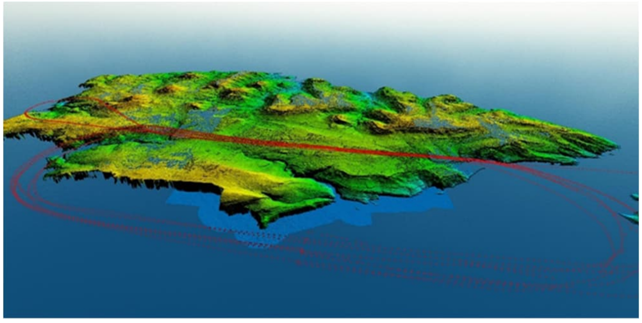

Gozo Airfield Upgrade and Extension Application. Noise and Vibration Report

Prepared by:

Christian Calleja Dip.Ind.Elec. AMIOA

RafDouglas C. Tommasi C. PE, PhD

Matias Rios BSc Acoustics

Eur Ing Simon J. Shilton CEng FIOA

Acousti-Cal Consultancy

'Nest' Belvedere STR.
Gzira, Malta
Tel.: 00356-21337819
Mob.: 00356-99458400

E-mail: info@acousticalconsultancy.com

Web: www.acousticalconsultancy.com

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01	R01	13/04/2024	Initial document.
01	R02	15/04/2024	Metric, table review.
01	R03	29/04/2024	Final Draft.
01	R04	03/05/2024	Final.

Contents

1. Introduction

This document reports on the findings of a noise assessment on the likely significant effects from aircraft noise with the proposed development, which is described in Section 1.1. The term 'aircraft noise' in this document is used to cover two distinct noise sources. These are 'air noise', which is the noise associated with flights into and out of the airfield while the aircraft are airborne or using the runway system, including any start of roll, and 'ground noise', which is the noise associated with aircraft activities on the ground, excluding any start of roll or reverse thrust activities. The key aircraft ground operations are general aviation and inter-island air service aircraft start-up, taxiing from aprons, doing an engine run prior to take-off, and aircraft using a Ground Power Unit (GPU). Two cases are presented; for aircraft departing from Threshold 28 and approaching Threshold 10; and, for aircraft departing from Threshold 10 and approaching Threshold 28. Other noise sources such as road traffic noise and construction noise related to the development are also assessed to inform both ERA and other stakeholders.

1.1. Summary of the Proposed Development

The Proposed Development (PA 07333/22, EA 00007/32) seeks to extend the existing runway (which is currently 174m long) by a further 271-metres, to reach a total length of 445-metres (by 20-metres) wide, including a safety area of 30-metres on each side (at each end) of the airstrip. The proposed changes are within the Local Plan airfield-designated territory. The airfield presently serves as a heliport by air-ambulance helicopters stationed there in cases of emergency.

It is being proposed to introduce an inter-island air service between Gozo and Malta International Airport (MIA). While offering a space for general aviation activity. The proposed runway dimensions preclude the operation of medium and large-sized aircraft. General aviation aircraft operations shall be limited to daytime only whilst the inter-island air service aircraft will be limited to flights between 05:00 hours and 01:00 hours. The development will also provide four Aprons, with one hard standing and three reinforced grass paved areas. Present buildings will be renovated or upgraded, and no new buildings are being proposed.

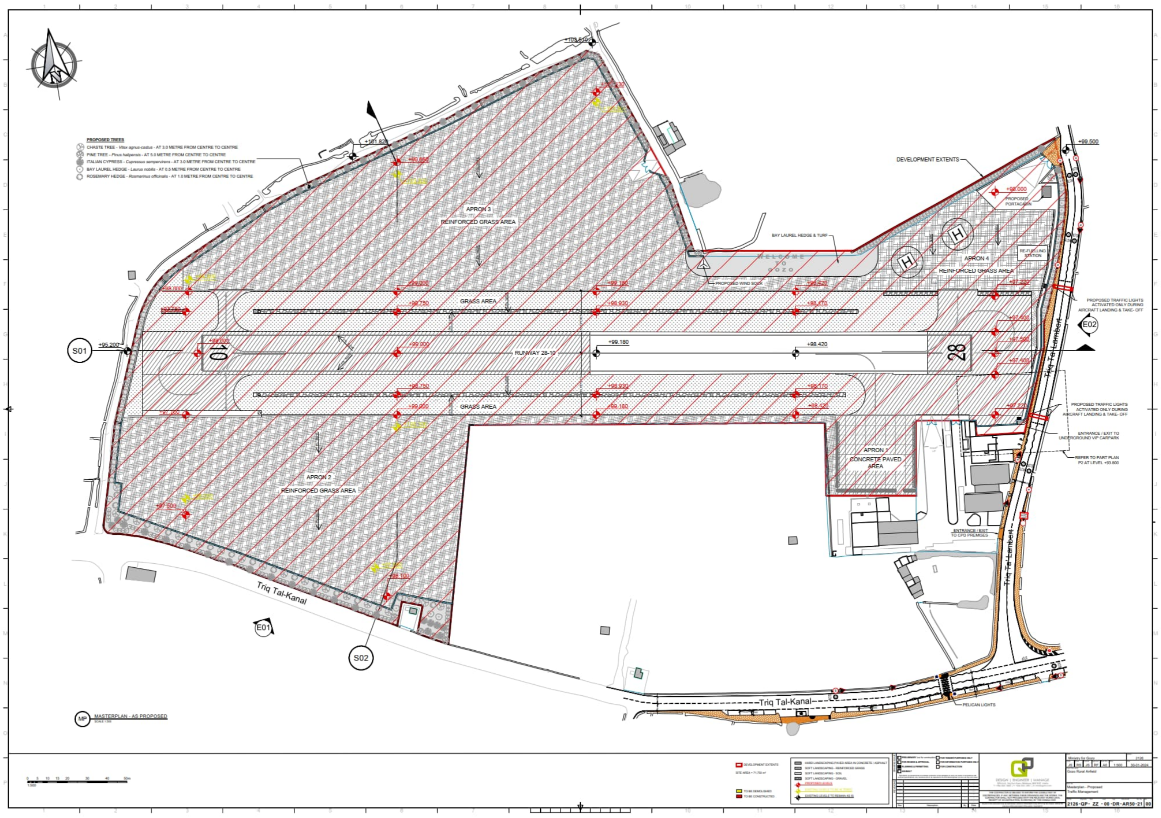


Figure 1-1 Proposed airfield layout - with runway extension, soft and hard aprons.

This report is based on an:

- Extension of the existing runway with a total length of circa 445-metres, including a 30-m safety distance at either end of the runway.
- Apron 1: this apron shall serve as a parking facility for two 15-m wingspan aircraft, with a hard-wearing concrete surface. This apron lies closest to the main terminal and will therefore accommodate the aircraft pertaining to the inter-island operator, to facilitate access to the passengers.
- Apron 2: this apron shall serve as a parking facility for small aircraft, finished in grass reinforced paving.
- Apron 3: this apron shall serve as a parking facility for small aircraft, a helicopter hover training area and a VTOL drone test site, finished in grass reinforced paving.
- Apron 4: this apron shall have two stands for air-ambulance helicopters and a small-scale fuelling mobile depot. The helicopters will be on a hard standing whilst the rest of the apron shall be finished in grass reinforced paving.
- Use of the airfield by general aviation after full sunrise and prior to sunset.
- An inter-island aircraft operating two movements at night catering for communication between Malta International Airport and Gozo.

1.2. Assessment Scenarios

The assessment scenarios comprise future situations with idealized aircraft tracks and with alternative track usage for inter-island air service flights – see Figure 1-2. Hereby, being described as the 'Main Scenario' and 'Secondary Scenario' or 'Scenario 1' and 'Scenario 2'.

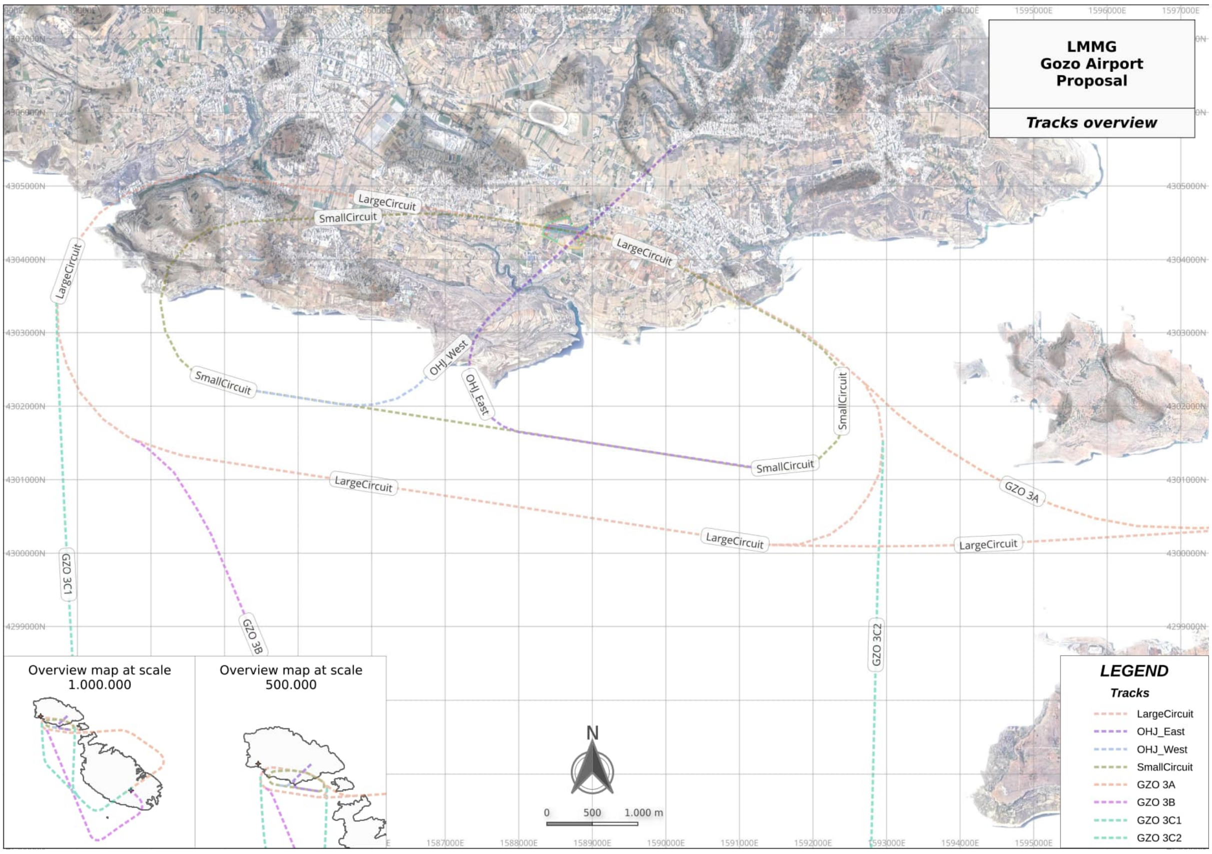


Figure 1-2 Proposed tracks and circuits used in AEDT model.

The main assessment Scenarios are as follows:

- Primary Scenario
- Secondary Scenario
- Ground Operations
- Construction Phase

The primary Scenario or Scenario 1 involves the proposed airfield usage by type, numbers of aircraft, whilst the secondary Scenario or Scenario 2 keeps the same distributions but changes the track usage for the inter-island link service flights. Two Scenarios are evaluated for ground noise revolving around the use of the runway either with take-off in one direction and landing in the other, or reversed, to represent a day of ground operations depending on wind direction. Another supplementary Scenario has been created to demonstrate a day during the construction phase whereby a significant number of earthworks are involved on the proposed site.

1.2.1. Movements expected.

Since this is a proposal for a new airfield the number of aircraft which would fly on a typical day had to be assembled both from the PDS and from what Transport Malta envisages the planned use to be. Although the daily flights are capped at 50, it is very likely that aircraft movements per twenty-four-hour period would be much less. A typical day break up of movements from all the types of aircraft that would be involved has been created, the distribution of which can be seen in Table 1-1. This along with the track distribution (Table 1-2) form the basis for the scenario models in the following sections. The final type and track distribution for Scenarios 1 and 2 can be seen in Table 1-3 and Table 1-4.

For each aircraft the following information was required, with consideration made to any operational differences between periods day, evening, and night:

- Movement Data (per aircraft)
- Arrival / Departure times
- Aircraft types
- ICAO (International Civil Aviation Organization) Codes
- Engine variant details
- Destination
- Destination of aircraft (used as an indication of fuel load)
- Runway
- Runway Direction
- Route
- Departure Route provided per aircraft.
- Arrival Route provided per aircraft.

The aircraft type distribution was set according to Table 1-1 and the aircraft to track distribution was set for each Scenario according to Table 1-2. With Scenario actual Scenario distribution per track and aircraft set according to Table 1-3 and Table 1-4.

Table 1-1 Aircraft movement distribution expected for a typical year and/or day.

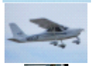
Aircraft type and										
Group	**AC Type**	**Engine**	**AEDT Substitution**	**Group %**	**Yearly**			**Daily**		
					D	**E**	**N**	**D**	**E**	**N**
Scheduled Service flights	Britten-Norman BN-2B Islander	Two Avco-Lycoming reciprocating engines		100%	**2290**	**0**	**730**	**6.27**	**0.00**	**2.00**
Charters	Tecnam P2012 STOL	Two Avco-Lycoming reciprocating engines		20%	**2190**	**0**	**730**	**6.00**	**0.00**	**2.00**
	Daher Kodiak	Single Pratt & Whitney PT-6 turbine engine		20%						
	Cessna Caravan	Single Pratt & Whitney PT-6 turbine engine		20%						
	Pilatus PC-6 Porter	Single Pratt & Whitney PT-6 turbine engine		20%						
	GippsAero G-8 Airvan	Single Avco-Lycoming reciprocating engine		20%						
Air Ambulance	EC135	Twin turboshaft engines		100%	**141**	**0**	**57**	**0.39**	**0.00**	**0.16**
AFM – F	Britten-Norman BN-2B Islander	Two Rolls-Royce/Allison turbine engines		100%	**144**	**0**	**0**	**0.39**	**0.00**	**0.00**
AFM – H	AW139	Twin turboshaft engines		100%	**144**	**0**	**0**	**0.39**	**0.00**	**0.00**
GA	Tecnam P92	Single Rotax 912 reciprocating engine		20%	**2920**	**0**	**0**	**8.00**	**0.00**	**0.00**
	Cessna 172	Single Avco-Lycoming reciprocating engine		16%						
	Piper Cherokee PA-28	Single Avco-Lycoming reciprocating engine		16%						
	Tecnam P-92 and P-2002	Single Rotax 912 reciprocating engine		16%						
	Ikarus C42	Single Rotax 912 reciprocating engine								
	Apollo Delta Jet 2	Single Rotax 912 reciprocating engine								
	Bell 505	Single turboshaft engine		16%						
	EC 135	Twin turboshaft engines		16%						
Totals					**7829**	**0**	**1517**	**21.45**	**0.00**	**4.16**
					9346			**25.61(capped at 50)**		

Table 1-2 Track usage distribution for a typical day.

Tracks											
#	**Group**	**Track Name**	**Altitudes (Ft.)**	**Sub tracks / components**							
				Small		**Large**		**OHJ**		**MLA**	
				E	**W**	**E**	**W**	**E**	**W**	**E**	**W**
1	Large Circuit	D28_large	1000/1500				1				
2		D10_large	1000/1500			1					
3		A28_large	1000/1500			1					
4		A10_large	1000/1500				1				
5	Large Circuit MLA	**D28_MLA**	1000/1500				1				2
6		**D10_MLA**	1000/1500			1				2	
7		**A28_MLA**	1000/1500			2					1
8		**A10_MLA**	1000/1500				2			1	
9	Large Circuit TGO	TGO_large_ccw	1000/1400			2	1				
10		TGO_large_cw	1000/1400			1	2				
11	Small Circuit	**D28_small**	800/1200		1						
12		**D10_small**	800/1200	1							
13		**A28_small**	800/1200	1							
14		**A10_small**	800/1200		1						
15	Small Circuit TGO	**TGO_small_ccw**	800/1200	2	1						
16		**TGO_small_cw**	800/1200	1	2						
17	Overhead Joins	**A28_OHJ_Fix**	2000/1200	2				1			
18		**A10_OHJ_Fix**	2000/1200		2				1		
19		**A28_OHJ_Helo**	2000/1500	2				1			
20		**A10_OHJ_Helo**	2000/1500		2				1		

Table 1-3 Aircraft and track distribution for Scenario 1.

Movements				Scenario 1			
				Tracks			
Group	**Fixed / Helo**	**AC Type**	**Group %**	**Approach**	**Departure**	**TGO**	**OHJ**
Scheduled Service flights	F	Britten-Norman BN-2B Islander	100%	20% A10_MLA 80% A28_MLA	20% D10_MLA 80% D28_MLA	--	--
		Britten-Norman BN-2T Islander	0%				
Charters	F	Tecnam P2012 STOL	20%				
		Daher Kodiak	20%				
		Cessna Caravan	20%				
		Pilatus PC-6 Porter	20%				
		GippsAero G-8 Airvan	20%				
Air Ambulance	H	EC135	100%	20% A10_MLA 80% A28_MLA	20% D10_MLA 80% D28_MLA	--	--
AFM – F	F	Britten-Norman BN-2B Islander	100%	20% A10_MLA 80% A28_MLA	20% D10_MLA 80% D28_MLA	50% TGO_small_ccw 50% TGO_small_cw	50% A10_OHJ_Fix 50% A28_OHJ_Fix
AFM – H	H	AW139	100%	20% A10_small 80% A28_small	20% D10_small 80% D28_small	50% TGO_small_ccw	50% A10_OHJ_Helo
			0%				
GA	F	Tecnam P92	20%	20% A10_small 80% A28_small	20% D10_small 80% D28_small	50% TGO_small_ccw 50% TGO_small_cw	--
		Cessna 172	16%				
		Piper Cherokee PA-28	16%				
	UL	Tecnam P-92 and P-2002	16%				
	UL	Ikarus C42					
	UL	Apollo Delta Jet 2					
	H	Bell 505	16%				
		EC135	16%				

Table 1-4 Aircraft and track distribution for Scenario 2.

Track Movements			Scenario 2			
			Tracks			
Group	**Fixed / Helo**	**AC Type**	**Approach**	**Departure**	**TGO**	**OHJ**
Scheduled Service flights	F	Britten-Norman BN-2B Islander	20% A10_small 80% A28_MLA	20% D10_MLA 80% D28_small	--	--
		Britten-Norman BN-2T Islander				
Charters	F	Tecnam P2012 STOL	20% A10_MLA 80% A28_MLA	20% D10_MLA 80% D28_MLA	--	--
		Daher Kodiak				
		Cessna Caravan				
		Pilatus PC-6 Porter				
		GippsAero G-8 Airvan				
Air Ambulance	H	EC135	20% A10_MLA 80% A28_MLA	20% D10_MLA 80% D28_MLA	--	--
AFM – F	F	Britten-Norman BN-2B Islander	20% A10_small 80% A28_MLA	20% D10_MLA 80% D28_small	50% TGO_small_ccw 50% TGO_small_cw	50% A10_OHJ_Fix 50% A28_OHJ_Fix
AFM – H	H	AW139	20% A10_small 80% A28_MLA	20% D10_MLA 80% D28_small	50% TGO_small_ccw	50% A10_OHJ_Helo
GA	F	Tecnam P92	20% A10_small 80% A28_small	20% D10_small 80% D28_small	50% TGO_small_ccw 50% TGO_small_cw	--
		Cessna 172				
		Piper Cherokee PA-28				
	UL	Tecnam P-92 and P-2002				
	UL	Ikarus C42				
	UL	Apollo Delta Jet 2				
	H	Bell 505				
		EC 135				

2. Legislation and Planning Policy Context

The following sections describe the relevant guidance, law, policy, directives and regulations which have been either consulted or used in this assessment, both locally and on an international level given the implications of the proposed development.

2.1. Malta Government Policy

Malta Transport Master Plan 2025 mentions the heliport at Xewkija and its previous connection to MIA by means of domestic helicopter flights and laments '*No other domestic air transport exists, apart from flights involved in training or aerial photography, surveys, and similar activities.*'. It also identifies issues: limitations such as, connectivity for passengers arriving by air to other parts of the archipelago; civilian domestic air transport limited to scenic flights other than technical flights due to the single landing point (MIA), and desires development of other civilian landing points to open other economic avenues currently unavailable. It also suggests a Policy Framework development enabling the use of helicopters, their related navigational and safety requirements, to connect hospitals, hotels, and cargo movement.

Furthermore, *National Transport Strategy 2050 Malta* encourages better links between Malta and Gozo.

The *Strategic Environmental Assessment of Malta's National Transport Strategy and Master Plan, Environmental Report & Appropriate Assessment (ERDF Malta 2007 to 2013)* does not consider the air links previously mentioned but refers to *A Civil Aviation Policy for Malta 2014-2020* which aimed to update the aviation sector policy to 2020. The policy includes the enactment of a Civil Aviation Act and the setting up of a Civil Aviation Authority (CAA). Other initiatives put forward include: the re-establishment of an air-link between Malta and Gozo, the establishment of a General and Business Aviation Terminal and an Airport Zone Master Plan.

In a Ministry for Transport, Infrastructure and Capital Projects report: *A Civil Aviation Policy for Malta 2023-2030*, an objective is set to 'Exploit the potential of the aviation sector in Gozo'. Whereby, the Government is committing to enhancing aviation facilities in Gozo with the aim of re-establishing air-links between Malta and Gozo; create local aviation related economic activities and attract foreign business whilst 'ensuring the most practical and sustainable measures for potential aviation facilities in Gozo.'

This same statement appears under another publication of said ministry titled *A Civil Aviation Policy for Malta 2022 – 2023* under Objective Area 02: Economic Benefits.

In 2022, the Gozo Regional Development Authority (GRDA) engaged the general public, Local Councils, National Authorities and NGOs to a public consultation to gauge responses for the introduction of the proposed airfield. This was undertaken as part of a Regional Impact Assessment (RIA) process resulting in a series of documents discussing the possible impacts and views as seen by said stake holders. In the resulting document[1], an incremental noise level was identified as the only possible 'material negative social impact on the community', whilst several other positive social benefits were extolled.

2.2. Strategic Planning Context

The principal laws governing aviation in Malta are:

- the Civil Aviation Act, which regulates flight licensing and liability.
- the Civil Aviation (Air Operators' Certificates) Act, which regulates the certification of aircraft operators for professional ability and safety.
- the Aircraft Registration Act (Chapter 503 of the Laws of Malta), which regulates the registration of aircraft and covers mortgages and other special privileges to which aircraft may be subject.

The principal regulatory authority is Transport Malta, which operates under the Ministry for Transport, Infrastructure and Capital Projects. Within Transport Malta, the Civil Aviation Directorate (CAD) is tasked with implementing the strategies and objectives of its parent authority. The CAD is responsible for, among other things:

- aircraft registration and safety;
- aircraft and aerodrome operators;
- air navigation service providers;
- aeronautical personnel licensing; and
- international air services agreements.

The CAD would also coordinate with the European Aviation Safety Agency (EASA) with regards to this development. The Air Navigation (Noise Certification and Operation of Aircraft) Order[2] grants the CAD the power to issue noise certificates pursuant to Annex 16 of the Chicago Convention on International Civil Aviation. They are also entitled by S.L.499.39[3] regulations to accept or restrict particular types of aircraft from operating on the proposed development.

The proposed airfield does not fall under the following directives (implemented by various Subsidiary Legislation and Legal Notices in Malta) due to either the lack of movements envisaged, geographically falls outside the reporting agglomeration and/or no noise issue has been previously identified:

[1] https://grda.mt/wp-content/uploads/2022/02/Regional-Impact-Assessment-July2022.pdf

[2] AIR NAVIGATION (NOISE CERTIFICATION AND OPERATION OF AIRCRAFT) S.L.499.18 SUBSIDIARY LEGISLATION 499.18 AIR NAVIGATION (NOISE CERTIFICATION AND OPERATION OF AIRCRAFT) ORDER 1st April 2002, LEGAL NOTICE 162 of 2001, as amended by Legal Notices 83 of 2004and 411 of 2007 and Act XL of 2023

[3] CIVIL AVIATION (NOISE RELATED OPERATING RESTRICTIONS AT AIRPORTS) S.L.499.39 SUBSIDIARY LEGISLATION 499.39 CIVIL AVIATION (NOISE RELATED OPERATING RESTRICTIONS AT AIRPORTS) REGULATIONS 19th August 2005, LEGAL NOTICE 296 of 2005.

- Environmental Noise Directive 2002/49/EC[4]
- EU Commission Regulation 598/2014[5]

But reference is made to these documents to advise and guide the methodology used in this document. Reference has also been made to *ERA Noise Action Plan Malta Agglomeration 2019-2024*, published in 2023, under Section 7.

2.3. Local Planning Policy

The proposed development has been part of the local planning policy documents since 1990, however despite the commitments within the local plan there have been no provisions controlling residential building encroaching on the area, planned use for the environs, or specific mention of how noise related to development is to be treated. The generation of noise maps for the local main aerodrome in policy documents is mentioned, but no further details for the designated land in Gozo are given.

The designated area was first mentioned in *Structure Plan for the Maltese Islands, December 1990*. With *POLICY AVN 4* stating:

> *A study will be made of the demand for and implications of a domestic air service between mainland Malta and Gozo, with particular reference to the environmental impact, the terminal facilities required, and the type of aircraft appropriate. In the interim the land area which may be required for a light aircraft facility on Gozo will continue to be safeguarded. The use of amphibious aircraft will be included in the study.*

The planning revision of 2006 created the document *GOZO AND COMINO LOCAL PLAN As Approved by the Malta Environment and Planning Authority JULY 2006* states under section *6.6 Air transport*:

> *The helicopter service provided by Malta Air Charter[6] provides a useful connection between the mainland and Gozo, particularly for some passengers of international flights. There has been some debate about the advantages, both operational and financial, of converting the service to a fixed-wing operation. However, there has been no comprehensive study that evaluates the potential benefits and compares them with the environmental consequences, most notably the implications of constructing an airstrip. Until this study is undertaken, MEPA will continue to safeguard the land required for an airstrip and its associated facilities. MEPA would assist the relevant agencies in drafting the Terms of Reference for this Study which would necessitate studies particularly relating to the environmental impacts arising from the proposals being considered.*

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[4] ASSESSMENT AND MANAGEMENT OF ENVIRONMENT NOISE S.L.549.371 SUBSIDIARY LEGISLATION 549.37 ASSESSMENT AND MANAGEMENT OF ENVIRONMENT NOISE REGULATIONS 23rd April 2004, LEGAL NOTICE 193 of 2004, as amended by Legal Notices 426 of 2007, 366 of 2018 and 35 of 2022.
[5] Repeals Directive 2002/30/EC of the European Parliament and of the Council of the 26th of March 2002 on the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Community airports
[6] Referring to the then Malta-Gozo helicopter link.

It also mentions the '*increased noise footprint*', the extent, and noise levels of which were not established at the time with either the then used helicopters or, possible future fixed wing aircraft. Still, the same plan extended development boundaries towards the airfield designated area.

It also refers to Policy GZ-TRAN-14 which states:

> *As indicated in Structure Plan policy AVN 4, the land at Xewkija indicated on MAP 14.13-E is being designated as a safeguarded area for a possible extension of air transport facilities. Any extension to the existing facilities will only be considered if the provisions of Structure Plan policy AVN 4 are fully implemented.*

Structure Plan policy AVN 4 indicates the requirements upon which a decision on the implications of a domestic air service between Malta and Gozo needs to be taken.

Chapter 552[7] Article 72 of the Development Planning Act has also been reviewed with regards to this development.

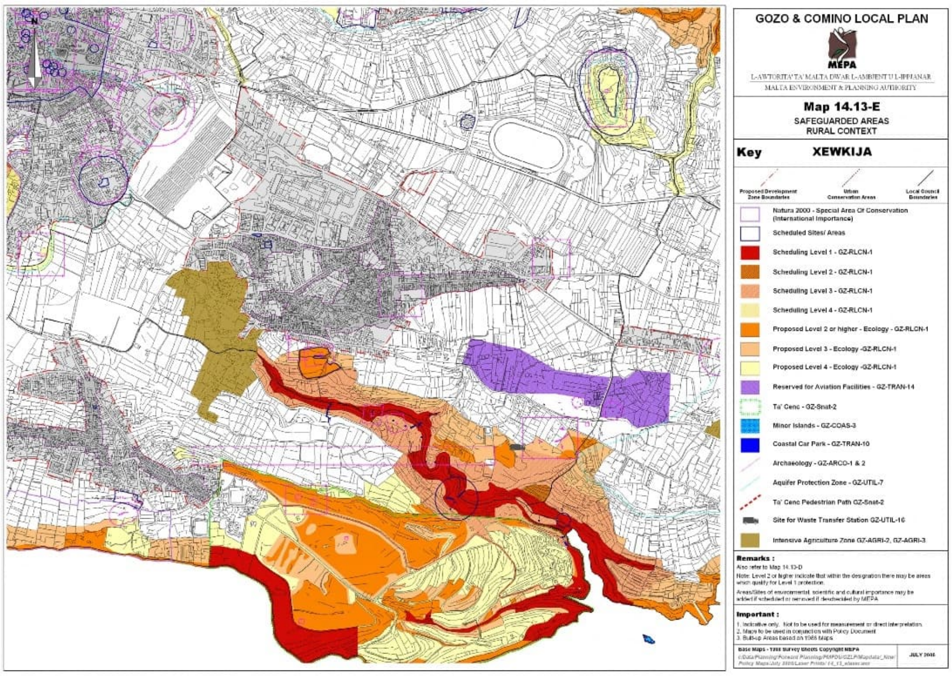

Figure 2 1 Local planning policy map 'MAP 14.13-E' – Note that development boundaries have not changed with rationalization.

In the Strategic Plan for the Environment and Development of July 2015 (otherwise known as the SPED), under Gozo Objective 1 goals, the '*Facilitating the implementation of strategic projects (Cruise Liner Terminal, a yacht marina, an airfield and a reverse osmosis plant).*' Includes the project as part of the local development.

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[7] CAP. 552. DEVELOPMENT PLANNING To make provision for sustainable planning and management of development and for the establishment of an authority with powers to that effect and for matters connected therewith or ancillary thereto.4th April 2016*ACT VII of 2016, as amended by Legal Notice 109 of 2020 and Acts XXXVI of 2020, XXI of 2022 and XVI of 2023.

The proposed development area is also a designated bird sanctuary at the national level since 1993 by means of *S.L. 549.42 Conservation of Wild Birds Regulations 29th March 2006*. (See Figure 2-1). The site is presently used as a heliport – a safety concern.

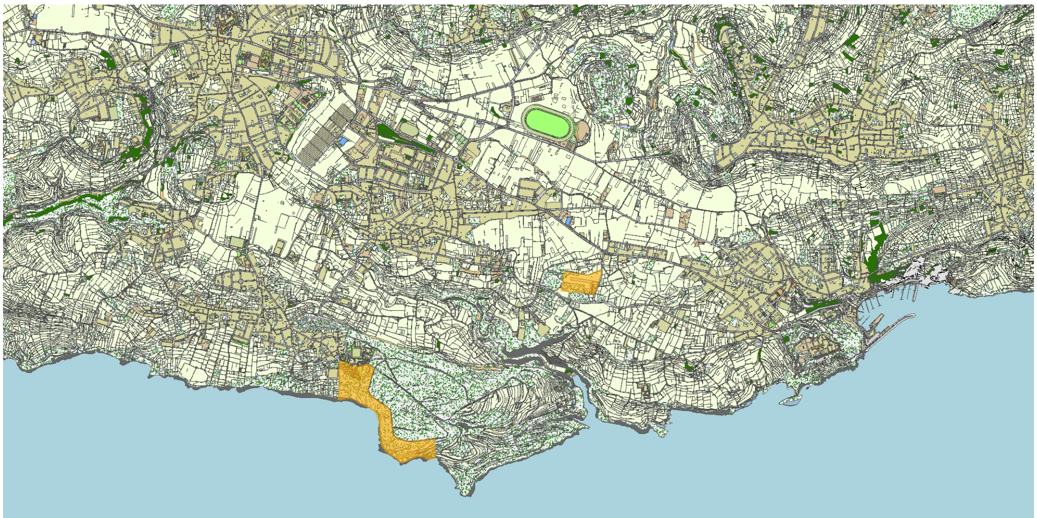

Figure 2-1 ERA/ MEEPS portal showing bird sanctuary status for site.

2.4. International Policy, Standards and Guidance

The following international policies, standards and guidance documents are considered relevant to this assessment.

- ICAO Balanced Approach
- ICAO Convention on International Civil Aviation, Annex 16, Volume 1
- EU Commission Regulation 598/2014
- World Health Organisation (WHO) Guidelines for Community Noise (1999)
- WHO Night Noise Guidelines for Europe (2009)
- WHO Environmental Noise Guidelines for the European Region (2018)
- ISO 9613-2:2024 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation

2.5. Relevant Malta Policy, Standards and Guidance

Chapter 549[8] the Environment Protection Act under First schedule [Article 58(2)a)] informs of the need 'to regulate activities expected to generate, intensify or modify ambient noise, vibrations, light pollution, currents or other

[8] CHAPTER 549 ENVIRONMENT PROTECTION ACT To make provision for the protection of the environment and for the establishment of an authority with powers to that effect and for matters connected therewith or ancillary thereto. 31st January 2016; 4th April, 2016, 1st February,2019, ACT I of 2016, as amended by Acts XXIII of 2018, XXXVI of 2020, XXX and XXXV of 2023.

disturbances to the environment.'. Said Chapter 549 was amended by S.L. 549.37 Assessment and Management of Environment Noise Regulations through Legal Notice L.N. 193 of 2004, as amended by Legal Notices 426 of 2007,366 of 2018 and 35 of 2022. In L.N. 366 of 2018 Environment Protection Act (CAP. 549) Assessment and Management of Environment Noise (Amendment) Regulations of 2018, the L_{den} hours for Malta are set.

Further reference is made to *ERA Guidance Terms of Reference for the Preparation of Environmental Noise Impact Study For Development and Industrial Permit Proposals Ambient Quality and Waste Version 1.0* in reviewing construction noise significance. And to Malta Travel and Tourism Services Act (CAP. 409) Tourism Accommodation Establishments Regulations, 2012 which mentions the need for hotels to consider 'Appropriate noise control of the windows.'.

The Policy, Standards and Guidance described above set out the overall approach to assessing the significance or otherwise of aircraft noise and vibration, and much of the technical detail required to carry out such an assessment. There are however some areas where additional information is considered beneficial to fill gaps, such as in relation to the significance of particular noise levels and criteria.

Information has been taken from the following ISO standards and UK guidance documents. This UK or foreign based information – which is also referred to by some Government Departments in the course of their specific projects - is used to supplement information relevant to this assessment.

- ProPG: Planning & Noise, Professional Practice Guidance on Planning & Noise, New Residential Development, May 2017. ANC, IOA and CIEH.
- BS 8233:2014 Sound insulation and noise reduction in buildings – code of practice
- Department of Education – Acoustic design of schools: performance standards BB93 (2015)
- Department of Health – Specialist Services, Health Technical Memorandum 08-01: Acoustics (2013)
- ISO 1996-2:2017 Acoustics - Description, measurement and assessment of environmental noise Part 2: Determination of sound pressure levels
- CAP2091: CAA Policy on Minimum Standards for Noise Modelling
- BS 5228-1:2009+A1:2014 - Code of practice for noise and vibration control on construction and open sites - Noise

3. Assessment Methodology

This section describes the approach to the assessment of the aircraft noise in this document, covering the following:

- The key sources of information or data collection that have been consulted throughout the preparation of this document;
- The methodology behind the assessment of aircraft noise, including the criteria on magnitude due to the proposed airfield;
- An explanation as to how the identification and assessment of potential aircraft noise has been reached;
- The significance criteria and terminology for the assessment of aircraft noise.

Key sources of information that have been utilised for this assessment are as follows:

- Project Description Statement (PDS) produced by QPM;
- Discussion with Transport Malta as to what type of aircraft could be put in use;
- The proposed frequency of aircraft for both charter/line flights and general aviation aircraft;
- The creation of idealized tracks to and from the runway with possible dispersion – note no tracks exist at present;
- The creation of 3D and 2D datasets from LIDAR, building layers, CORINE 2000, and other geospatial data;
- A distribution of the aircraft frequency, type, and operation to tracks and time periods according to the assessment time period;
- The results obtained from measurements on site.

The general assessment methodology involves the following:

- Derivation of assessment criteria;
- Computation of future noise levels under the various scenarios;
- Assessment of magnitude of impacts (absolute) on sensitive receptors, for each scenario;
- Determination of the change in noise levels, and associated impacts (relative) as a result of the proposed airfield;
- Consideration of the likely significant effects of the Proposed Development, based on both the absolute and relative noise levels.

Different types of noise sources are involved in evaluating an airfield. The character of these noise sources differs, with air noise consisting of intermittent noise events often with a duration of less than a minute; ground noise consisting of a combination of periods of steady noise from ground power units interspersed with noise from taxiing aircraft; and road traffic noise consisting of multiple vehicle passbys of only a few seconds each which result in a relatively steady noise for busy roads. Consequently, it is standard practice to consider the noise from each separately. This is consistent with the statement in the European Commission Directive 2020/367 that:

> "*The exposure of the population shall be assessed independently for each noise source and harmful effect. Where the same people are simultaneously exposed to different noise sources, the harmful effects may -in general- not be cumulated. However, those effects may be compared to assess the relative importance of each noise*."

Hence, separate evaluations have been conducted for the air and ground noise sources.

3.1. Present Environment Measurement Methodology

Measurement of the existing community or locality sound levels were conducted at eight locations, shown in Figure 3-1. These were carried out as two sets of four simultaneous measurements; with F1 to F4 being one set, and F5 to F8 being another. The measurements were conducted over the period of a week, to provide many sampled measurements, spread over time, to capture a representative example of the current situation. The measurement height varied according to the measurement location, see Appendix 3 for details. The measurement results are used for assessment of both air and ground noise. These have been chosen to represent communities in the vicinity of the airfield and/or close to flight paths.

Weather data was collected at two locations in each set of measurements: F1 and F4; F7 and F8.

A further set of short, attended measurements were undertaken at Locations B1 and B2 to give an indication of the noise levels above the cliffs, were Yelkouan Shearwater and Scopoli's Shearwater birds normally nest.

Figure 3-1 Visual guide to measurement locations.

The receiver positions used for the assessment and their absolute height above sea level can be seen in Figure 3-1 and Table 3-1

Table 3-1 Receiver positions and altitude relative to sea level.

Receiver	WGS84 Position of receiver		Altitude above sea level	
Location	Lat	Lon	Ft	Mtrs.
F1	36.03182393	14.26812411	328.0	100.0
F2	36.02833094	14.26490172	279.6	85.2
F3	36.02282172	14.28586245	183.2	55.8
F4	36.0255002	14.27782911	281.1	85.7
F5	36.02320558	14.25060495	450.4	137.3
F6	36.02787597	14.24123987	329.9	100.5
F7	36.02826745	14.25774004	268.5	81.8
F8	36.03306281	14.23744391	293.9	89.6
B1	36.01446988	14.25895013	260.8	79.5
B2	36.01402954	14.26128462	248.6	75.8

See Appendix 3 for further details of the measurements and positions.

3.2. Noise Modelling Methodology

The assessment of aircraft noise relies heavily on the modelling of noise levels. This has been carried out using industry standard software. For air noise, the noise modelling software produced by the Federal Aviation Administration (FAA), the Aviation Environmental Design Tool (AEDT) Version 3.0e has been used. This software evaluates aircraft noise in the vicinity of airports based on aircraft type, operation, route, and flight profile, as well as taking into account local terrain and meteorological information. This software was used to produce noise contours and to predict noise levels at specific locations. The model has been validated by taking into account the measurements recorded during some test flights taken with typical aircraft. Details of the modelling methodology are given in Appendix 1 Section 0.

For ground noise the SoundPLAN Version 9.0 noise modelling software produced by SoundPLAN GmbH has been used. This software uses the methodology set out in ISO 9613-2:2024 to produce noise contours and to predict noise levels at specific locations. The scenarios are based on take-off from one or the other threshold over a 24-hour period. Whereby, aircraft would be taking off from the threshold declared and landing in the other direction. Details of the modelling methodology are given in Appendix 2.

The aircraft movements, and associated ground operations, assessed as part of the aircraft noise assessments include all proposed types of aircraft taking off from or landing at the proposed airfield, with the exception of helicopter and military aircraft. Operations by helicopter and military aircraft make up a very small proportion of the total and are not able to be assessed to the same level of accuracy. At the current state these aircraft types made up less than 1% of the total. This is also true when considering night flights. As a result, their inclusion would have a negligible effect on the findings of this chapter.

The FAA's Aviation Environmental Design Tool (AEDT)[9] has been developed to replace a series of legacy FAA tools for modelling noise, emissions, and fuel consumption. These legacy tools include the Integrated Noise Model (INM), Emissions and Dispersion Modelling System (EDMS), and Noise Integrated Routing System (NIRS). Although there is significant overlap in functionality and underlying methodologies between AEDT and the legacy tools, AEDT has a fundamentally different system architecture, design and capabilities which allow the user to simultaneously model aviation noise, fuel consumption, and emissions within a common interface and common inputs.

The inputs are based on the movements distributed as in Section 1.2.1 with a track dispersion as in Figure 3-2.

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[9] https://aedt.faa.gov/Documents/Comparison_AEDT_Legacy_Summary.pdf

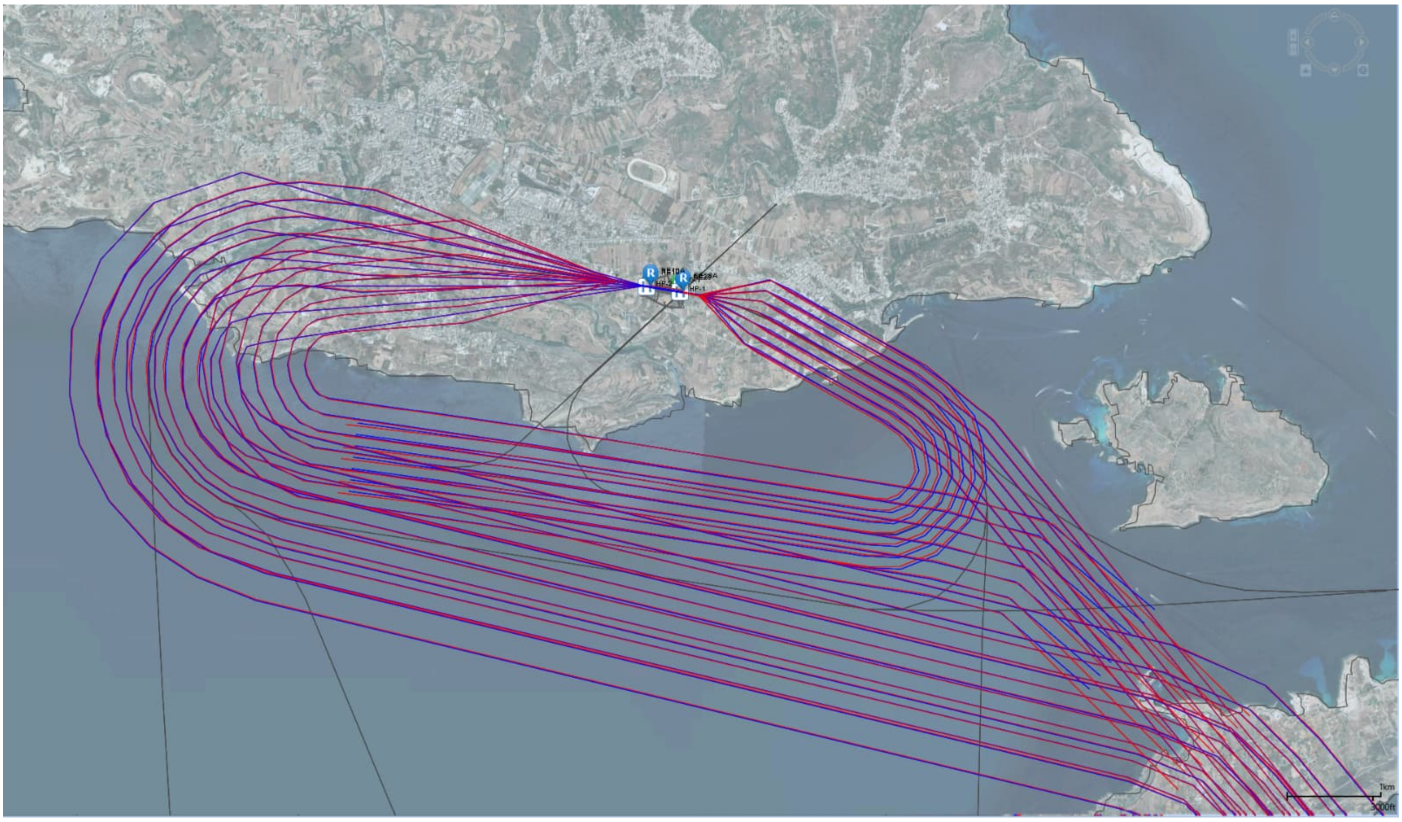


Figure 3-2 Track dispersion simulated.

For construction noise the SoundPLAN Version 9.0 noise modelling software produced by SoundPLAN GmbH has been used. The methodology set out in BS 5228-1:2009+A1:2014 was used to produce noise contours and to predict noise levels at specific locations. The scenario is based on a 16-hour work period. Whereby, several earth moving machinery is working on site over a working day. Details of the modelling methodology are given in Appendix 2.

3.3. Primary Assessment Metrics – Air Noise

There are various noise metrics available for the assessment of aircraft noise, but the adoption of various European Directives in Malta tends towards using metrics used around Europe for strategic noise mapping purposes and in noise action plans. Whilst other supplementary metrics have been considered in this assessment, emphasis has been placed on the European noise metrics:

- L_{den}, which considers the annual activity throughout the 24-hour period, with a 5 dB penalty applied to noise in the evening (19:00-23:00) period and a 10 dB penalty applied to noise in the night (23:00-07:00) period. The key effect linked with this metric is annoyance.
- L_{night}, which considers the annual activity during the night (23:00-07:00) period (No penalty). The key effect linked with this metric is sleep disturbance.

These two metrics are required to be used for air noise to comply with the requirements of EU Directive 2002/49/EC (as amended), transposed through the Assessment and Management of Environmental Noise Regulations (S.L.

549.37) in Malta, and used for strategic noise mapping under Annex II, and the assessment of harmful effects under Annex III.

Given that the inhabitant distribution data available is not so robust as it is based on people registered with Water Services as residents whilst it is known that some of these dwellings are used for holiday purposes; and/or misrepresenting distribution in comparison to the census, the assessment of harmful effects under Annex III has not been conducted.

3.4. Primary Assessment Metrics – Ground Noise

The ground noise assessment metrics used are the same as for the air noise assessment, i.e. L_{den} and L_{night}. Changes in both relative and absolute levels are considered, keeping with L_{den} 65 dB and 55 dB L_{night} limits. A geospatial assessment of dwellings falling within the noise level contour results is also presented for informational purposes.

3.5. Primary Assessment Metrics – Vibration

There could be two potential vibration issues due to aircraft pass-by, take-off or landing; low frequency issues and vortex coupled issues. Due to the type of airfield and aircraft being proposed neither of these issues will arise at this airfield.

In the case of low frequency issues, the aircraft could create a perceptible vibration level within houses due to so termed 'coupling', whereby the dimensions of a particular room or building element could favour resonances which act in sympathy with the aircraft generated noise. While it is appreciated that low frequency noise from aircraft can induce perceptible vibration levels in lightweight structures and loose- fitting components, the vibration levels are below those at which even minor cosmetic damage would be likely to occur.

The other potential effect from airborne aircraft vibration is vortex damage to buildings. Aircraft in flight create vortices, circulating currents of air that are shed from the aircraft wings. For the most part, these vortices are dissipated by the effects of the wind and atmospheric turbulence before they reach the ground and, whilst they may more often be heard after an aircraft has passed, they seldom have any physical impact at ground level. Occasionally, however, vortices may persist long enough to contact buildings underneath the flight path. In practice, such events may be encountered due to the passage of larger wide-bodied jets which create the largest vortices and during landing when aircraft are relatively close to the ground, not the case with this size of airfield and designated types of aircraft.

Aircraft ground operations do not typically produce any significant vibration effects at sensitive receptors outside of the airfield site, and therefore does not require detailed assessment.

No metrics have been assessed for vibration from aircraft noise.

3.6. Supplementary Noise Metrics – Air Noise

As it is proposed that two air-link movements occur during the night, the following supplementary noise metrics are being put forward:

- In the case of measurement metrics, the L_{day} and $L_{evening}$ metrics which are optional under EU Directive 2002/49/EC are being supplied. These describe the average noise level during an annual day (07:00-19:00) and evening (19:00-23:00) respectively. They provide information on the variation in noise across the day and evening.
- The L_{AFmax} and more specifically the $L_{AFmax,\ night}$. These describe the maximum A weighted level of a single event over a point on the ground during the day or measurement period, and in the latter case the maximum A weighted level reached during the night. More specifically the intent is to quantify the number of events exceeding 70 dB L_{AFmax} at night externally at the previously proposed measurement locations, and understand what changes two or three other events (from the proposed flights) could bring about at these locations.

