiple.

Figure 19 shows an overview of the airport master plan with the developments coloured per phase. The numbers correspond to the phasing timeline as shown in Figure 20.

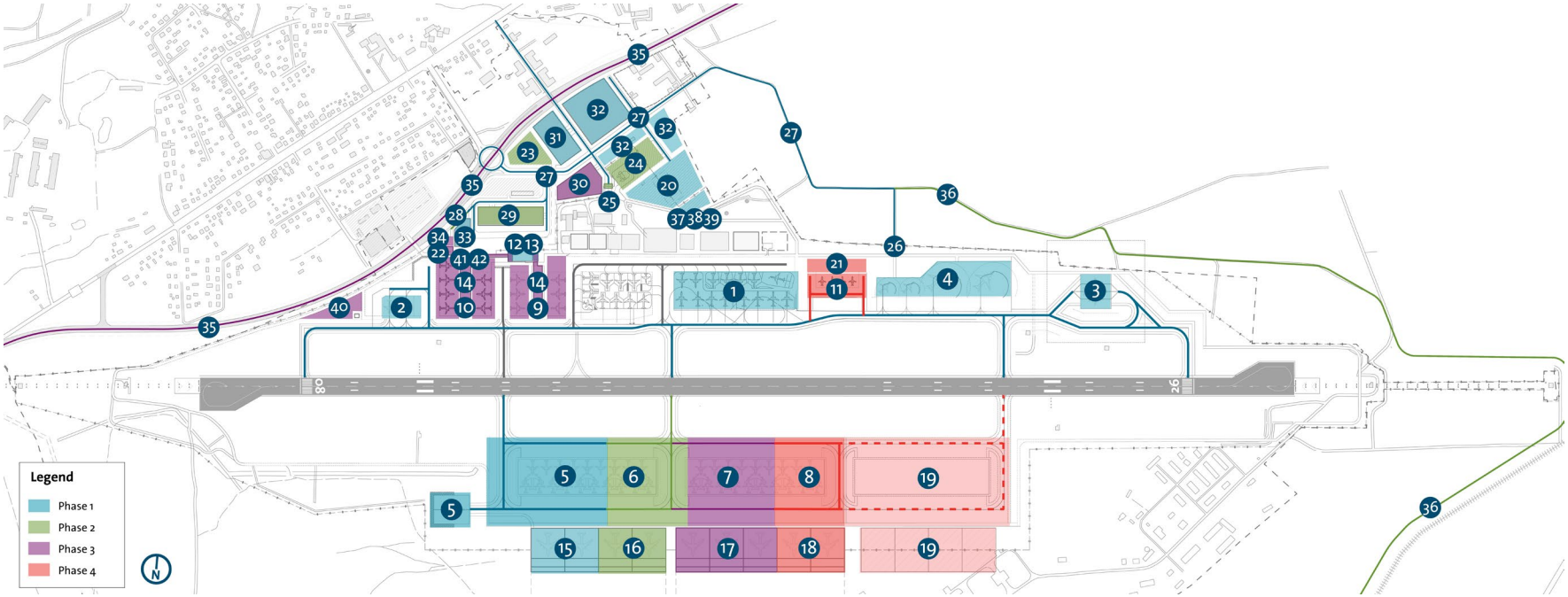

FIGURE 19 PHASING STRATEGY

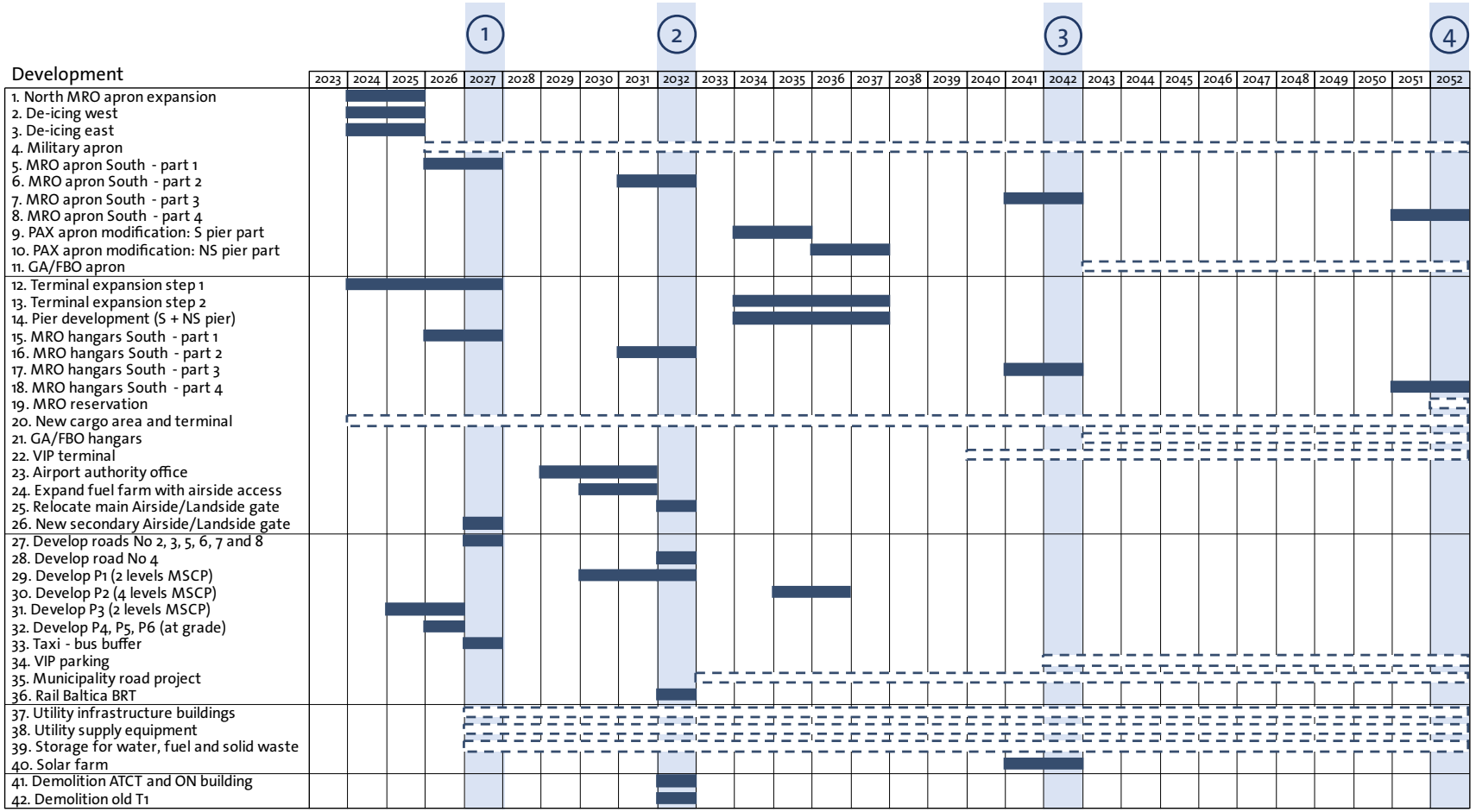

FIGURE 20 PHASING TIMELINE

6. Environmental Aspects

The environmental aspects analyses has been performed in accordance with the Directive 2001/42/EC of the European Parliament and of the Council of the European Union of 27 June 2001 on the assessment of the effects of certain plans and programs on the environment, transposed in the Environmental Law of Lithuania.

The current and general environmental impact has been assessed as low, with particular attention points on noise and carbon emissions.

In scoping this environmental assessment, three key issues (noise and its impact on residential areas, CO_2 emissions and how to reach Net Zero Carbon and air quality and its impact on human health) have been particularly assessed, following the topics developed by the EU in their major vision (Zero Pollution Act) and policy initiatives (European Green Deal).

Noise impact

By 2052, it is expected that the maximum number of annual movements will be around 20,000, against 9,744 in 2019. This increase in number of movements will have an impact on the noise regulations as well as the noise footprint and its impact on residential areas.