The use of $L_{AFmax,\ night}$ as a single event noise metric is mostly due to the practicality of extraction from longer duration measurement than SEL due to the sporadic nature of multiple events. It is represented in multiple standards (e.g. BS 8233) for new builds thus making a better reference, but more importantly, it gives some correlation to WHO Night Noise Guidelines for Europe, whereby it is suggested that internally (i.e. in the bedroom) the number of L_{Amax} events should not exceed 45 dB more than ten to fifteen times a night. The resulting internal L_{Amax} obviously is ultimately dependant on the building insulation, an unknown and unquantified metric in Malta. For purposes of guidance, the following Figure 3-3 is being used[10].

[10] Spreng M. Cortical Excitations, Cortisol Excretion and Estimation of Tolerable Nightly Over-Flights. Noise Health. 2002;4(16):39-46. PMID: 12537840.

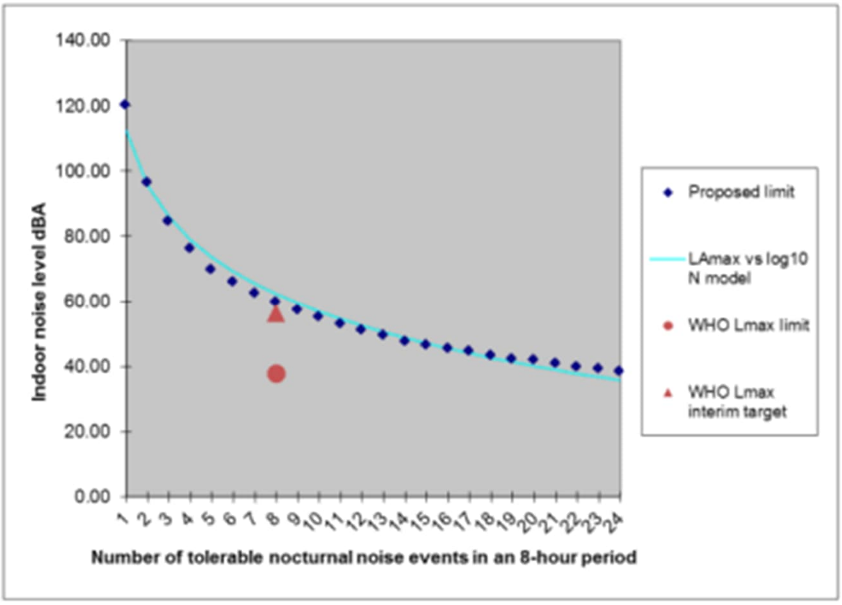


Figure 3-3 Number of tolerable noise events versus internal noise event level.

3.7. Supplementary Noise Metrics – Ground Noise

No other supplementary noise metrics were used to assess the ground noise.

3.8. Methodology for Determining Study Area and Sensitive Receptors

The study area is based on the largest extent of likely impacts due to each noise source, i.e. encompassing an envelope formed by the lowest value noise contours assessed for each primary metric detailed above, and the allowed dispersion of the flight tracks. The extents of the study area are contained within the following:

- Air noise – all of Gozo and south of Gozo extending to Comino.
- Ground noise – a two-kilometre radius from the airfield at Ta' Lambert.
- Construction noise - same extent as ground noise.

Registered and built dwellings have been considered as potential receptors of high sensitivity for this assessment. Industrial buildings have been excluded from assessment. The dwellings are based on ARMS Ltd. data distribution of dwellings spread across several or single buildings.

3.9. Methodology for Determining Operational Effects

The effects of the proposed airfield are determined by comparing the forecast situation with the present data collected. The changes experienced at the sample receptor points have been assessed for both the absolute levels from the calculated results that the airfield operation would create and the relative change that would come about between the resulting noise level logarithmically added with the present level versus the present level – this is the introduction of a new source to the area. An assessment of both the absolute change and the relative change at each position is conducted to quantify the effect significance.

3.10. Significance Criteria – Air Noise

The air noise effects are considered in terms of both the absolute noise level and the change in noise level due to the proposed development (relative) to determine the significance of the effects due to the proposed airfield. Both need to be considered to determine whether a significant effect arises from the Proposed Development in an EIA context; for example, if a receptor experiences a high absolute noise level but no change due to the proposed development then this is not a significant effect. Equally if a receptor experiences a large change in noise level due to the development but the resulting level is still very low, then this receptor is not considered to be significantly affected.

Absolute noise impacts for dwelling receptors have been developed against an effect scale and are given in Table 3-2. The derivation of these, is based on a combination of guidance, professional judgement and Directive 2002/49/EC.

Table 3-2 Absolute impact scale.

Noise Impact Criteria (absolute) – residential		
Scale Description	Annual dB L_{den}	Annual dB L_{night}
Negligible	<45	<40
Very Low	45 - 50	40 - 45
Low	50 - 55	45 - 50
Medium	55 - 65	50 - 55
High	65 - 70	55 - 60
Very High	≥70	≥60

The effect scale used to assess the change in noise level is given in Table 3-3. A semantic scale of this type, following the format of examples given in the Institute of Environmental Management and Assessment (IEMA) guidelines, has been applied in previous air noise assessments and accepted in Public Inquiries for airport developments in the UK and Ireland. The thresholds are derived from the difference contour bands recommended in CAP1616i[11].

[11] Paragraph 5.44, Environmental Assessment Requirements and Guidance for Airspace Change Proposals CAP 1616i

Table 3-3 Relative impact scale.

Noise Impact Criteria (relative)	
Scale Description	Change in noise level dB(A)
Negligible	0 - 1
Very Low	1 - 2
Low	2 - 3
Medium	3 - 6
High	6 - 9
Very High	≥9

The effect of a change in noise level tends to increase with the absolute level of noise experienced at a receptor. If, for example, the night-time noise level at a dwelling were to change from 45 dB to 50 dB L_{night}, the overall effect for the occupants would be less than if the night-time noise level were to increase by the same amount but from 55 dB to 60 dB L_{night}.

There is no clearly accepted method of how to rate the magnitude of the effect of a change in the absolute air noise level and the associated change in noise level. Some guidance however has been provided in the UK's Planning Practice Guidance (PPG) which states[12]:

"In cases where existing noise sensitive locations already experience high noise levels, a development that is expected to cause even a small increase in the overall noise may result in a significant adverse effect occurring even though little or no change in behaviour would be likely to occur."

The magnitude of an effect from changing between one scenario and another (i.e. a scenario without the airfield to a scenario with the airfield) has been established by considering both the absolute noise level in the higher of the two scenarios, and the relative change in noise level that occurs at a given receptor.

Table 3-4 shows how the absolute and relative impacts are interpreted into magnitude of effect. This takes into account the criteria presented above, other guidance and professional judgement.

A potential significant effect (adverse or beneficial) would be considered to arise if in Table 3-4 the magnitude of the effect was rated as significant or higher.

[12] Guidance Noise Advises on how planning can manage potential noise impacts in new development. Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities & Local Government Paragraph: 006 Reference ID: 30-006-20190722 Revision date: 22 07 2019

Table 3-4 Magnitude of effect from absolute and relative scales.

Absolute Noise Level Rating	Change in Noise Level Rating					
	Negligible	Very Low	Low	Medium	High	Very High
Negligible	Imperceptible	Imperceptible	Imperceptible	Not Significant	Slight	Moderate
Very Low	Imperceptible	Imperceptible	Not Significant	Slight	Moderate	Significant
Low	Imperceptible	Not Significant	Slight	Moderate	Significant	Significant
Medium	Not Significant	Slight	Moderate	Significant	Significant	Very Significant
High	Slight	Moderate	Significant	Significant	Very Significant	Profound
Very High	Moderate	Significant	Significant	Very Significant	Profound	Profound

3.11. Significance Criteria – Ground Noise

The same significance criteria have been adopted for ground noise as for air noise.

3.12. Limitations and Assumptions

The resulting effects being determined in this document are dependent on the measured results obtained during a winter period, variation between winter and summer months is likely. With more activity during the summer, the air temperature gradients then available, and the ground temperature, there is a likelihood that the noise levels measured and presently being used for comparison could be higher. Thus, we think this represents the worst-case scenario. Given that AEDT, albeit being an industry standard tool, the likelihood of some over estimation exists[13,14], it would be a good representation of the worst-case scenario.

It is also assumed that the aircraft ultimately in use will fall within their noise certification, and proper supervision of what aircraft types will be allowed on the airfield will be maintained. If the movement quantities with the declared caps, aircraft types, flight tracks and flight times are adhered to under the supervision of Transport Malta's CAD, the results should remain representative.

None of the aircraft types used have silencing kits and/or other modifications and are as is, in the EASA database. All modelled data except where noted are based on a wide gaussian track dispersion as explained in Appendix 1.

[13] Meister, J.; Schalcher, S.; Wunderli, J.-M.; Jäger, D.; Zellmann, C.; Schäffer, B. Comparison of the Aircraft Noise Calculation Programs sonAIR, FLULA2 and AEDT with Noise Measurements of Single Flights. Aerospace 2021, 8, 388. https://doi.org/10.3390/aerospace8120388

[14] Ran Giladi, Eliav Menachi, Validating aircraft noise models: Aviation environmental design tool at Heathrow, Journal of Air Transport Management, Volume 116, 2024, 102557, ISSN 0969-6997, https://doi.org/10.1016/j.jairtraman.2024.102557

4. Current State of the Environment

This section describes the current state of the environment in the vicinity of Ta' Lambert; where the airfield is located, and the wider area it may affect. The surrounding communities are primarily exposed to modern anthropogenic noise of a working and commuting society. There are some areas which seemed, and were measured to be, more active in terms of traffic activity, whilst others, either because of the physical geography or their orientation towards local noise sources, were less active in terms of events and/or noise levels. The primary choice of measurement locations was those with an open and unobstructed view of the proposed airfield, , and representative of the nearby residences.

4.1. Present L_{den}, L_{night} and $L_{Amax, night}$ Metric

Table 4-1 presents a summary of the measurement results at the monitoring locations. All locations had an L_{den} below 65 dB and an L_{night} below 55 dB. As measurements were carried out over a seven-day period, they can be seen to capture a representative example of the current situation. Since the L_{Amax} is being considered as a possible indicator by means of number of events that might be affecting the receiving areas, particularly at night, a threshold of 70 dB was used to mark night-time events in the areas. The number of events ranging between 0.5 seconds and not longer than 10 seconds during the night period were recorded and can be seen in Table 4-2. And broken down to a per night basis in Table 4-3. The proposed airfield would add the proposed two nighttime flights in some areas.

Table 4-1 Resulting levels at each location.

Community Measurements						
Receiver	Measured Metrics					
Location	$L_{Aeq, 24 hour}$	L_{den}	L_{night}	L_{day}	$L_{amax, period}$	$L_{Amax, night}$
F1	53.6	57.7	49.6	54.8	89.2	82.9
F2	59.8	63.6	53.9	61.2	99.9	93.0
F3	53.0	55.8	46.8	54.4	105.2	81.5
F4	58.7	62.4	53.2	60.1	102.7	85.6
F5	55.0	56.5	43.2	56.7	98.6	89.9
F6	58.1	60.5	49.8	59.6	98.1	85.8
F7	51.7	53.6	42.1	53.3	91.9	77.0
F8	50.4	53.4	43.2	52.0	88.7	72.0
B1	44.5	44.4	44.5	44.5	62.8	N/A
B2	42.6	42.6	42.6	42.6	65.0	N/A

Table 4-2 Number of night-time L_{Amax} events exceeding 70dBA at each receptor point.

Receiver	Number of external $L_{Amax, night}$ events exceeding 70 dB over week measurement period - Night Time Only (23:00 to 07:00)*
Location	Qty.
F1	16
F2	429
F3	18
F4	592
F5	48
F6	134
F7	4
F8	2

* *Most of the events are between 04:00 and 07:00 with a minimum duration of 0.5 secs.*

Table 4-3 Measured $L_{Amax, night}$ event distribution.

	Measured $L_{Amax, night}$ event distribution																	
Location	11/12/2023 Mon	12/12/2023 Tue	13/12/2023 Wed	14/12/2023 Thu	15/12/2023 Fri	16/12/2023 Sat	17/12/2023 Sun	18/12/2023 Mon	19/12/2023 Tue	01/02/2024 Thu	02/02/2024 Fri	03/02/2024 Sat	04/02/2024 Sun	05/02/2024 Mon	06/02/2024 Tue	07/02/2024 Wed	08/02/2024 Thu	09/02/2024 Fri
F1	0	0	0	0	2	0	1	12	1	_	_	_	_	_	_	_	_	_
F2	0	22	59	27	84	22	9	175	31	_	_	_	_	_	_	_	_	_
F3	0	0	0	0	2	0	5	11	0	_	_	_	_	_	_	_	_	_
F4	0	66	47	85	96	49	34	196	19	_	_	_	_	_	_	_	_	_
F5	_	_	_	_	_	_	_	_	_	0	9	6	8	5	4	6	10	0
F6	_	_	_	_	_	_	_	_	_	7	11	20	21	19	19	23	14	0
F7	_	_	_	_	_	_	_	_	_	0	0	1	0	0	1	2	0	0
F8	_	_	_	_	_	_	_	_	_	0	0	0	0	0	0	0	2	0

4.2. Present Traffic and Heliport Sources

The helicopter service operates on an ad-hoc basis depending on the emergency requirements of Gozo General Hospital. During the measurement period around the airfield (F1 to F4), there were three occasions when helicopter movements operated from the airfield. In all three cases it was found that a car pass-by had a higher L_{Amax} than the helicopter at the nearby measurement locations. The only aircraft noise source at present is the emergency use of the helicopter (EC135).

In all measurement locations, the ambient sound levels are dominated by road traffic noise. In the case of F5 and F7, during the day, instances of a concrete product manufacturing plant vibrating table (under Xewkija) were audible and measurable.

5. Future Receiving Environment

This section describes the future receiving environment when the airfield would be operating under the circumstances set out for Scenario 1 and 2.

Air noise has been modelled for each scenario, and the results are presented in separate sections. Ground noise levels have been modelled for each possible take-off threshold, direction 10 and 28. The assessment metrics are presented separately for each ground operation scenario.

A separate section presents the results obtained for a construction scenario, on which a separate assessment is conducted.

5.1. Scenario 1

The following are the results obtained from the AEDT model outputs, both as noise contours, individual receptor points and wider effects by number of dwellings.

5.1.1. Air Noise – Calculated L_{den}

Noise contours for aircraft movements have been produced for the primary assessment metric of L_{den} using the methodology described in Section 3.2. For the future assessment year, these are based on forecast aircraft movements and track usage as set out in Section 1.2 for Scenario 1.

Figure 5-1 presents the full set of L_{den} noise contours over a 24-hour period for Scenario 1. To provide further information on changes in the noise environment for specific areas, noise levels have also been computed at the previously declared receptor locations and height above ground; shown in Table 5-1.

For each noise level band of the contours, the number of dwellings exposed has been determined by geospatial analysis. This has been done based on the existing dwellings declared for residential use, the results of which can be seen in Table 5-2.

The contour results presented in this chapter are not cumulative, e.g. any dwellings within the 55 - 59 dB contour band are not included in the totals for any lower value contour bands.

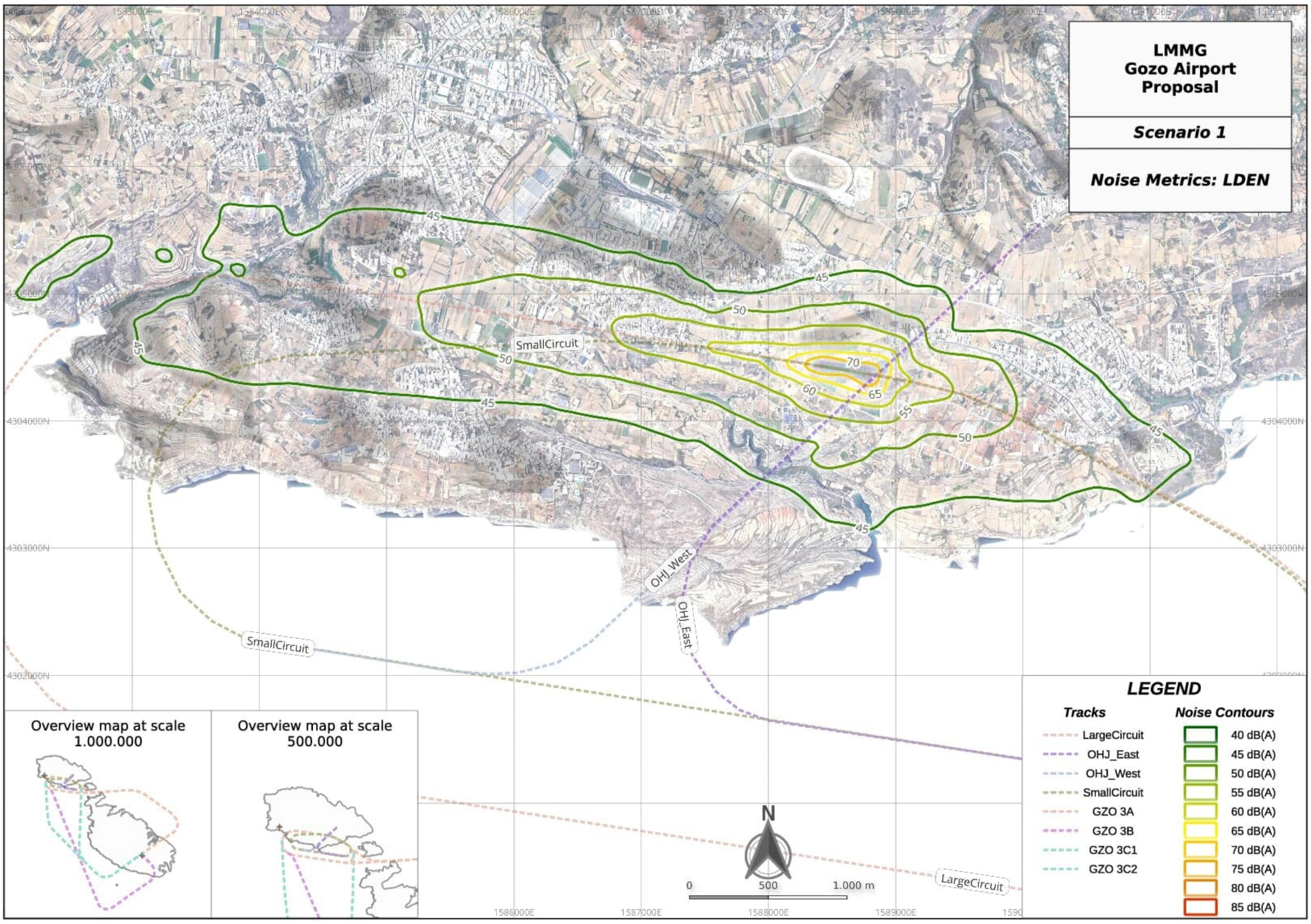


Figure 5-1 Scenario 1 resulting L_{den} noise contours.

Table 5-1 Scenario 1 - L_{den} receptor calculated results.

Receiver	Scenario 1 L_{den} AEDT Calculated Results(dB)
Location	L_{den}
F1	47.3
F2	61.9
F3	48.4
F4	54.5
F5	37.0
F6	48.7
F7	55.2
F8	49.3
B1	38.3
B2	38.6

Table 5-2 Scenario 1 - L_{den} Number of dwellings exposed.

Noise Contour Level dB	Scenario 1 L_{den} Number of dwellings exposed to level - **Externally**
≥65	0
60- 64	5
55dB	100
50dB	198
45dB	855
40 - 44	1002

5.1.2. Air Noise – Calculated L_{night}

Noise contours for aircraft movements have been produced for the primary assessment metric of L_{night} using the methodology described in Section 3.2. For the future assessment year, these are based on forecast aircraft movements and track usage as set out in Section 1.2 for Scenario 1.

Figure 5-2 presents the full set of L_{night} noise contours over a 24-hour period for Scenario 1. To provide further information on changes in the noise environment for specific areas, noise levels have also been computed at the previously declared receptor locations and height above ground; shown in Table 5-3.

For each noise level band of the contours, the number of dwellings has been determined by geospatial analysis. This has been done based on the existing dwellings declared for residential use, the results of which can be seen in Table 5-4.

The contour results presented in this chapter are not cumulative, e.g. any dwellings within the 55 - 59 dB contour band are not included in the totals for any lower value contour bands.

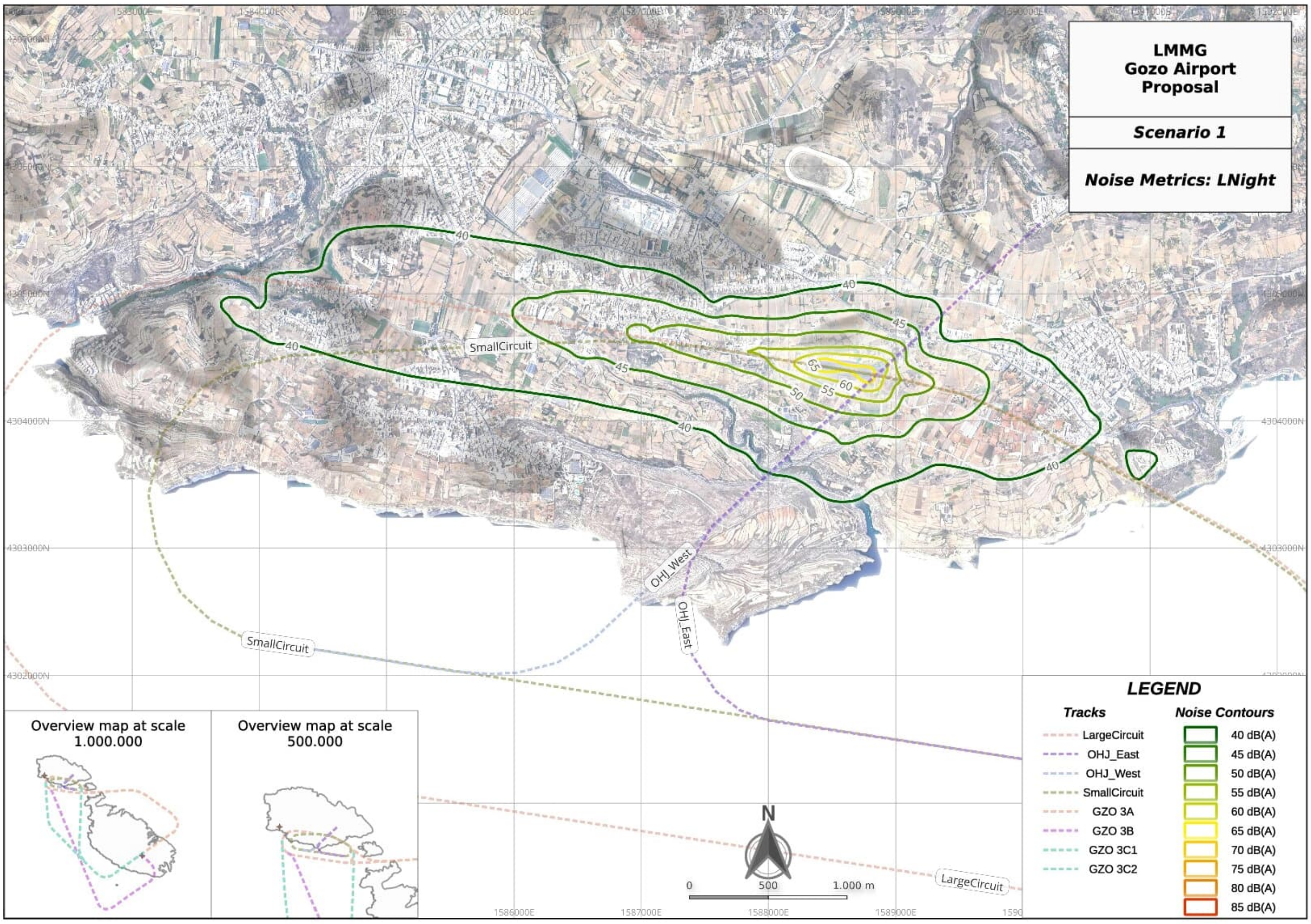


Figure 5-2 Scenario 1 L_{night} noise contours.

Table 5-3 Scenario 1 - L_{night} receptor calculated results.

	Scenario 1 L_{night}
Receiver	AEDT Modelled Metrics(dB)
Location	L_{night}
F1	40.6
F2	55.3
F3	41.6
F4	47.6
F5	29.8
F6	41.7
F7	48.6
F8	42.8
B1	30.8
B2	31.1

Table 5-4 Scenario 1 - L_{night} - Number of dwellings exposed.

Noise Contour Level dB	Scenario 1 L_{night} Number of dwellings exposed to level - **Externally**
≥65	0
60 - 64	0
55dB	1
50dB	62
45dB	179
40 - 45	654

5.1.3. Air Noise – Calculated $L_{Amax, night}$

Noise contours for aircraft movements have been produced for the primary assessment metric of $L_{Amax, night}$ using the methodology described in Section 3.2. For the future assessment year, these are based on forecast aircraft movements and track usage as set out in Section 1.2 for Scenario 1. The $L_{Amax, night}$ value is used to describe the very short-term maximum level, less than half a second, associated with a noise event, such as an aircraft flyover or car pass-by.

Figure 5-3 presents the full set of $L_{Amax, night}$ noise contours over a 24-hour period for Scenario 1. To provide further information on changes in the noise environment for specific areas, noise levels have also been computed at the previously declared receptor locations and height above ground; shown in Table 5-5.

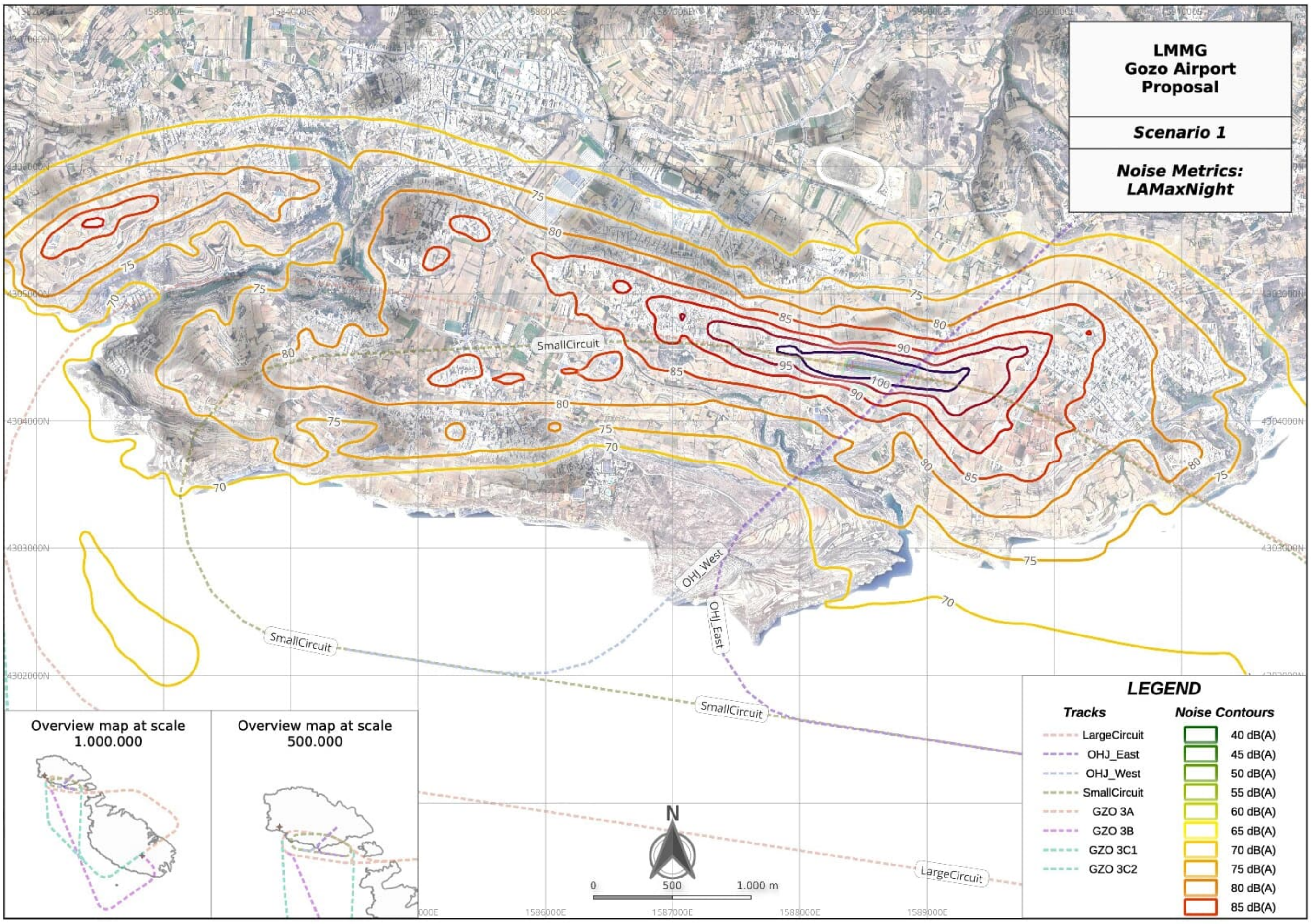


Figure 5-3 Scenario 1 $L_{Amax,\ night}$ noise contours.

Table 5-5 Scenario 1 - $L_{Amax,\ night}$ receptor calculated results.

Scenario 1 $L_{Amax,\ night}$	
Receiver	AEDT Calculated Results(dB)
Location	$L_{Amax,\ night}$
F1	77.0
F2	99.0
F3	82.1
F4	95.3
F5	71.1
F6	85.1
F7	89.1
F8	82.5
B1	65.1
B2	65.3

5.2. Scenario 2

5.2.1. Air Noise – Calculated L_{den}

Noise contours for aircraft movements have been produced for the primary assessment metric of L_{den} using the methodology described in Section 3.2. For the future assessment year, these are based on forecast aircraft movements and track usage as set out in Section 1.2 for Scenario 2.

Figure 5-4 presents the full set of L_{den} noise contours over a 24-hour period for Scenario 2. To provide further information on changes in the noise environment for specific areas, noise levels have also been computed at the previously declared receptor locations and height above ground; shown in Table 5-6.

For each noise level band of the contours, the number of dwellings has been determined by geospatial analysis. This has been done based on the existing dwellings declared for residential use, the results of which can be seen in Table 5-7.

The contour results presented in this chapter are not cumulative, e.g. any dwellings within the 55 - 59 dB contour band are not included in the totals for any lower value contour bands.

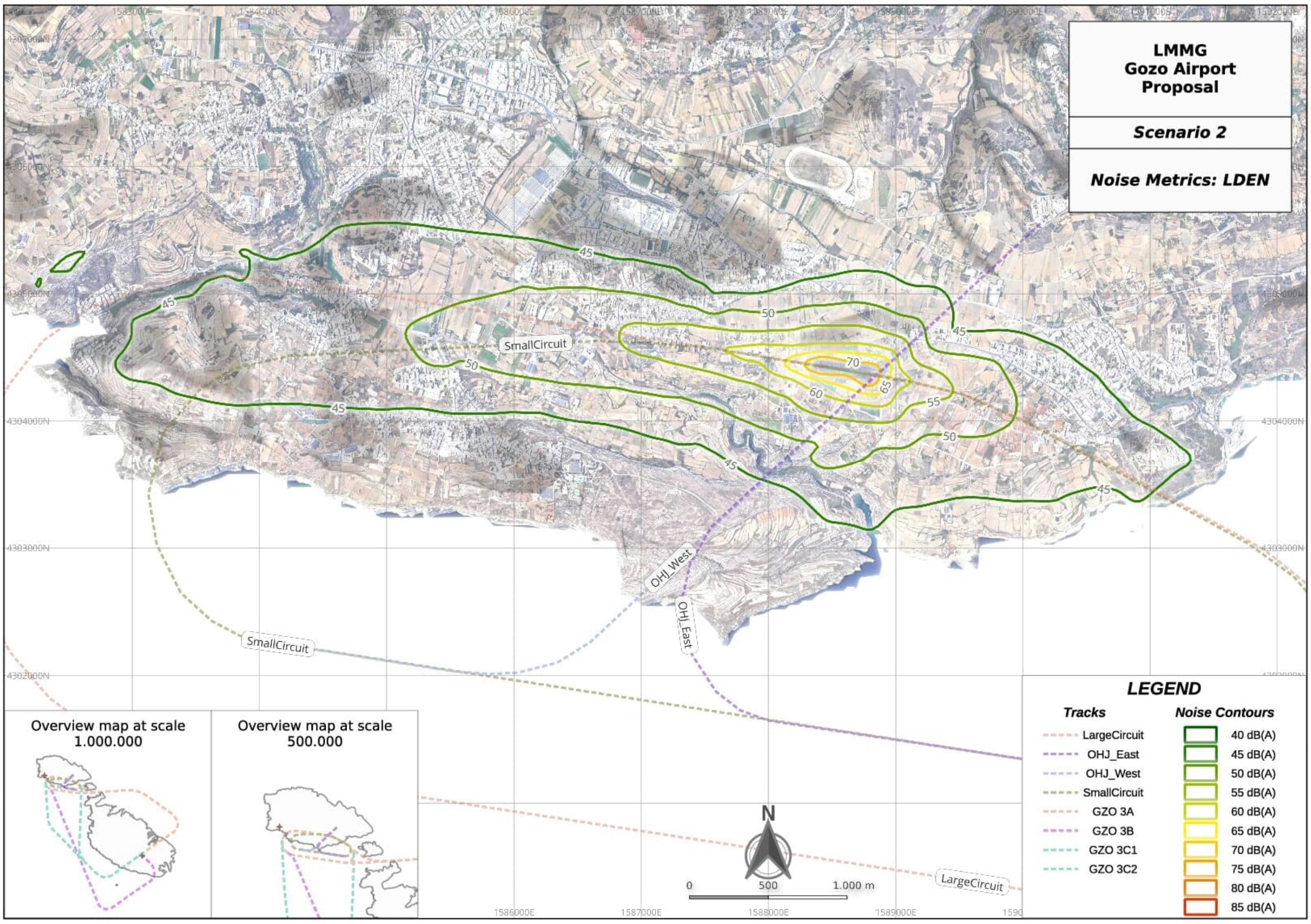


Figure 5-4 Scenario 2 L_{den} noise contours.

Table 5-6 Scenario 2 - L_{den} calculated results.

Receiver	Scenario 2 L_{den} AEDT Calculated Results(dB)
Location	L_{den}
F1	47.2
F2	61.5
F3	48.4
F4	54.5
F5	38.0
F6	49.8
F7	55.5
F8	48.5
B1	38.6
B2	38.8

Table 5-7 Scenario 2 - L_{den} Number of dwellings exposed.

Noise Contour Level dB	Scenario 2 L_{den} Number of dwellings exposed to level - **Externally**
≥65	0
60 - 64	2
55dB	87
50dB	199
45dB	916
40 - 44	976

5.2.2. Air Noise – Calculated L_{night}

Noise contours for aircraft movements have been produced for the primary assessment metric of L_{night} using the methodology described in Section 3.2. For the future assessment year, these are based on forecast aircraft movements and track usage as set out in Section 1.2 for Scenario 2.

Figure 5-5 presents the full set of L_{night} noise contours over a 24-hour period for Scenario 2. To provide further information on changes in the noise environment for specific areas, noise levels have also been computed at the previously declared receptor locations and height above ground; shown in Table 5-8.

For each noise level band of the contours, the number of dwellings has been determined by geospatial analysis. This has been done based on the existing dwellings declared for residential use, the results of which can be seen in Table 5-9.

The contour results presented in this chapter are not cumulative, e.g. any dwellings within the 55 - 59 dB contour band are not included in the totals for any lower value contour bands.

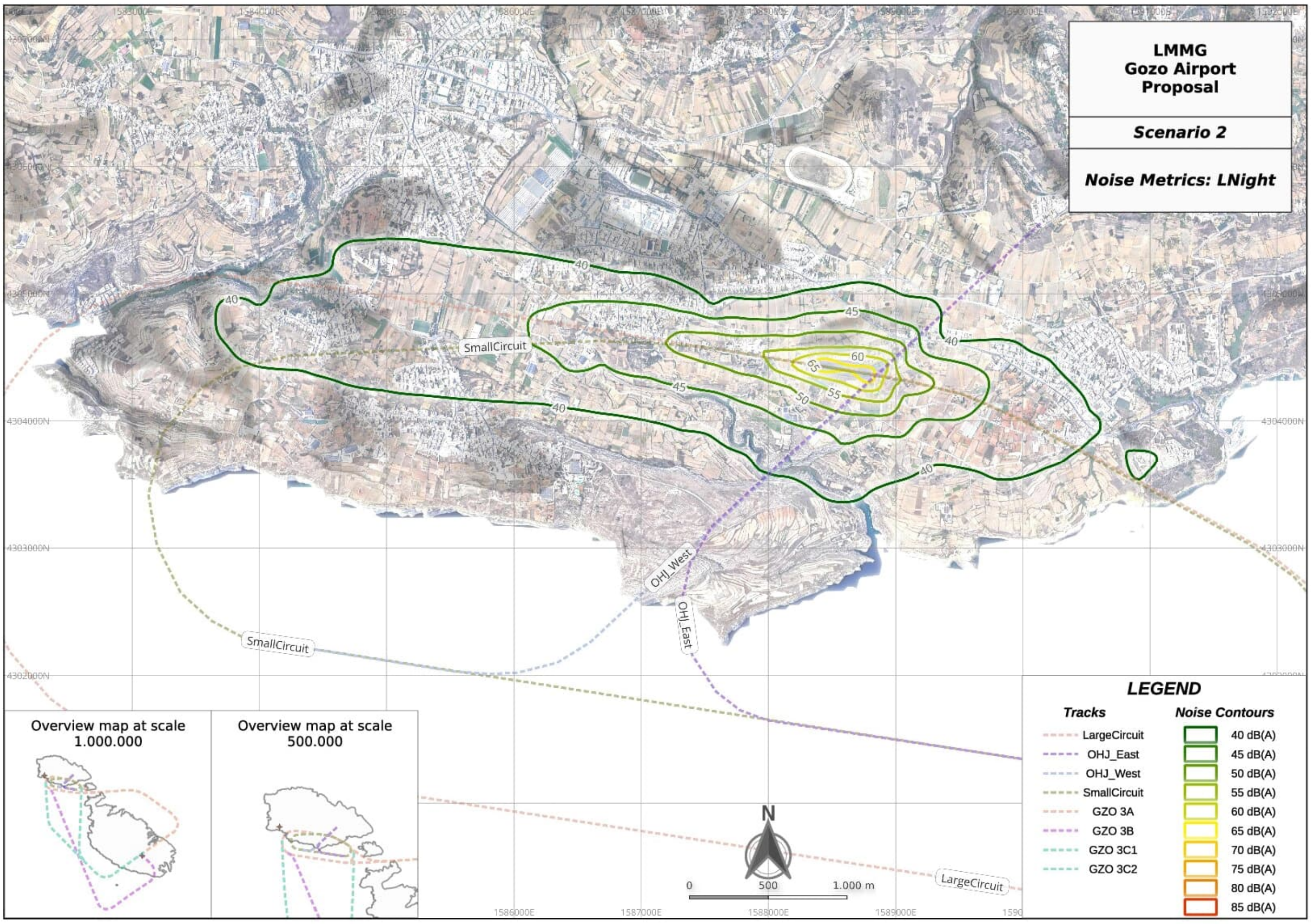


Figure 5-5 Scenario 2 L_{night} noise contours.

Table 5-8 Scenario 2 - L_{night} receptor calculated results.

Receiver	Scenario 2 AEDT Calculated Results(dB)
Location	L_{night}
F1	40.6
F2	54.9
F3	41.6
F4	47.6
F5	30.9
F6	42.9
F7	48.9
F8	42.0
B1	31.1
B2	31.3

Table 5-9 Scenario 2 - L_{night} - Number of dwellings exposed.

Noise Contour Level dB	Scenario 2 L_{night} Number of dwellings exposed to level - **Externally**
≥65	0
60 - 64	0
55dB	0
50dB	25
45dB	198
40 - 44	663

5.2.3. Air Noise – Calculated $L_{Amax, night}$

Noise contours for aircraft movements have been produced for the primary assessment metric of $L_{Amax, night}$ using the methodology described in Section 3.2. For the future assessment year, these are based on forecast aircraft movements and track usage as set out in Section 1.2 for Scenario 2.

Figure 5-6 presents the full set of $L_{Amax, night}$ noise contours over a 24-hour period for Scenario 2. To provide further information on changes in the noise environment for specific areas, noise levels have also been computed at the previously declared receptor locations and height above ground; shown in Table 5-10.

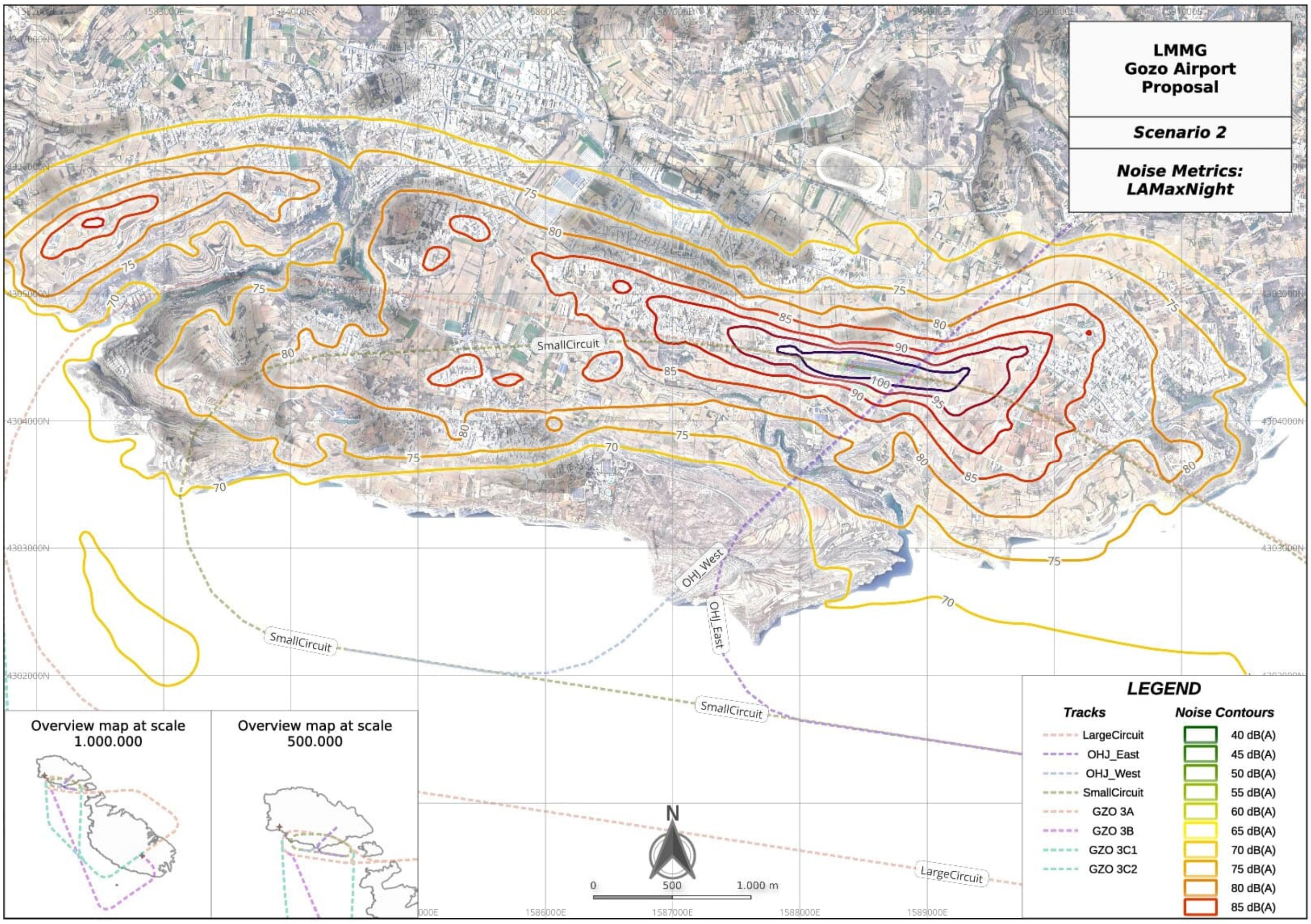


Figure 5-6 Scenario 2 $L_{Amax,\ night}$ noise contours.

Table 5-10 Scenario 2 - $L_{Amax,\ night}$ receptor calculated results.

Scenario 2 $L_{Amax,\ period}$ and $L_{Amax,\ night}$	
Receiver	AEDT Calculated Results(dB)
Location	$L_{Amax,\ night}$
F1	77.0
F2	99.0
F3	82.1
F4	95.3
F5	71.6
F6	85.1
F7	89.1
F8	82.5
B1	65.1
B2	65.3

5.3. Ground Noise – Calculated L_{den}

5.3.1. Take-off Threshold 10 L_{den}

Noise contours for ground operations have been produced for the primary assessment metric of L_{den} using the methodology described in Appendix 0 . For the future assessment year, these are based on forecast type of aircraft, Apron usage, and taxing to or from Threshold 10 for the start of roll, with a weather requirement or otherwise.

Figure 5-7 presents the full set of L_{den} noise contours over a 24-hour period for Threshold 10 usage. To provide further information on changes in the noise environment for specific areas, noise levels have also been calculated at the previously declared receptor locations and height above ground; shown in Table 5-11.

For each noise level band of the contours, the number of dwellings has been determined by geospatial analysis. This has been done based on the existing dwellings declared for residential use, the results of which can be seen in Table 5-12.

The contour results presented in this chapter are not cumulative, e.g. any dwellings within the 55 - 59 dB contour band are not included in the totals for any lower value contour bands.

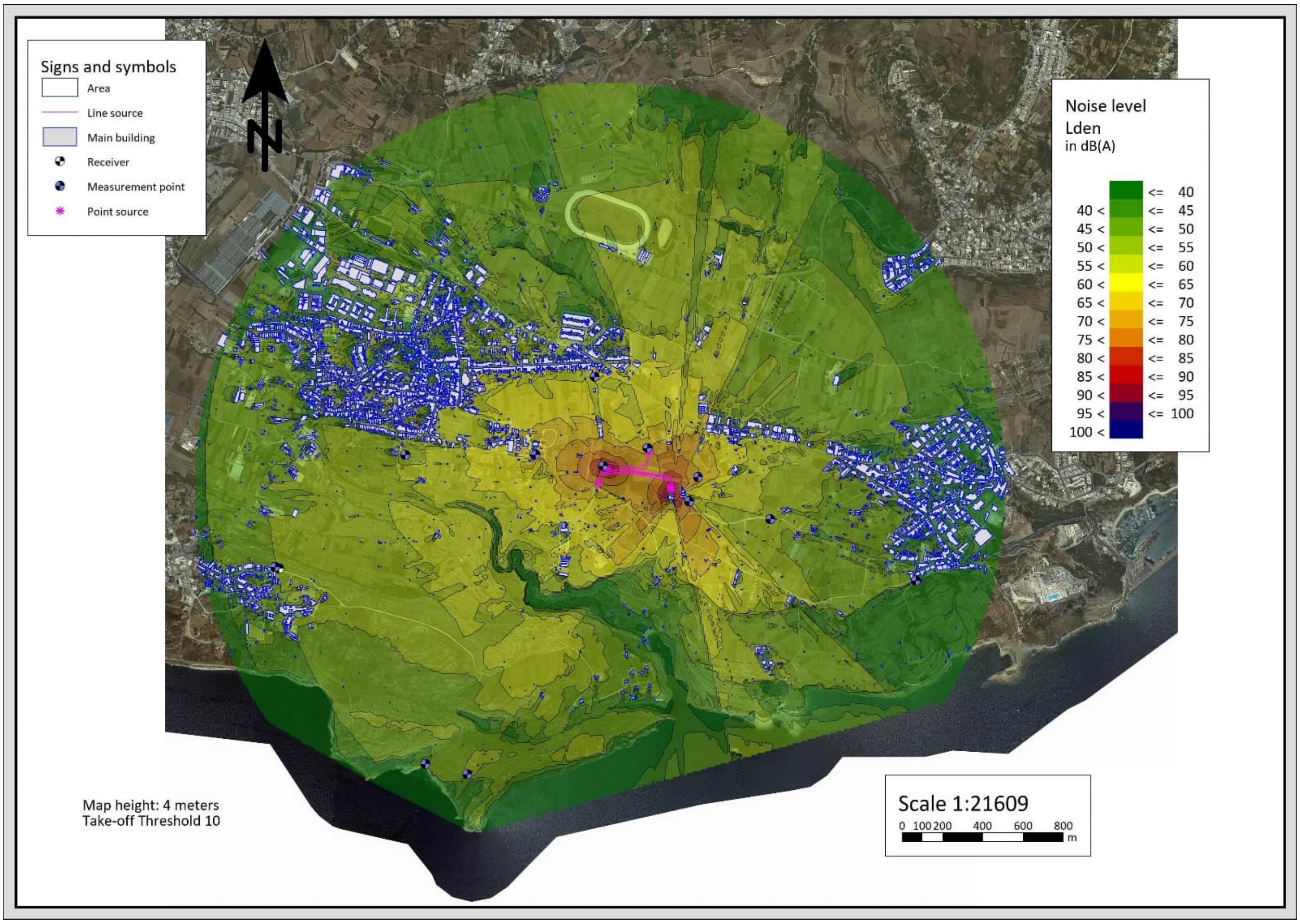


Figure 5-7 L_{den} for take-off from Threshold 10.

Table 5-11 Take-off Threshold 10 - L_{den} receptor calculated results.

Taxi and start of roll from Threshold 10	
Receiver	ISO 9613-2 Calculated Results (dB)
Location	L_{den}
F1	59.6
F2	67.6
F3	34.0
F4	51.9
F5	48.0
F7	53.9
B1	42.4
B2	45.1

Table 5-12 Take-off Threshold 10 - L_{den} number of dwellings exposed.

	Take-off Threshold 10 L_{den}
Noise Contour Level dB	Number of dwellings exposed to level - **Externally**
≥70	0
65 - 69	6
60dB	7
55dB	19
50 - 54	3118

5.3.2. Take-off Threshold 28 L_{den}

Noise contours for ground operations have been produced for the primary assessment metric of L_{den} using the methodology described in Appendix 0 . For the future assessment year, these are based on forecast type of aircraft, Apron usage and taxing to or from Threshold 28 for the start of roll with a weather requirement or otherwise.

Figure 5-8 presents the full set of L_{den} noise contours over a 24-hour period for Threshold 28 usage. To provide further information on changes in the noise environment for specific areas, noise levels have also been calculated at the previously declared receptor locations and height above ground; shown in Table 5-13.

For each noise level band of the contours, the number of dwellings has been determined by geospatial analysis. This has been done based on the existing dwellings declared for residential use, the results of which can be seen in Table 5-14.

The contour results presented in this chapter are not cumulative, e.g. any dwellings within the 55 - 59 dB contour band are not included in the totals for any lower value contour bands.

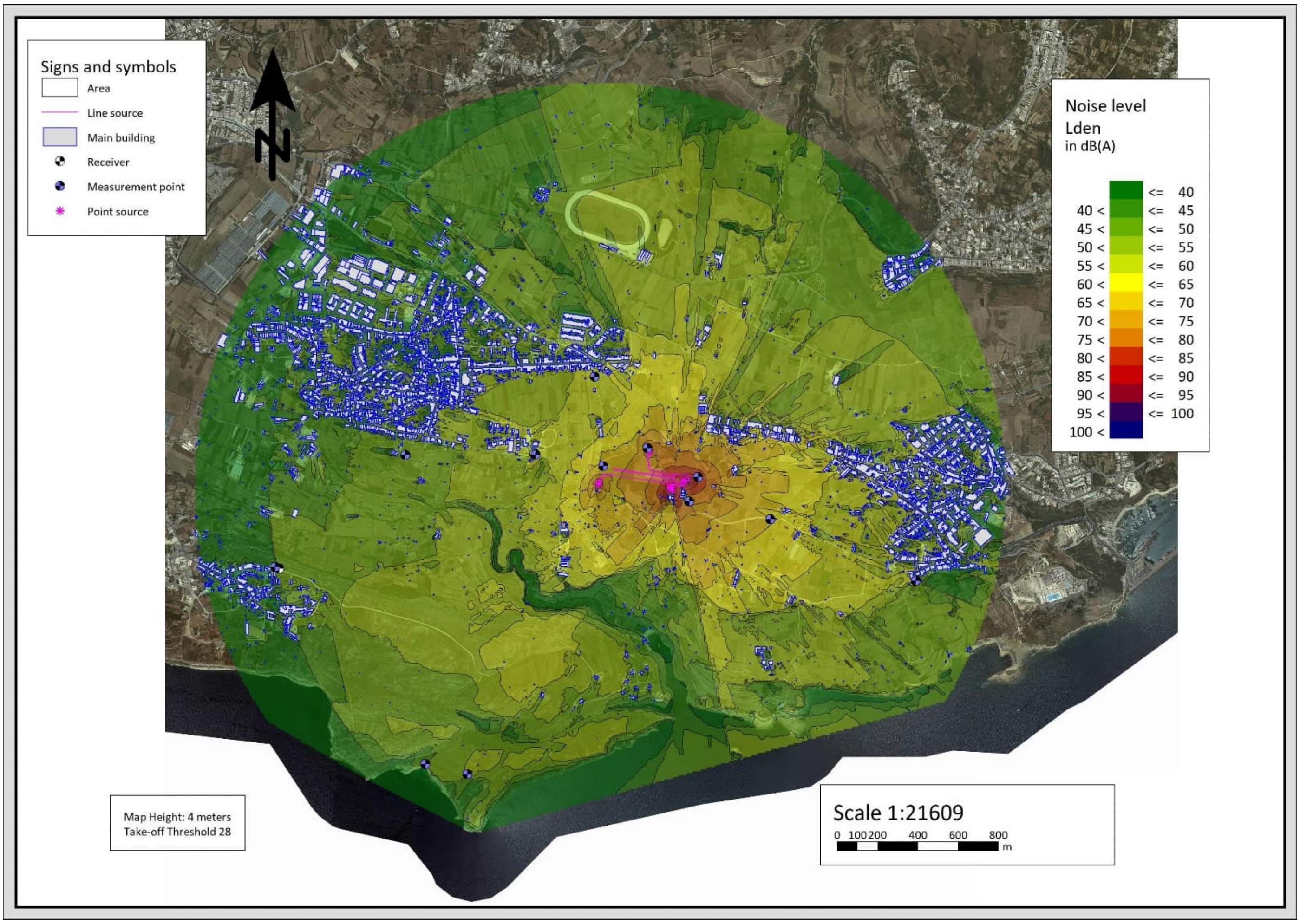


Figure 5-8 L_{den} for take-off from Threshold 28.

Table 5-13 Take-off Threshold 28 - L_{den} receptor calculated results.

Taxi and start of roll from Threshold 28	
Receiver	ISO 9613-2 Calculated Results (dB)
Location	L_{den}
F1	56.9
F2	56.1
F3	42.2
F4	65.5
F5	43.3
F7	47.5
B1	42.3
B2	45.2

Table 5-14 Take-off Threshold 28 - L_{den} number of dwellings exposed.

Noise Contour Level dB(A)	Take-off Threshold 28 L_{den} Number of dwellings exposed to level - **Externally**
≥70	0
65 - 69	1
60dB	4
55dB	17
50–- 54	3128

5.4. Ground Noise – Calculated L_{night}

5.4.1. Take-off Threshold 10 L_{night}

Noise contours for ground operations have been produced for the primary assessment metric of L_{night} using the methodology described in Appendix 0 . For the future assessment year, these are based on forecast type of aircraft, Apron usage and taxing to or from Threshold 10 for the start of roll with a weather requirement or otherwise.

Figure 5-9 presents the full set of L_{night} noise contours over a 24-hour period for Threshold 10 usage. To provide further information on changes in the noise environment for specific areas, noise levels have also been calculated at the previously declared receptor locations and height above ground; shown in Table 5-15.

For each noise level band of the contours, the number of dwellings has been determined by geospatial analysis. This has been done based on the existing dwellings declared for residential use, the results of which can be seen in Table 5-16.

The contour results presented in this chapter are not cumulative, e.g. any dwellings within the 55 – 59 dB contour band are not included in the totals for any lower value contour bands.

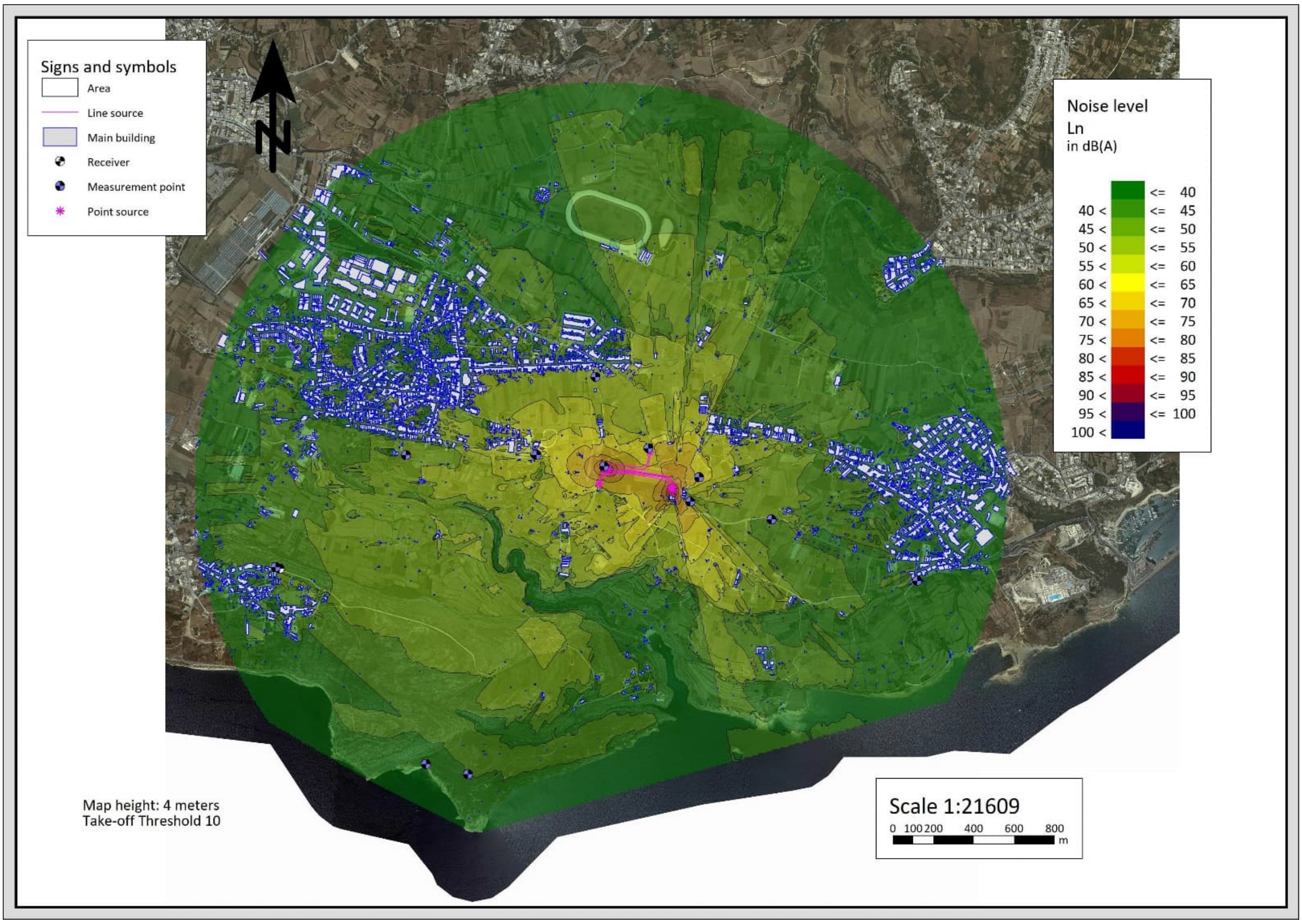


Figure 5-9 L_{night} for take-off from Threshold 10.

Table 5-15 Take-off Threshold 10 - L_{night} receptor calculated results.

Taxi and start of roll from Threshold 10	
Receiver	ISO 9613-2 Calculated Results (dB)
Location	L_{night}
F1	52.6
F2	60.6
F3	26.9
F4	44.9
F5	40.9
F7	46.8
B1	35.4
B2	38.1

Table 5-16 Take-off Threshold 10 L_{night} – number of dwellings exposed.

Noise Contour Level dB	Take-off Threshold 10 L_{night} Number of dwellings exposed to level - **Externally**
≥65	0
60 - 64	0
55dB	8
50dB	13
45 - 49	3129

5.4.2. Take-off Threshold 28 L_{night}

Noise contours for ground operations have been produced for the primary assessment metric of L_{night} using the methodology described in Appendix 0 . For the future assessment year, these are based on forecast type of aircraft, Apron usage and taxing to or from Threshold 28 for the start of roll with a weather requirement or otherwise.

Figure 5-10 presents the full set of L_{night} noise contours over a 24-hour period for Threshold 28 usage. To provide further information on changes in the noise environment for specific areas, noise levels have also been calculated at the previously declared receptor locations and height above ground; shown in Table 5-17.

For each noise level band of the contours, the number of dwellings has been determined by geospatial analysis. This has been done based on the existing dwellings declared for residential use, the results of which can be seen in Table 5-18.

The contour results presented in this chapter are not cumulative, e.g. any dwellings within the 55 - 59 dB contour band are not included in the totals for any lower value contour bands.

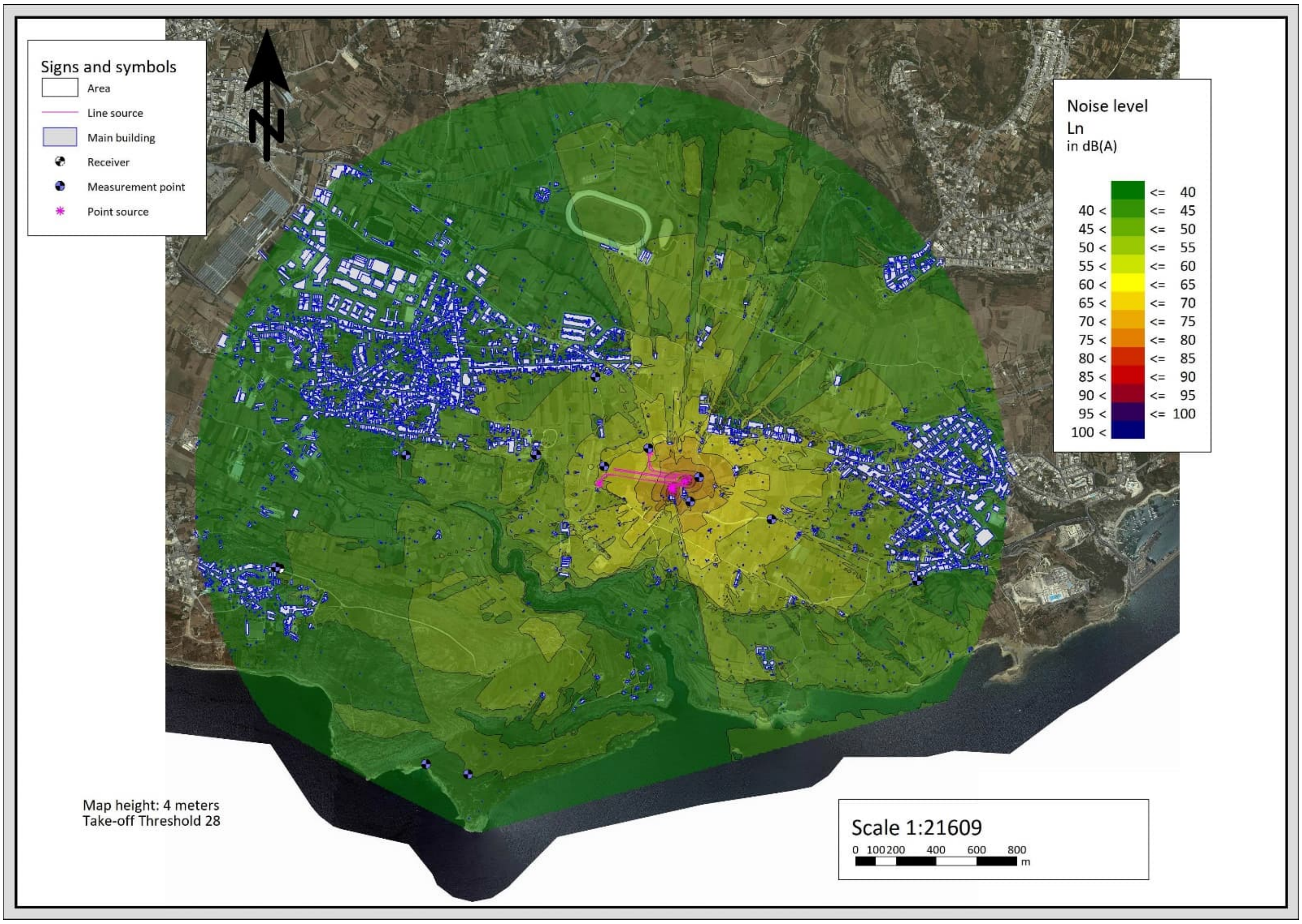


Figure 5-10 L_{night} for take-off from Threshold 28.

Table 5-17 Take-off Threshold 28 - L_{night} receptor calculated results.

Taxi and start of roll from Threshold 28	
Receiver	ISO 9613-2 Calculated Results (dB)
Location	L_{night}
F1	46.8
F2	47.9
F3	35.1
F4	58.4
F5	35.7
F7	39.6
B1	35.1
B2	37.9

Table 5-18 Take-off Threshold 28 L_{night} – number of dwellings exposed.

Noise Contour Level dB	Take-off Threshold 28 L_{night} Number of dwellings exposed to level - **Externally**
≥65	0
60 - 64	0
55dB	1
50dB	11
45 - 49	3138

5.5. Noise Modelling to Inform Construction Effects

A calculation of forecast construction activities has been undertaken according to BS 5228-1:2009+A1:2014 , the resulting L_{day} noise contours as shown in Figure 5-11.

Forecast construction noise levels were also calculated at the designated receptors, they have been logarithmically added to the present-day levels determined by the measurement programme, and the resulting combined levels are presented in Table 5-20.

The construction phase is based on five sources operating variedly but continuously across a 12-hour period. The equipment is based on four dozers and a scarifier operating on the west of the perimeter where most of the earth moving works are required. The apparent sound power (varying speed) and working distance of said sources can be seen in the Table below - Table 5-19.

Table 5-19 Sources used in construction scenario and their relative sound power or level.

Name	Source type	l or A m,m²	L'w dB(A)	Lw dB(A)	63Hz dB(A)	125Hz dB(A)	250Hz dB(A)	500Hz dB(A)	1kHz dB(A)	2kHz dB(A)	4kHz dB(A)	8kHz dB(A)
Dozer 1	Line	277.18	67	91.4	60.6	74.7	74.2	80.6	85.8	89	76.8	64.7
Dozer 2	Line	260.75	67	91.2	60.3	74.4	73.9	80.3	85.5	88.7	76.5	64.4
Dozer 3	Line	531.03	70	97.3	66.4	80.5	80	86.4	91.6	94.8	82.6	70.5
Dozer 4	Line	254.2	67	91.1	60.2	74.3	73.8	80.2	85.4	88.6	76.4	64.3
Scarifier	Line	494.46	83.6	110.5				110.5				

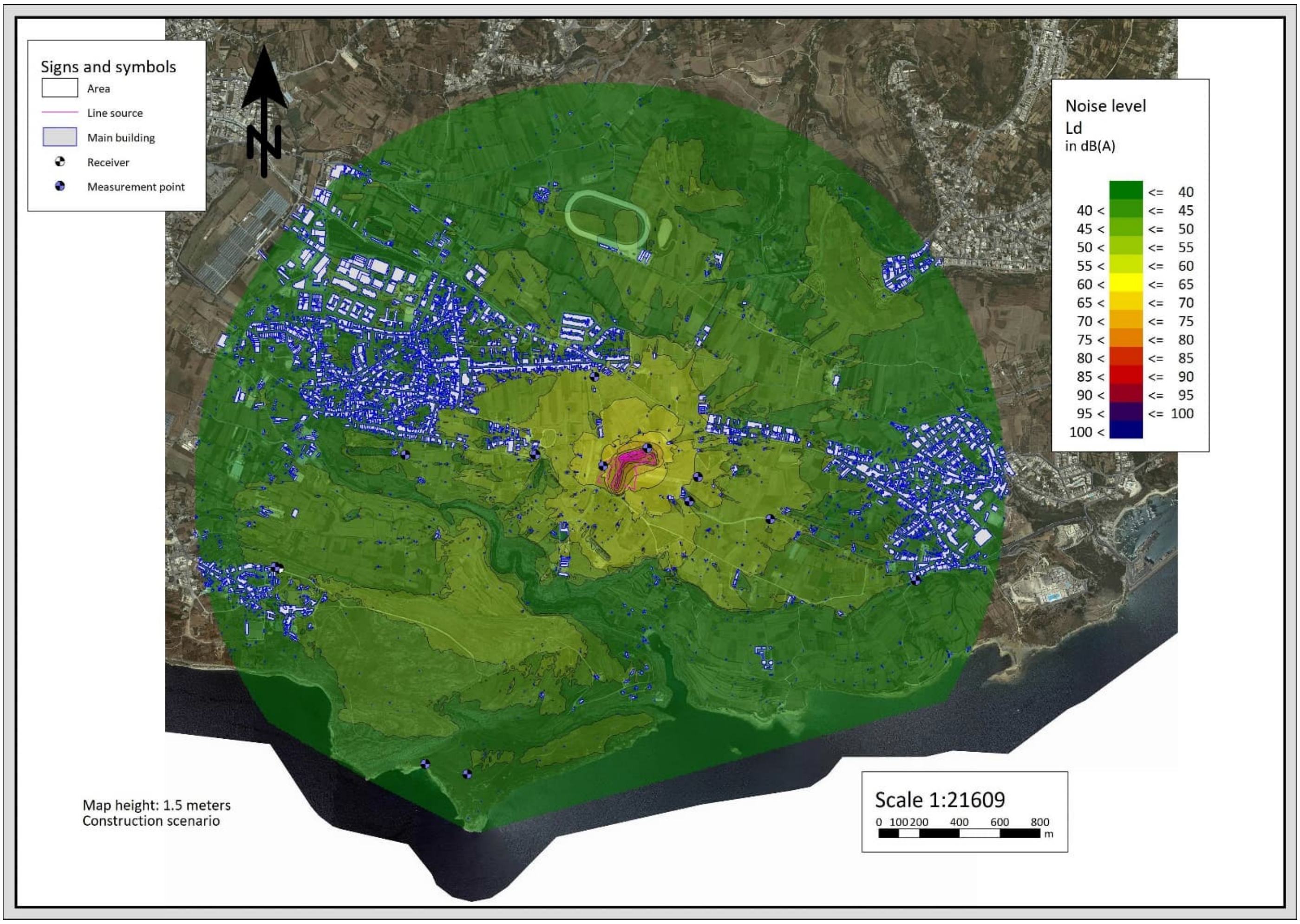


Figure 5-11 L_{day} extent for construction activities.

Table 5-20 Construction receptor construction related noise levels, present levels and the resulting L_{day} combined.

Receiver	Predicted Construction levels (dB)	Measured Present levels (dB)	Resulting noise levels (dB)
Location	L_{day}	L_{day}	L_{day}
F1	52.9	54.8	57.0
F2	51.3	61.2	61.6
F3	26.7	54.4	54.4
F4	47.6	60.1	60.3
F5	43.2	56.7	56.9
F7	43.1	53.3	53.7
B1	31.2	44.6	44.8
B2	33.6	42.9	43.4

6. Assessment of Effects and Significance

This section assesses the future situations that have been forecast to occur with the proposed airfield. Each scenario is compared to the measured metrics.

The proposed movement changes between Scenarios 1 and 2 are solely a re-routing of the night flights i.e. using the shorter circuit to proffer an alternative route for the night flights.

Measurements for B1 and B2 were not conducted at night, hence there is no stated $L_{Amax, night}$. It was noted that during these measurements (B1 and B2) aircraft departing MIA and flying over Gozo were achieving a higher level with a longer duration than general aviation aircraft passing within a thousand feet of the area. Passing boats close inshore were also at a similar level, the frequency of which would likely rise during the summer period.

L_{Amax} contours for both the dispersed situation and undispersed situation are presented. The reason being that the dispersed situation shows the extent of the effect over time, whilst the undispersed situation depicts a typical situation with the aircraft following a tight corridor for take-off and landing.

6.1. Proposed Development Effects – Air Noise

6.1.1. Air Noise - 2025 Scenario 1 - L_{den}, L_{night} and $L_{Amax, night}$

Noise contours have been produced for the primary assessment metrics of L_{den}, L_{night} and $L_{Amax, night}$ using the methodology described in Appendix 0, based on forecast aircraft movements for future assessment year according to Scenario 1.

The results obtained at each designated receptor point are detailed below, including results for the supplementary noise metrics, and are also presented with the following noise contours.

- Figure 6-1 shows the noise contours representing an absolute high impact, 65 dB L_{den} extent from the airfield.
- Figure 6-2 shows the noise contours representing an absolute high impact, 55 dB L_{night}.
- Figure 6-3 shows the noise contours representing the coverage $L_{Amax, night}$ for the 70 dB and 100 dB for a dispersed track analysis, whilst Figure 6-4 represents the same noise contours to show the footprint of an undispersed situation – this would assist in visualising the extent a single air-link aircraft would have during the night.

- Table 6-2 shows the linear level difference for the designated receptors between the modelled and the measured metrics.

The relative impact of L_{den}, L_{day}, L_{night} and $L_{Amax, period}$ is mostly negligible or very low, except in the case of F2 and F7; whereby, F2 ranges from very low to low and F7 ranges from low to high. In the case of $L_{Amax, night}$ the relative level for F2, F3, F4, F6, F7 and F8 range from medium to very high. It should be noted that it is currently proposed to cap movements to two events of this kind during the night. The number of receptor point nighttime events exceeding 70 dB L_{Amax} are given in Table 6-3. Events were noticed up to 01:30 in the morning, and mostly between 04:00 and 07:00, both periods are the times in which the proposed flights will occur. The impact of the resulting dwelling internal L_{Amax} cannot exactly be quantified as the façade insulation average reductions to the housing is unknown.

Table 6-1 Calculated outputs for Scenario 1.

Receiver	Scenario 1 AEDT Calculated Metrics		
Location	L_{den}	L_{night}	$L_{Amax, night}$
F1	47.3	40.6	77.0
F2	61.9	55.3	99.0
F3	48.4	41.6	82.1
F4	54.5	47.6	95.3
F5	37.0	29.8	71.1
F6	48.7	41.7	85.1
F7	55.2	48.6	89.1
F8	49.3	42.8	82.5
B1	38.3	30.8	65.1
B2	38.6	31.1	65.3

Table 6-2 Scenario 1 - difference between calculated and measured levels.

Receiver	Scenario 1 versus Measured Level diff. Calculated vs Measured Metrics		
Location	L_{den}	L_{night}	$L_{Amax, night}$
F1	-10.4	-9.0	-5.9
F2	-1.7	1.4	6.0
F3	-7.4	-5.2	0.6
F4	-7.9	-5.6	9.7
F5	-19.5	-13.4	-18.8
F6	-11.8	-8.1	-0.8
F7	1.6	6.5	12.1
F8	-4.1	-0.4	10.5
B1	-6.1	-13.7	N/A
B2	-4.0	-11.5	N/A

Table 6-3 Measured number of night events at receptor points.

Receiver	Number of external events exceeding 70 dB L_{Amax} over week measurement period -Night Time Only (23:00 to 07:00) *
Location	Qty.
F1	16
F2	429
F3	18
F4	592
F5	48
F6	134
F7	4
F8	2

* *Most of the events are between 04:00 and 07:00*

Figure 6-1 Scenario 1 extent of 65 dB L_{den}.

Figure 6-2 Scenario 1 extent of 55 dB L_{night}.

Figure 6-3 Scenario 1 with dispersed tracks, extent of 70 dB L_{Amax} and highest L_{Amax} from scenario.

Figure 6-4 Scenario 1 single track extent of 70 dB L_{Amax} and highest L_{Amax} from scenario.

A spatial analysis of the number of residential dwellings effected according to the L_{den} and L_{night} under Scenario 1 has been conducted, the results of which are presented below – *Note that the L_{den} and L_{night} limits are 65 and 55 dB respectively.*

Table 6-4 Scenario 1 - Number of dwellings exposed according to L_{den} contours.

Noise Contour Level dB	Scenario 1 L_{den} Number of dwellings exposed to level - **Externally**
≥70	0
65 - 69	0
60dB	5
55dB	100
50dB	198
45dB	855
40 - 44	1002

Table 6-5 Scenario 1 - Number of dwellings exposed according to L_{night} contours.

Noise Contour Level dB(A)	Scenario 1 L_{night} Number of dwellings exposed to level - **Externally**
≥65	0
60dB	0
55dB	1
50dB	62
45dB	179
40 - 44	654

Table 6-6 Scenario 1 - Absolute, relative, and final significance.

Scenario 1 Assessment						
Receiver	Absolute Scale		Relative Scale		Significance	
Location	L_{den}	L_{night}	L_{den}	L_{night}	L_{den}	L_{night}
F1	Very Low	Very Low	Negligible	Negligible	Imperceptible	Imperceptible
F2	Medium	High	Negligible	Very Low	Not Significant	Moderate
F3	Very Low	Very Low	Negligible	Negligible	Imperceptible	Imperceptible
F4	Low	Low	Negligible	Negligible	Imperceptible	Imperceptible
F5	Negligible	Negligible	Negligible	Negligible	Imperceptible	Imperceptible
F6	Very Low	Very Low	Negligible	Negligible	Imperceptible	Imperceptible
F7	Medium	Low	Very Low	High	Slight	Significant
F8	Very Low	Very Low	Negligible	Negligible	Imperceptible	Imperceptible
B1	Negligible	Negligible	Negligible	Negligible	Imperceptible	Imperceptible
B2	Negligible	Negligible	Negligible	Negligible	Imperceptible	Imperceptible

F2 and F7 are the only receptors with a moderate to a significant change in L_{night} levels.

6.1.2. Air Noise - 2025 Scenario 2 - L_{den}, L_{night} and $L_{Amax, night}$

Noise contours for aircraft movements have been produced for the primary assessment metrics of L_{den}, L_{night} and $L_{Amax, night}$ using the methodology described in Appendix 0, based on forecast aircraft movements for future assessment year according to Scenario 2.

The results obtained at each designated receptor point are detailed below including results for the supplementary noise metrics and are also presented with the following noise contours.

- Figure 6-1 shows the noise contours representing an absolute high impact, 65 dB L_{den} extent from the airfield.
- Figure 6-6 shows the noise contours representing an absolute high impact, 55 dB L_{night}.
- Figure 6-7 shows the noise contours representing the coverage $L_{Amax, night}$ for the 70 dB and 100 dB for a dispersed track analysis, whilst Figure 6-8 represents the same noise contours to show the footprint of an undispersed situation – this would assist in visualising the extent a single air-link aircraft would have during the night.
- Table 6-8 shows the linear level difference for the designated receptors between the calculated and the measured metrics.

The relative impact of L_{den}, L_{day}, L_{night} and $L_{Amax, period}$ is mostly negligible or very low except for of F2, F7 and F8; whereby, F2 ranges from very low to low, F7 ranges from low to high and F8 entering the low region. In the case of $L_{Amax, night}$ the relative level for F2, F3, F4, F6, F7 and F8 range from medium to very high. It should be noted that it is currently proposed to cap movements to two events of this kind during the night. The number of receptor point nighttime events exceeding 70 dB L_{Amax} are given in Table 6-9 for reference. Measured events were noticed up to 01:30 in the morning and mostly between 04:00 and 07:00, both periods are the times in which the proposed flights will occur. The impact of the resulting dwelling internal L_{Amax} cannot exactly be quantified as the façade insulation average reductions to the housing is unknown.

Table 6-7 Modelled outputs for Scenario 2.

Receiver	Scenario 2 AEDT Calculated Metrics		
Location	L_{den}	L_{night}	$L_{Amax, night}$
F1	47.2	40.6	77.0
F2	61.5	54.9	99.0
F3	48.4	41.6	82.1
F4	54.5	47.6	95.3
F5	38.0	30.9	71.6
F6	49.8	42.9	85.1
F7	55.5	48.9	89.1
F8	48.5	42.0	82.5
B1	38.6	31.1	65.1
B2	38.8	31.3	65.3

Table 6-8 Scenario 2 - Level differences of calculated versus measured.

Receiver	Scenario 2 versus Measured Level diff. Calculated vs Measured Metrics		
Location	L_{den}	L_{night}	$L_{Amax, night}$
F1	-10.5	-9.0	-5.9
F2	-2.1	3.5	6.0
F3	-7.4	1.1	0.6
F4	-7.9	1.1	9.7
F5	-18.5	0.3	-18.3
F6	-10.7	0.8	-0.8
F7	1.9	7.6	12.1
F8	-4.9	2.4	10.5
B1	-5.9	0.2	N/A
B2	-3.9	0.3	N/A

Table 6-9 Measured number of night events at receptor points.

Receiver	Number of external events exceeding 70 dB L_{Amax} over week measurement period -Night Time Only (23:00 to 07:00)*
Location	Qty.
F1	16
F2	429
F3	18
F4	592
F5	48
F6	134
F7	4
F8	2

* *Most of the events are between 04:00 and 07:00*

Figure 6-5 Scenario 2 extent of 65 dB L_{den}.

Figure 6-6 Scenario 2 extent of 55 dB L_{night}.

Figure 6-7 Scenario 2 with dispersed tracks, extent of 70 dB L_{Amax} and highest L_{Amax} from scenario.

Figure 6-8 Scenario 2 single track extent of 70 dB L_{Amax} and highest L_{Amax} from scenario.

A spatial analysis of the number of residential dwellings effected according to the L_{den} and L_{night} under Scenario 2 has been conducted, the results of which are presented below – *Note that the L_{den} and L_{night} limits are 65 and 55 dB respectively.*

Table 6-10 Scenario 2 - Number of dwellings exposed according to L_{den} contours.

Noise Contour Level dB	Scenario 2 L_{den} Number of dwellings exposed to level - **Externally**
≥70	0
65 - 69	0
60dB	2
55dB	87
50dB	199
45dB	916
40 - 44	976

Table 6-11 Scenario 2 - Number of dwellings exposed according to L_{night} contours.

Noise Contour Level dB	Scenario 2 L_{night} Number of dwellings exposed to level - **Externally**
≥65	0
60 - 64	0
55dB	0
50dB	25
45dB	198
40 - 44	663

Table 6-12 Scenario 2 - Absolute, relative, and final significance.

Scenario 2 Assessment						
Receiver	Absolute Scale		Relative Scale		Significance	
Location	L_{den}	L_{night}	L_{den}	L_{night}	L_{den}	L_{night}
F1	Very Low	Very Low	Negligible	Negligible	Imperceptible	Imperceptible
F2	Medium	Medium	Negligible	Medium	Not Significant	Significant
F3	Very Low	Very Low	Negligible	Very Low	Imperceptible	Imperceptible
F4	Low	Low	Negligible	Very Low	Imperceptible	Not Significant
F5	Negligible	Negligible	Negligible	Negligible	Imperceptible	Imperceptible
F6	Very Low	Very Low	Negligible	Negligible	Imperceptible	Imperceptible
F7	Medium	Low	Very Low	High	Slight	Significant
F8	Very Low	Very Low	Negligible	Low	Imperceptible	Not Significant
B1	Negligible	Negligible	Negligible	Negligible	Imperceptible	Imperceptible
B2	Negligible	Negligible	Negligible	Negligible	Imperceptible	Imperceptible

F2 and F7 are the sole receptor points were the L_{night} is significant.

6.2. Proposed Development Effects – Ground Noise

The following section assesses the effects from the ground operations of the airfield i.e. the aircraft starting up with any ground power units, engine run, taxing, and a final engine run prior to starting roll off.

6.2.1. Ground Noise - 2025 Taxi Point 10 - L_{den} and L_{night}

Noise contours for ground operations have been produced for the primary assessment metric of L_{den} and L_{night} using the methodology described in Section 3.9. For the future assessment years these are based on forecast aircraft movements.

The results for days and nights when Threshold 10 is being used are detailed below.

The extent of the noise contours representing a medium impact of 65 dB L_{den} and 55 dB L_{night} are shown below in Figure 6-9 and Figure 6-10.

Figure 6-9 Take-off Threshold 10 65 dB L_{den} extent.

Figure 6-10 Take-off Threshold 10 55 dB L_{night} extent.

Table 6-13 Take-off Threshold 10 calculated results.

Taxi and start of roll from Threshold 10		
Receiver	ISO1913-2 Calculated Results	
Location	L_{den}	L_{night}
F1	59.6	52.6
F2	67.6	60.6
F3	34	26.9
F4	51.9	44.9
F5	48	40.9
F7	53.9	46.8
B1	42.4	35.4
B2	45.1	38.1

Table 6-14 Take-off from Threshold 10 levels with calculated results versus measured levels.

Taxi and start of roll from Threshold 10		
Receiver	Level diff. Calculated vs Measured Metrics	
Location	L_{den}	L_{night}
F1	1.9	3.0
F2	4.0	6.7
F3	-21.8	-19.9
F4	-10.5	-8.3
F5	-8.5	-2.3
F7	-6.6	-3.0
B1	-11.2	-6.7
B2	-8.3	-5.1

The number of dwellings falling under each level band contour can be seen below.

Table 6-15 Take-off from Threshold 10 L_{den} dwellings exposure.

	Take-off Threshold 10 L_{den}
Noise Contour Level dB	Number of dwellings exposed to level - **Externally**
≥70	0
65 - 69	6
60dB	7
55dB	19
50 - 54	3118

Table 6-16 Take-off from Threshold 10 L_{night} dwellings exposure.

	Take-off Threshold 10 L_{night}
Noise Contour Level dB	Number of dwellings exposed to level - **Externally**
≥65	0
60 - 64	0
55dB	8
50dB	13
45 - 49	3129

When comparing the calculated ground noise results to the present levels, there is an expected significant impact on Location F2 for the L_{den} due to the absolute level exceeding 65dB and a relative change of 4 dB. Whilst an L_{night}

significant change is expected for F1 and a profound change for F2 with respective relative changes of 3 and 6.7 dB – see Table 6-17 below.

Table 6-17 Threshold 10 operations - Absolute, relative, and final significance.

Ground operations: departure vs East (Thr. 10), arrivals from West (Thr. 28) Assessment						
Receiver	Absolute Scale		Relative Scale		Significance	
Location	L_{den}	L_{night}	L_{den}	L_{night}	L_{den}	L_{night}
F1	Medium	Medium	Very Low	Medium	Slight	Significant
F2	High	Very High	Medium	High	Significant	Profound
F3	Negligible	Negligible	Negligible	Negligible	Imperceptible	Imperceptible
F4	Low	Very Low	Negligible	Negligible	Imperceptible	Imperceptible
F5	Very Low	Very Low	Negligible	Negligible	Imperceptible	Imperceptible
F7	Low	Low	Negligible	Negligible	Imperceptible	Imperceptible
B1	Negligible	Negligible	Negligible	Negligible	Imperceptible	Imperceptible
B2	Very Low	Negligible	Negligible	Negligible	Imperceptible	Imperceptible

6.2.2. Ground Noise - 2025 Taxi Point 28 - L_{den} and L_{night}

Noise contours for ground operations have been produced for the primary assessment metric of L_{den} and L_{night} using the methodology described in Section 3.9. For the future assessment years these are based on forecast aircraft movements.

The results for days and nights when Threshold 28 is being used are detailed below.

The extent of the noise contours representing a medium impact of 65 dB L_{den} and 55 dB L_{night} are shown below in Figure 6-11 and Figure 6-12.

Figure 6-11 Take-off Threshold 28 65 dB L_{den} extent.

Figure 6-12 Take-off Threshold 28 55 dB L_{night} extent.

Table 6-18 Take-off Threshold 28 calculated results.

Taxi and start of roll from Threshold 28		
Receiver	ISO1913-2 Calculated Results	
Location	L_{den}	L_{night}
F1	56.9	46.8
F2	56.1	47.9
F3	42.2	35.1
F4	65.5	58.4
F5	43.3	35.7
F7	47.5	39.6
B1	42.3	35.1
B2	45.2	37.9

When comparing the calculated ground noise results to the measured levels, there is a negligible impact – see Table 6-18 below.

Table 6-19 Take-off Threshold 28 level change with calculated results versus measured levels.

Taxi and start of roll from Threshold 28		
Receiver	Level diff. Calculated vs Measured Metrics	
Location	L_{den}	L_{night}
F1	-0.8	-2.8
F2	-7.5	-6.0
F3	-13.6	-11.7
F4	3.1	5.2
F5	-13.2	-7.5
F7	-13.0	-10.2
B1	-11.3	-7.0
B2	-8.2	-5.3

The number of dwellings falling under each level band contour can be seen below.

Table 6-20 Take-off from Threshold 28 L_{den} dwellings exposure.

Noise Contour Level dB	Take-off Threshold 28 L_{den} Number of dwellings exposed to level - **Externally**
≥70	0
65 - 69	1
60dB	4
55dB	17
50 - 54	3128

Table 6-21 Take-off from Threshold 28 L_{night} dwellings exposure.

Noise Contour Level dB(A)	Take-off Threshold 28 L_{night} Number of dwellings exposed to level - **Externally**
≥65	0
60 - 64	0
55dB	1
50dB	11
45 - 49	3138

When comparing the calculated ground noise results to the present levels, there is an expected significant impact on Location F4 for the L_{den} and L_{night} due to; the L_{den} absolute level exceeding 65dB (by 0.5 dB) and a relative change of 3.1 dB. Whilst an L_{night} significant change is expected due to the absolute level exceeding 55 dB and, a relative change of 5.2 dB – see Table 6-22 below.

Table 6-22 Threshold 28 operations - Absolute, relative, and final significance.

Ground operations: departure vs West (Thr. 28), arrivals from East (Thr. 10) Assessment						
Receiver	Absolute Scale		Relative Scale		Significance	
Location	L_{den}	L_{night}	L_{den}	L_{night}	L_{den}	L_{night}
F1	Medium	Low	Negligible	Negligible	Not Significant	Imperceptible
F2	Medium	Low	Negligible	Negligible	Not Significant	Imperceptible
F3	Negligible	Negligible	Negligible	Negligible	Imperceptible	Imperceptible
F4	High	High	Medium	Medium	Significant	Significant
F5	Negligible	Negligible	Negligible	Negligible	Imperceptible	Imperceptible
F7	Very Low	Negligible	Negligible	Negligible	Imperceptible	Imperceptible
B1	Negligible	Negligible	Negligible	Negligible	Imperceptible	Imperceptible
B2	Very Low	Negligible	Negligible	Negligible	Imperceptible	Imperceptible

6.3. Effects with Proposed Development – Construction Noise

Reference to ERA's guidance for environmental noise impact studies, it was decided to use the ABC[15] method to evaluate the impact from the proposed site. From the community measurement results, it was seen that the L_{day} noise level did not exceeded 65 dB, which according to BS 5228-1:2009+A1:2014 would classify as a Category A area. The calculated results were logarithmically added to the measured present levels and negative results are obtained

[15] BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites - Noise

in comparison to the measured present levels at the receptor points, indicating that the calculated construction noise is below the existing measured levels. Thus, the construction noise impact can be considered negligible.

Table 6-23 Construction phase results for each measured receptor point – predicted versus measured.

Receiver	Calculated Construction contribution (dB)	Present measured levels (dB)	Resulting noise levels (dB)	Expected change in level (dB)	'The ABC Method' BS 5228-1:2009+A1:2014 Limit	Construction Noise versus designated limit (dB)	Significance
Location	L_{day}	L_{day}	L_{day}	δ dB	Category	δ dB	
F1	44.0	54.8	55.1	0.3	A – 65 dB	-9.9	Negligible
F2	42.3	61.2	61.3	0.1	A – 65 dB	-3.7	Negligible
F3	15.4	54.4	54.4	0.0	A – 65 dB	-10.6	Negligible
F4	39.4	60.1	60.1	0.0	A – 65 dB	-4.9	Negligible
F5	33.2	56.7	56.7	0.0	A – 65 dB	-8.3	Negligible
F7	34.4	53.3	53.4	0.1	A – 65 dB	-11.6	Negligible
B1	23.8	44.6	44.6	0.0	A – 65 dB	-20.4	Negligible
B2	25.7	42.9	43.0	0.1	A – 65 dB	-22.0	Negligible

6.4. Other Noise Effects from Aircraft and Road Traffic

No specific road traffic study has been conducted with regards to the contributions from the development. However, from a four-day video-capture traffic survey conducted in 2019 on the roundabout on Triq L'Imgarr, vehicle counting has indicated that Triq Ta' Lambert has an average of 1031.5 car movements (Std. Dev. 268.2) per 24 hours.

With the worst-case assumptions that:

- Eight aircraft movements with 20 passengers,
- Ten general aviation aircraft with two persons,
- Two charter flights with fifteen people,

It is possible that up to an additional 260 road traffic vehicle movements would occur. With a 10 log N change of 0.98dB on average, and 1.8 dB change on the higher deviation, both levels are considered negligible changes in terms of noise level contributions.

7. Environmental Design and Management

As the proposed airfield design replaces and upgrades an existing heliport facility, there are no particular environmental procedures or abatement requirements in place. The following procedures have been considered in the proposed design.

This assessment considers the following inherent mitigation effects:

- No general aviation flights prior to 07:00,
- No general aviation flights after sunset,
- Two different routes for the night flights,
- A capped number of flights per day,
- The night flights (23:00 to 07:00) are capped to two flights.

It considers a worst-case scenario with a GPU (Ground Power Unit) which will likely not be used. It does not consider the boundary conditions with the shrubbery in the proposed design. It should be noted that during the test flights conducted over the proposed airfield area (twenty flights with an Islander BN-2T and twenty flights with a light aircraft in a period of three hours) no complaints were received by the authorities.

If a noise problem were subsequently identified at the airfield, then analysis of various measures available to reduce noise could be undertaken, aimed at seeking to identify noise-related measures that achieve maximum environmental benefit most cost-effectively using objective and measurable criteria, in line with the ICAO guidance on the implementation of the balanced approach[16].

[16] Guidance on the Balanced Approach to Aircraft Noise Management, ICAO Doc 9829, 2008.

8. Residual Effects and Conclusions

In view of the overall significance by Location for air noise – see Table 8-1 - Location F2 and F7 (and most likely the immediate surroundings) suffer a moderate and a significant change in noise during the night in Scenario 1, whilst both Locations are expected to have a significant change in noise under Scenario 2 at night. Location F2 is located on part of the land associated with the original war time airfield at this location, which remains designated airfield ground under local policies, and outside the development zones for the old local plans and after planning rationalization. Location F7 is located close to the development zone, so a further gradual divergence on take-off to the south would reduce the effect on this location. Immediate changes in direction from take-off would expose these locations to the aircraft's noise cone.

Table 8-1 Scenario 1 and 2 assessment summaries.

Receiver	Scenario 1 Assessment Significance		Scenario 2 Assessment Significance	
Location	L_{den}	L_{night}	L_{den}	L_{night}
F1	Imperceptible	Imperceptible	Imperceptible	Imperceptible
F2	Not Significant	Moderate	Not Significant	Significant
F3	Imperceptible	Imperceptible	Imperceptible	Imperceptible
F4	Imperceptible	Imperceptible	Imperceptible	Not Significant
F5	Imperceptible	Imperceptible	Imperceptible	Imperceptible
F6	Imperceptible	Imperceptible	Imperceptible	Imperceptible
F7	Slight	Significant	Slight	Significant
F8	Imperceptible	Imperceptible	Imperceptible	Not Significant
B1	Imperceptible	Imperceptible	Imperceptible	Imperceptible
B2	Imperceptible	Imperceptible	Imperceptible	Imperceptible

In the overall scale, the other Locations are expected to have an imperceptible effect. This would not be the case for ground noise - see Table 8-2 – where the effects are seen on Locations F1 and F2 when take-offs are towards the East and F4 when take-offs are towards the West. Given that the dominant wind direction for the Islands is from the Northwest, it is expected that take-offs towards the West would be statistically prominent. Making Locations F2, F7 and F4 most likely susceptible to the overall effects from the development in normal use.

The changes in relative noise levels for said locations range from 1.9 dB to less than 7 dB for L_{night}. It is worth keeping in mind that it typically takes about a 10 dB change in the level of a given noise for people to judge (or perceive) that the sound is now half or double as loud as it used to be.

It is generally considered to take a reduction in noise levels (typically expressed as average noise levels, or L_{Aeq}) of approximately 5 dBA for a community to clearly notice the change and to potentially alter their level of response (e.g., expressed annoyance) to the noise. Smaller reductions (1 to 3 dBA) are generally only clearly noticeable if an immediate change occurs.

Table 8-2 Ground operations from threshold 10 and 28 assessment summaries.

Receiver	Ground operations: departure vs East (Thr. 10), arrivals from West (Thr. 28) Assessment Significance		Ground operations: departure vs West (Thr. 28), arrivals from East (Thr. 10) Assessment Significance	
Location	L_{den}	L_{night}	L_{den}	L_{night}
F1	Slight	Significant	Not Significant	Imperceptible
F2	Significant	Profound	Not Significant	Imperceptible
F3	Imperceptible	Imperceptible	Imperceptible	Imperceptible
F4	Imperceptible	Imperceptible	Significant	Significant
F5	Imperceptible	Imperceptible	Imperceptible	Imperceptible
F7	Imperceptible	Imperceptible	Imperceptible	Imperceptible
B1	Imperceptible	Imperceptible	Imperceptible	Imperceptible
B2	Imperceptible	Imperceptible	Imperceptible	Imperceptible

The $L_{Amax, night}$ metric has been assessed to provide an indication of the likely risk of increased sleep disturbance at the nearby residential areas. It has shown that individual flight movements may result in a short-term event-based change between 0.1 dB to 12 dB $L_{Amax, night}$ compared to the existing measured sound environment.