While evaluating what will be the impact, a noise modelisation using tool compliant with ECAC Doc 29 has been performed, comparing 2019 and 2052 scenarios.

Focusing on Lden 65dB(A) and Lnight 55dB(A), the surface are likely to increase by +58% and +64% respectively. However, noise impact remain limited as the airport is located in a very low-density area.

Impact on CO_2 and air quality

The impact on CO_2 and air quality is directly correlated to the increase in traffic, the local emissions coming in majority from the LTO (landing and take-off) cycle.

While a set of regulations are being taken with regards to CO_2 emissions, at the European level, there are various legislation regarding air quality (e.g. 2008/50/EC, 2008/1/EC, 2001/81/EC) but none of them are specifically targeted to airport-related emissions. In the future, with the science evolving on this topic, this could change and in order to prepare for more stringent legislation and to pioneer in working conditions for ground staff, there are measures that KUN can already implement.

First of all, it is recommended that KUN monitors its emissions impacting air quality (CO, NOx, VOS, SO_2, PM10, PM2.5) using sensors. These sensors should be placed strategically around the airport as to measure the concentration of these emissions, both at the runway thresholds and at places under the flight paths. Furthermore, as to limit the impact of temporary meteorological and therefore to get exploitable results, it is advised to conduct this study at different times of the year.