The number of events presently exceeding 70 dB $L_{Amax, night}$ at receptors were also looked at, and it was shown that the proposed two nighttime flights (or more accurately two movements as they would be one inbound flight, staging for another outbound flight) would increase the number of events at F7 and F8, from the occasional two events to two events every night, based on the week when the environmental measurements were conducted. Locations F7 and F8 are representative of areas where occasional or no events above 70 dB $L_{Amax, night}$ occur. Whereas, at the other assessment locations the existing nighttime events above 70 dB $L_{Amax\ already}$ significantly exceed the two nighttime events expected due to the proposed development (between 6 and 196 depending on location).

The effects of noise on sleep from individual noise events are an important consideration, as recognised by BS 8233. It suggests that a site should not be regarded as negligible risk if the $L_{Amax, F}$ exceeds, or is likely to exceed, 60 dB more than 10 times per night, and that a site should be regarded as high risk if the $L_{Amax, F}$ exceeds, or is likely to exceed 80 dB more than 20 times per night. In view of this guidance, it would suggest that the proposed nighttime flight operations would not be regarded as an additional risk at locations F1 to F6. At Locations F7 and F8 the number of nighttime events above 80 dB L_{Amax} would increase from 0 to 2, which may increase the risk on sleep disturbance, but is not expected to be a high risk.

8.1. Birds and Special Areas of Conservation

The assessment of calculated noise level results for the areas around Ta' Cenc where bird breeding grounds on the cliffs exist indicate that there will be no significant effects. The majority of nesting locations on the cliff face are within the shadow zone of the barrier effect provided by the cliff edge itself, leaving only diffracting artefacts onto the upper areas of the cliff. These would be well below the existing sound levels from the sea below.

During the attended measurements in the locality, it was noticed that aircraft departing MIA had a longer impact on the measurement level than general aviation aircraft passing overhead at 1000 feet. Both noise levels (for each type of aircraft) were exceeded by activity on the ground from passing sparrows. Any activity on the sea was more apparent at B1 (closer to the edge).

No effect of the nesting birds on the cliff are expected in this location due to either noise levels or frequency content from activity associated with the proposed airfield development.

Reference should also be made to *A STUDY OF POSSIBLE IMPACTS ON AVIFAUNA AS A RESULT OF A PROPOSED EXTENSION TO THE EXISTING HELIPORT AIRSTRIP AT XEWKIJA, GOZO* authored by Dr Natalino Fenech PhD in January 2022[17] available from the Gozo Regional Development Authority website.

[17] https://grda.mt/wp-content/uploads/2022/02/Gozo-Airfield_Avifauna-Study.pdf

9. Summary

This document has assessed the likely significant effects from aircraft noise as a result of the proposed airfield development.

Noise associated from the proposed operations has been assessed as two aspects:

- air noise; the noise of the aircraft from roll-off, take-off, landing and in the circuit, and
- ground noise: the noise from the aircraft during start-up, taxiing, final engine run and ground power generators where required.

The following is a summary of the results of the assessment.

9.1. Air Noise

The assessment of air noise has considered future forecast scenarios for the proposed flight times, flight tracks, aircraft types and frequency of operations. Two primary assessment metrics have been considered, one relating to the overall situation (L_{den}) and the other just to the situation at night (L_{night}). For each of these metrics the number of dwellings exposed to various noise levels has been determined for each assessment scenario. From these the absolute and relative noise changes compared to the present noise levels have been determined.

Table 9-1 Summary of significance effects for both Scenarios.

Receiver	Scenario 1 Assessment Significance		Scenario 2 Assessment Significance	
Location	L_{den}	L_{night}	L_{den}	L_{night}
F1	Imperceptible	Imperceptible	Imperceptible	Imperceptible
F2	Not Significant	Moderate	Not Significant	Significant
F3	Imperceptible	Imperceptible	Imperceptible	Imperceptible
F4	Imperceptible	Imperceptible	Imperceptible	Not Significant
F5	Imperceptible	Imperceptible	Imperceptible	Imperceptible
F6	Imperceptible	Imperceptible	Imperceptible	Imperceptible
F7	Slight	Significant	Slight	Significant
F8	Imperceptible	Imperceptible	Imperceptible	Not Significant
B1	Imperceptible	Imperceptible	Imperceptible	Imperceptible
B2	Imperceptible	Imperceptible	Imperceptible	Imperceptible

Using a significance scale related to both changes it has been found that for all the receivers except F2 and F7 the magnitude of effects is imperceptible or insignificant. (See Table 9-1)

In Scenario 1, F2 and F7 can be seen to be expected to experience a moderate and significant effect, this is due to the change relative to the measured present noise levels, and not because of the absolute level. These relative changes have been found to be: 1.42 and 6.5 dB L_{night}, In Scenario 2, F2 and F7 can be seen both to be expecting to experience a significant effect, this is again due to the change relative to the measured present noise levels, and not because of the absolute level. These relative changes have been found to be 3.5 and 7.6 dB L_{night}.

The $L_{Amax, night}$ metric has been assessed to provide an indication of the likely risk of increased sleep disturbance at the nearby residential areas. It has shown that individual flight movements may result in a short-term event-based change between 0.1 dB to 12 dB $L_{Amax, night}$ compared to the existing measured sound environment.

The effects of noise on sleep from individual noise events are an important consideration, as recognised by BS 8233. It suggests that a site should not be regarded as negligible risk if the $L_{Amax, F}$ exceeds, or is likely to exceed, 60 dB more than 10 times per night, and that a site should be regarded as high risk if the $L_{Amax, F}$ exceeds, or is likely to exceed 80 dB more than 20 time per night. In view of this guidance, it would suggest that the proposed nighttime flight operations would not be regarded as an additional risk at locations F1 to F6. At Locations F7 and F8 the number of nighttime events above 80 dB L_{Amax} would increase from 4 to 6 and 2 to 4 respectively, which may increase the risk on sleep disturbance, but is not expected to be a high risk.

9.2. Ground Noise

The assessment of ground noise associated with operation of the airfield has considered taxiing and the use of ground power units.

Two primary assessment metrics have been considered, one relating to the overall situation (L_{den}) and the other just to the situation at night (L_{night}). For each of these metrics the number of dwellings exposed to various noise levels have been determined for each assessment scenario.

An assessment of significant effects has also been carried out based on the comparison between the calculated levels for the assessment scenarios and the measured present noise levels. The assessment has considered the change in noise level for individual receptor points, and the significance based on both absolute and relative levels. Significant effects were found in the assessment scenarios for ground noise, the point locations were assessed as being significant and profound at Location F2 for both L_{den} and L_{night}; and significant for F1 during the night when departure operations for the day were towards the East. For departures towards the West (the most likely occurrence due to the island's dominant wind being from the Northwest), it can be expected that Location F4 will see a significant effect.

Table 9-2 Summary of ground operations significance assessment.

Receiver	Ground operations: departure vs East (Thr. 10), arrivals from West (Thr. 28) Assessment Significance		Ground operations: departure vs West (Thr. 28), arrivals from East (Thr. 10) Assessment Significance	
Location	L_{den}	L_{night}	L_{den}	L_{night}
F1	Slight	Significant	Not Significant	Imperceptible
F2	Significant	Profound	Not Significant	Imperceptible
F3	Imperceptible	Imperceptible	Imperceptible	Imperceptible
F4	Imperceptible	Imperceptible	Significant	Significant
F5	Imperceptible	Imperceptible	Imperceptible	Imperceptible
F7	Imperceptible	Imperceptible	Imperceptible	Imperceptible
B1	Imperceptible	Imperceptible	Imperceptible	Imperceptible
B2	Imperceptible	Imperceptible	Imperceptible	Imperceptible

9.3. Cumulative Noise

The assessment of cumulative noise impact has considered the combination of air noise and ground noise from the proposed airfield operations, together with road traffic noise. In accordance with standard industry practice, it is generally not considered appropriate to combine the noise levels from different noise sources for assessment purposes, as they have different characteristics, and as such there are no current standards or guidance available to assess the effects of the in-combination noise levels. However, information is provided on their relative contributions to the overall noise environment at representative locations, and the conclusions are in line with those for the assessments of individual noise sources, which no significant effects within the development zone from ground operations depending on the day operating threshold, and significant effect for two receptors, F2 and F7, closest to the airfield at night – between Triq it-Torri Gorgun and Triq Tal Kanal - albeit having an absolute noise level within the 55 dB L_{night}, but with a change relative to the present situation ranging from 1.9 dB to 6.7 dB.

9.4. Vibration

No significant vibration effects are expected as a result of the proposed development.

9.5. Birds and Special Areas of Conservation

No effect of the nesting birds on the cliff are expected in this location due to either noise levels or frequency content from activity associated with the proposed airfield development. The airfield which is proposed to be developed is also currently designated as a bird sanctuary, which appears to be at odds with its current use as an operating heliport, and possibly something which should be reviewed.

9.6. Other sources

Traffic noise due to additional vehicles associated with the proposed use of the airfield has been assessed as an incremental change to the existing traffic flows counted in the nearby area. The additional vehicles are expected to be small in nymber compared to the present traffic flows, therefore leading to no significant impact from road traffic noise.

9.6.1. Unconventional aircraft

The PDS suggests the possible use of drones (UAV, UTM), eVTOL, hybrid and electric aircraft operating from proposed Apron 3. These aircraft have not been included in this study as there are currently no detailed proposals for the type of aircraft which could be used, or the frequency of operation. Furthermore, the material subject is still under study for what the impacts could be – no guidance presently exists -but there are qualifying factors by means of classification and licensing for the control of the noise emitted by drones. For the classification of UAS, vehicles are separated into different categories depending on a number of factors, including (but not limited to) weight, size, purpose and proximity of use to human populations. These categories are called Open (low-risk operations), Specific (moderate risk) and Certified (high risk) within the EU. Depending on the classification of the UAS the noise certification method is different.

Experimental drones would require TM-CAD UAS Certification which will be guided by EASA *Guidelines on Noise Measurement of Unmanned Aircraft Systems Lighter than 600 kg Operating in the Specific Category (Low and Medium Risk)*[18], whereby, the use of L_{Aeq} and L_{AE} (also known as SEL) are the metrics describing the hover and level flight manoeuvres. The Certified category guidelines have gone through the consultation phase and do propose the combination of L_{Aeq} and EPNL metrics for the hover and moving manoeuvres.

TM-CAD would also need to designate new geographical areas and tracks for their operation (there are such areas designated for Malta). It is suggested that such new tracks would look at the special areas of conservation, other environmentally sensitive areas, and residential areas.

[18] https://www.easa.europa.eu/en/document-library/product-certification-consultations/guidelines-noise-measurement-unmanned-aircraft

Appendices

1 Appendix 1 - Gozo Airfield Project Noise Model Description

1.1 Introduction

This appendix describes the characteristics of the noise model used to simulate noise impact of the proposed airfield in Gozo and related air operations.

The software model used is Aviation Environmental Design Tool (or AEDT) version 3e, a software developed by and maintained by the US Federal Aviation Administration (FAA). Besides being able to provide noise modelling, AEDT is also capable of outputting gas emission and dispersion assessments and models.

As most aviation noise simulation tools, AEDT is compliant with ECAC.CEAC Doc 29 4th Edition Volume 3 Part 1, and comprises a series of tools that allow to:

Define:

- a georeferenced model of the runway, airfield, or airport
- tracks for take-offs, approaches, touch-and-goes, circling, etc.
- air operations for both aircraft and helicopters
- weather conditions and terrain
- receptor points and grids of receptors
- desired output metrics

Model:

- individual operations
- groups and combinations of operations

Visualize and export:

- noise level at receptor points for selected metrics
- contour lines for selected metrics.

1.2 Model description.

AEDT is a quite complex software system, which conceptually inherits from two historical (a now discontinued) software suites provided by the FAA, namely:

- INM - Integrated Noise Model, which was used to model noise impacts from airports and air operations.
- EDMS - Emissions and Dispersion Modelling System, which provided numerical evaluations of gas emissions from aircraft and the expected concentrations on the ground.

Even if providing features comparable to today's software, INM and EDMS required distinct modelling efforts, thus proved to be impractical to be created and updated for large airports.

AEDT, on the other hand, can output maps and assessments for both noise and gas emission and dispersion with the same modelling process.

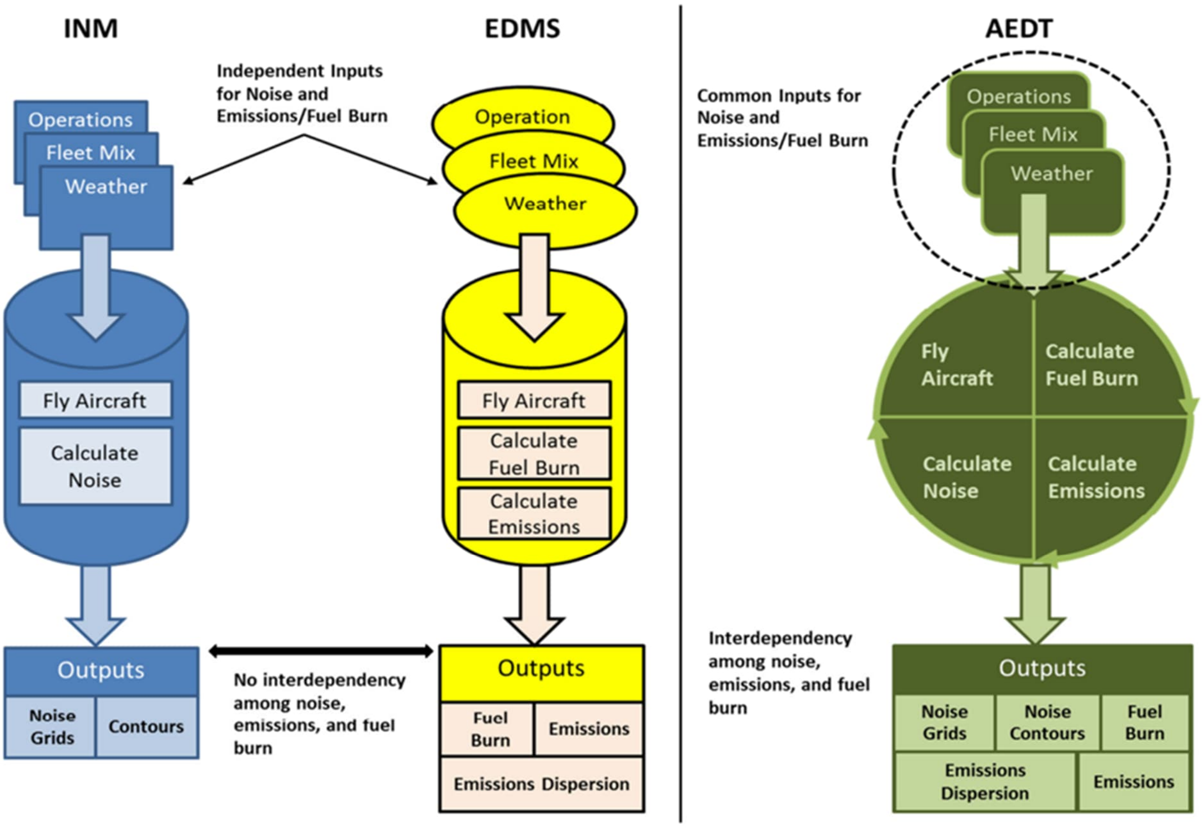


Figure 1-1 Comparison between legacy FAA's software INM/EDMS and FAA's AEDT.

AEDT runs on Microsoft Windows™ operating system, and for storing all data uses Microsoft SQL Server™, which needs to be installed either on the same machine or on an accessible server.

For very large or complex models, the calculation step can be distributed across a number of auxiliary computers.

1.2.1.1 Aircraft database

AEDT provides an underlying set of databases for all available aircraft, which include:

- aircraft dimensions and geometry
- kinematics
- dynamics

for all operation types and flight conditions, encompassing all stages of flight.

This data can be retrieved from two distinct databases, known as ANP and BADA, respectively.

1.2.1.2 Input data

1.2.1.2.1 Runway(s)

Runways are the backbone for all subsequent definitions, and are essential to define an airport or an airfield which AEDT can use to run any model.

In AEDT, a runway is a simple geo-referenced segment, meaning it needs to be encompassed by two geo-referenced points representing the runway ends.

Thresholds can be displaced relative to the runway ends to reflect the markings on the physical runway.

Similarly to the common use, runway ends are identified by a two-digit number between 01 and 36, representing the runway orientation as seen from the respective end, rounded to the nearest 10 degrees, and truncating the last digit, plus an optional letter to distinguish parallel runways.

1.2.1.2.2 Tracks

Generally speaking, tracks are the projection on the horizontal plane of the three-dimensional path covered by an aircraft during its air or ground movements. Tracks have therefore no intrinsic vertical information.

In the realm of airport noise (and air quality) simulation a track can be either the representation of a real-world track or a planned one.

Planned tracks are typically designed to model the paths foreseen in AIPs, which in turn should represent the average path of aircraft.

However, due to a number of factors like weather conditions or overall performance, aircraft cannot precisely follow tracks and considering a large number of flight movements a dispersion can be observed around the official paths.

To make the simulation more compliant with reality, that dispersion can be modelled by means of sub-tracks, designed around the main tracks. Both the main track and the sub-tracks carry a fraction of the traffic in such a way that the sum of the traffic of all sub-tracks and the main track equals the original traffic.

Sub-tracks therefore produce no change on the number of movements but can help simulate more accurately the effects on noise levels at receptors, due to the adjustments in lateral distance.

It is to be noted that lighter aircraft tend to incur into larger track dispersion than heavier wide-bodied aircraft.

1.2.1.2.3 Sub-tracks

In this case a good practice, also foreseen by the Environmental Noise Directive - Appendix C[19], is that to create sub-tracks around the nominal one according to a Gaussian distribution and assign to each sub-track a fraction of the foreseen operations.

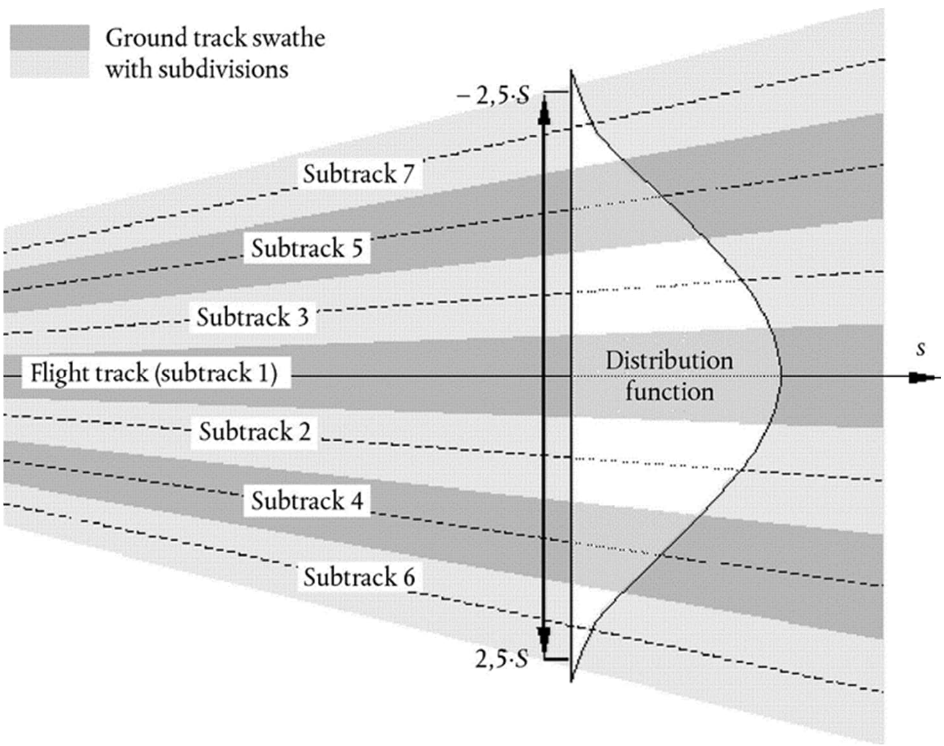


Figure 1-2 Scheme of the sub-track dispersion around the central one in the case of 7 sub-tracks.

19 https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX%3A02002L0049-20150702#tocId117

Ground tracks will be therefore represented as a group of symmetrical sub-tracks, starting from the central one, which will be assigned the highest percentage of operations, and moving on to the side ones, with less and less percentage assignment.

In the common cases of 5 or 7 sub-tracks, the percentage assigned to each is summarized in the following table:

Subtrack Number	Percentage of movements		Location of subtracks	
	5 subtracks	7 subtracks	5 subtracks	7 subtracks
1	38,6 %	28,2 %	0	0
2/3	24,4 %	22,2 %	± 1,00·S	± 0,71·S
4/5	6,3 %	10,6 %	± 2,00·S	± 1,43·S
6/7		3,1 %		± 2,14·S

1.2.1.2.4 Vertical profiles

The vertical complement to (horizontal) tracks, are vertical profiles, which define the vertical variation of a specific aircraft taking into consideration a number of factors, among which the weight of the aircraft (including an estimation of the fuel weight based on the expected or declared flight range), engine performance, flaps and slats use, etc.

Vertical profiles also must consider regulatory restrictions imposed by AIPs, and as such play a crucial role in noise abatement procedures put in place by airport operators to reduce noise exposure of populated areas.

In AEDT, as in all simulation engines, vertical profiles are usually retrieved from official FAA/EASA databases, which for most aircraft models provide a number of different profiles to choose from.

1.2.1.2.5 Terrain

While not a primary issue in flat areas, terrain can play an important role in orographically complex regions.

In the field of aircraft noise, the main effect of a hilly terrain is that of changing the source-receiver distance, while noise absorption and reflection have a minor role. This effect can be easily observed while looking at the noise contours produced by a simulation: in areas with vertical displacements (hills and valleys), contours display distortions similar to the ones which affect elevation contour lines.

In Gozo, for example, this effect can be clearly seen in the southern side of the contours, where the height variation of the terrain, combined with the track curvature, creates distinct feature alterations.

1.2.1.2.6 Weather

AEDT can use a number of weather input sources, depending on the availability of the data gathered in the previous years.

Complex models are generally not easily obtainable, and their use makes sense especially when the precise distribution of flight operations, including day of the year, timing, and take-off weights are known, i.e. for modelling actual, past years.

In the case of forecast scenarios, where the exact movement profiles are only a rough estimate, simpler models are usually adopted in order to avoid the introduction of further uncertainties and to make the model more reproducible.

To provide an historical comparison, earlier aircraft noise modelling software (including FAA's INM, the direct predecessor of AEDT) only foresaw the use of simple weather models.

1.2.1.2.6.1 ISA Weather

ISA Weather represents a conceptual framework, illustrating a perfect atmospheric condition, as formulated by the International Civil Aviation Organization. It's a model stripped of elements like water vapour, wind, and air turbulence. This framework establishes baseline measurements for attributes such as pressure, density, viscosity, and temperature, which are noted at varying levels of altitude. Essentially, it provides a tabular overview illustrating the variations of these atmospheric properties across different heights.

ISA Weather therefore remains constant across seasons and geographical locations, influenced solely by changes in altitude. In this model, the normative values for pressure and temperature at sea level are set at 1,013.25 millibars and 15°C, respectively. With increasing elevation, there's a reduction in atmospheric pressure and a corresponding decline in temperature, following a fixed rate known as the standard temperature lapse rate, which is about a 2°C decrease for every ascent of a thousand feet, valid up to an altitude of 36,000 feet. Beyond this threshold, the temperature remains relatively stable up until about 65,600 feet. However, this standard lapse rate can alter with the introduction of moisture.

Being Gozo at an altitude of about 320 ft, ISA Weather uses almost the basic reference conditions.

1.2.1.2.6.2 Airport Weather

The default method is also a simple one, which take into account the average weather conditions across the years for the specific airport location. In addition to average temperature and humidity conditions, it is possible to specify the average wind speed and direction.

The database provided with AEDT provides average weather data for airports, cataloguing yearly averages for the latest decade and providing a cumulative 10-year rolling average. The weather information integrated into this database is sourced from the latest available records from the National Oceanic and Atmospheric Administration's Integrated Surface Database (ISD), aligned with the timing of each AEDT update.

This is the Weather model used for calculating the scenarios of the present study.

1.2.1.2.6.3 High Fidelity Weather

In advanced modelling software like AEDT, aircraft noise is modelled as a sequence of segment sources along the 3D operation path; for each of the segments, the average position, speed, acceleration, thrust and other factors are taken into account.

High fidelity weather can be conceived as a 4D grid which maps weather conditions (in particular; temperature, humidity, wind speed and direction) in the 3D space (longitude, latitude, and altitude) and in time.

This allows to also derive the precise atmospheric conditions for each segment of the modelled aircraft position, thus contributing to a very high degree of physical accuracy of the model.

High Fidelity Weather have not been easy to obtain and validate especially outside the USA territories, however the latest generation of satellite data has started to provide means to map HFW globally and should be made available in the upcoming years.

1.2.1.2.7 Operations

The AEDT models the various phases of aircraft operations, each distinct in terms of aircraft performance and noise emission. The main phases include take-off, landing, cruise, and taxiing, capturing the complete lifecycle of a flight from departure gate to arrival gate. This comprehensive modelling allows for the complete representation of aircraft emissions, fuel consumption, and noise pollution across different stages of flight.

During the take-off phase, the AEDT models the aircraft's acceleration along the runway and its ascent until it reaches a predefined altitude. This phase is characterized by high engine power and thrust settings, leading to significant noise generation.

In contrast, the landing phase is modelled from the point the aircraft begins its descent until it comes to a complete stop on the runway. This phase involves a reduction in engine power as the aircraft prepares for touchdown, followed by the use of braking and optionally of reverse thrust to decelerate.

The cruise phase represents the aircraft's journey at a stable altitude and is marked by optimized fuel efficiency and reduced noise compared to take-off and landing. From the strict point of view of noise analysis, this is the least impacting phase, since it takes place at higher altitude, thus very far from the receivers on the ground.

Lastly, the taxiing phase, which occurs both before take-off and after landing, involves the aircraft moving on the ground at low speeds. This phase is important for assessing noise emissions at ground level, which however only affects the are immediately around airports.

1.2.1.2.8 Aircraft Substitutions

AEDT aircraft database and Eurocontrol's BADA[20] (Base of aircraft data) provide and impressive number of models, including hundreds of equipment, i.e. variations taking into account the airframe, possible number, model and type of the engine, noise improvements, etc.

Since each of the entry in those databases derives from a standardized measurement procedure which is expensive and time intensive, only the most widespread aircraft models are present and the number of existing variations by far surpasses those available. This does not mean that some aircraft cannot be modelled, but a careful analysis is needed when an aircraft is not directly available in AEDT's database, in order to find out which among the provided AC models is the closest to the needed one. This approach is called "substitution" and is the official method to deal with aircraft not defined in the database.

In several cases, FAA or other agencies indicate official substitutions, e.g. for aircraft of the same models and similar engines, or for different aircraft with similar characteristics. In other cases, the modeller needs to identify which aircraft to use based on a similarity analysis of frame type, wing placement, engines, weight, etc.

[20] https://www.eurocontrol.int/model/bada

1.2.1.2.9 Annualization

In AEDT it is possible to define aircraft operations in a number of ways, including:

- single operations with a defined AC model, date and time,
- weighted groups of operations,

conditional operation profiles, depending for example on recorded weather conditions for each moment of the year.

An Annualization is an operation which combines different types of operation definitions into a standardized, processable list. The Annualization method is useful to analyse different options, for example assigning different weightings to each group/profile in order to compare several scenarios.

1.2.1.2.10 Metrics definitions

Since AEDT is developed by the United States FAA, the available metrics are either the standard "physical" ones (EPNL, LAEQ, SEL, TAUD) or those mostly defined by regulations in the Anglosphere (CNEL, NEF, etc).

In order to comply with the European Union standards, two additional metrics (LDEN and LDEN night) were defined:

Metric Name	Metric Type	User Defined
CDNL	Noise	No
CEXP	Noise	No
CNEL	Noise	No
DNL	Noise	No
EPNL	Noise	No
LAEQ	Noise	No
LAEQD	Noise	No
LAEQN	Noise	No
LAMAX	Noise	No
LCMAX	Noise	No
NEF	Noise	No
PNLTM	Noise	No
SEL	Noise	No
TALA	Noise	No
TALC	Noise	No
TAPNL	Noise	No
WECPNL	Noise	No
LDEN	Noise	Yes
LDENn	Noise	Yes

For a given scenario, any number of defined metrics can be calculated.

1.3 Scenarios

For each airport defined in AEDT it is possible to evaluate different layouts, for example to check the effect of several runway orientations, and scenarios.

The term "scenario" is actually a legacy from the previous software produced by FAA, namely INM, and while AEDT does not directly offer an option to create scenarios, it is possible to create more subtle combinations of layouts, group of operations, operational profiles and annualizations. These still go under the common name of "Scenario", as it is a term easily understood at all levels.

1.3.1 Scenario 1

The selected scenario for the modelling of the Gozo airfield serves as the baseline for any upcoming modification or alternative scenario and is based on the information provided by the stakeholders during the beginning phase of the project and gathered on the field during the following months.

1.3.1.1 Assumptions

Since the airfield is not yet operative, all the data used to create the simulation are forecasts of future usage scenario, therefore it is recommended to perform a check on the assumptions after the first year of operation, when actual data will have been gathered.

1.3.1.2 Aircraft in use and substitutions

The following table shows the aircraft used in the simulation, whether they are the actual model or an AEDT substitution[21], and in case which substitute was used, along with the engine reference.

To ease the reading, the table is subdivided in fixed wing aircraft (airplanes) and rotary ones (helicopters).

[21] https://aedt.faa.gov/Documents/AEDT_2b_FAQ_and_knowledge_base.pdf

Fixed Wing/ Helicopter	Aircraft	Is Substitution	AEDT Default/Suggested Substitution	Substitution ID	AEDT /Substitution Aircraft	Engine
Fixed Wing	Britten-Norman BN-2B Islander	Yes	Yes	6219_PA31	PIPER NAVAJO CHIEFTAIN PA-31-350 / TIO-540	RR 250B17B
	Cessna 172	No	Yes	1267_CNA172	Cessna 172	O-320
	Cessna Caravan	No	Yes	6169_CNA208	Cessna 208 Caravan	PW PT6A-135A
	Daher Kodiak	Yes	Yes	4672_CNA208	Cessna 208 Caravan	PW PT6A-34
	GippsAero G-8 Airvan	Yes	Yes	6297_GASEPV	GASEPV	TIO-540-J2B2
	Pilatus PC-6 Porter	Yes	Yes	6297_GASEPV	GASEPV	TIO-540-J2B2
	Piper Cherokee PA-28	Yes	Yes	2102_GASEPF	GASEPF	IO-360-B
	Tecnam P-92 and P-2002	Yes	No	2102_GASEPF	GASEPF	IO-360-B
	Tecnam P2012 STOL	Yes	Yes	6532_BEC58P	Baron 58P	TIO-540-J2B2
Helicopter	AW139	Yes	Yes	4116_SA330J	Aerospatiale SA 330J Puma (Note_1)	T700-GE-401
	Bell 505	Yes	Yes	4117_SA341G	Aérospatiale SA 341G Gazelle	PT6A-27
	EC135	Yes	Yes	3806_EC130	Eurocopter EC130 (Note_2)	TPE331-3

1.3.1.3 Operations

Starting from a table structure similar to the one presented in the previous chapter, the yearly and daily movements are shown[22] .

The number of yearly movements represents the best possible estimate at the time of writing, and it is to be noted that while some movement groups (notably the "Scheduled Service Flights") are expected to be quite consistent, some other are extrapolated from the data of the previous years, taking into account the anticipated possible expansion due to the availability of the extended runway.

The number of daily movements is subsequently derived by dividing the yearly movements by 365, while respecting the day/evening/night subdivision.

Overall, the average daily movements are just under 25.6 movements/day, and the number will be capped at 50. The capping is expected to be applied especially during summer weekends, when larger number of GA movements are anticipated.

[22] References:

- Ref_1: ERA Noise Study, Q_A Appendices
- Ref_2: Email of 10/03/23
- Ref_3: Zoom call 10/10/23

Notes:

- Note_1: Movements (A + D) are double the number of sorties.
- Note_2: Ref_1 reports 50D +25N.
- Note_3: Ref_1 reports 100D +50N.
- Note_4: GA movements will need confirmation after the first operational year.

Movements												
Group	Fixed / Helo	AC Type	Engine	AEDT Substitution	Group %	Notes / Reference	Yearly			Daily		
							D	E	N	D	E	N
Scheduled Service flights	F	Britten-Norman BN-2B Islander	Two Avco-Lycoming reciprocating engines	SF1_PA31	100%	Ref_1, Note_1	2.290		730	6,27		2,00
		Britten-Norman BN-2T Islander	Two Rolls-Royce/Allison turbine engines	SF1_PA31	0%							
Charters	F	Tecnam P2012 STOL	Two Avco-Lycoming reciprocating engines	CH1_BEC58P	20%	Ref_1, Note_1	2.190		730	6,00		2,00
		Daher Kodiak	Single Pratt & Whitney PT-6 turbine engine	CH2_CNA208	20%							
		Cessna Caravan	Single Pratt & Whitney PT-6 turbine engine	CH3_CNA208	20%							
		Pilatus PC-6 Porter	Single Pratt & Whitney PT-6 turbine engine	CH4_PA28	20%							
		GippsAero G-8 Airvan	Single Avco-Lycoming reciprocating engine	CH5_GASEPV	20%							
Ambulance	H	EC135	Twin turboshaft engines	AM1_EC130	100%	Ref_1	141		57	0,39		0,16
AFM – F	F	Britten-Norman BN-2B Islander	Two Rolls-Royce/Allison turbine engines	MI1_PA31	100%	Ref_2, Note_1 & 2	144			0,39		0,00
AFM – H	H	AW139	Twin turboshaft engines	MI2_SA365N	100%	Ref_2, Note_1, Note_3	144			0,39		0,00
			Single turboshaft engine	MI2_SA365N	0%							
GA	F	Tecnam P92	Single Rotax 912 reciprocating engine	GA1_GASEPF	20%	Ref_3, Note_1, Note_4	2.920			8,00		
		Cessna 172	Single Avco-Lycoming reciprocating engine	GA2_CNA172	16%							
		Piper Cherokee PA-28	Single Avco-Lycoming reciprocating engine	GA3_GASEPF	16%							
	UL	Tecnam P-92 and P-2002	Single Rotax 912 reciprocating engine	GA4_GASEPF	16%							
	UL	Ikarus C42	Single Rotax 912 reciprocating engine									
	UL	Apollo Delta Jet 2	Single Rotax 912 reciprocating engine									
	H	Bell 505	Single turboshaft engine	GA7_SA341G	16%							
		EC 135	Twin turboshaft engines	GA8_EC130	16%							
Totals							7.829	0	1.517	21,4	0	4,2
							9.346			25,61 (capped at 50)		

1.3.1.4 Tracks

After in-depth discussions with the stakeholders, a number of tracks were defined, to model the operations of different aircraft and operation groups.

Each track was then associated with a direction weighting to model the probable distribution of runway use both during departures and approaches.

The following tables summarise those weightings, which were included in the AEDT model:

Movements						Scenario 1			
						Tracks			
Group	Fixed / Helo	AC Type	Engine	AEDT Substitution	Group %	Approach	Departure	TGO	OHJ
Scheduled Service flights	F	Britten-Norman BN-2B Islander	Two Avco-Lycoming reciprocating engines	SF1_PA31	100%	20% A10_MLA 80% A28_MLA	20% D10_MLA 80% D28_MLA	–	–
		Britten-Norman BN-2T Islander	Two Rolls-Royce/Allison turbine engines	SF1_PA31	0%				
Charters	F	Tecnam P2012 STOL	Two Avco-Lycoming reciprocating engines	CH1_BEC58P	20%	20% A10_MLA 80% A28_MLA	20% D10_MLA 80% D28_MLA	–	–
		Daher Kodiak	Single Pratt & Whitney PT-6 turbine engine	CH2_CNA208	20%				
		Cessna Caravan	Single Pratt & Whitney PT-6 turbine engine	CH3_CNA208	20%				
		Pilatus PC-6 Porter	Single Pratt & Whitney PT-6 turbine engine	CH4_PA28	20%				
		GippsAero G-8 Airvan	Single Avco-Lycoming reciprocating engine	CH5_GASEPV	20%				
Air Ambulance	H	EC135	Twin turboshaft engines	AM1_EC130	100%	20% A10_MLA 80% A28_MLA	20% D10_MLA 80% D28_MLA	–	–
AFM – F	F	Britten-Norman BN-2B Islander	Two Rolls-Royce/Allison turbine engines	MI1_PA31	100%	20% A10_MLA 80% A28_MLA	20% D10_MLA 80% D28_MLA	50% TGO_small_ccw 50% TGO_small_cw	50% A10_OHJ_Fix 50% A28_OHJ_Fix
AFM – H	H	AW139	Twin turboshaft engines	MI2_SA365N	100%	20% A10_small 80% A28_small	20% D10_small 80% D28_small	50% TGO_small_ccw 50% TGO_small_cw	50% A10_OHJ_Helo 50% A28_OHJ_Helo
			Single turboshaft engine	MI2_SA365N	0%				
GA	F	Tecnam P92	Single Rotax 912 reciprocating engine	GA1_GASEPF	20%	20% A10_small 80% A28_small	20% D10_small 80% D28_small	50% TGO_small_ccw 50% TGO_small_cw	–
		Cessna 172	Single Avco-Lycoming reciprocating engine	GA2_CNA172	16%				
		Piper Cherokee PA-28	Single Avco-Lycoming reciprocating engine	GA3_GASEPF	16%				
	UL	Tecnam P-92 and P-2002	Single Rotax 912 reciprocating engine	GA4_GASEPF	16%				
	UL	Ikarus C42	Single Rotax 912 reciprocating engine						
	UL	Apollo Delta Jet 2	Single Rotax 912 reciprocating engine						
	H	Bell 505	Single turboshaft engine	GA7_SA341G	16%				
		EC 135	Twin turboshaft engines	GA8_EC130	16%				

The following companion map represents those tracks in respect to the Island of Gozo and the runway:

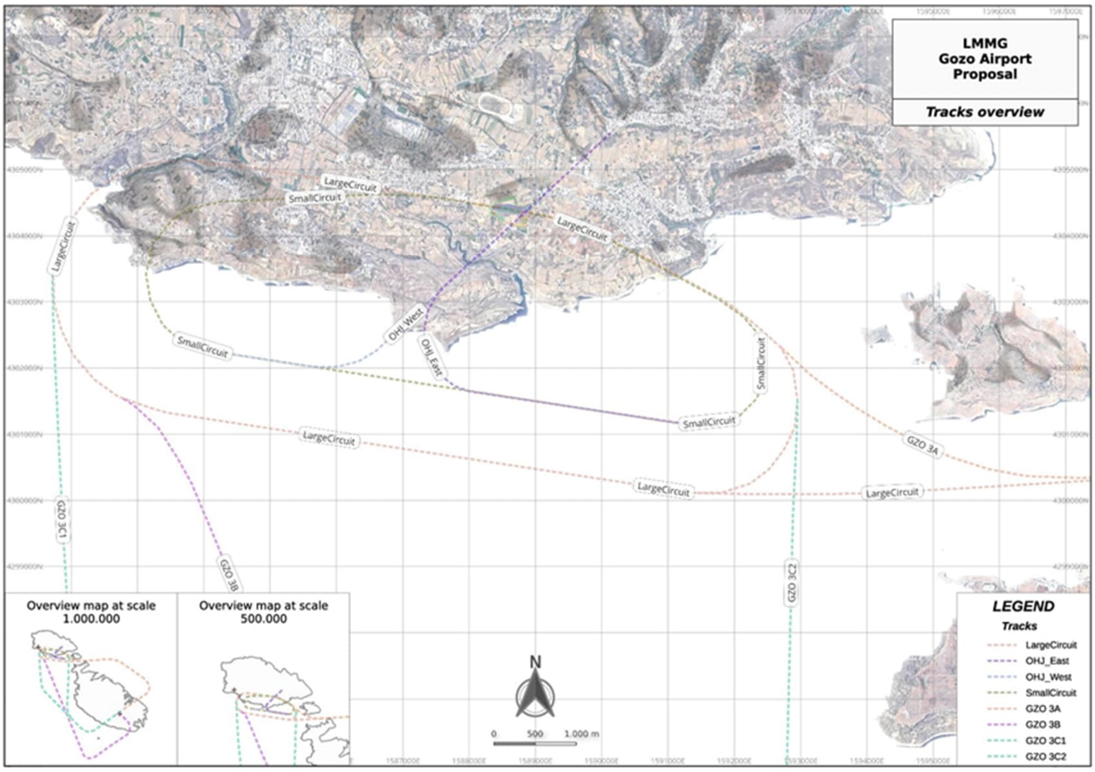


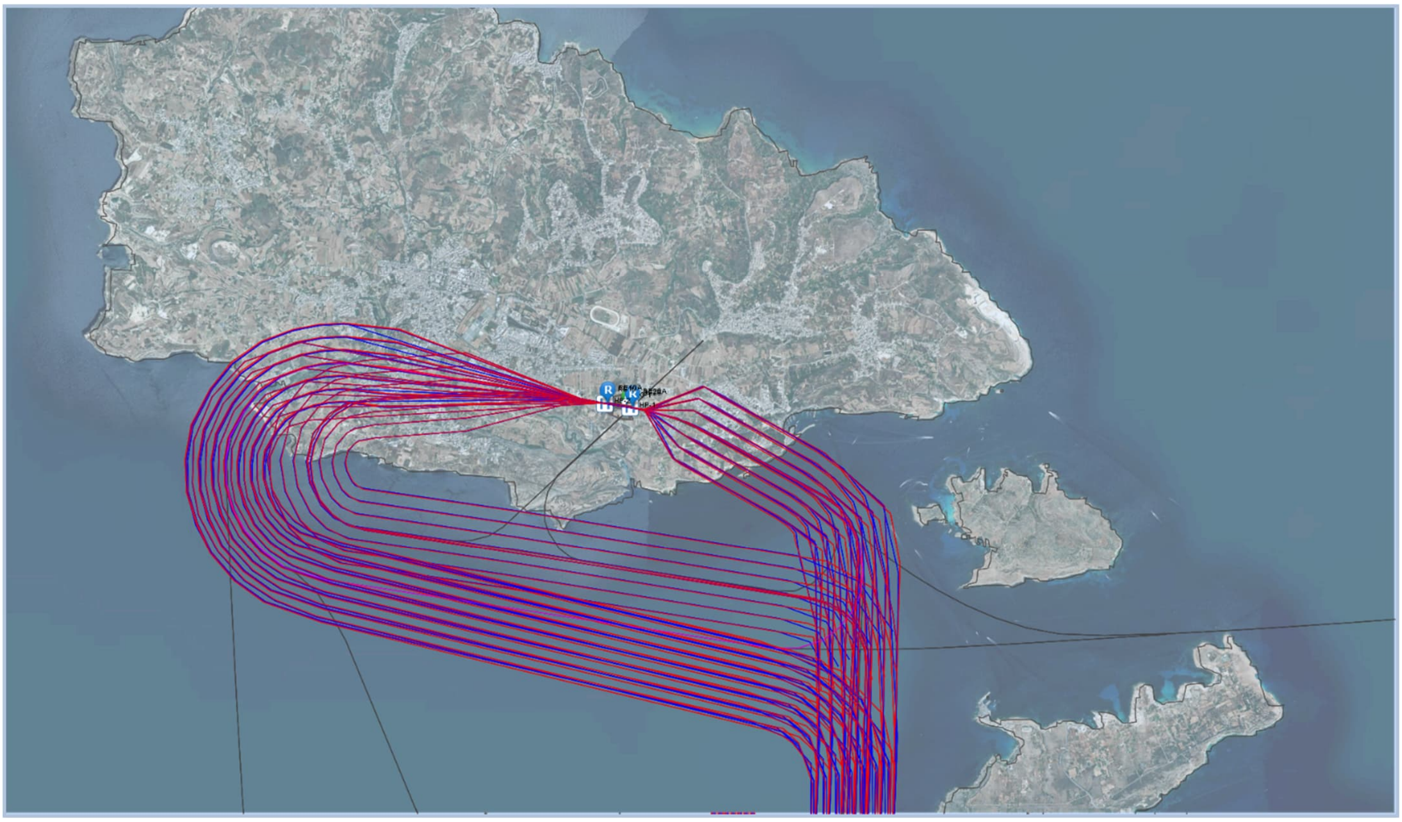
Figure 1-3 Proposed track layout.

1.3.1.5 Track dispersion.

Given the absence of actual radar recordings of the flights, it is not possible to precisely assess the dispersion of actual tracks around the nominal ones.

Taking into account the concepts exposed in the Sub-track chapter, the theoretical tracks proposed for the operations on the Gozo airfield were dispersed using a numerosity of 7 sub-tracks.

The output tracks map, including dispersed sub-tracks, is the following:



1.3.1.6 Note about the Britten-Norman Islander model

It is to be noted that the specific model of the Britten-Norman Islander used in Gozo is one that features two turboprop engines, as a modification of the original configuration carried out to enhance performances. The modified version mounts two Rolls Royce Model 250 B17 turboprop engines.

Within AEDT, the suggested substitution aircraft for this specific model is a Piper PA-31 Navajo, with the same engines.

However, for this AEDT aircraft model, it is not possible to use a procedural track, since the PA-31 profile is defined as a point-profile, which seems not to be compatible with the existing procedural tracks (AEDT in fact refused to complete the calculations, raising an error).

On the other hand, it was not possible to create a procedural profile since the model (in AEDT) does not define the flaps in a way they are usable to create a procedural profile.

The adopted solution was therefore that of creating point-tracks, retracing the procedural ones, and using those special-made tracks for this specific AC model.

Since the Britten-Norman Islander will be one of the most characteristic aircraft in Gozo, it was deemed worth investing some additional study effort to have a model matching the reality as close as possible.