There are two specific points worth mentioning related to the development at LTOU airports:

- Increase in nitrogen emissions by latest/newest generation aircraft
- Health impact of UFP for ground staff

These points are being developed in the core document.

Becoming 'zero-emissions'

In 2021, European airports have committed to reach Net Zero carbon emissions by 2050 as well as the full aviation sector. To prepare for this objective, the European Union put forward the Green Deal, the backbone of the European decarbonisation strategy. For the transport sector, a milestone is to be reached in 2030 where emissions must have reduced of 55% against a 1990 baseline. The figure below, summarises the legislation that KUN will be impacted by, as of now, when it comes to its sustainability policy.

TABLE 4 SURFACES OF NOISE CONTOURS FOR BEFORE AND AFTER MITIGATION MEASURES

Scenario	Lden 65 dB(A)		Lden 55 dB(A)	
	Surface (m^2)	Impact	Surface (m^2)	Impact
2019	1,002,805		1,250,993	
2052	1,583,936	+ 58%	2,047,281	+ 64%

KUN should therefore prepare its infrastructure, in alignment with this set of regulation (GPU at stands, access to airport by rail mode...).

Moreover, LTOU has committed to Net Zero by 2050 for its 3 airports: Vilnius, Kaunas and Palanga and should provide their roadmap to ACI Europe by May 2024 at the latest, including an intermediate step of being carbon neutral by 2030.

Being Net Zero Carbon, in the ACA program and for ACI, means reducing its own emissions (i.e. Scope 1 and scope 2 emissions) as much as possible[1].

Three main sources of (scope 1 and scope 2) emission are present at KUN:

- Electricity: in order to achieve the European Net Zero ambitions and the Lithuanian airports ambition to produce, on site, 100% green electricity for its consumption, it is necessary to foresee local electricity supply. The installation of a solar farm on the airport facilities and investing in power purchase agreements with wind farms is among the preferred solution.
- Transport: progressively replacing light vehicles with electric vehicles and purchase HVO100 for heavy vehicles before the introduction of a more mature solution seems to be most suitable at this stage
- Thermal energy: multiple options might be feasible such as biomass, heat pump and biogas and should be explored further.

Moreover, airport have a role of guiding and influencing its stakeholders to reduce scope 3 emissions. This influence might impact the infrastructure in the future and especially with the introduction of fossil-fuel free aircraft.

[1] According to the European Commission mobility plan, Net Zero emission means a reduction of 90% of Carbon emissions against a 1990 baseline (resource.html (europa.eu))

TABLE 5 IMPACTING LEGISLATION

Legislation	Emission targeted	Palanga
Energy efficiency **Energy building performance** Expected to be adopted Q3 2023 **dates are yet to be set by the European legislator*	New building Net Zero emissions	2030
	Solar panels on roof of new/existing buildings*	~ 2030
AFIR Expected to be adopted Q3 2023	GPU at contact stands	2025
	GPU at remote stands	2030
	EV chargers (along TEN-T network)	2025 +
Refuel EU Expected to be adopted Q4 2023	All measures	2025
TEN-T Provisional agreement expected by the end of 2023	*PCA at contact stand*	*2040*
	Access to airport by rail mode	*2040*

TABLE 6 BENEFITS AND CONCERNS OF NEW AIRCRAFT TECHNOLOGIES

	Electric flight	Hydrogen	SAF
Benefits	• 100% emissions reduction (when using green energy) • Commercially available • Small adjustments to infrastructure	• 100% emissions reduction • No limit on capacity and range	• No infrastructural adjustments required • Commercially available • No limit on capacity and range
Concerns	• Limited capacity and range • High electricity demand • Medium-term solution • Medium TRL	• high energy demand • Long-term solution • Low TRL • Safety	• Not fully eliminating emissions • Availability is limited • High price • Land use impacts

Future aircraft

Radical changes to aircraft are required to meet sustainability targets. There are multiple sustainable aviation technologies in development, which all have their own specific relevance in terms of aircraft size and range. Airports should prepare for these new technologies. The Alliance for Zero-Emission Aviation (AZEA) is currently developing guidelines for airports how to prepare infrastructure for future aircraft. The table below identifies the benefits and concerns of the new technologies.

Some of the first highlighted infrastructure requirements are developed in the core document. This topic being currently in constant development, it is strongly advised to follow the latest developments in the near future.

Other aspects

The other aspects of the environment and in particular water, waste, biodiversity have been evaluated and the impact will remain low with the foreseen developments. Some examples to lower the impact as developing waste management strategy to reduce waste under circular economy principles could be explored further.