1.3.1.7 Metrics

As requested, the output of the simulation was produced in the following metrics:

- L_{den}
- L_{Aeq}
- L_{night} ($L_{den,\ night}$)
- L_{Amax}

L_{den} is defined as follows:

$$L_{den} = 10\lg\frac{1}{24}\left(12*10^{\frac{L_{day}}{10}} + 4*10^{\frac{L_{evening}+5}{10}} + 8*10^{\frac{L_{night}+10}{10}}\right)$$

in which (as defined in Annex I[23] of the END):

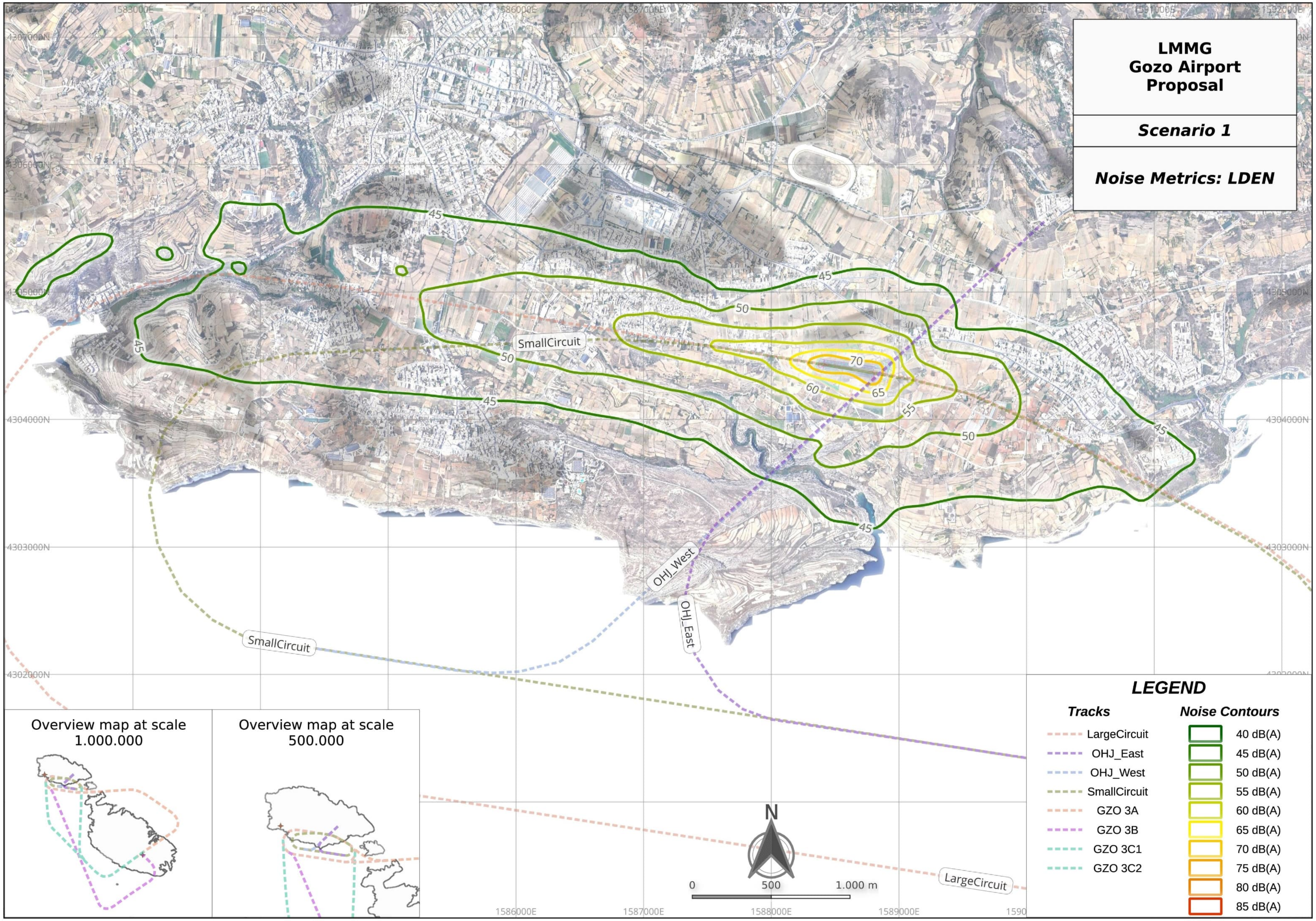
- L_{day} is the A-weighted long-term average sound level as defined in ISO 1996-2: 1987, determined over all day periods of a year,
- $L_{evening}$ is the A-weighted long-term average sound level as defined in ISO 1996-2: 1987, determined over all the evening periods of a year,

[23] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX%3A02002L0049-20150702#tocId19

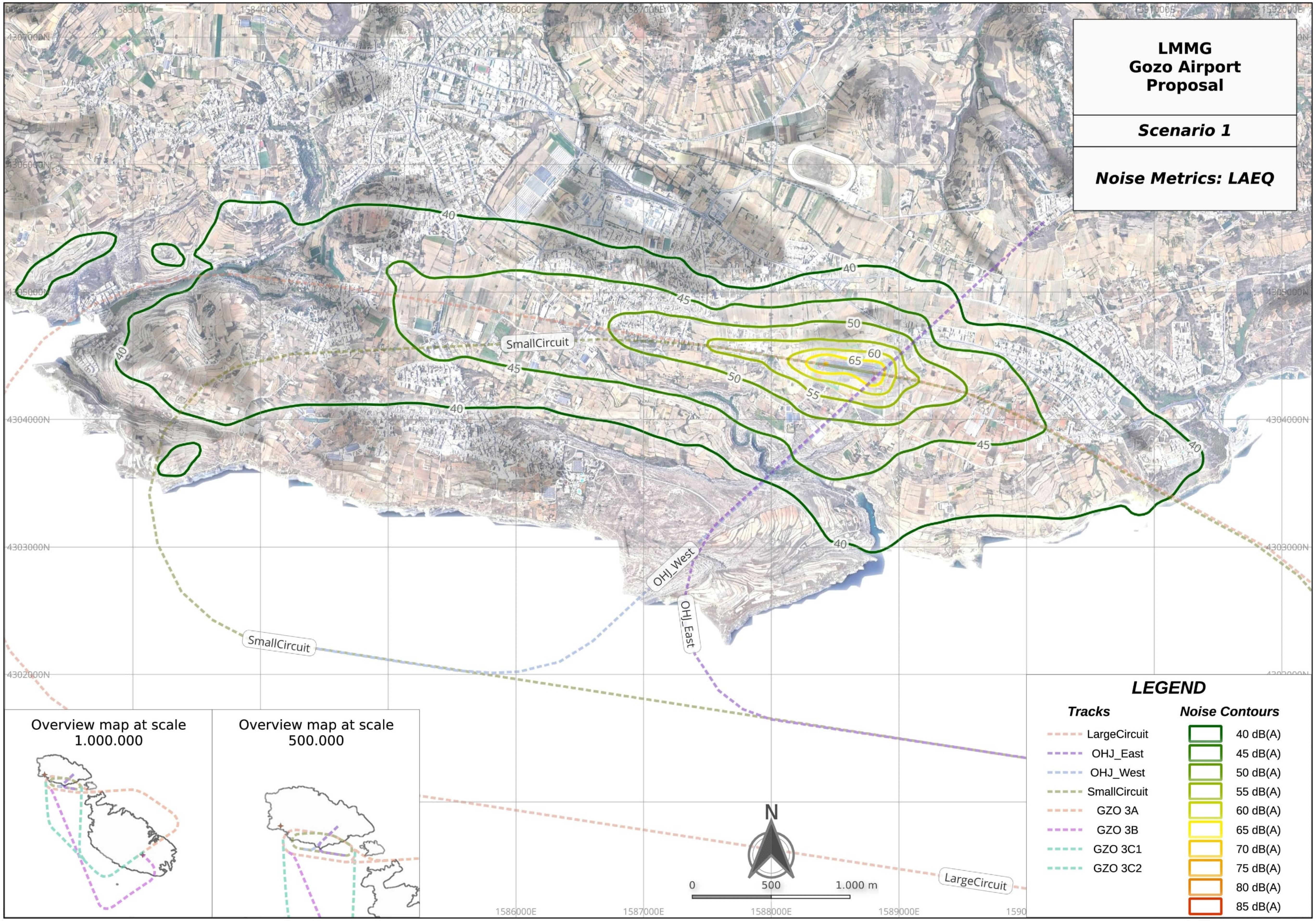
- L_{night} is the A-weighted long-term average sound level as defined in ISO 1996-2: 1987, determined over all the night periods of a year.

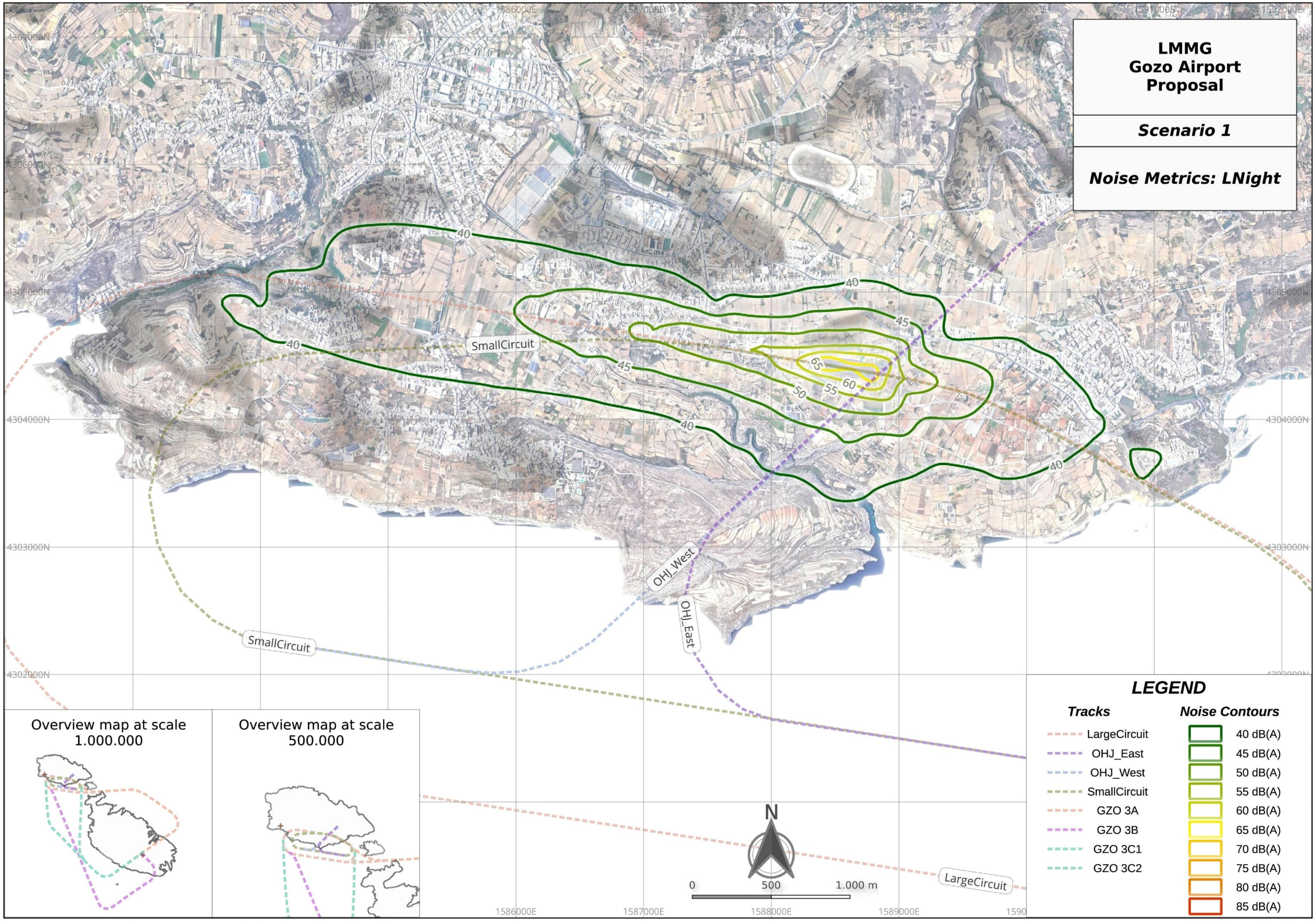
1.3.1.8 Outputs

The following Figures are the outputs for Scenario 1.

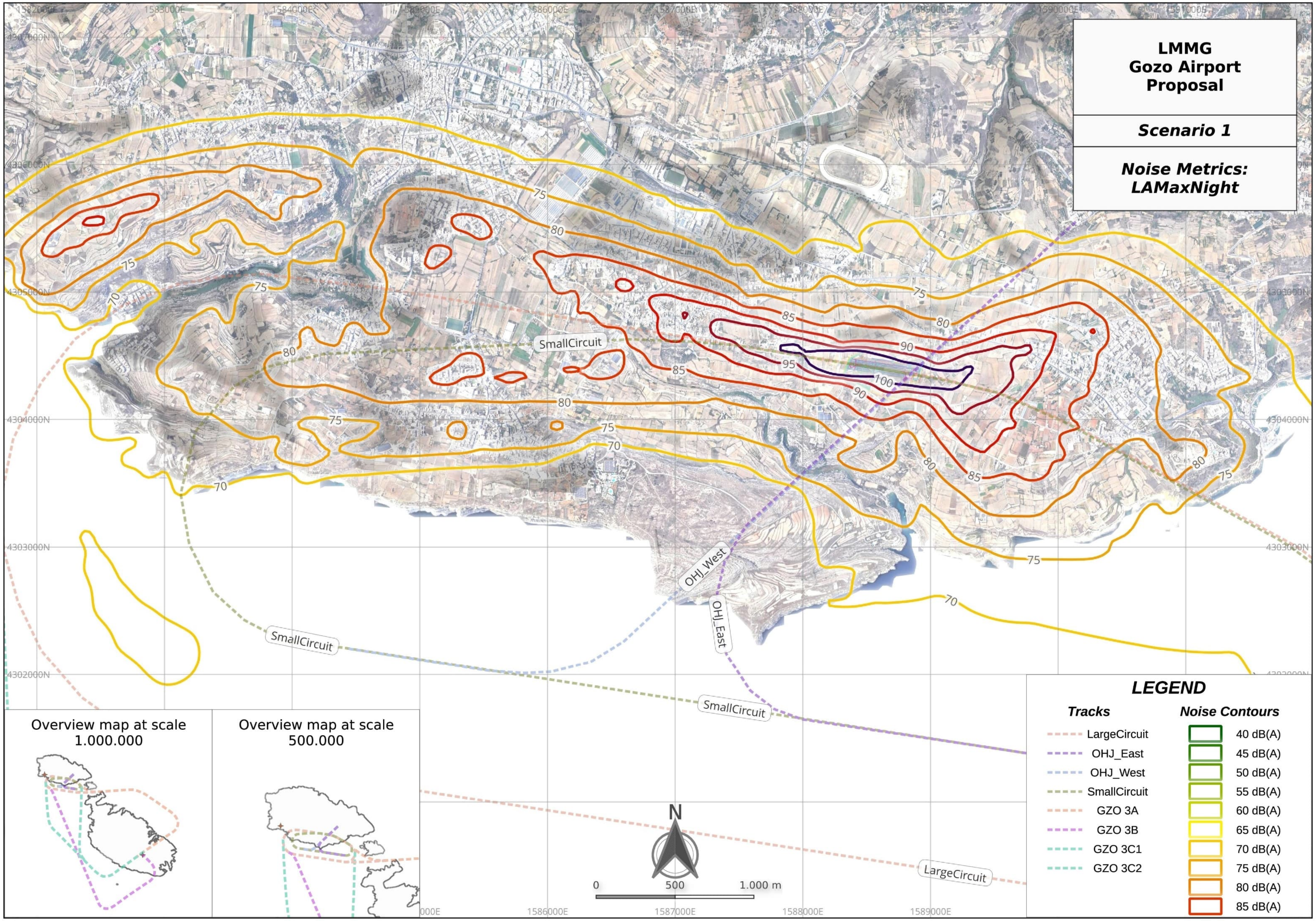


LMMG
Gozo Airport
Proposal
Scenario 1
Noise Metrics: LDEN
SmallCircuit
OHJ_West
OHJ_East
LargeCircuit
45
50
55
60
65
70
Overview map at scale 1.000.000
Overview map at scale 500.000
N
0
500
1.000 m
1586000E
1587000E
1588000E
1589000E
4304000N
4303000N
4302000N
LEGEND
Tracks
LargeCircuit
OHJ_East
OHJ_West
SmallCircuit
GZO 3A
GZO 3B
GZO 3C1
GZO 3C2
Noise Contours
40 dB(A)
45 dB(A)
50 dB(A)
55 dB(A)
60 dB(A)
65 dB(A)
70 dB(A)
75 dB(A)
80 dB(A)
85 dB(A)


LMMG
Gozo Airport
Proposal
Scenario 1
Noise Metrics: LAEQ
SmallCircuit
OHJ_West
OHJ_East
LargeCircuit
40
45
50
55
60
65
Overview map at scale 1.000.000
Overview map at scale 500.000
N
0
500
1.000 m
LEGEND
Tracks
LargeCircuit
OHJ_East
OHJ_West
SmallCircuit
GZO 3A
GZO 3B
GZO 3C1
GZO 3C2
Noise Contours
40 dB(A)
45 dB(A)
50 dB(A)
55 dB(A)
60 dB(A)
65 dB(A)
70 dB(A)
75 dB(A)
80 dB(A)
85 dB(A)



LMMG
Gozo Airport
Proposal
Scenario 1
Noise Metrics: LNight
SmallCircuit
OHJ_West
OHJ_East
SmallCircuit
LargeCircuit
40
45
50
55
60
65
Overview map at scale
1.000.000
Overview map at scale
500.000
N
0
500
1.000 m
LEGEND
Tracks
LargeCircuit
OHJ_East
OHJ_West
SmallCircuit
GZO 3A
GZO 3B
GZO 3C1
GZO 3C2
Noise Contours
40 dB(A)
45 dB(A)
50 dB(A)
55 dB(A)
60 dB(A)
65 dB(A)
70 dB(A)
75 dB(A)
80 dB(A)
85 dB(A)



LMMG
Gozo Airport
Proposal
Scenario 1
Noise Metrics:
LAMaxNight
LEGEND
Tracks
Noise Contours
LargeCircuit
OHJ_East
OHJ_West
SmallCircuit
GZO 3A
GZO 3B
GZO 3C1
GZO 3C2
40 dB(A)
45 dB(A)
50 dB(A)
55 dB(A)
60 dB(A)
65 dB(A)
70 dB(A)
75 dB(A)
80 dB(A)
85 dB(A)
Overview map at scale
1.000.000
Overview map at scale
500.000
SmallCircuit
OHJ_West
OHJ_East
LargeCircuit
N
0
500
1.000 m

1.3.2 Scenario 2

After analysing the outputs of the first Scenario, it was considered to define a further scenario to assess and study the possible effects of modifying the westward tracks, i.e. Approaches on RWY 10 and Departures on RWY 28 for the largest aircraft in operation, namely the Britten-Norman Islander with the intent of trying to improve or better the night levels at nearby residences. The total number and hourly distribution of operations was kept identical with Scenario 1, as were the tracks used by all aircraft except the Britten-Norman Islander.

Said scenario was named Scenario 2 and is presented in this chapter.

1.3.2.1 Assumptions

Since the airfield is not yet operative, all the data used to create the simulation are forecasts of future usage scenario, therefore it is recommended to perform a check on the assumptions after the first year of operation, when actual data will have been gathered. The same assumptions apply as highlighted in the Scenario 1.

1.3.2.2 Aircraft in use and substitutions

The same aircraft and AEDT substitutions were used as described for the Scenario 1. Only the track usage changes.

1.3.2.3 Operations

The same aircraft and AEDT substitutions were used as described for the Scenario 1.

1.3.2.4 Tracks

As anticipated, all tracks remain the same for all aircraft, but for the Britten-Norman Islander, which in its west-bound operations was assigned to the smaller track in order to avoid flying over the inhabited areas of Sannat and Munxar. These tracks are those used by the aircraft for Approaches using RWY 10 and for Departures on RWY 28.

It is to be noted that also the East-bound tracks (i.e. Approaches on RWY 28 and Departures on RWY 10) of the Britten-Norman Islander are identical to the ones defined for Scenario 1.

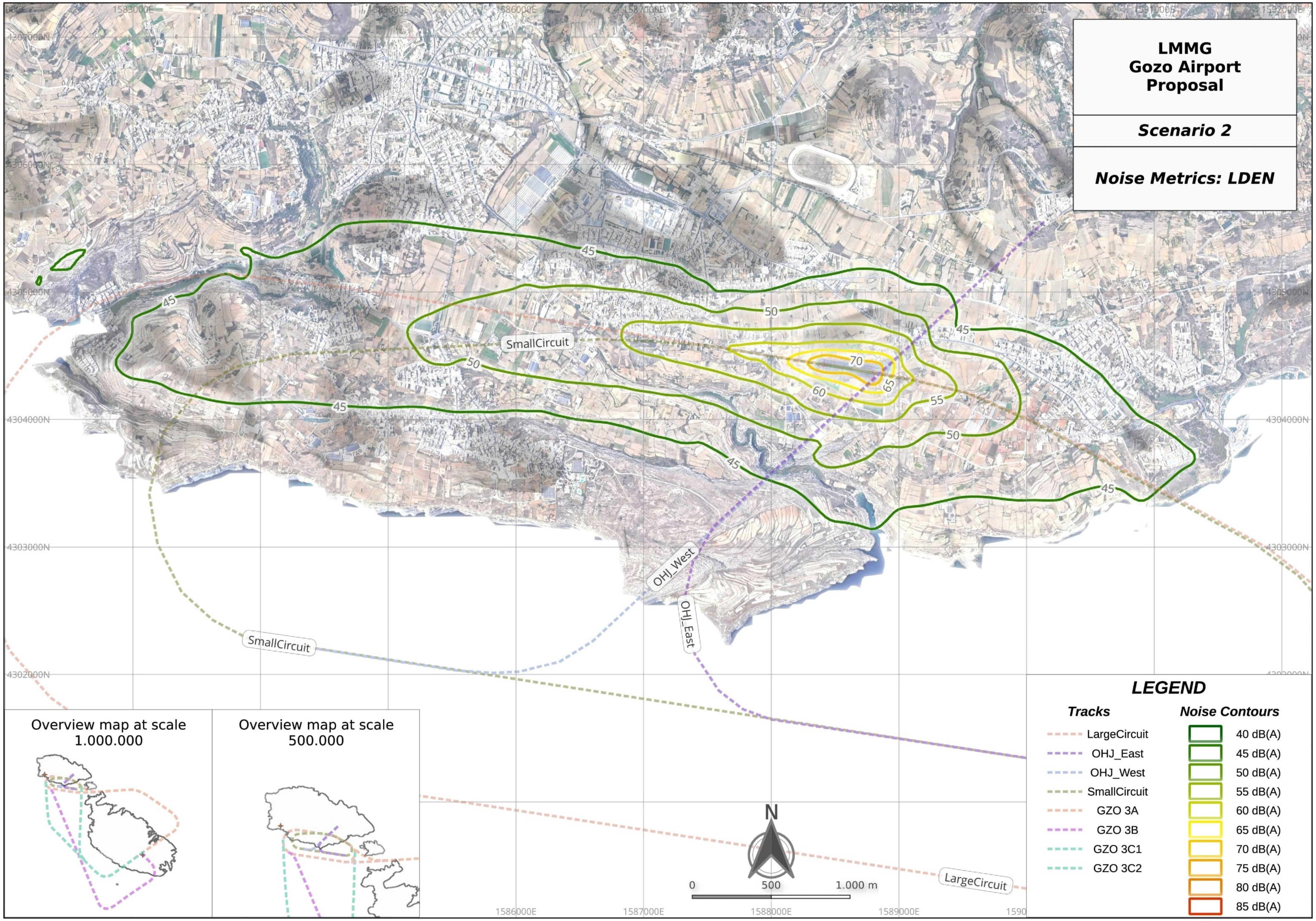
The sought-after effect was not only that of spreading the noise energy over a larger area, thus limiting the peak impacts, but also to avoid flying over a populated area. This in turn reduces the already minimal risks, diminishes the visual and psychological effect on the population, thus incrementing the overall acceptance from the community.

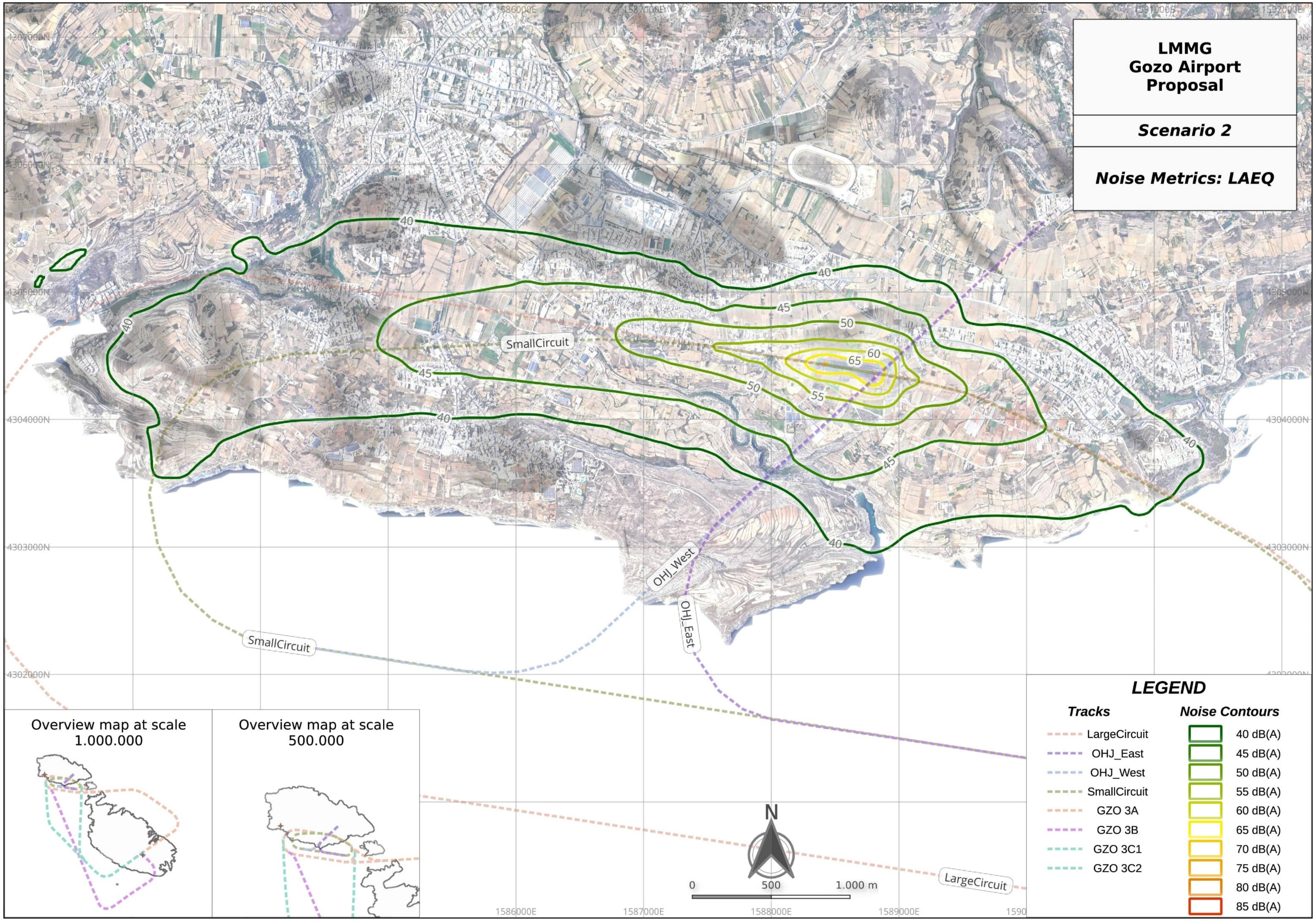
1.3.2.5 Metrics

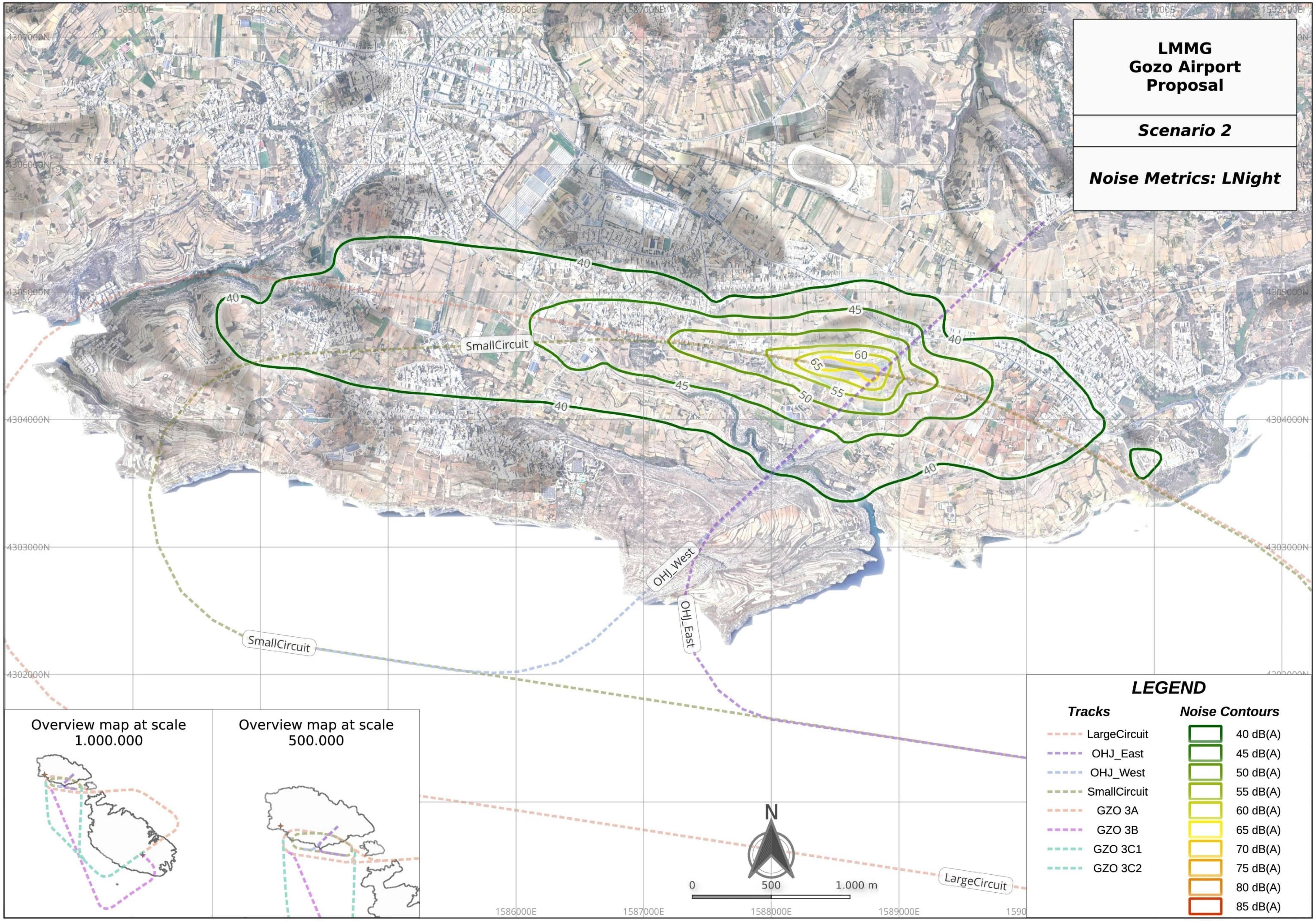
Also, the metrics were kept coherent with the ones adopted in Scenario 1.

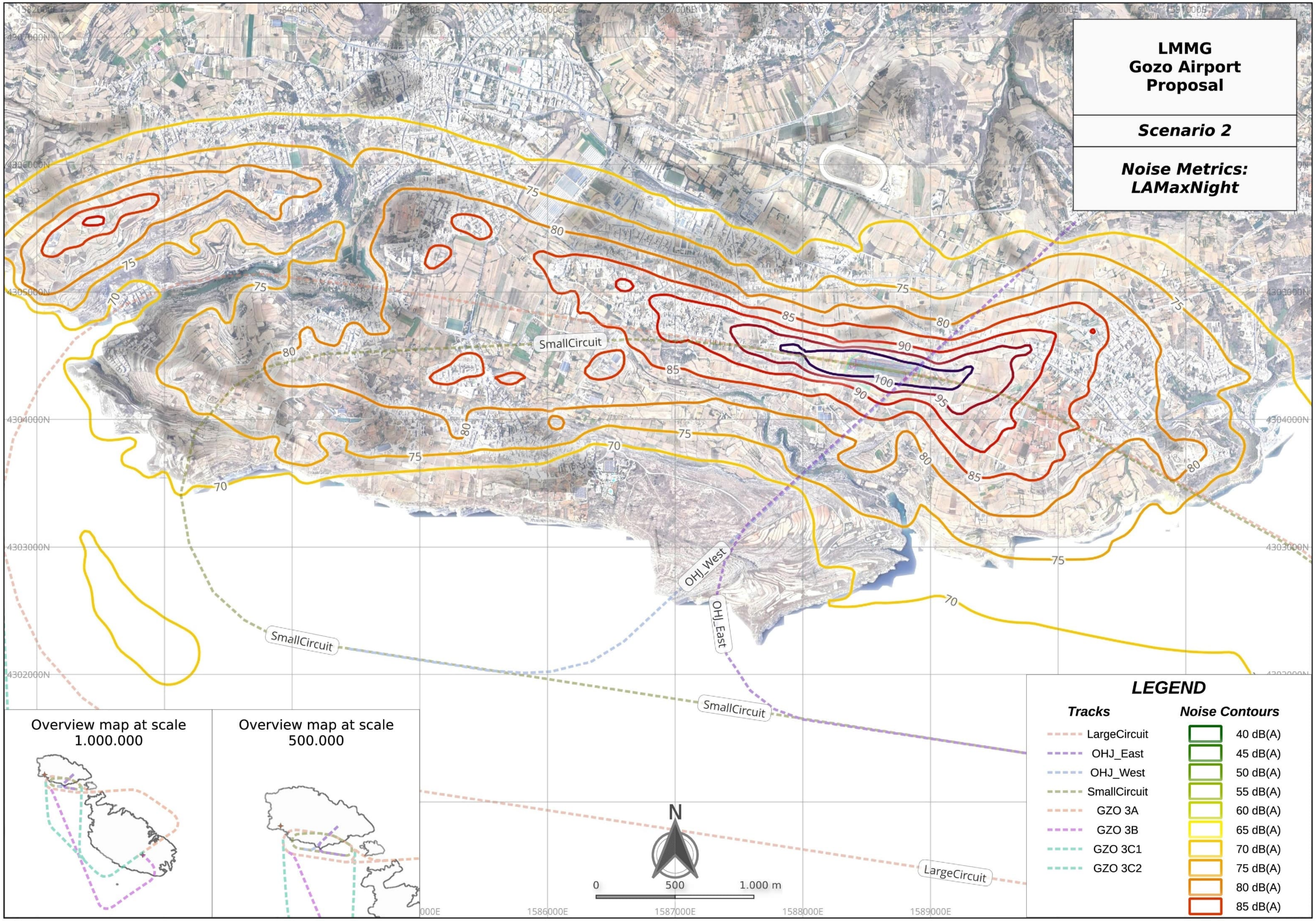
1.3.2.6 Outputs

The following Figures are the outputs for Scenario 2.


LMMG
Gozo Airport
Proposal
Scenario 2
Noise Metrics: LDEN
45
50
55
60
65
70
SmallCircuit
OHJ_West
OHJ_East
LargeCircuit
4304000N
4303000N
4302000N
1586000E
1587000E
1588000E
1589000E
Overview map at scale
1.000.000
Overview map at scale
500.000
N
0
500
1.000 m
LEGEND
Tracks
LargeCircuit
OHJ_East
OHJ_West
SmallCircuit
GZO 3A
GZO 3B
GZO 3C1
GZO 3C2
Noise Contours
40 dB(A)
45 dB(A)
50 dB(A)
55 dB(A)
60 dB(A)
65 dB(A)
70 dB(A)
75 dB(A)
80 dB(A)
85 dB(A)


LMMG
Gozo Airport
Proposal
Scenario 2
Noise Metrics: LAEQ
LEGEND
Tracks
LargeCircuit
OHJ_East
OHJ_West
SmallCircuit
GZO 3A
GZO 3B
GZO 3C1
GZO 3C2
Noise Contours
40 dB(A)
45 dB(A)
50 dB(A)
55 dB(A)
60 dB(A)
65 dB(A)
70 dB(A)
75 dB(A)
80 dB(A)
85 dB(A)
Overview map at scale
1.000.000
Overview map at scale
500.000
N
0
500
1.000 m
SmallCircuit
OHJ_West
OHJ_East
LargeCircuit
40
45
50
55
60
65
4304000N
4303000N
4302000N
1586000E
1587000E
1588000E
1589000E


LMMG
Gozo Airport
Proposal
Scenario 2
Noise Metrics: LNight
40
45
50
55
60
65
SmallCircuit
OHJ_West
OHJ_East
LargeCircuit
4304000N
4303000N
4302000N
1586000E
1587000E
1588000E
1589000E
Overview map at scale
1.000.000
Overview map at scale
500.000
N
0
500
1.000 m
LEGEND
Tracks
LargeCircuit
OHJ_East
OHJ_West
SmallCircuit
GZO 3A
GZO 3B
GZO 3C1
GZO 3C2
Noise Contours
40 dB(A)
45 dB(A)
50 dB(A)
55 dB(A)
60 dB(A)
65 dB(A)
70 dB(A)
75 dB(A)
80 dB(A)
85 dB(A)



LMMG
Gozo Airport
Proposal
Scenario 2
Noise Metrics:
LAMaxNight
SmallCircuit
OHJ_West
OHJ_East
LargeCircuit
Overview map at scale
1.000.000
Overview map at scale
500.000
N
0
500
1.000 m
LEGEND
Tracks
LargeCircuit
OHJ_East
OHJ_West
SmallCircuit
GZO 3A
GZO 3B
GZO 3C1
GZO 3C2
Noise Contours
40 dB(A)
45 dB(A)
50 dB(A)
55 dB(A)
60 dB(A)
65 dB(A)
70 dB(A)
75 dB(A)
80 dB(A)
85 dB(A)

1.4 Test Flights

On January 10th, 2024, a campaign of test flight was undertaken using the current Gozo runway as a reference.

The test flight campaign was carried out by:

- performing a set of test flights with an AFM's Britten-Norman Islander,
- performing a set of test flights with an Island Microlight Club microlight aircraft,
- simultaneously deploying five sound level meters, overseen by three technicians on the field.

1.5 *Rationale*

While aircraft noise models, including AEDT, can be described as a deterministic model for what the underlying algorithms are concerned, the actual scenario-wide behaviour is notoriously to be treated as a statistical model. This means that the outputs of any aircraft noise model are reliable while considering the large number of operations typical of an entire year.

This is due to a number of factors which affect the uncertainty associated with the model, including:

- actual weather conditions while carrying out each operation, both at the local scale and at the micro scale (air temperature, pressure, and speed at each stage of each operation, as well as turbulences and other sub-local effects)
- actual path flown during each operation
- history of the actual power setting during each operation
- the variability of the load and total weight of each aircraft

With that being said, the rationale of the test flight campaign was that of performing predefined flight operations in a controlled environment in order to measure their effect in terms of noise and evaluate at least the order of magnitude of future scenarios against the output of a specifically created AEDT scenario.

In turn, the outcomes of said campaign were used to optimize the noise model used to simulate Scenarios 1 and 2 at the Gozo airfield under the new proposed configuration. Since the physical length of the existing runway did not allow for actual, safe take-offs and landings, the adopted procedures can be considered as the closest possible simulation of the future operations.

1.6 *Methodology*

Departures were simulated by:

- approaching the designated take-off threshold while maintaining a safety clearance of 50 ft,
- decelerating the aircraft to the lowest possible safe airspeed at the designated take-off threshold,
- accelerating at level to reach take-off speed and rotation at the end of the proposed runway,
- subsequently proceeding with the actual transition and climb-out.

Similarly, landings were simulated by:

- following the approach phase as normal,
- approaching, with the landing gear in place where applicable, the designated landing threshold while maintaining a safety clearance of 50 ft,
- decelerating the aircraft to the lowest possible safe airspeed, with the landing gear in place where applicable, to simulate the landing roll.

1.7 *Operations*

1.7.1 Flight line offset

Given the possible presence of parked helicopters on the runway, flight lines were kept offset by 15 meter / 50 feet to the North, as depicted in the following example:

1.7.2 Tracking

It was essential for test flights to be performed while using a precise, dependable tracking method.

The operations were tracked with two independent means:

- Radar tracking: MIA ATC provided the radar tracks of all aircraft operation during the test day. As usual for this technology, radar tracks are derived connecting the 3D return echoes of each call-sign at every revolution of the antenna, which takes place every several seconds. The average distance between subsequent radar points in this study is about 130 m.
- GPS tracking: the Islander used for the test operations was provided with a GPS tracker, which acquired position and speed of the aircraft every 1.0 seconds, thus outputting a generally smoother output.

Both tracking means were adequately precise for the study, and a comparison of both tracks is shown in the following map:

1.7.3 Flight groups

Two groups of calibration flights were foreseen, following the alignment of the existing runway:

- one in the East-West direction (280°),
- the other in the opposite direction (010°)

Each flight was performed maintaining a straight line, as described in the following chapters.

1.7.4 Flight Group 1 – Direction 28

Simulation of departures 28

Arriving from East and flying in a straight path in axis with the Runway (R28) a descent was executed at the slowest possible safe airspeed until reaching Threshold 28, keeping a safe ground clearance (at least 50 feet) and the offset to the North (15 meters / 50 feet).

While maintaining the offset to the North, the aircraft was flown at level until the end of the Runway / Threshold 10.

A simulation of a take-off on a straight line (heading 28) was performed, with a profile which brought the aircraft at 1000 ft above Ix-Xlendi.

Then the aircraft was circled back, and the procedure was repeated 5 times.

Simulation of arrivals 28

Arriving from East and flying in a straight path in axis with the Runway (R28) while keeping the offset to the North, a descent was executed to reach the slowest possible safe airspeed when reaching Threshold 10, keeping a safe ground clearance (at least 50 feet) and offset to the North (15 meters / 50 feet).

Then the aircraft was circled back, and the procedure was repeated 5 times.

1.7.5 *Flight Group 1 – Direction 10*

Simulation of departures 10

Arriving from West and flying in a straight path in axis with the Runway (R10) a descent was executed at the slowest possible safe airspeed until reaching Threshold 10, keeping a safe ground clearance (at least 50 feet) and offset to the North (15 meters / 50 feet).

While maintaining the offset to the North, the aircraft was flown at level until the end of the Runway / Threshold 28.

A simulation of a take-off on a straight line (heading 10) was performed, with a profile which brought the aircraft at 1500 ft above Comino Santa Maria Bay.

Then the aircraft was circled back, and the procedure was repeated 5 times.

Simulation of arrivals 10

Arriving from West and flying in a straight path in axis with the Runway (R10) while keeping the offset to the North, a descent was executed to reach the slowest possible safe airspeed when reaching Threshold 28, keeping a safe ground clearance (at least 50 feet) and offset to the North (15 meters / 50 feet).

Then the aircraft was circled back, and the procedure was repeated 5 times.

1.8 Measurement points

A set of five measurement points was foreseen and deployed to monitor the noise level during the test flights operations.

Each station was provided with a Larson Davis 831C sound level meter, each positioned on a mast so that the microphone capsule plane was at 1.5 m from the ground.

Also, two independent weather stations were used to monitor temperature, pressure, wind speed and direction during the campaign.

The following maps represents the position of the measurement stations on Jan 10th, 2024.

Figure 1-4 Test flight measurement points.

1.9 Sound level meters used

The sound level meters were all Larson Davis 831C and have been used to acquire the most complete record of metrics, in order to ensure that any post processing would be possible: both broadband metrics (like L_{Aeq}, L_{Ceq}, L_{AFast}, L_{Amax}, etc) and third-octave spectra were acquired, along with a precise time alignment and, for two stations, also weather data.

The following pictures show some examples of the deployed SLM stations.

Figure 1-5 Station Cal2 with the Britten-Norman Islander landing on Runway 10.

Figure 1-6 Station Cal4 with the SLM's microphone (on the second tripod from the left), and the weather sensors mounted on the higher mast on the right.

Figure 1-7 Meters at positions Cal 3, 1 and 5 (left to right).

Figure 1-8 Island Microlight Club microlight aircraft 'landing' on Runway 10 as seen from position Cal4.

1.10 *Selected metrics for test flights*

As requested, the output of the simulation was produced in the following metrics:

- L_{den}
- L_{Aeq}
- L_{night} ($L_{den, night}$)
- L_{Amax}
- SEL

1.11 *Output Comparison*

Being mindful of the notes previously expressed, i.e. that a direct comparison with just a few operations cannot be regarded as conclusive but still can provide a broad guidance in understanding the overall model behaviour, the following table presents a comparison between the AEDT model output and the measured values.

In particular, the Sound Exposure Level (or SEL) value was calculated, as the SEL represents the total noise energy delivered at the measurement point by each operation.

The comparison shows that, while individual operations have different levels between model and measures, the overall averages for the sets of operations are surprisingly aligned, with differences under 3.1 dB at all stations with the only exception of the most distant one (Cal5):

Group	Description	Tracks Group	#	Cal1	Cal2	Cal3	Cal4	Cal5
				SEL	SEL	SEL	SEL	SEL
AEDT Model	Levels	A28_11		88.4	79.5	80.9	78.0	64.3
		D28_18		83.5	100.1	88.9	90.9	86.8
		A10_21		100.2	87.2	90.3	91.7	69.7
		D10_22		77.4	84.9	77.7	84.0	76.5
	Combined	A+D 28		89.6	100.1	89.6	91.1	86.8
		A+D 10		100.2	89.2	90.5	92.3	77.3
		A+D 10+28		97.6	97.4	90.1	91.8	84.3
Measures	Individual Levels	A28	1	96.2	94.9	85.2	80.9	82.3
			2	97.6	96.7	82.8	78.3	82.8
			3	96.8	97.2	82.4	79.0	82.2
			4	96.6	96.4	83.5	80.0	81.6
			5	97.5	95.8	82.8	79.1	82.5

		D28	6	97.5	96.1	81.6	77.2	81.3
			7	97.5	94.7	82.3	76.6	83.1
			8	96.7	94.6	82.3	77.5	81.7
			9	99.0	95.4	83.1	75.9	81.3
			10	99.8	96.3	83.8	76.9	83.4
		A10	11	100.3	98.1	98.7	99.5	101.9
			12	99.0	97.6	98.3	98.2	99.6
			13	91.7	91.1	93.2	92.4	94.9
			14	92.3	92.2	93.1	92.6	94.2
			15	77.2	75.8	76.3	76.9	73.6
		D10	16	81.4	81.8	81.6	82.0	72.1
			17	72.2	71.1	72.3	72.2	73.0
			18	79.1	78.2	78.7	79.0	79.2
			19	77.2	76.4	77.9	76.6	76.3
			20	83.6	83.4	84.2	83.1	83.5
	StDev	StDev A		0.6	0.9	1.1	1.0	0.4
		StDev D		1.5	1.4	7.1	10.2	8.8
		StDev A+D		1.1	0.9	1.0	1.6	0.7
	Averages	A28		97.0	96.3	83.5	79.6	82.3
		D28		98.3	95.5	82.7	76.9	82.3
		A10		96.4	94.8	95.6	95.8	97.8
		D10		80.1	79.9	80.5	80.0	78.9
	Combined	A+D 28		97.7	95.9	83.1	78.4	82.3
		A+D 10		93.5	92.0	92.8	92.9	94.9
		A+D 10+28		96.1	94.4	90.2	90.1	92.1
AEDT Model - Measures	**Averages**	A28_11		-8.6	-16.8	-2.6	-1.5	
		D28_18		-14.7	4.6	6.2	14.0	4.5
		A10_21		3.8	-7.6	-5.4	-4.2	-28.1
		D10_22		-2.7	4.9	-2.8	3.9	-2.4
	Combined	A+D 28		-8.0	4.2	6.5	12.7	4.5
		A+D 10		6.7	-2.8	-2.3	-0.6	-17.5
		A+D 10+28		**1.5**	**3.1**	**-0.1**	**1.7**	**-7.8**

1.12 *Conclusions and model tuning*

The test flight campaign proved to be very useful in identifying several factors which allowed the model to align more closely with the real world.

Among these factors, which were built into the final model and scenarios, the most important is the identification of the closest match of aircraft substitution for the Britten-Norman Islander (which is also the aircraft type that will produce the highest noise energy), where the default substitution proposed by AEDT wouldn't have been satisfactory. Also, the evaluation of the actual take-off profiles was possible, along with a full characterization of the noise spectrum produced on the ground.

2 Appendix 2 - Construction and Ground Operational Model

The following sections are a brief description of the process of assembling the two models used for construction noise and ground operation evaluations.

2.1 Model Inputs

2.1.1.1 DTM – Digital terrain Model

A digital terrain model was created extending beyond the required distance (radius two kilometres from airfield) based on the 2018 LIDAR data - *SintegraM data, (2018), Developing Spatial Data Integration for the Maltese Islands, Planning Authority.* The data is originally based on a 10 cm by 10 cm grid and was filtered to 20 cm by 20cm and filtered accordingly in height depending on the data variation. Detail was kept to a level where there was no need for any other break lines or contours.

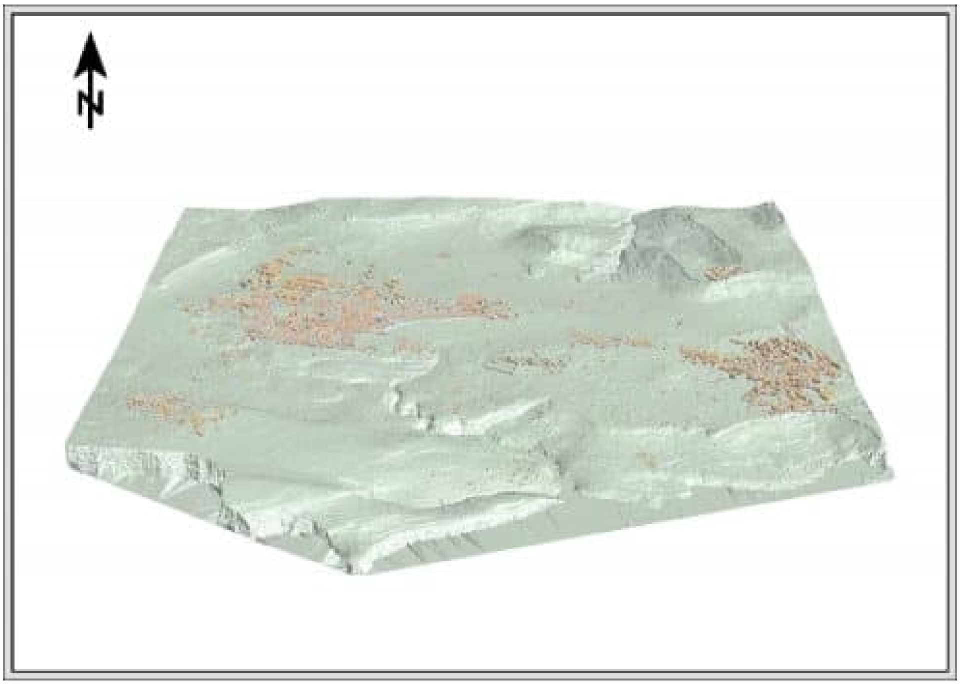


Figure 2-1 DGM hull constructed from SintegraM data for construction and modified with proposed architect's drawings for ground noise analysis.

The same hull was used as a basis in both the construction and the ground noise scenarios. In the case of the ground noise, the airfield was constructed according to the architects' drawings and proposed survey ground levels.

2.1.1.2 Ground Type

The ground absorption type is based around the CORINNE 2000 GIS layer, but also further information was included for multiple areas considering the macro size of the project with ground absorption ranging from 0.1 to 0.8 i.e. hard reflective ground to softer arable areas.

2.1.1.3 Barriers/ walls

No street walls or barriers are separately included in the model. Given the DTM detail field walls, and other ledges are automatically included in the model. Tree lines and bushes surrounding the airfield (as suggested in the PDS) are not included as they would not have the effect desired on actual noise level, but this does not preclude the trees not being installed as they do have some effect on particular frequencies without reducing noise level which also has a psycho-physiological effect on human hearing which is not quantified[24].

2.1.1.4 Buildings

Both residential and non-residential buildings are taken from the national buildings layer in GIS. The building footprints are split to reflect dwellings per building footprint using ARMS data for registered buildings. Buildings are in their actual GIS 2.5D height.

2.2 Construction sources

The sources for the construction are based around the major earth moving works which are required to the west of the site. Whereby, large amounts of earth will be moved from one area of the site to another. Assuming that scarification of the rock to the North would be occurring and four dozers would be operating on site.

The operating emissions of the equipment are as follows:

Name	Source type	l or A m,m^2	L'w dB(A)	Lw dB(A)	63Hz dB(A)	125Hz dB(A)	250Hz dB(A)	500Hz dB(A)	1kHz dB(A)	2kHz dB(A)	4kHz dB(A)	8kHz dB(A)
Dozer 1	Line	277.18	67	91.4	60.6	74.7	74.2	80.6	85.8	89	76.8	64.7
Dozer 2	Line	260.75	67	91.2	60.3	74.4	73.9	80.3	85.5	88.7	76.5	64.4
Dozer 3	Line	531.03	70	97.3	66.4	80.5	80	86.4	91.6	94.8	82.6	70.5
Dozer 4	Line	254.2	67	91.1	60.2	74.3	73.8	80.2	85.4	88.6	76.4	64.3
Scarifier	Line	494.46	83.6	110.5				110.5				

The equipment was in use between the hours of 07:00 and 18:00.

2.3 Aircraft ground Movements

The following aircraft ground sources were distributed across a twenty-four hour period:

[24] Nguyen T, Morinaga M. Effect of roadside trees on pedestrians' psychological evaluation of traffic noise. Front Psychol. 2023 Aug 16; 14:1166318. doi: 10.3389/fpsyg.2023.1166318. PMID: 37663361; PMCID: PMC10469599.

Aircraft ground activity for Threshold 10 and 28																								
Name	0-1 Hrs. dB(A)	1-2 Hrs. dB(A)	2-3 Hrs. dB(A)	3-4 Hrs. dB(A)	4-5 Hrs. dB(A)	5-6 Hrs. dB(A)	6-7 Hrs. dB(A)	7-8 Hrs. dB(A)	8-9 Hrs. dB(A)	9-10 Hrs. dB(A)	10-11 Hrs. dB(A)	11-12 Hrs. dB(A)	12-13 Hrs. dB(A)	13-14 Hrs. dB(A)	14-15 Hrs. dB(A)	15-16 Hrs. dB(A)	16-17 Hrs. dB(A)	17-18 Hrs. dB(A)	18-19 Hrs. dB(A)	19-20 Hrs. dB(A)	20-21 Hrs. dB(A)	21-22 Hrs. dB(A)	22-23 Hrs. dB(A)	23-24 Hrs. dB(A)
Ground Generator Guinault ga90v13d1100						100.2						100.2				100.2				100.2				
Island Taxi landing		98.2								98.2				98.2				98.2						
Islander startup						129.7						129.7				129.7				129.7				
Islander startup 2						129.7						129.7				129.7				129.7				
Islander taxi						95.7						95.7				95.7				95.7				
Ultralight 1 final idle									95.4		95.4		95.4		95.4		95.4	86.2						
Ultralight 1 Taxi									80.3		80.3		80.3		80.3		80.3	71.1						
Ultralight 1 Taxi landing									82.4		78.5		82.4		82.4		82.4	82.4						
Ultralight 2 Final idle 2										95.4				95.4		95.4		95.4						
Ultralight 2 Taxi										75.3				75.3		75.3		75.3						
Ultralight 2 Taxi landing												81.3				81.3	81.3		81.3					
Ultralight idle 1									95.4		95.4		95.4		95.4		95.4	86.2						
Ultralight idle 2										95.4				95.4		95.4		95.4						

3 Appendix 3 - Community Noise measurements - Detailed Measurements

3.1.1 F1 - Unnamed Road, off Triq L'Imgarr, Xewkija

WGS84 Latitude: 36.03182 Longitude: 14.26812 Altitude in feet: 327.99

Figure 11 2 Monitoring station at position F1.

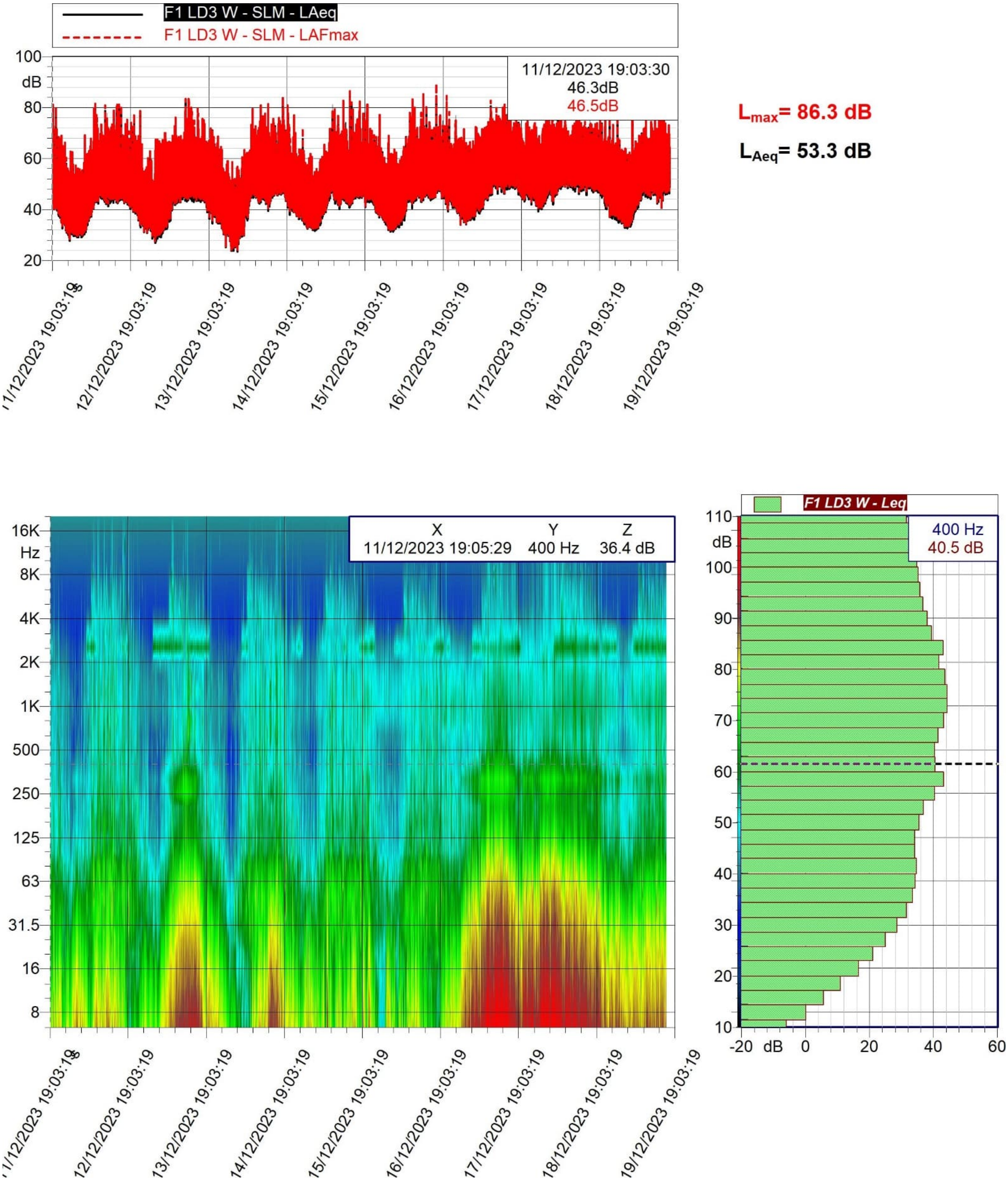
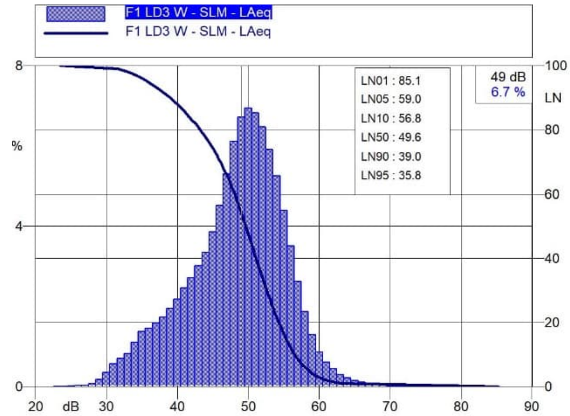
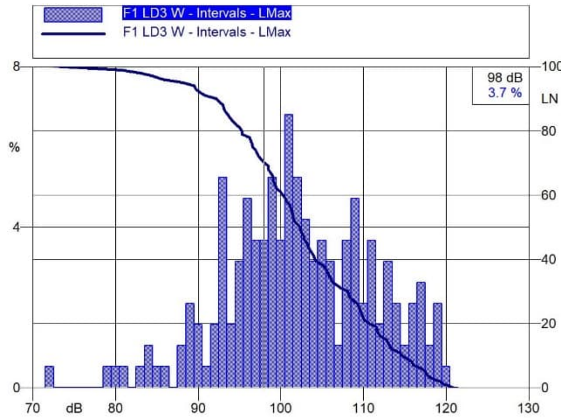
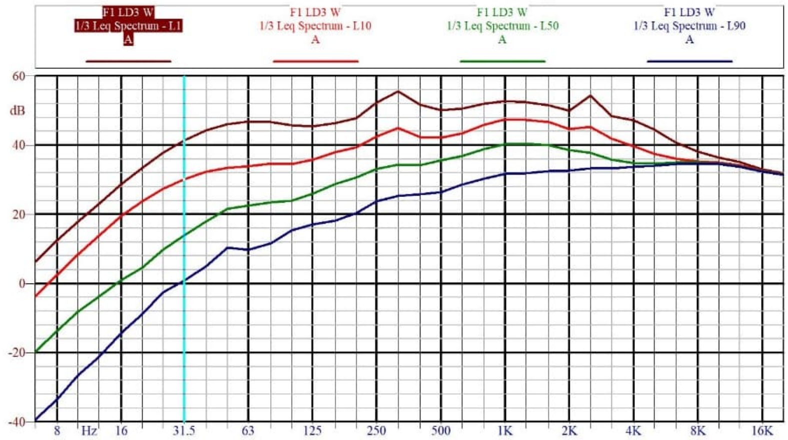


Figure 11 3. Measurement Time History and Spectrogram of position F1.







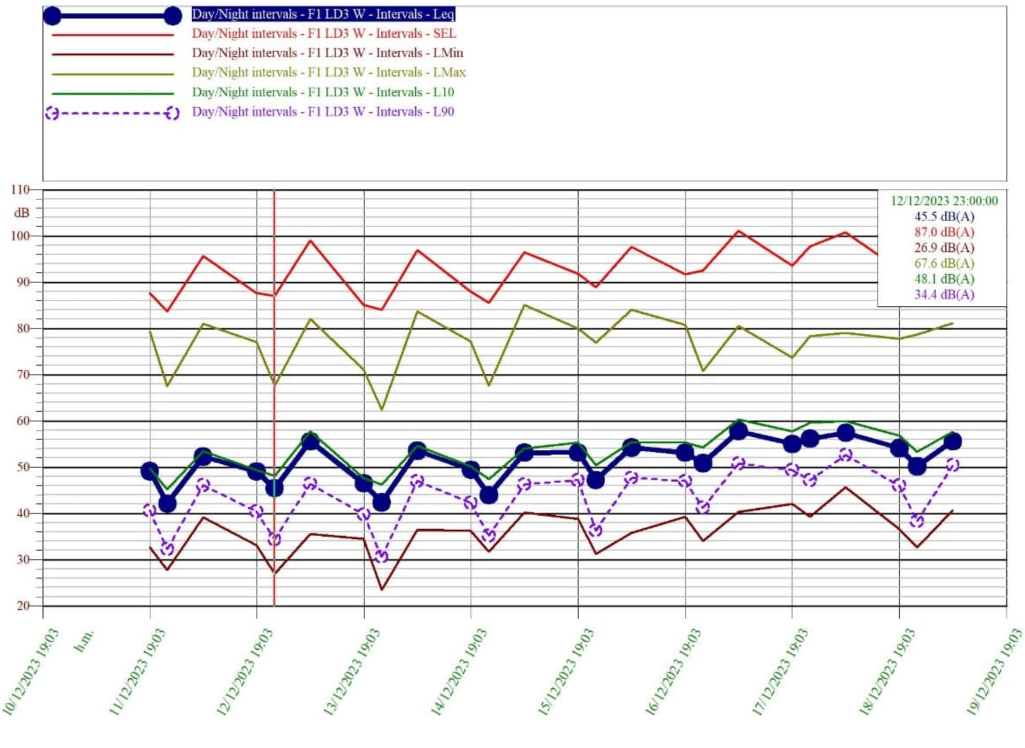


Figure 11 4. Community measurement Day, Evening and Night interval statistics of position F1.

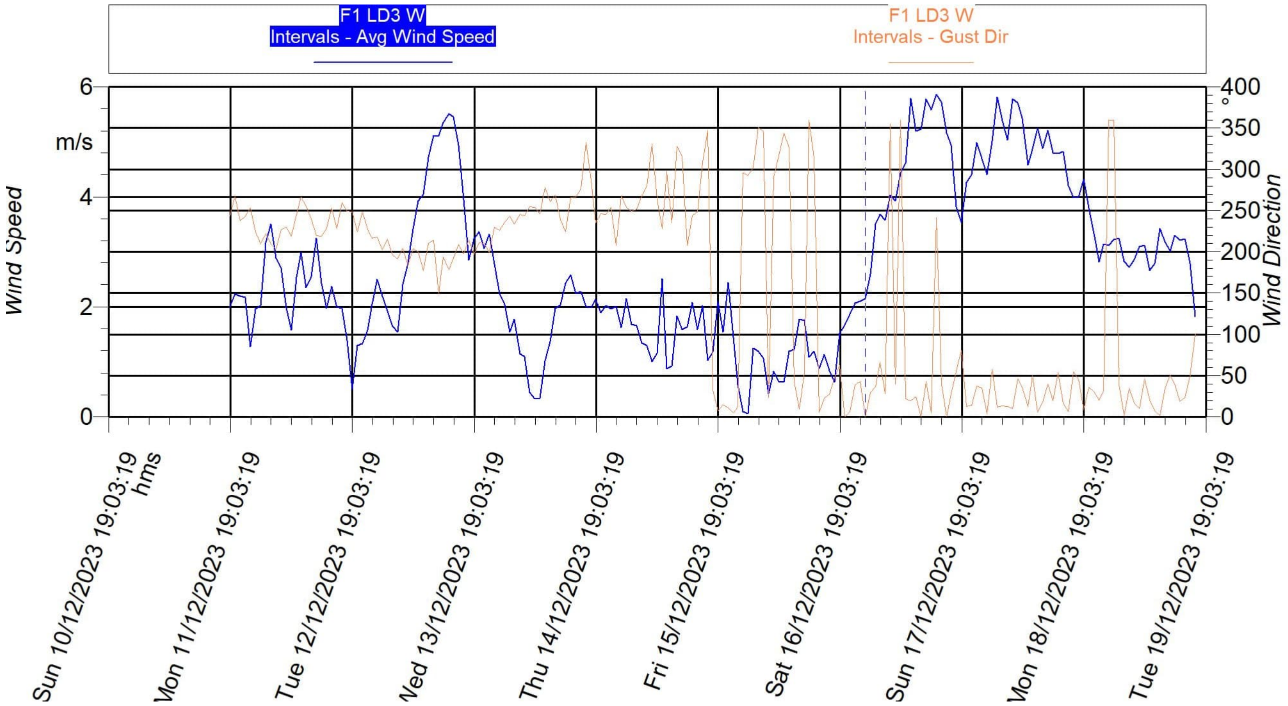
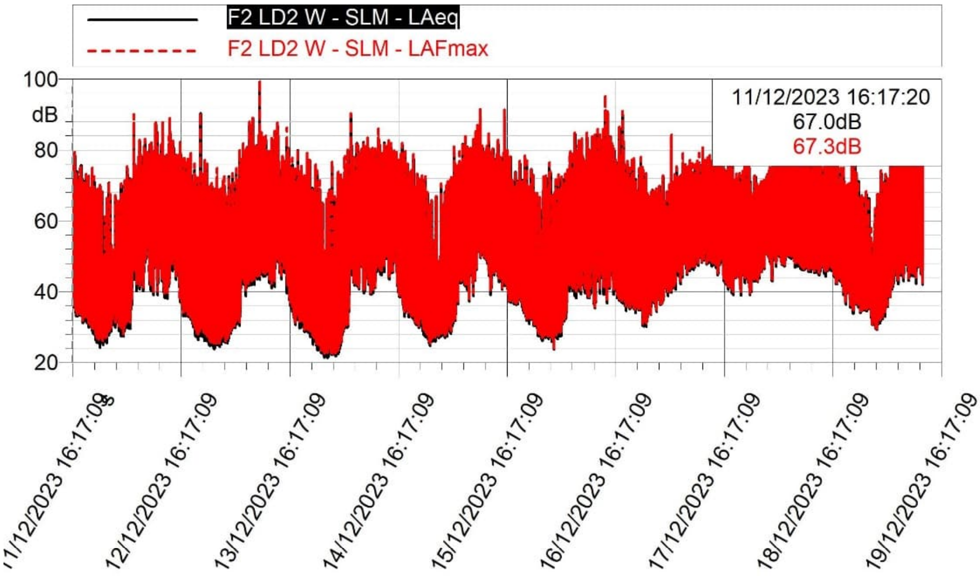


Figure 11 5. Average Wind speed and Gust direction time history of position F1.

3.1.2 F2 - Triq il-Kav. Lorenzo Zammit Haber, Xewkija

WGS84 Latitude: 36.02833 Longitude: 14.2649 Altitude in feet: 279.56

Figure 11 6. Monitoring station at position F2.



L_{max}= 95.7 dB

L_{Aeq}= 59.7 dB

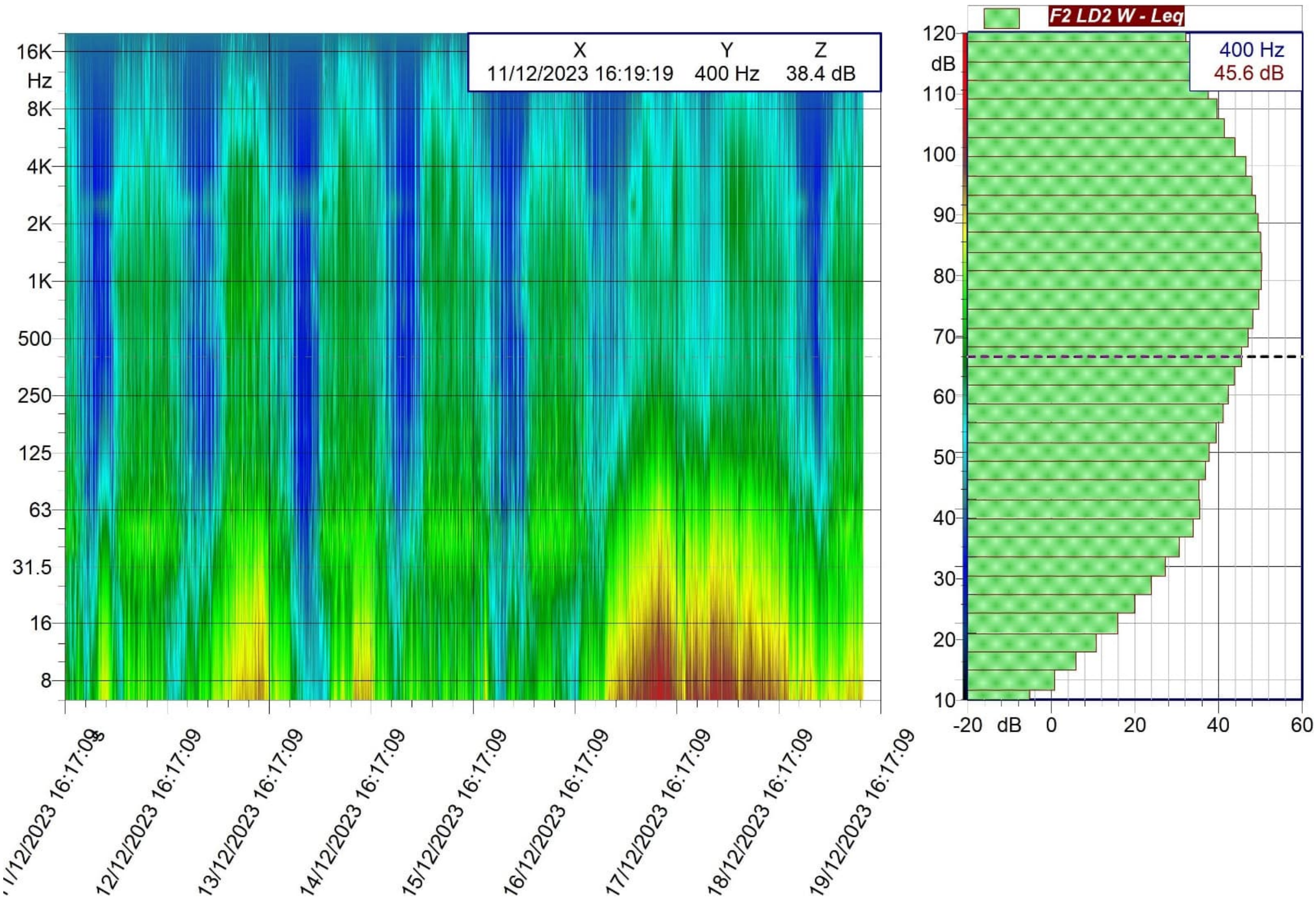


Figure 11 7. Measurement Time History and Spectrogram of position F2.

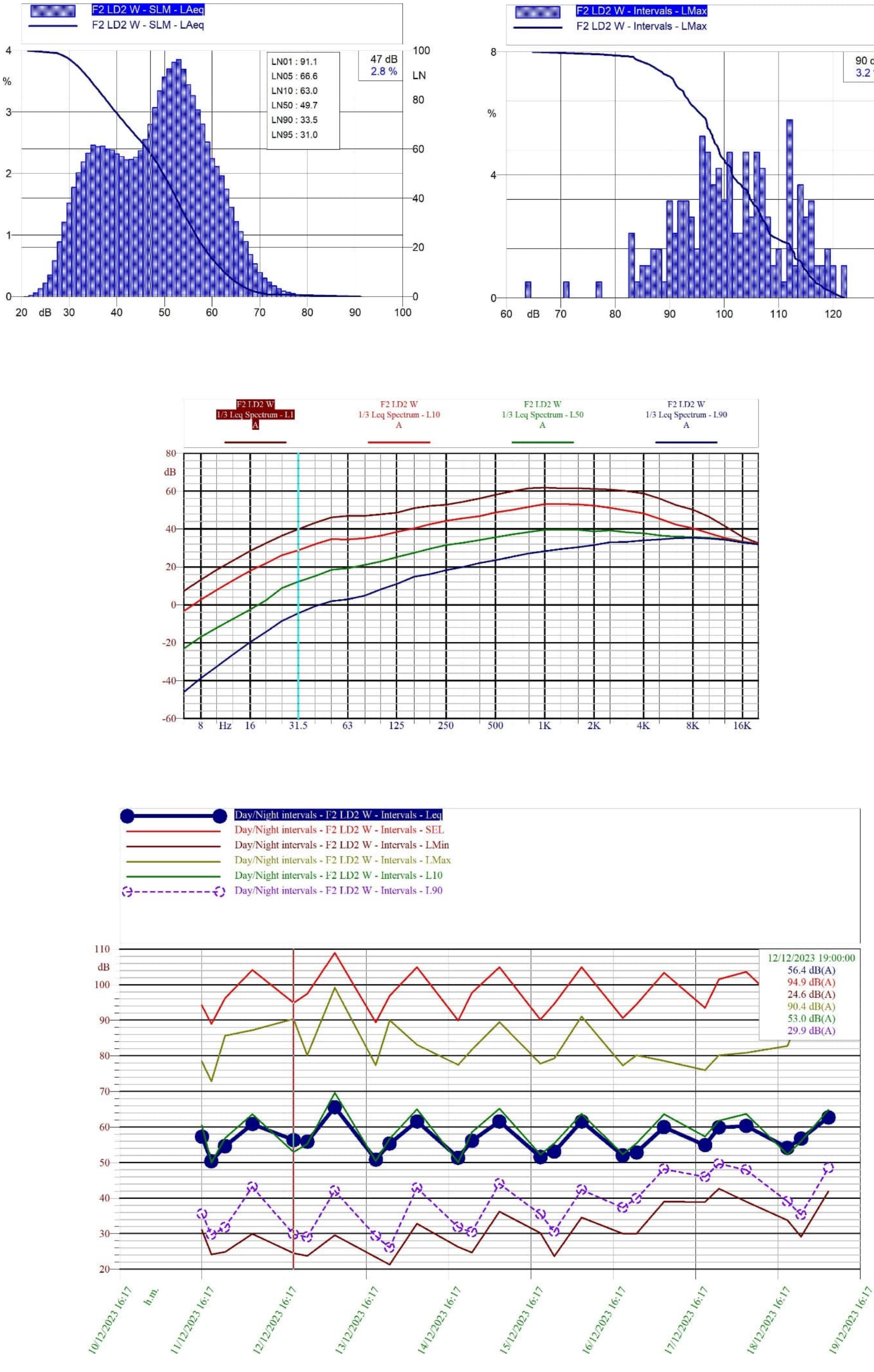
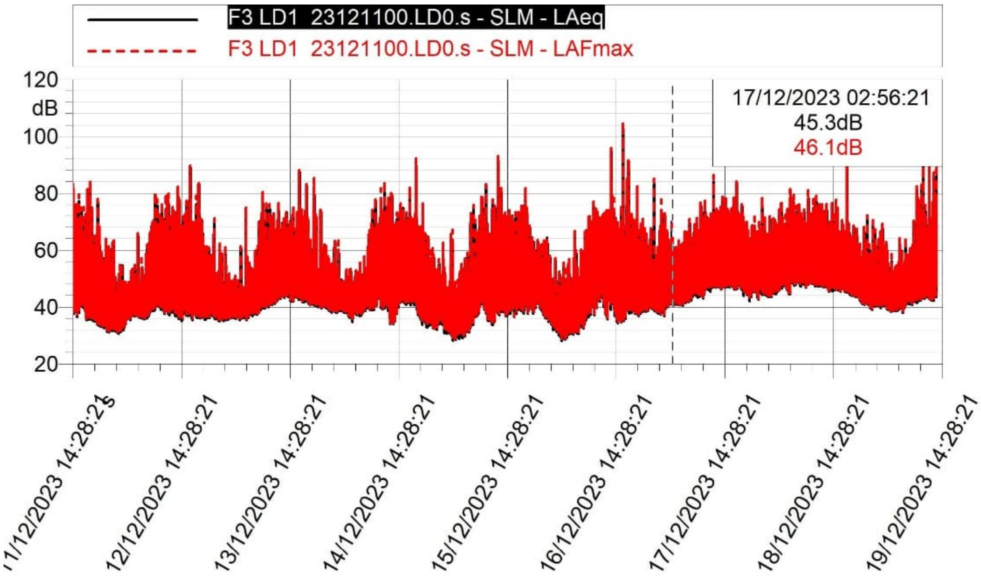


Figure 11 8. Community measurement Day and Night interval statistics of position F2.

3.1.3 F3 - Santu Liju, Ghajnsielem

WGS84 Latitude:36.02282 Longitude: 14.28586 Altitude in feet: 183.19

Figure 11 9. Monitoring station at position F3.



L_{max}= 105.2 dB

L_{Aeq}= 52.5 dB

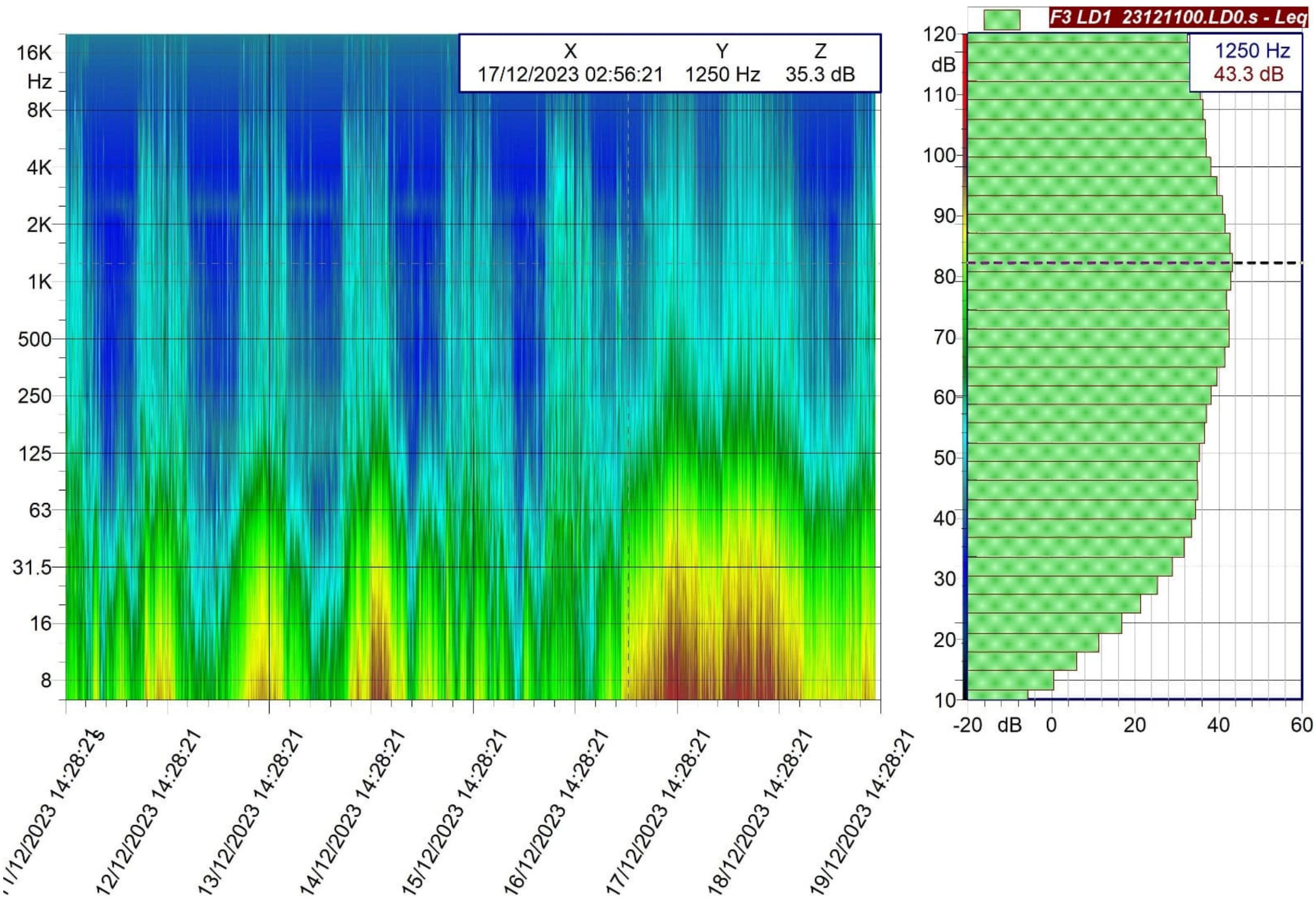


Figure 11 10. Measurement Time History and Spectrogram of position F3.

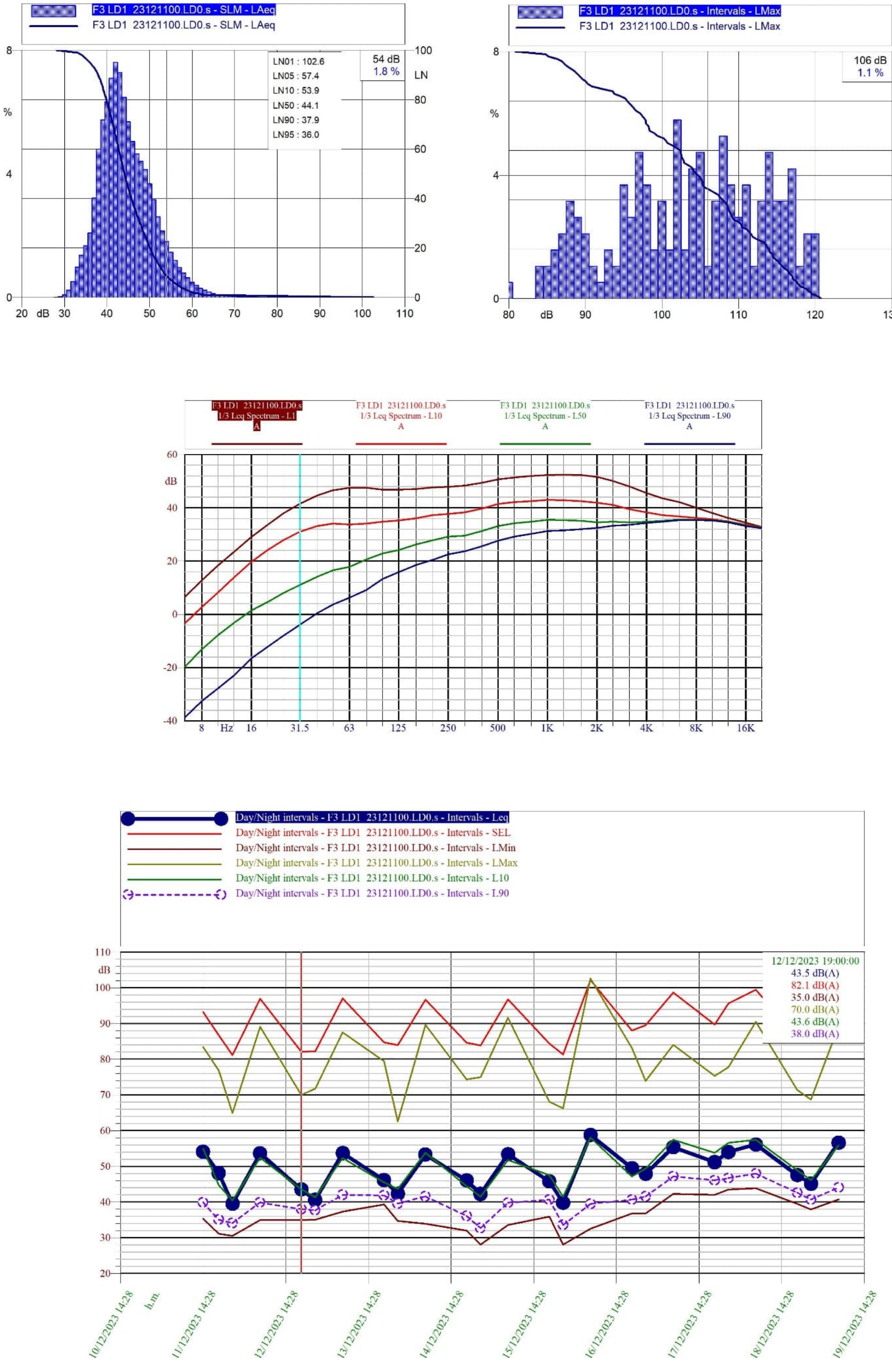
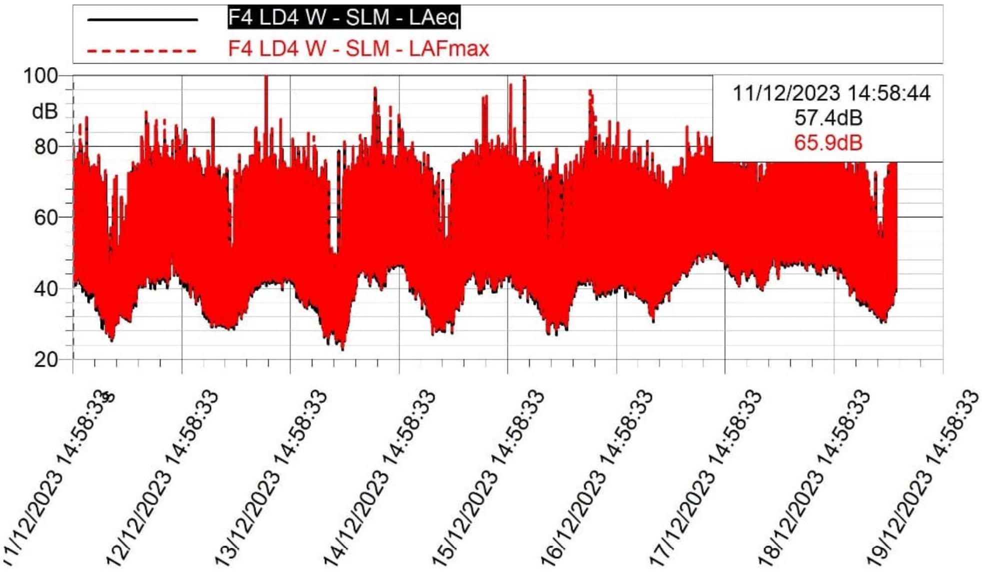


Figure 11 11. Community measurement Day and Night interval statistics of position F3.

3.1.4 F4 - Triq Ta' Bwier, Ghajnsielem

WGS84 Latitude:36.0255 Longitude: 14.27783 Altitude in feet: 281.05

Figure 11 12. Monitoring station at position F4.



L_{max}= 97.4 dB

L_{Aeq}= 58.5 dB

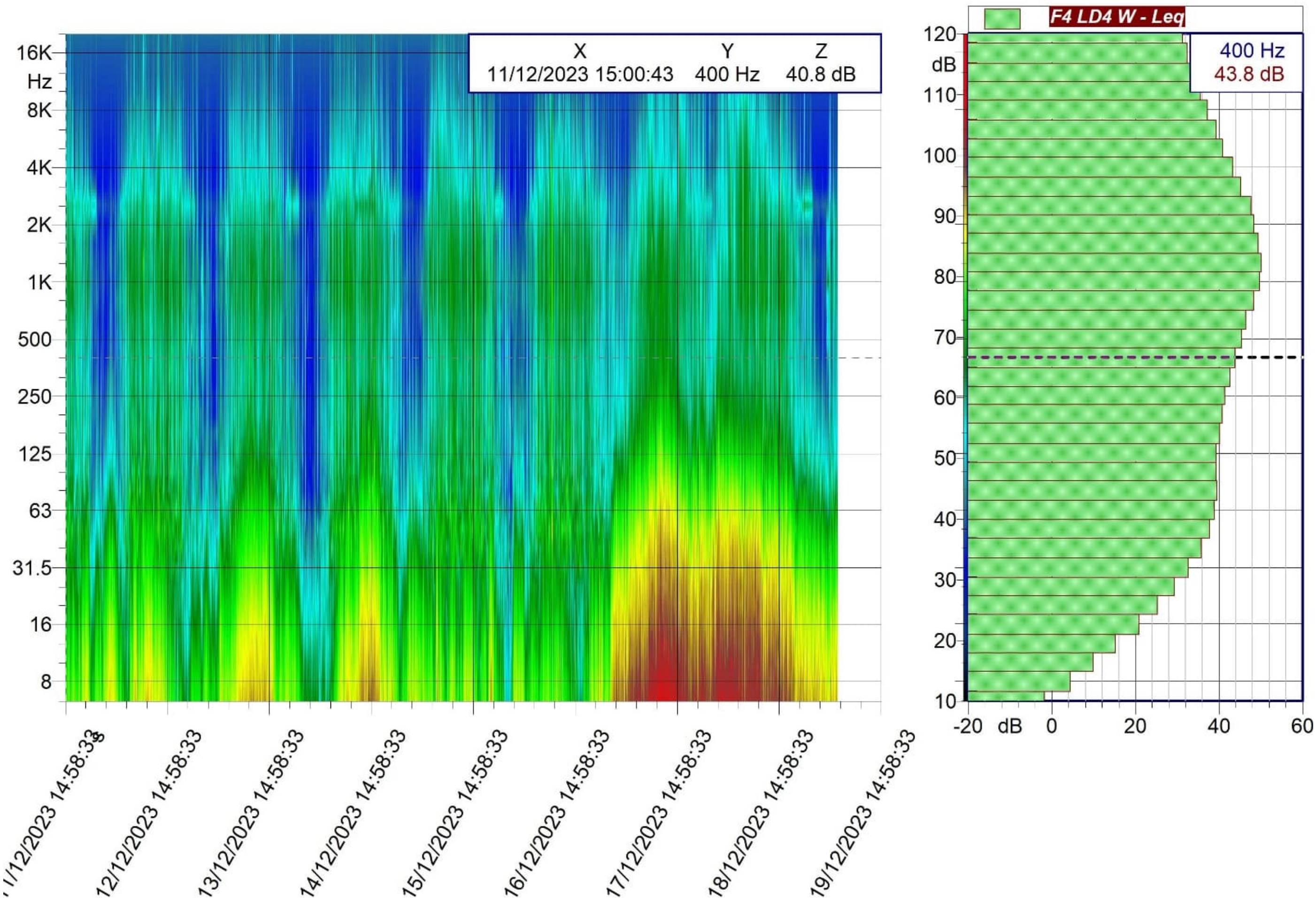
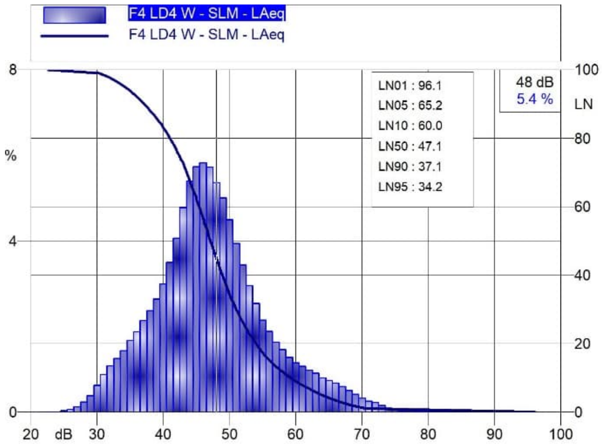
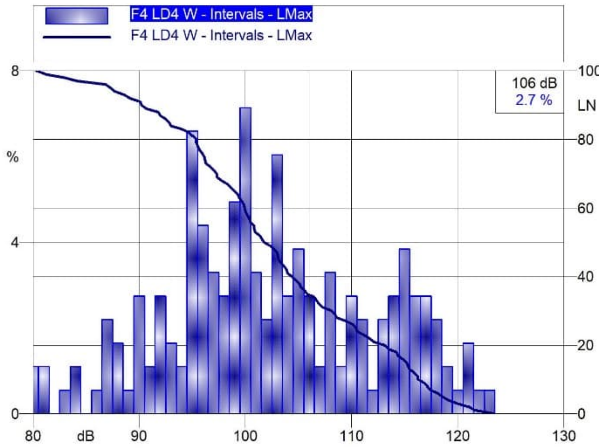
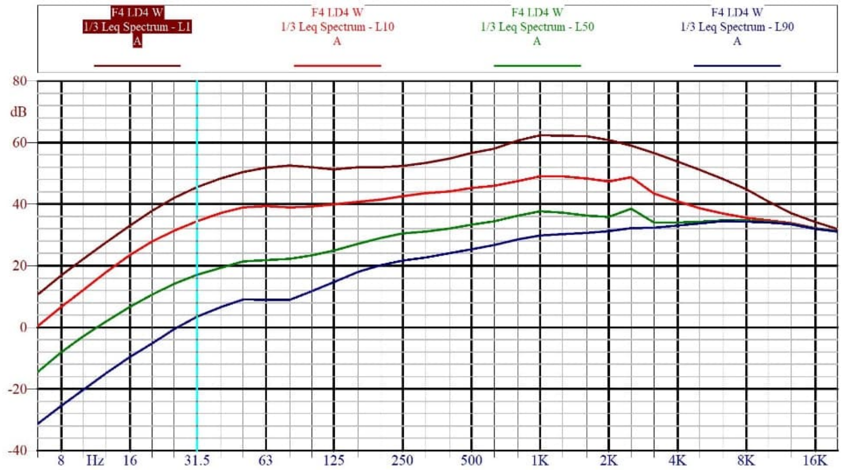


Figure 11 13. Measurement Time History and Spectrogram of position F4.







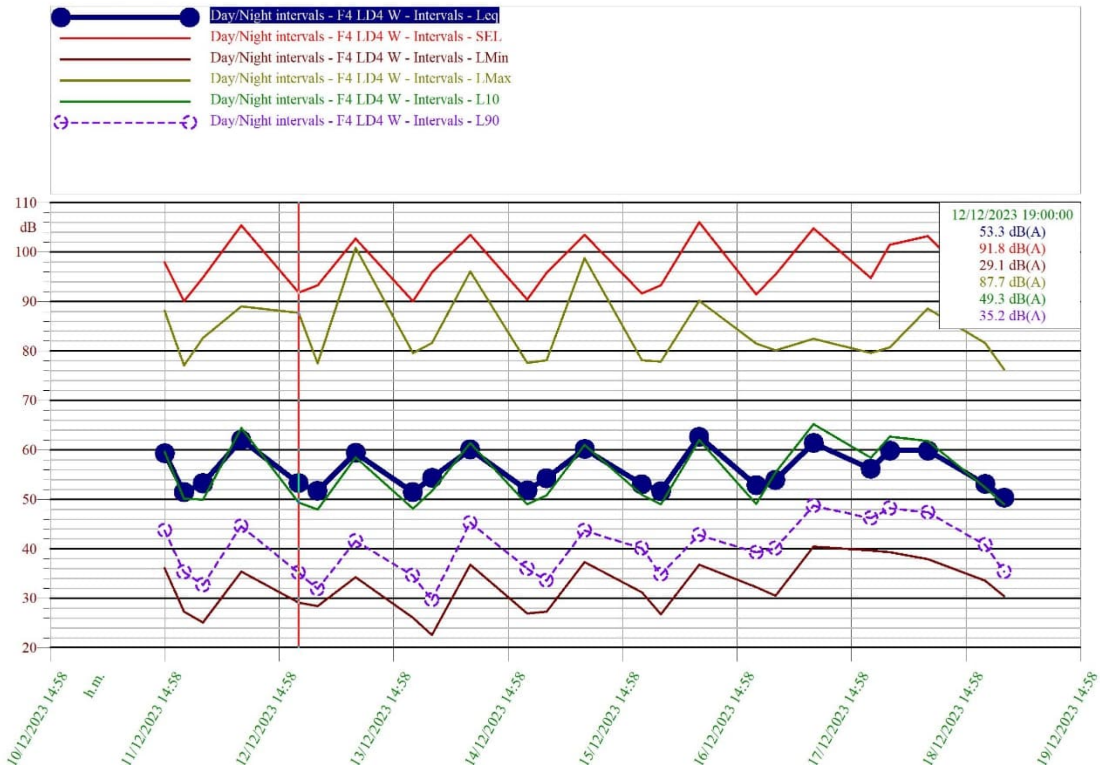


Figure 11 14. Community measurement Day and Night interval statistics of position F4.

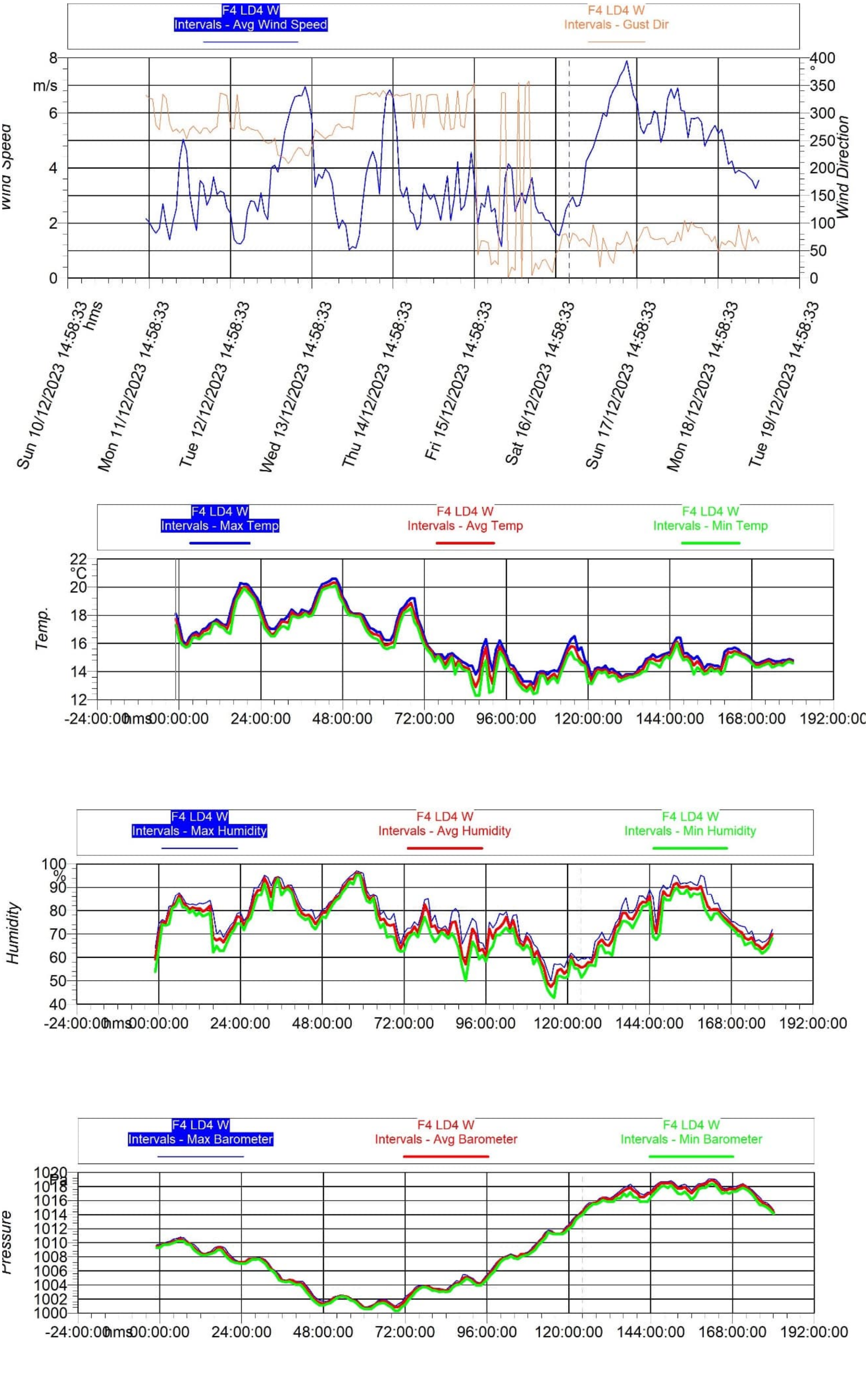
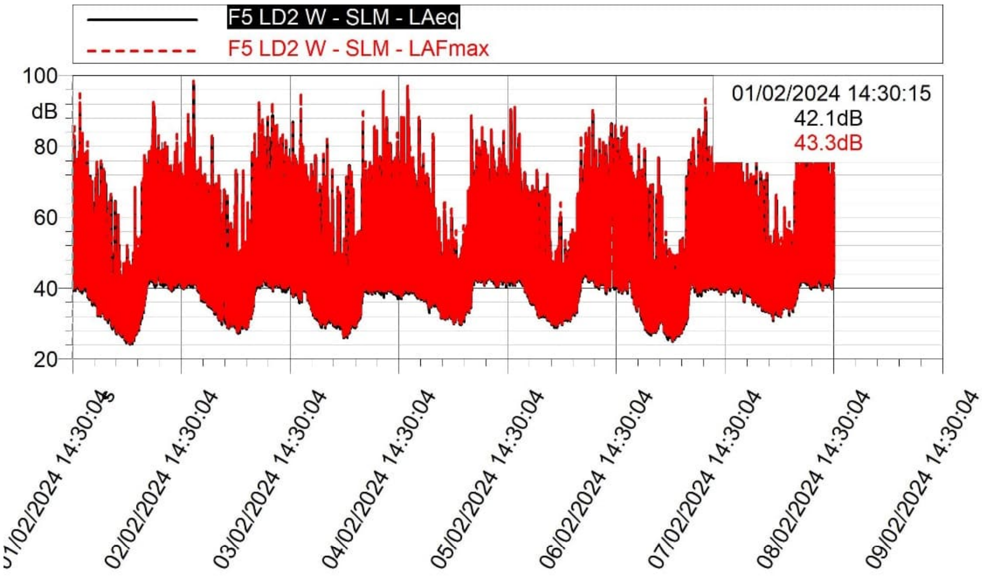


Figure 11 15. Weather time history and statistics of position F4.

3.1.5 F5 - Triq ta' Skerla, Sannat

WGS84 Latitude:36.02321 Longitude: 14.2506 Altitude in feet: 450.43

Figure 11 16. Monitoring station at position F5.



L_{max}= 98.6 dB

L_{Aeq}= 54.1 dB

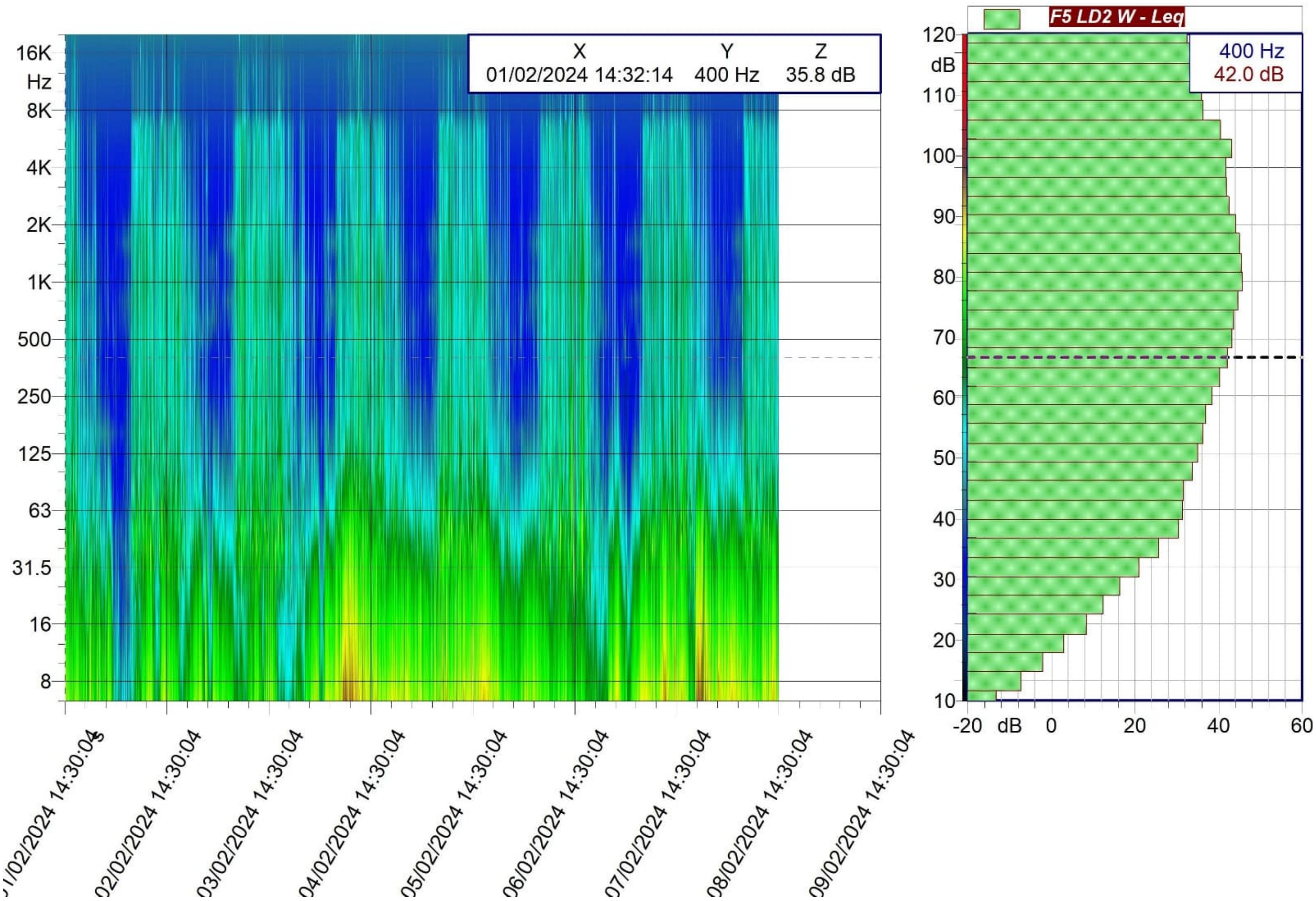


Figure 11 17. Measurement Time History and Spectrogram of position F5.

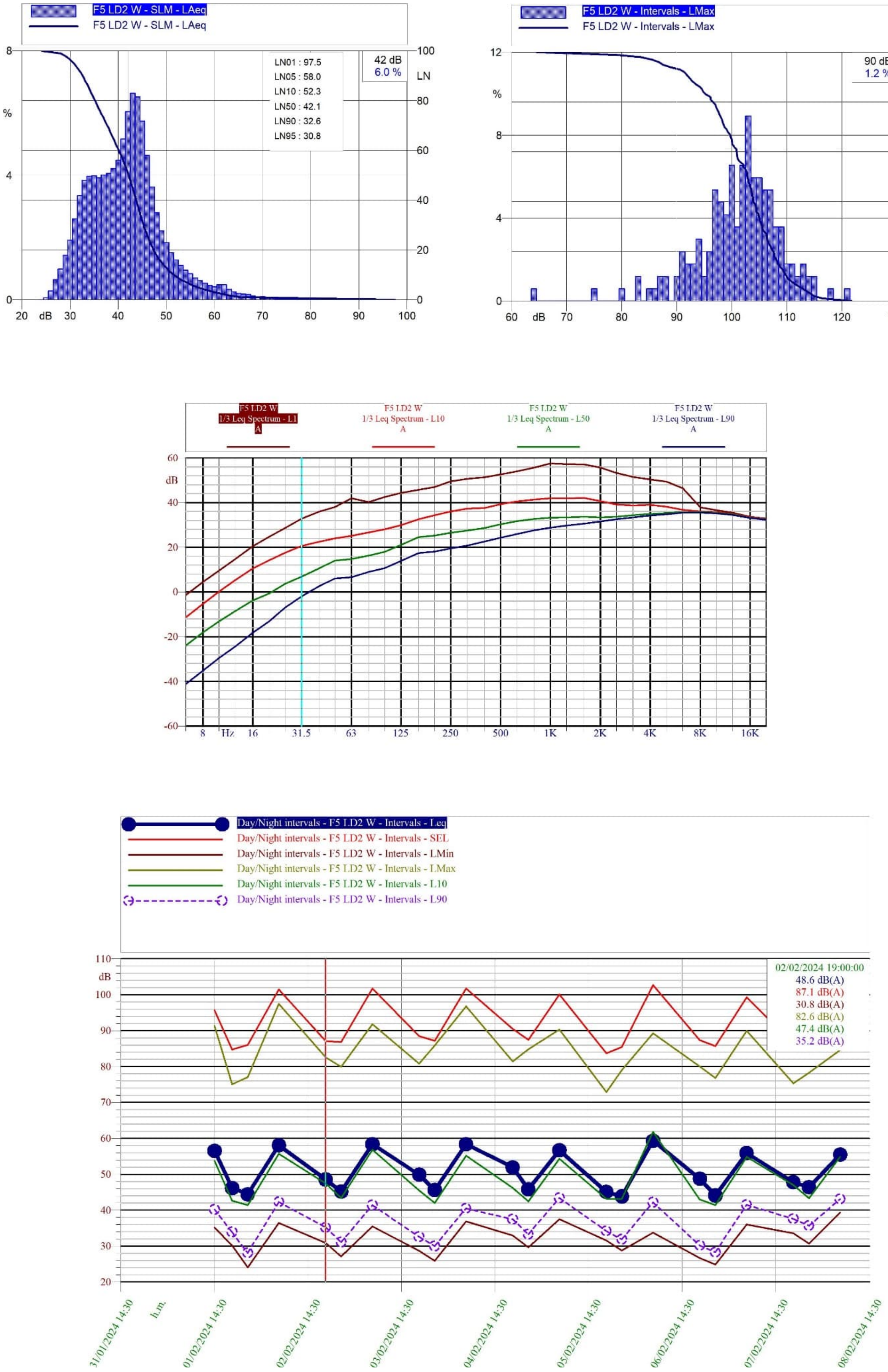
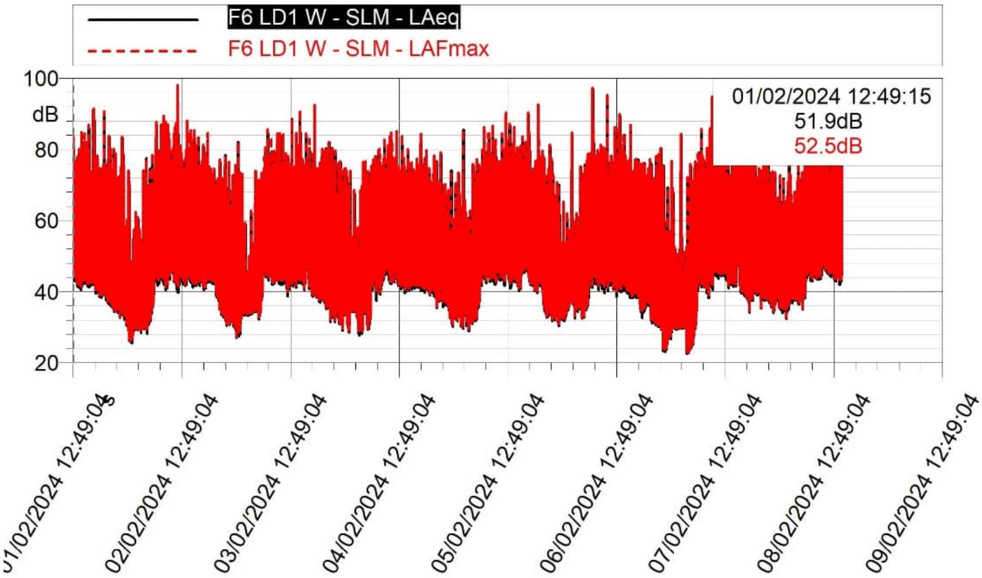


Figure 11 18. Community measurement Day and Night interval statistics of position F5.

3.1.6 F6 - Triq 28t'April 1688, Sannat

WGS84 Latitude:36.02788 Longitude: 14.24124 Altitude in feet: 329.86

Figure 11 19. Monitoring station at position F6.



L_{max}= 97.4 dB

L_{Aeq}= 57.4 dB

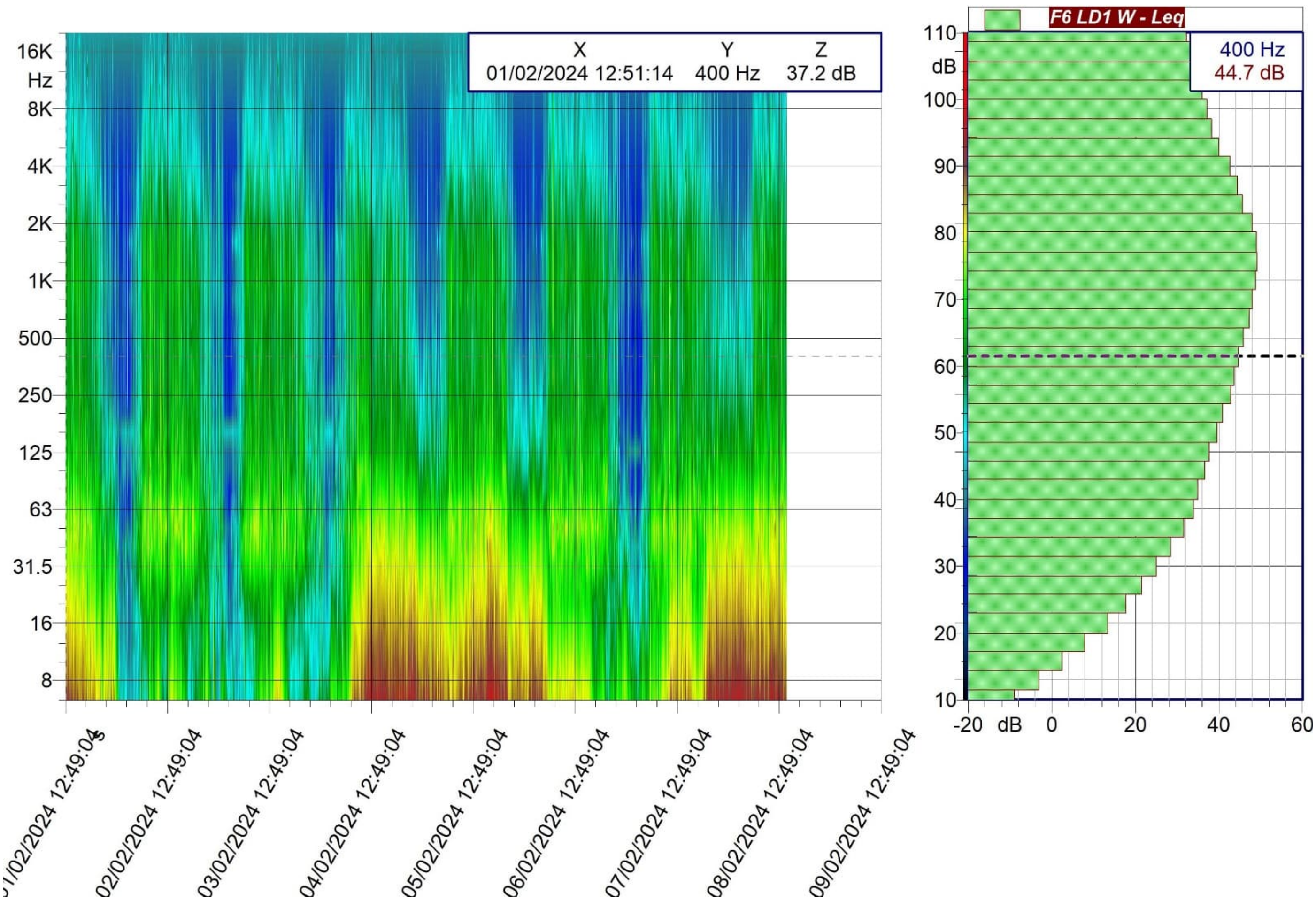


Figure 11 20. Measurement Time History and Spectrogram of position F6.

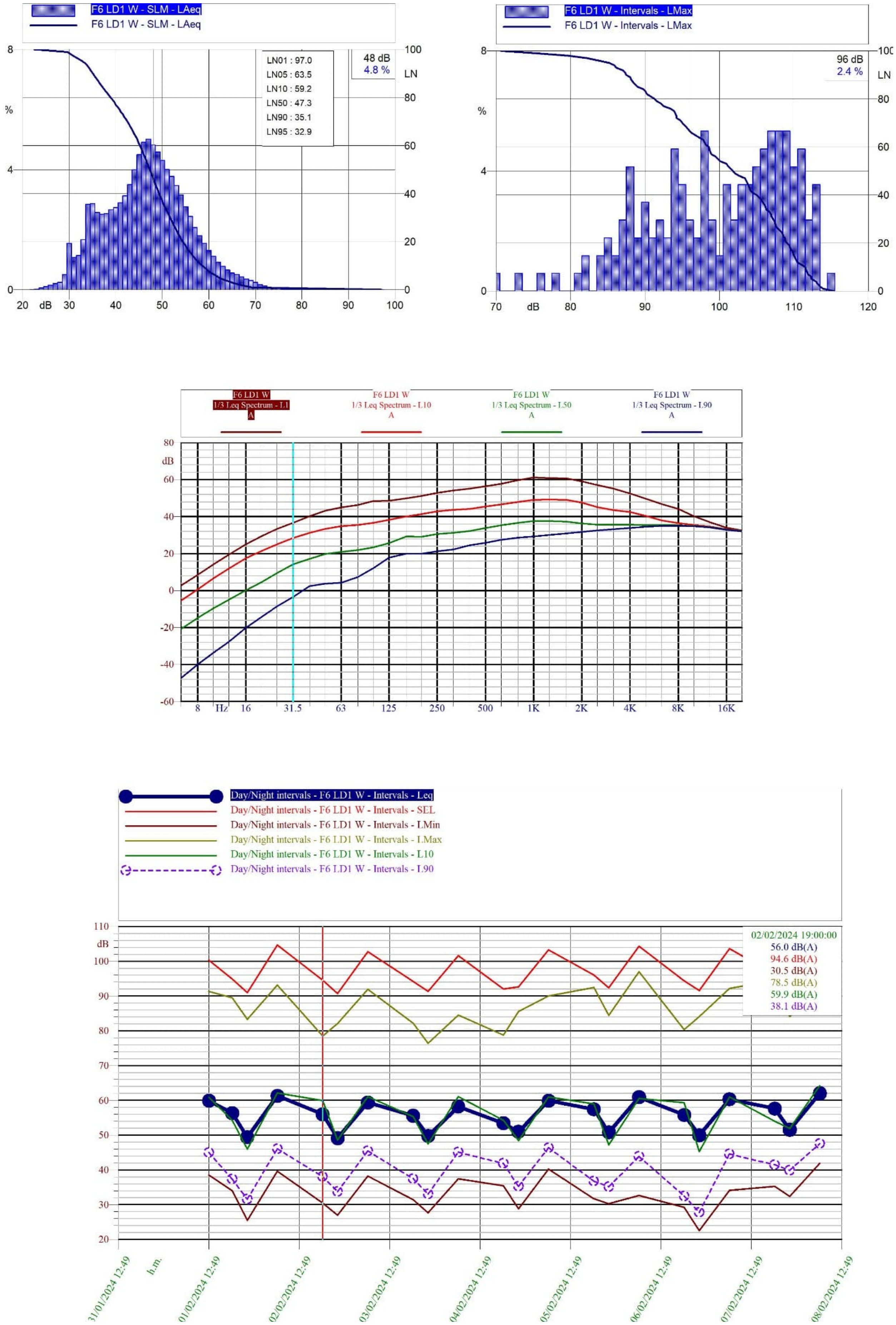
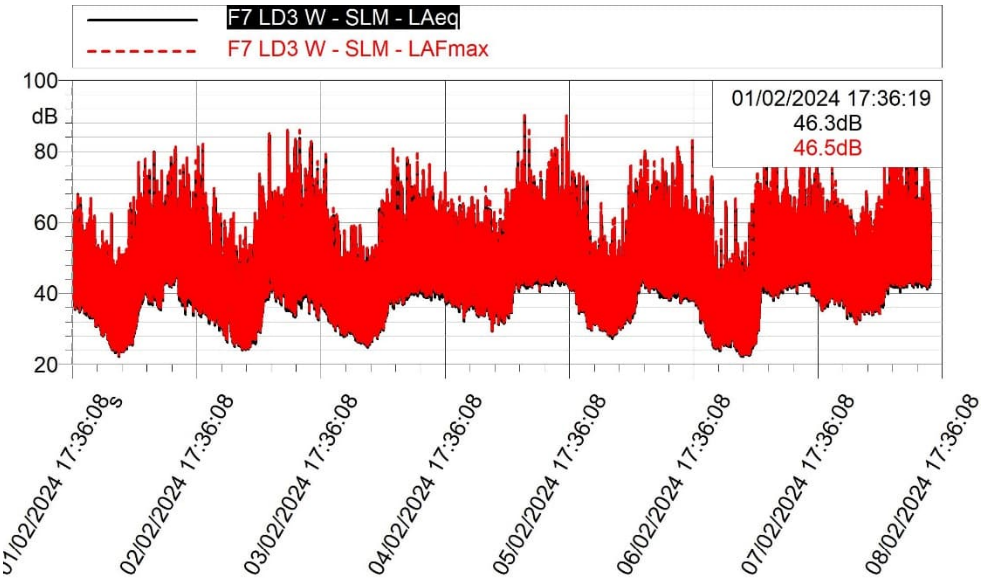


Figure 11 21. Community measurement Day and Night interval statistics of position F6.

3.1.7 F7 - Triq tal-Logga, Xewkija

WGS84 Latitude:36.02827 Longitude: 14.25774 Altitude in feet: 268.51

Figure 11 22. Monitoring station at position F7.



L_{max}= 91.2 dB

L_{Aeq}= 51.3 dB

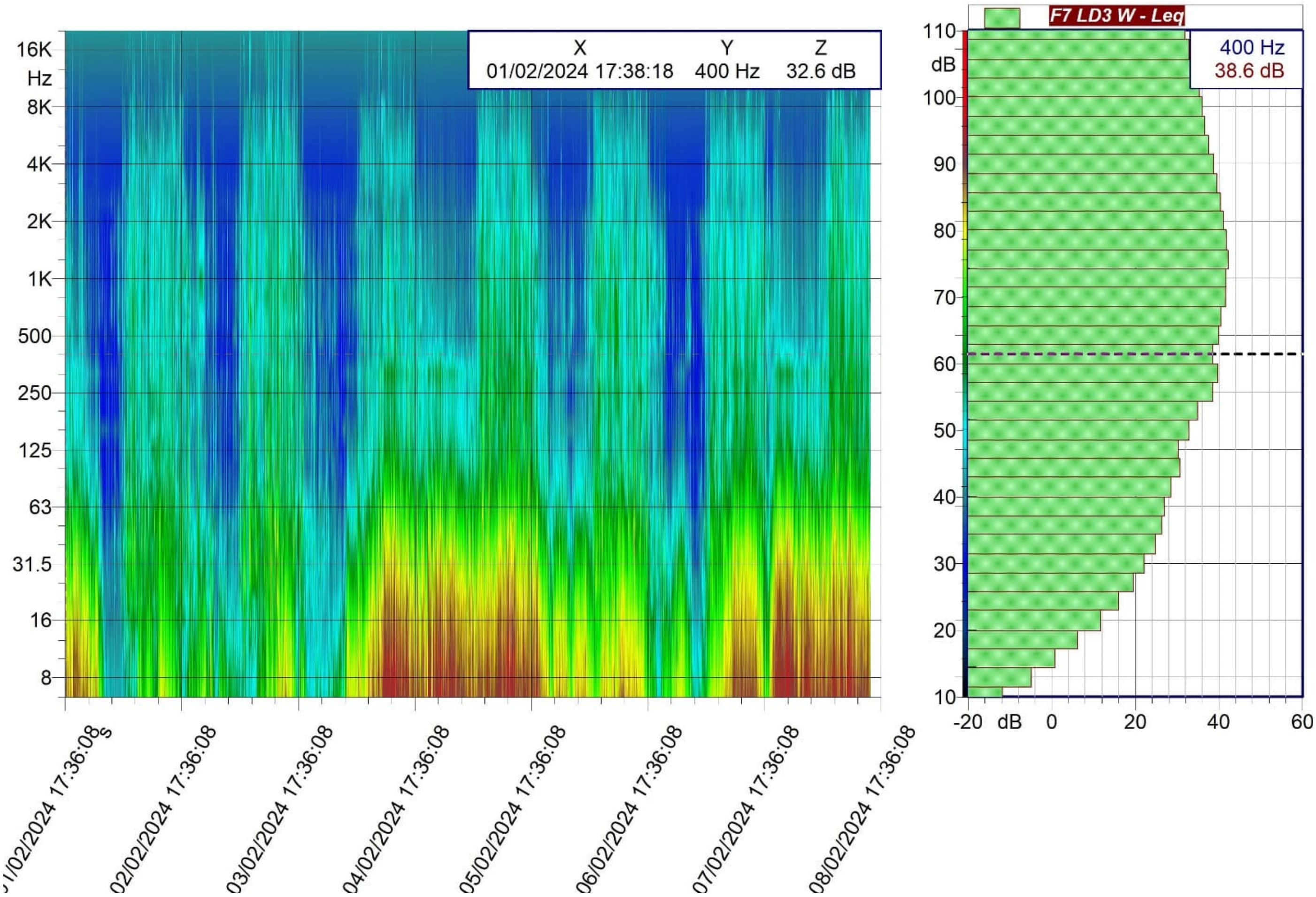


Figure 11 23. Measurement Time History and Spectrogram of position F7.

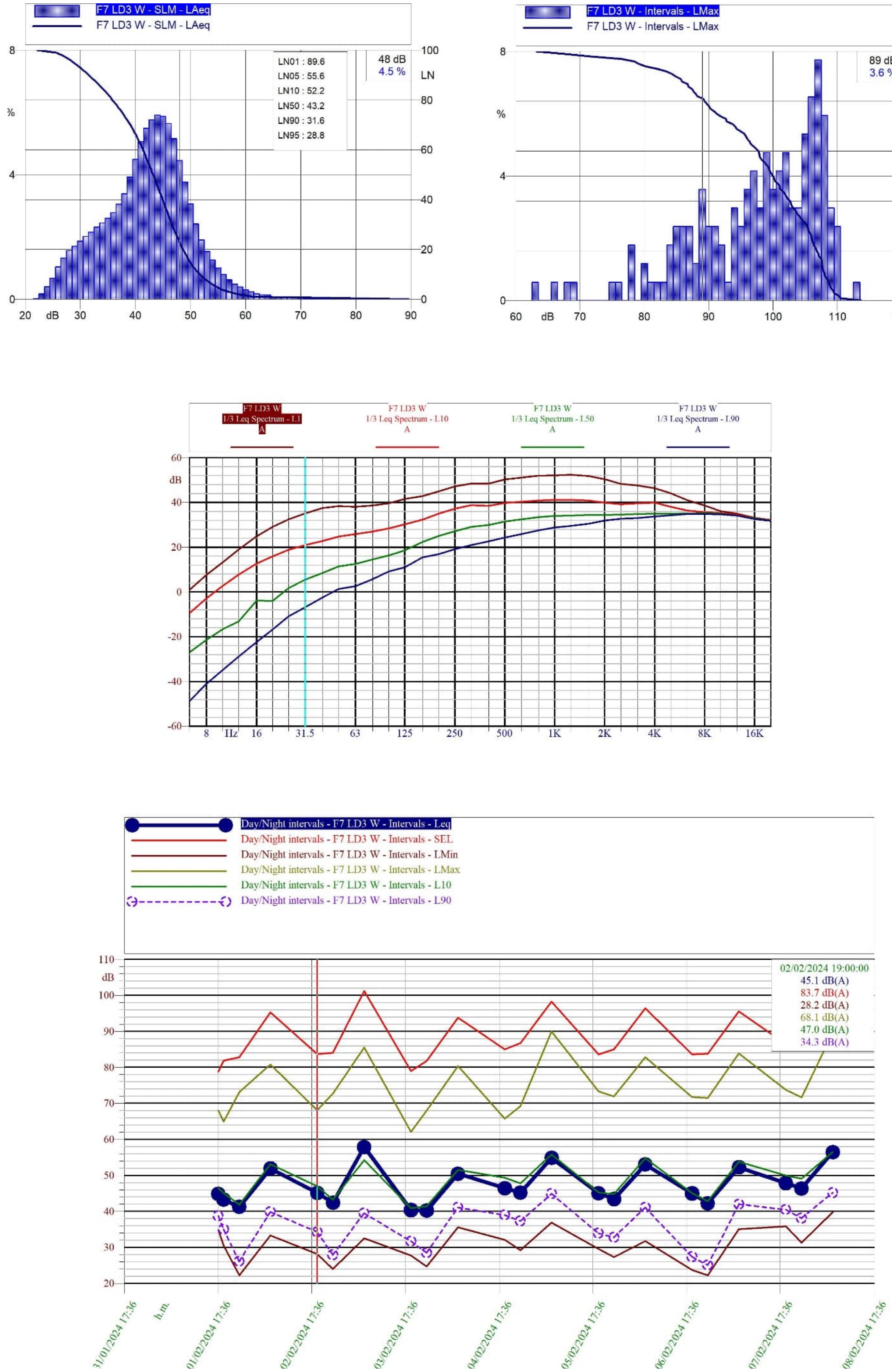


Figure 11 24. Community measurement Day and Night interval statistics of position F7.

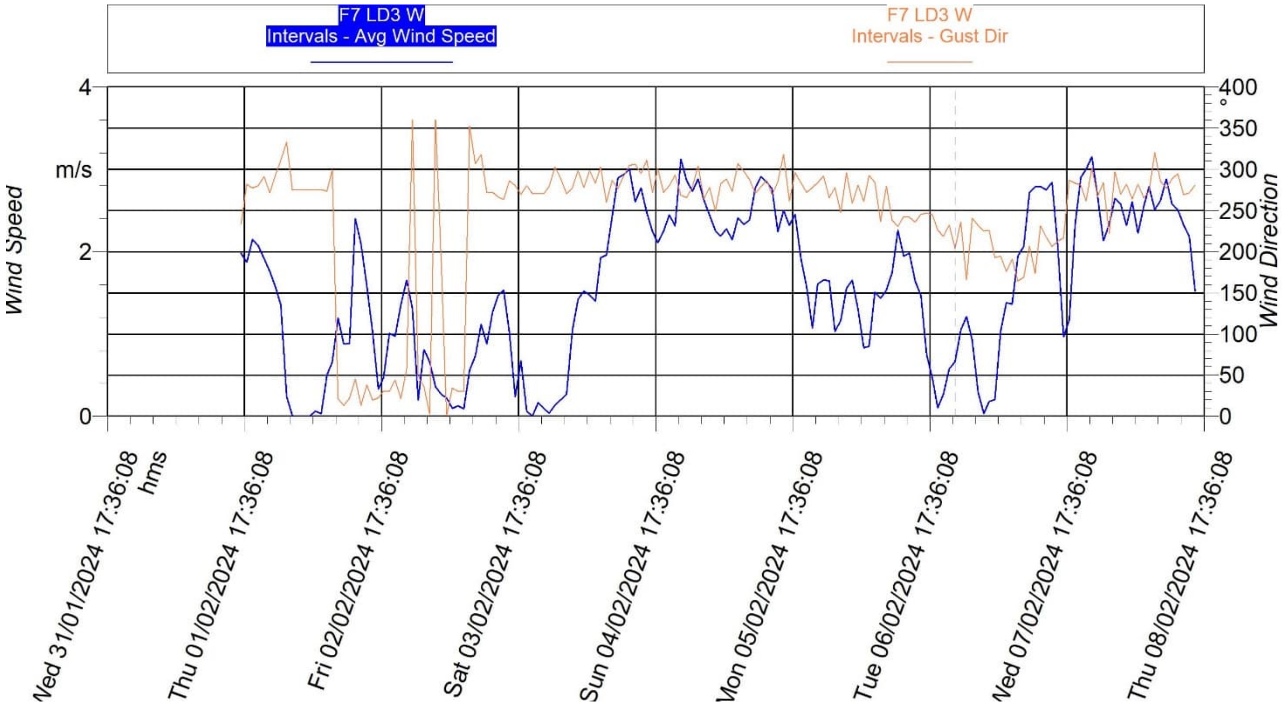
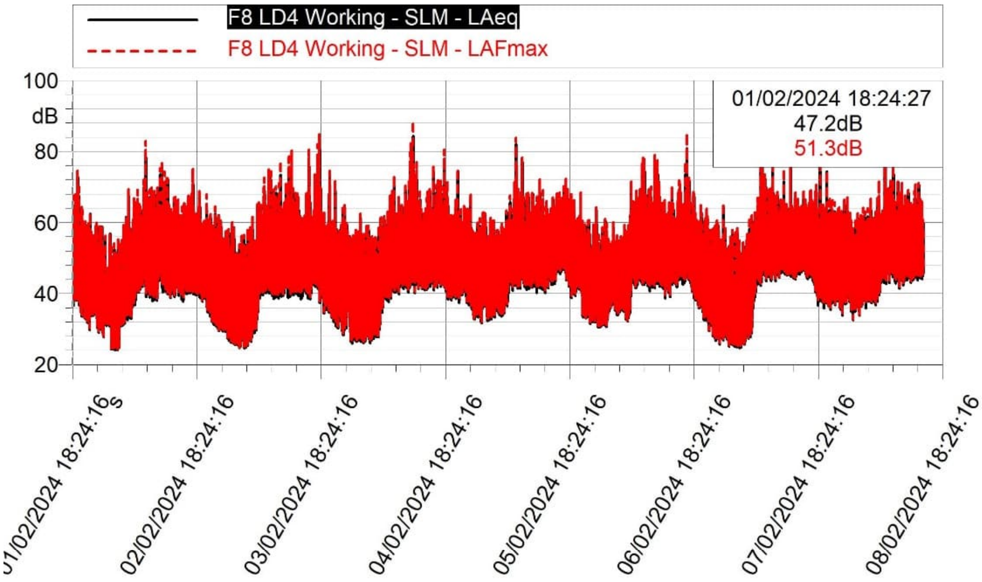


Figure 11 25. Average Wind speed and Gust direction time history of position F7.

3.1.8 F8 - Triq John Gaspard leMerchant, Fontana

WGS84 Latitude:36.03306 Longitude: 14.23744 Altitude in feet: 293.94

Figure 11 26. Monitoring station at position F8.



L_{max}= 88.7 dB

L_{Aeq}= 50.4 dB

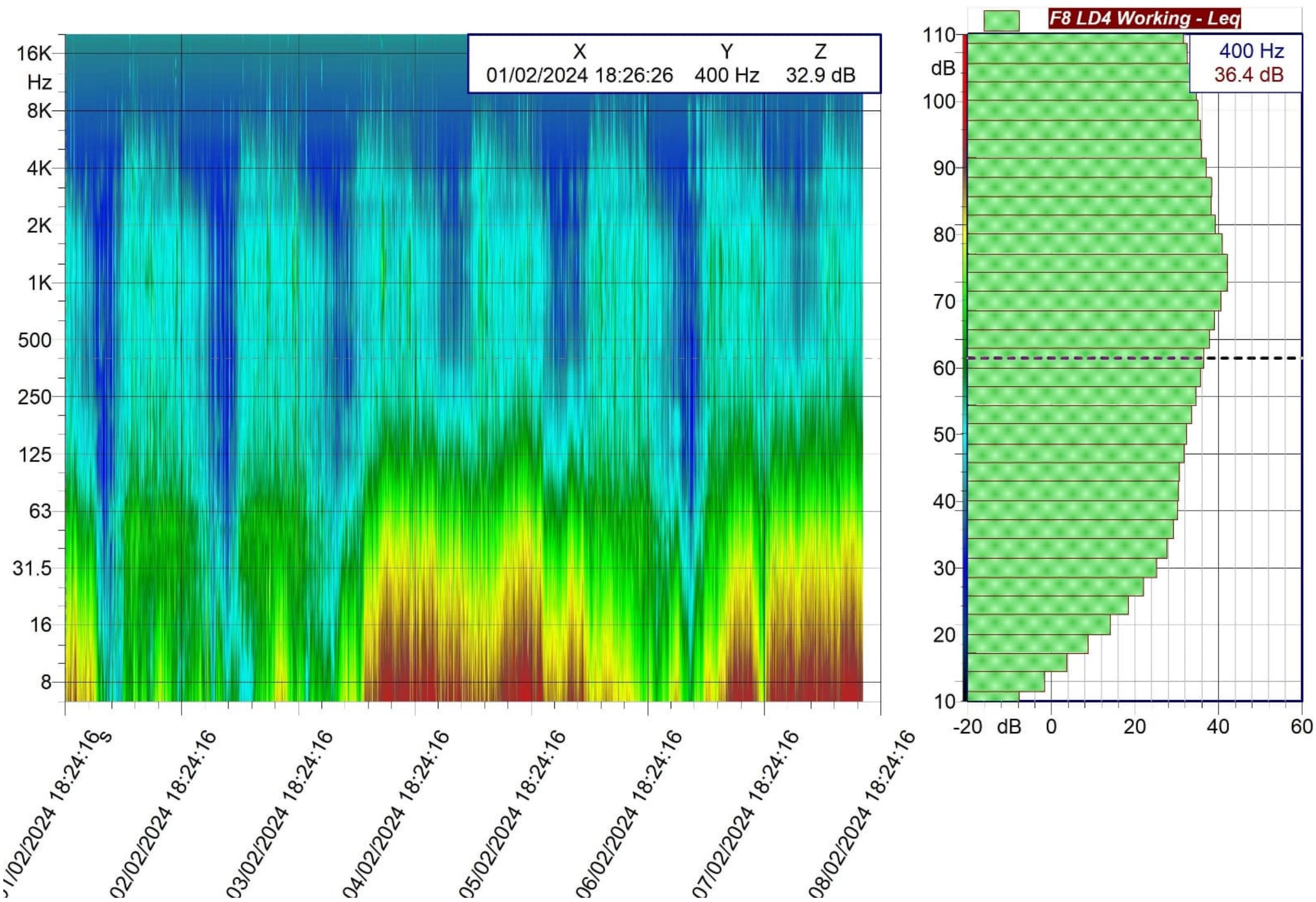


Figure 11 27. Measurement Time History and Spectrogram of position F8.

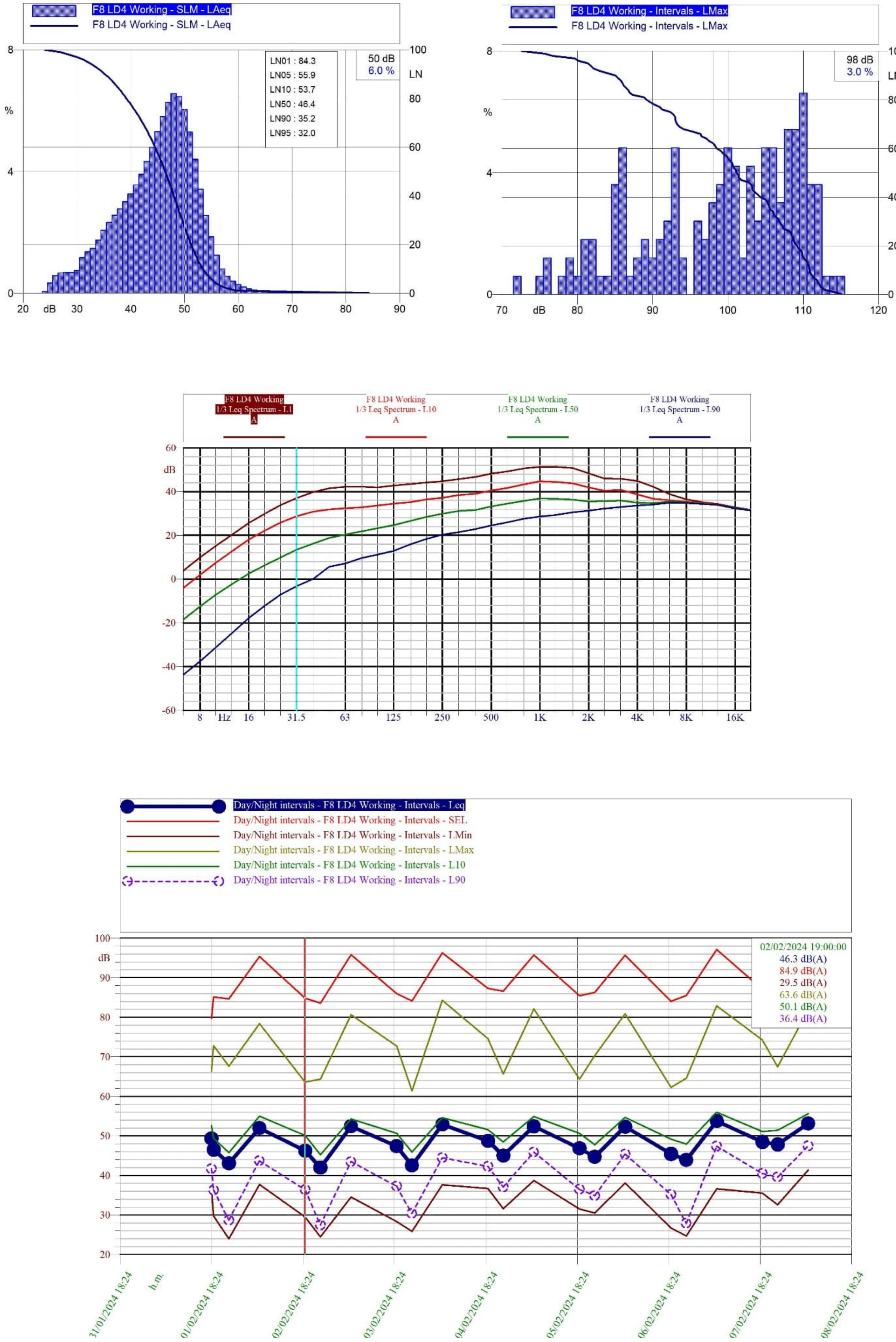
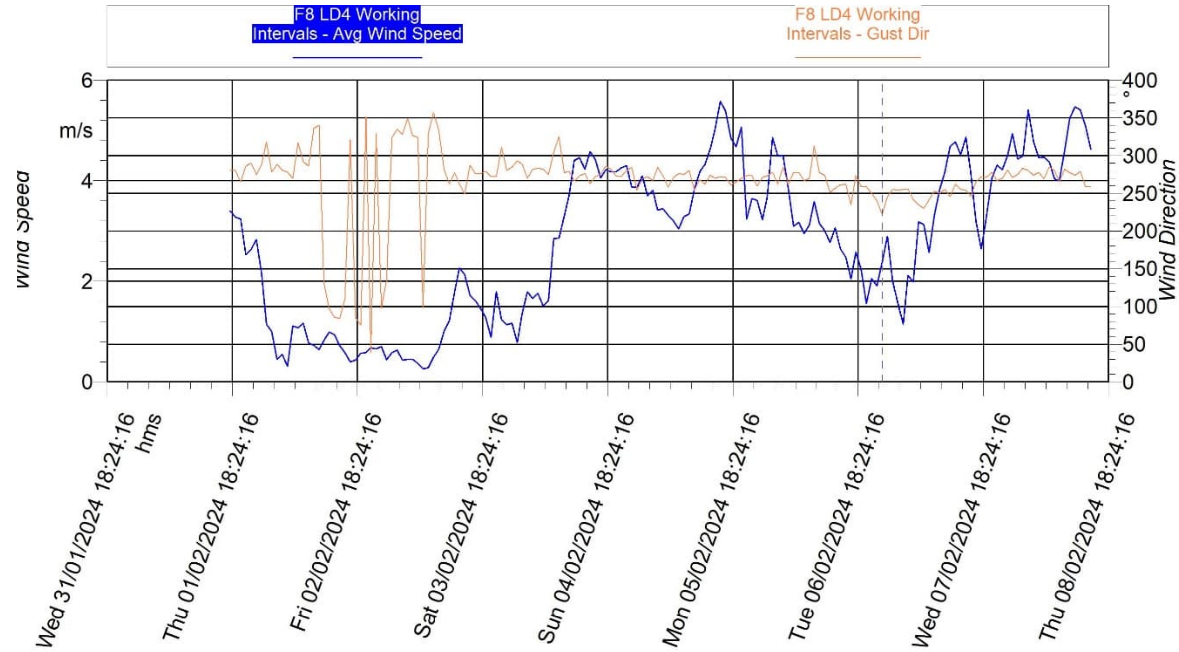
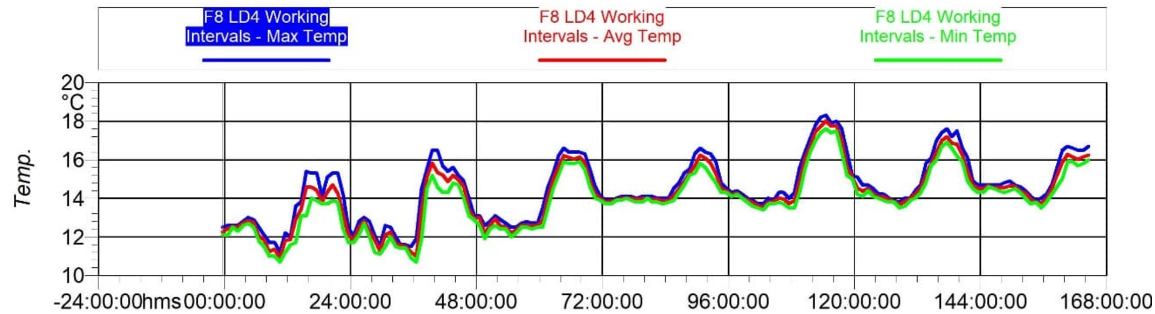
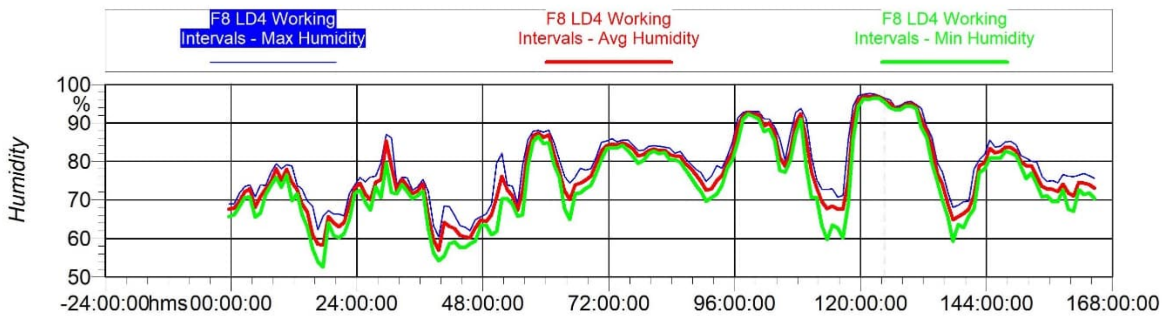


Figure 11 28. Community measurement Day and Night interval statistics of position F8.







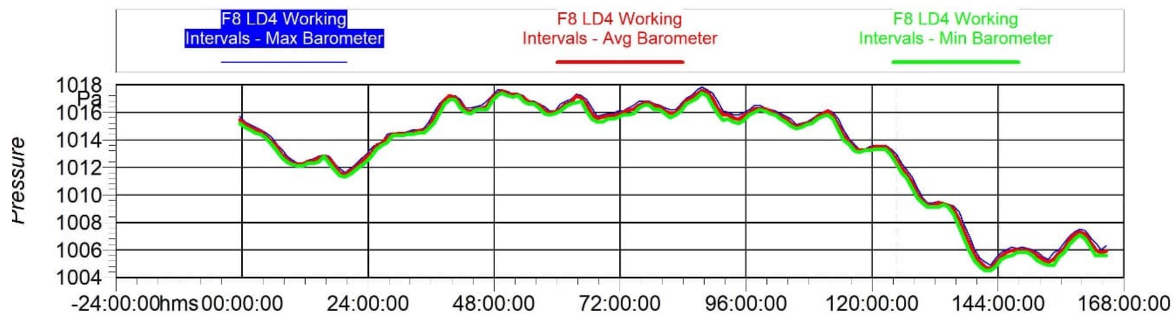


Figure 11 29. Weather time history and statistics of position F8.

4 Appendix 4 - Aircraft Ground Measurements

The noise from aircraft is quite particular and complex since some of them have one engine in the front while others can have several engines per wing, where noise data is not always available. In order to obtain the SWL (sound power level) of different aircraft, two aircraft were measured using fixed SPL (sound pressure level) positions with the purpose to characterize the aircraft ground noise with real data. With special thanks to Col. Mark Anthony Said AFM(Ret.) and AFM Air Wing Commanding Officer Lieutenant Colonel Nicholas Grech, AFM, we were able to conduct such measurements to give a more realistic picture for ground operations.

The available aircrafts were:

- The Britten Norman BN-2T Islander, and
- A typical microlight aircraft that would be used on the airfield.

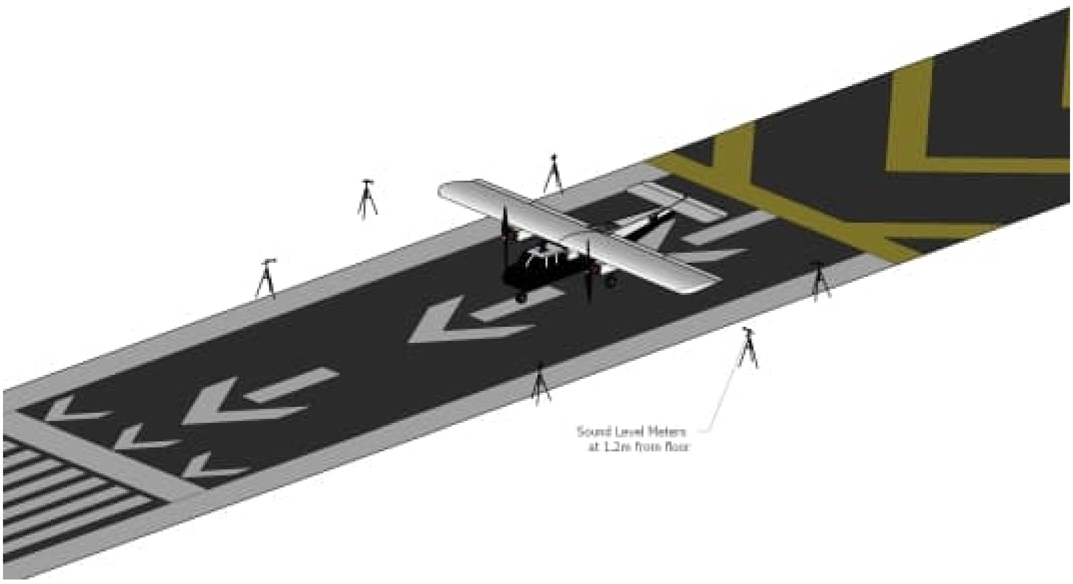
4.1 Britten-Norman BN-2 Islander (Twin engine).

Figure 4-1 Britten-Norman BN-2 Islander aircraft during test.

Figure 4-2 Britten-Norman BN-2 Islander aircraft during test.

In the case of the Islander, 2 different tests were done, where the first one was in IDLE mode (stand by), and the second one in taxi mode.

The first test was done using 6 sound level meters with a height of 1.2 m from the floor, following a circle with a radius of 10 m approximately around the aircraft to obtain the directivity of the plane.



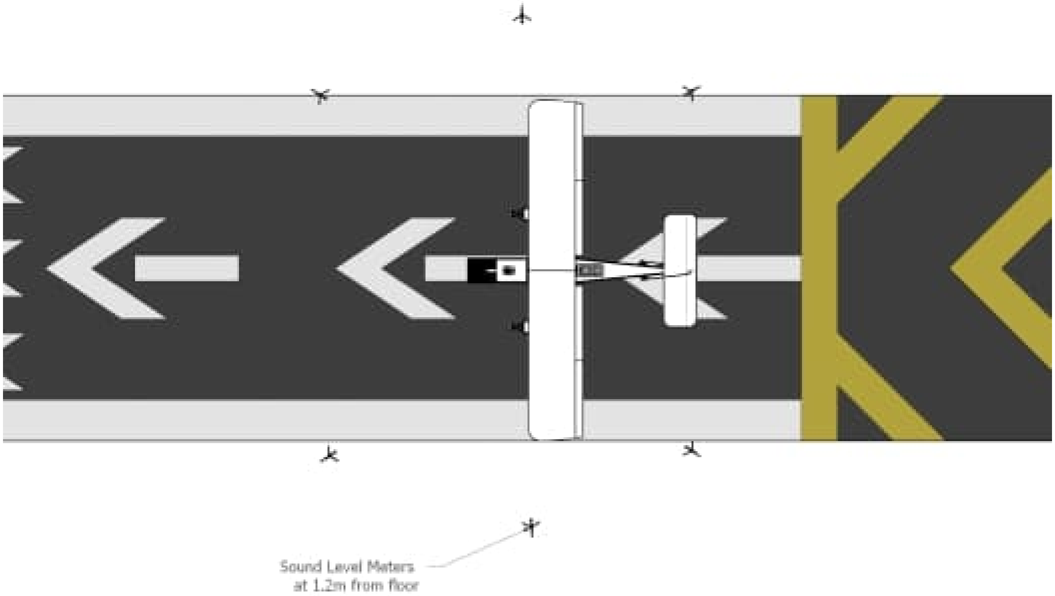


Figure 4-3 Test setup of IDLE mode and microphone positions for Britten-Norman BN-2 Islander aircraft.

The following figure shows the noise spectrum from the measurements:

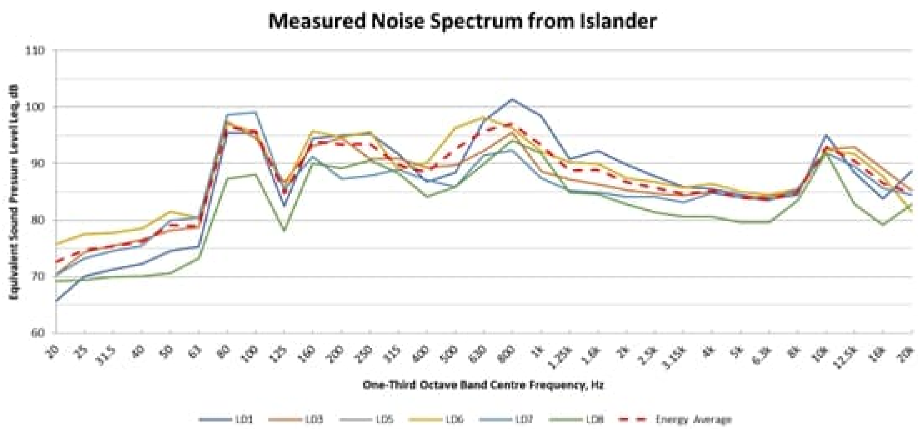


Figure 4-4 Noise spectrum for each position.

Using the energy average at each measurement position the obtained directivity in octave-band is the following:

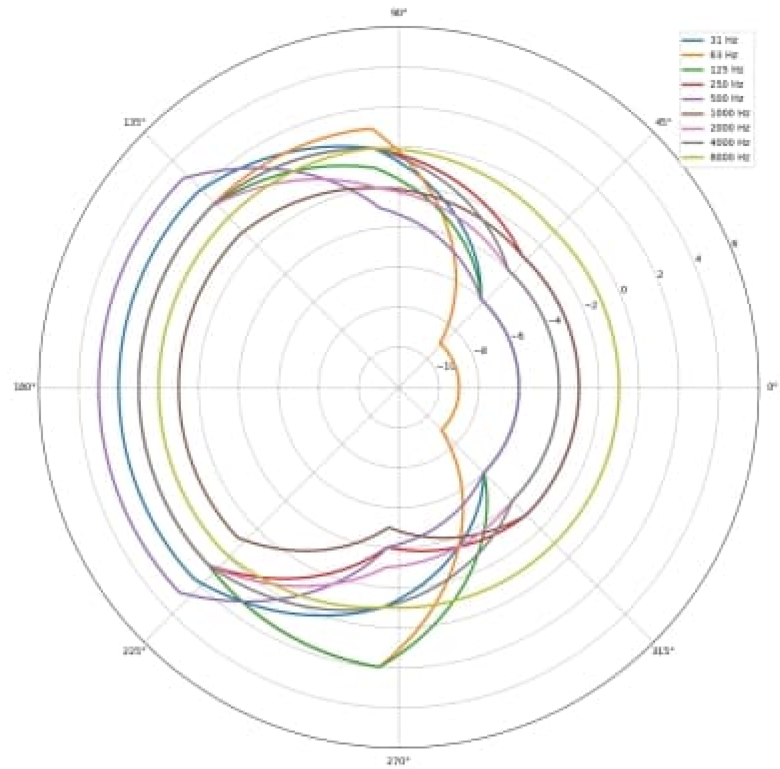


Figure 4-5 Directivity from Islander aircraft.

The second test was done using 6 sound level meters with a height of 1.2 m from the floor, placed on the sides of the landing strip with a distance of 20 meters between them.

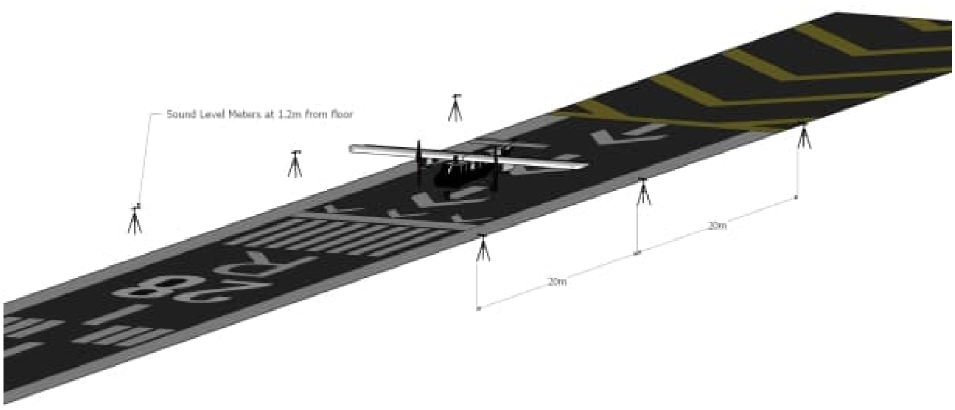


Figure 4-6 Test setup and microphones placed next to the landing strip for Britten-Norman BN-2 Islander aircraft.

The following figure shows the noise spectrum in taxi mode obtained from the measurements:

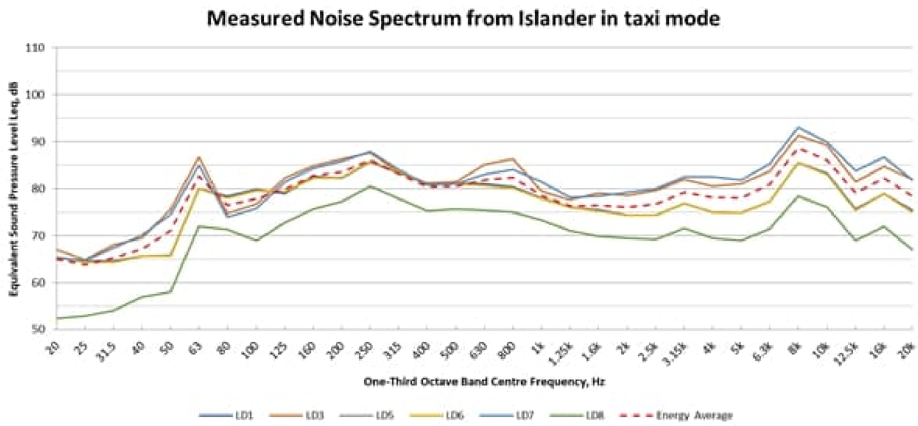


Figure 4-7 Noise spectrum for each position in taxi mode.

The estimated SWL from the Islander aircraft is the following:

Sound Power Level, dB										
Aircraft	Octave Band Centre Frequency, Hz									Overall dB
	31.5	63	125	250	500	1k	2k	4k	8k	
BN-2 Islander	96	109	116	123	122	117	112	115	123	129

4.2 Microlight aircraft (single engine).

Figure 4-8 Microlight aircraft during test.

Figure 4-9 Microlight aircraft during test.

In the case of the microlight aircraft, 2 test were done, where the first one was IDLE mode (stand by) while the second one in IDLE but making use of the plane flaps.

Both tests were done using 6 sound level meters with a height of 1.2 meter from the floor, following a circle with a radius of 5 m around the aircraft to obtain the directivity of the small plane.

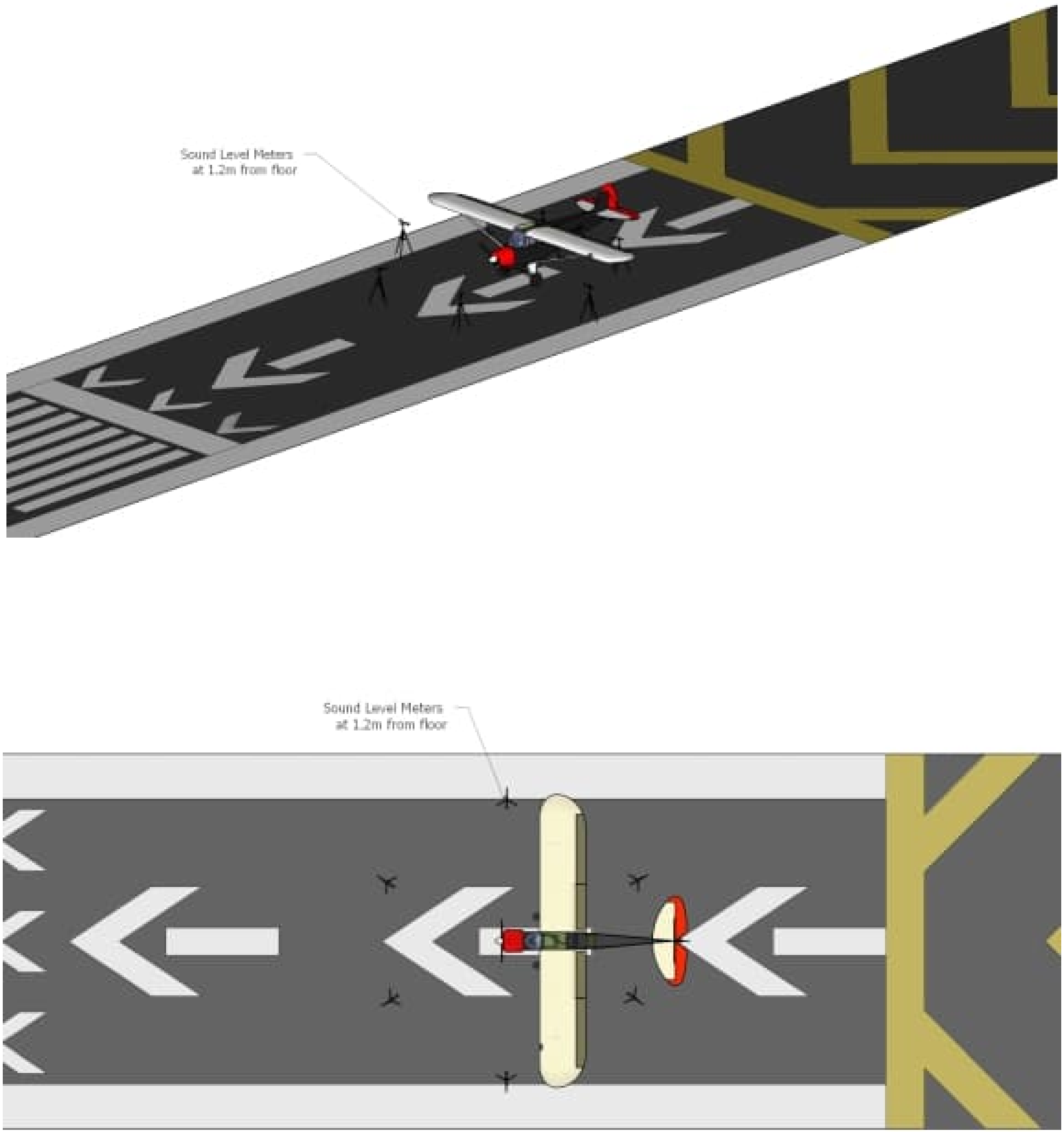


Figure 4-10 Test setup of IDLE mode and microphone positions for Microlight aircraft.

The following figure shows the noise spectrum from the measurements:

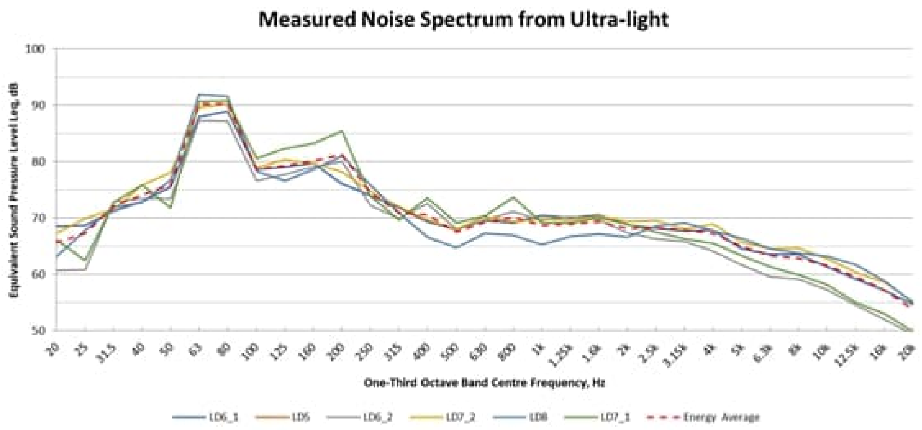


Figure 4-11Noise spectrum for each position

Using the energy average and each measurement position the obtained directivity in octave-band is the following:

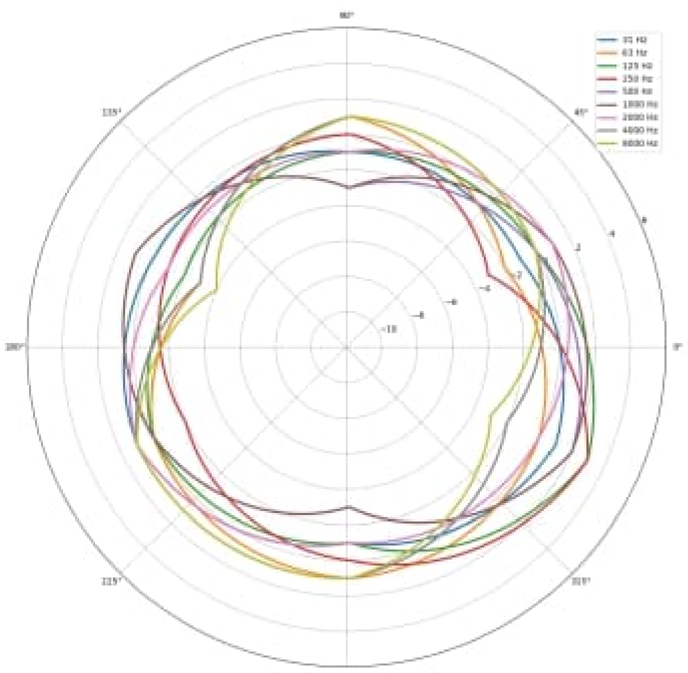


Figure 4-12 Directivity from Microlight aircraft.

The next figure shows the noise spectrum of the second test obtained from the measurements:

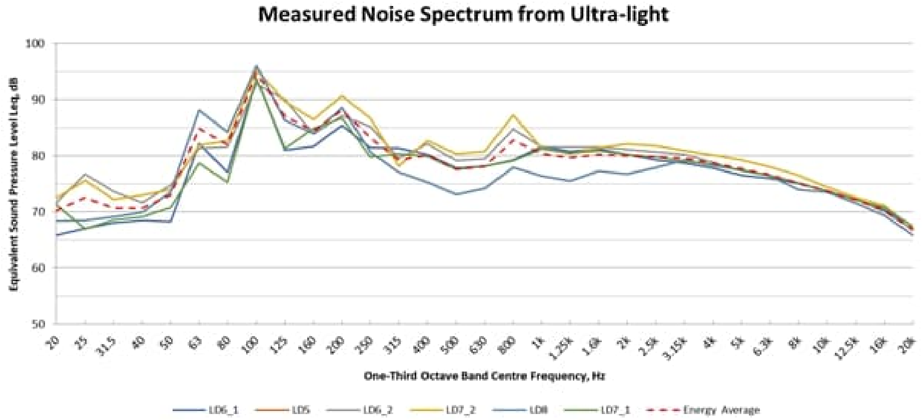
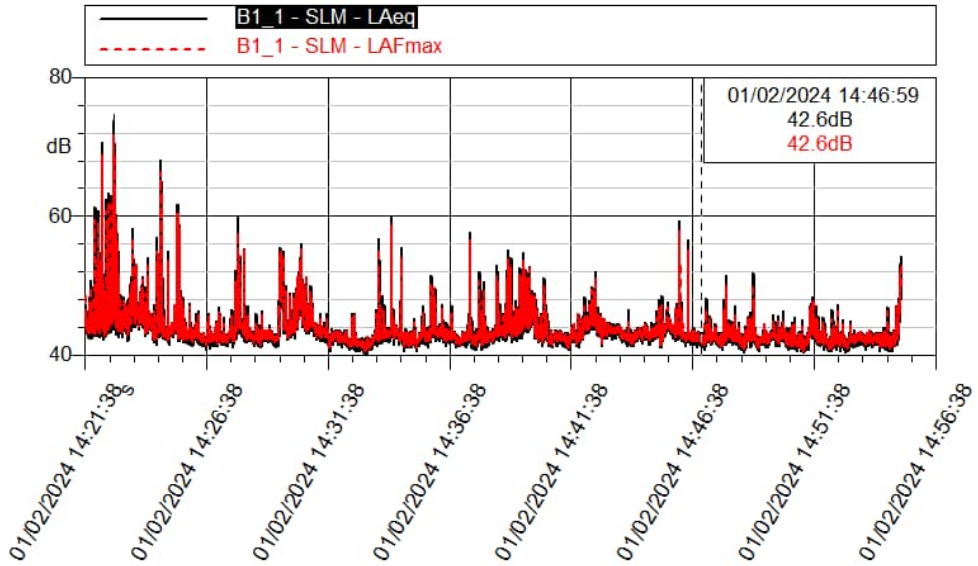


Figure 4-13 Noise spectrum for each position in the second test.

The estimated SWL from the Microlight aircraft is the following:

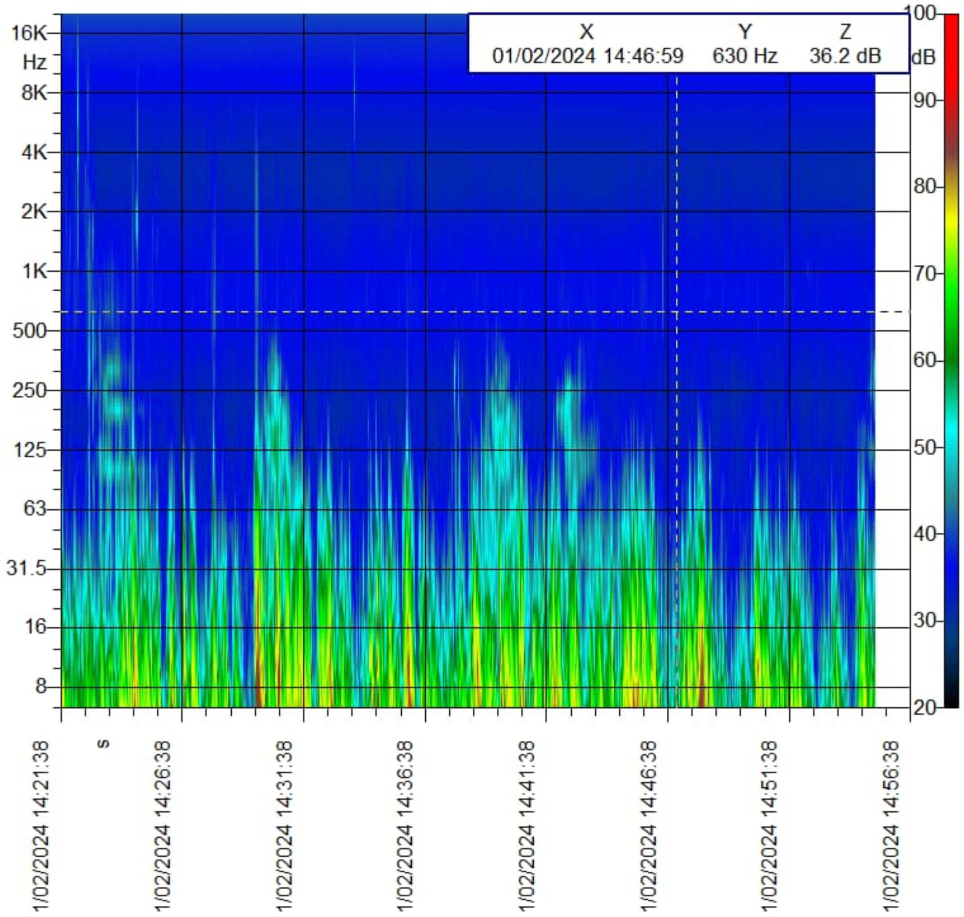
Sound Power Level, dB										
Aircraft	Octave Band Centre Frequency, Hz									Overall dB
	31.5	63	125	250	500	1k	2k	4k	8k	
Microlight	95	106	120	116	111	111	109	108	105	123

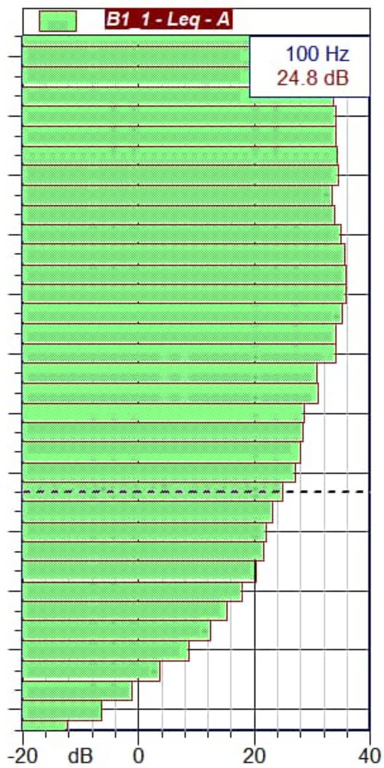
5 Appendix 5 - Fauna related measurements

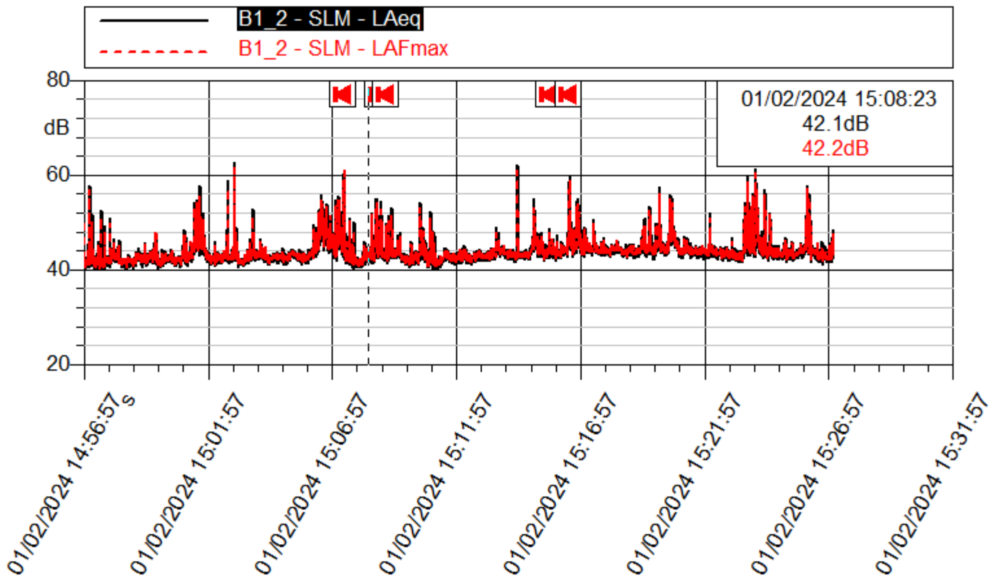


L_{max}= 69.3 dB

L_{Aeq}= 44.4 dB

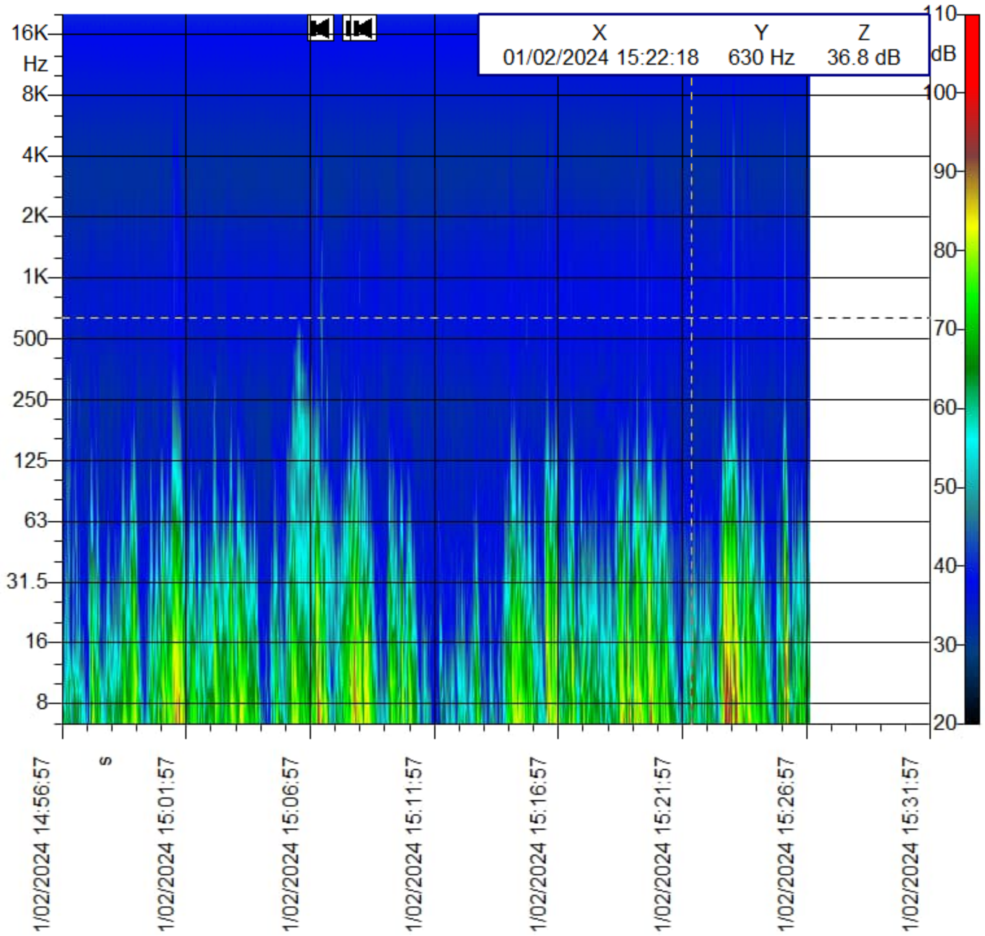


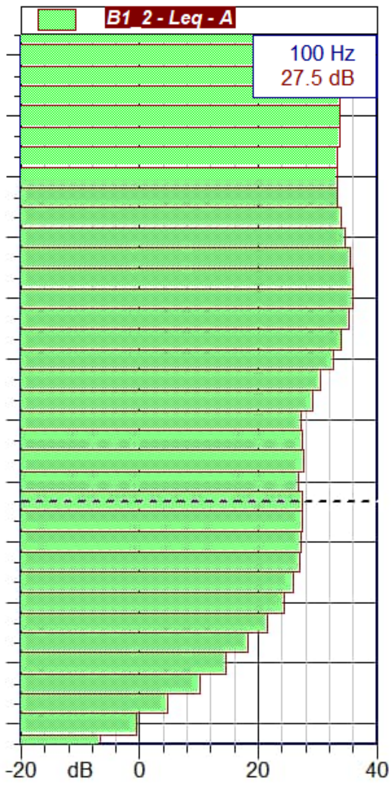


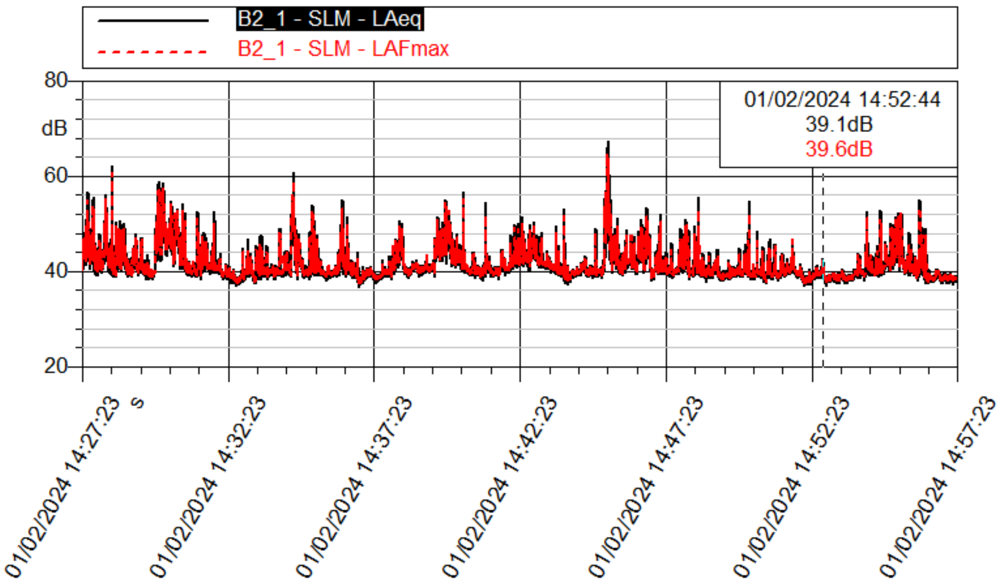


L_{max}= 61.5 dB

L_{Aeq}= 44.5 dB

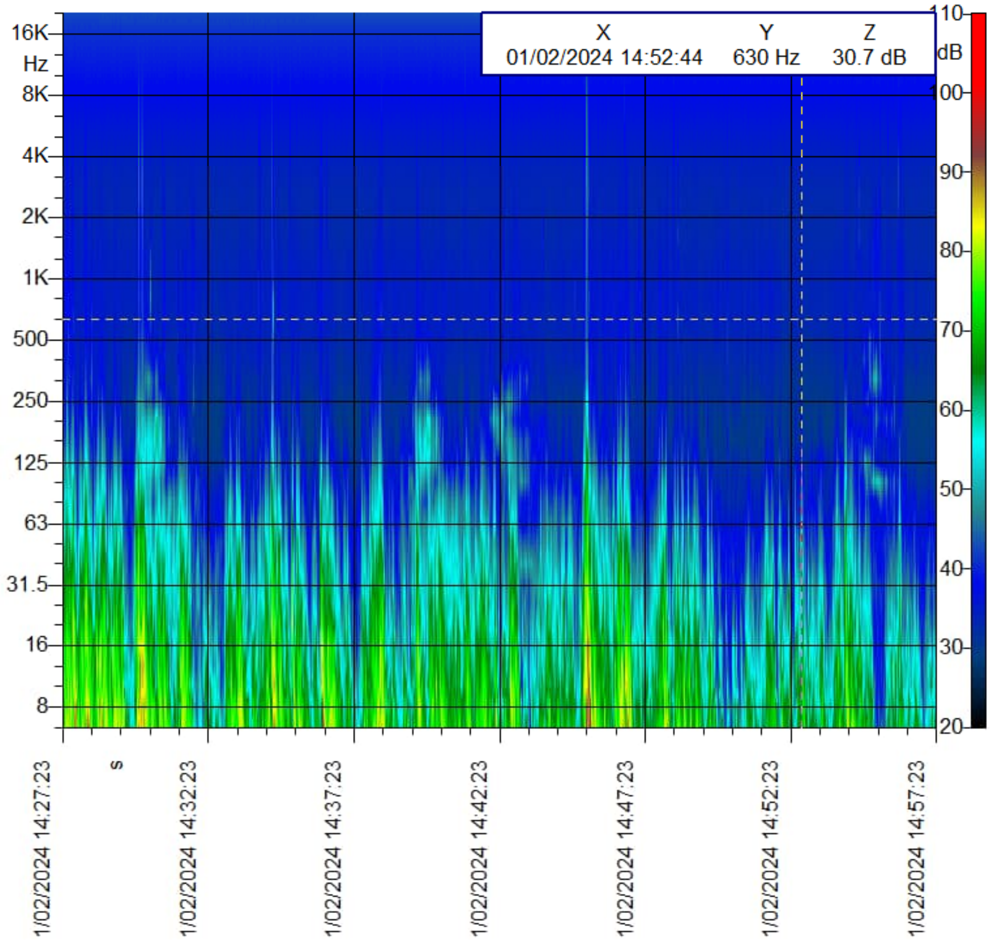


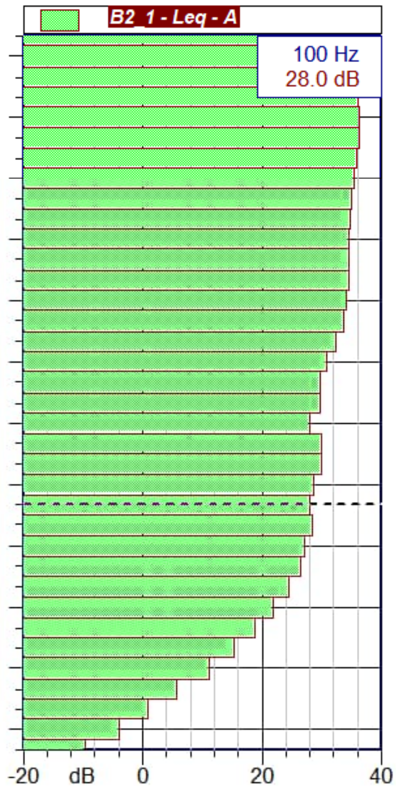


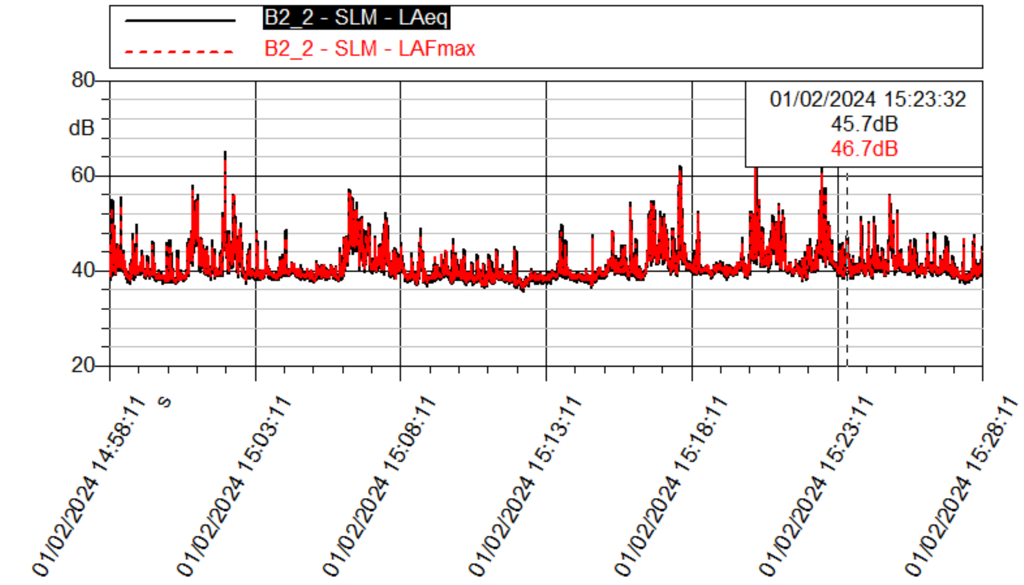


L_{max}= 60.8 dB

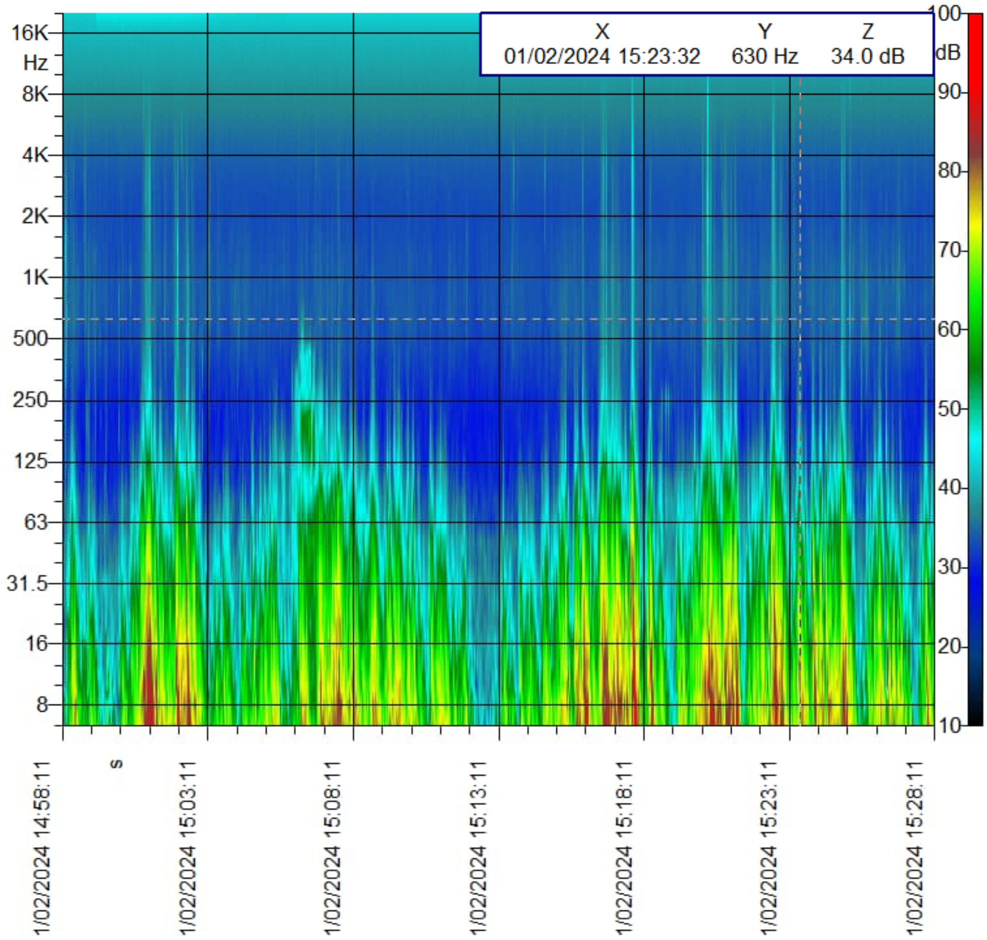
L_{Aeq}= 42.8 dB

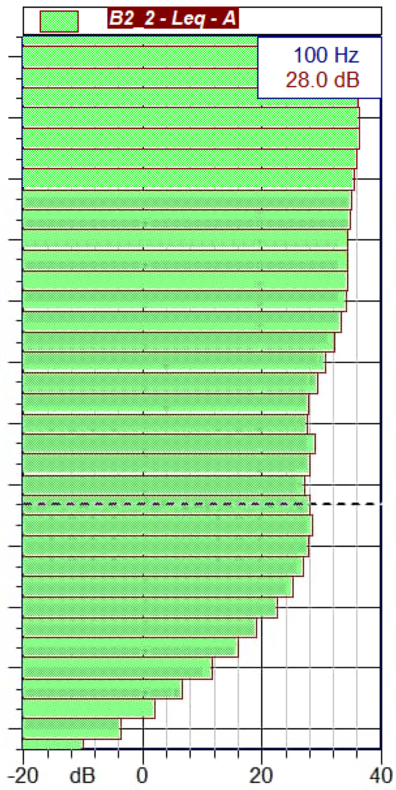






L_{max}= 63.6 dB
L_{Aeq}= 42.6 dB





References

Applied Acoustics 68 (2007) 1263–1279 Estimation of directivity and sound power levels emitted by aircrafts during taxiing, for outdoor noise prediction purpose C. Asensio *, I. Pavo´n, M. Ruiz, R. Pagan, M. Recuero

EXTERNAL NOISE OF LIGHT PROPELLER-DRIVEN AIRCRAFT, F.W.J. van Deventer and G.J.J. Ruijgrok Dept, of Aerospace Engineering Delft University of Technology Delft, The Netherlands.

Helicopter Noise Reduction Technology Status Report 21 April 2015 Contributors: ICCAIA: Snecma, Airbus Helicopters, Sikorsky Aircraft, Bell Helicopter, AgustaWestland, Turbomeca, Marenco Swisshelicopter Research Centers: NASA, DLR, ONERA, JAXA

The new EU helicopter noise model NORAH, Nico van Oosten Anotec Engineering, Spain. Luis Meliveo Anotec Engineering, Spain. Marthijn Tuinstra NLR – Netherlands Aerospace Centre, Netherlands. Herold Olsen SINTEF, Norway.

ProPG: Planning & Noise -Professional Practice Guidance on Planning & Noise - New Residential Development May 2017 ANC IOA CIEH

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Glossary

Average Sound Level (L_{avg}): It is the logarithmic average of the sound during a Measurement Duration (specific time period), using the chosen Exchange Rate Factor. Exposure to this sound level over the period would result in the same noise dose and the actual (unsteady) sound levels. Only sound levels above the Threshold Level are included in the integral.

Community Noise Equivalent Level (CNEL, L_{den}): A rating of community noise exposure to all sources of sound that differentiates between daytime, evening and nighttime noise exposure.

$$L_{den} = 10log_{10}\left\{\frac{1}{24}\left[\sum_{0000}^{0700} 10^{(L_i+10)/10} + \sum_{0700}^{1900} 10^{L_i+10} + \sum_{1900}^{2200} 10^{(L_i+5)/10} + \sum_{2200}^{2400} 10^{(L_i+10)/10}\right]\right\}$$

Day-Night Average Sound Level (DNL, L_{dn}): A rating of community noise exposure to all sources of sound that differentiates between daytime and nighttime noise exposure.

Day Noise Level (L_{day}, L_d): day noise level the A-weighted, L_{eq} (equivalent noise level), over the 12-hour day period (07:00-19:00), also known as the day noise indicator.

Evening Noise Level ($L_{evening}$, L_e): evening equivalent noise level, the A-weighted, L_{eq} (equivalent noise level) over the 4-hour evening period 19:00-23:00 hours, also known as evening noise indicator.

Night Noise Level (L_{night}, L_n): the A-weighted, L_{eq} (equivalent noise level) over the 8-hour night period of 23:00 to 07:00 hours, also known as the night noise indicator.

Decibel: Unit used to measure sound taking as a reference the minimum sound pressure level that the average human ear can detect. Units in dB.

Detector: The part of a sound level meter that converts the actual fluctuating sound or vibration signal from the microphone to one that indicates its amplitude. This results in an amplitude described as rms (root-mean-square).

Equivalent Sound Pressure Level (L_{eq}): The level of a constant sound over a specific time period T that has the same sound energy as the actual (unsteady) sound over the same period, defined in dB.

$$L_{eq} = 10log_{10}\left[\frac{\int_{T_1}^{T_2} p^2(t)dt}{p_0^2 T}\right]$$

Frequency (Hz, rad/sec): The measurement of the number of times that a repeated event occurs per unit of time. Has an inverse relationship to the concept of wavelength (the distance between two peaks) such that the frequency is equal to the velocity divided by the wavelength. Units in Hertz Hz.

Frequency Band Pass Filter: Covers a band of frequencies from a lower cut-off frequency to an upper cut-off frequency. Outside the filter bandwidth, the signal is attenuated.

Low Pass Filter: A frequency filter that permits signals to pass through that have frequencies below a certain fixed frequency, called a cutoff frequency. It is used to discriminate against higher frequencies.

High Pass Filter: A frequency filter that permits signals to pass through that have frequencies above a certain fixed frequency, called a cutoff frequency. It is used to discriminate against lower frequencies.

Octave band: A bandpass frequency filter that permits signals to pass through that have a bandwidth based on octaves. An octave is a doubling of frequency, so the upper cutoff frequency is twice the lower cutoff frequency.

Third Octave Band: Sub-divide the signal spectrum typically into 33 bands with constant percentage bandwidth filtering, three times more detailed than octave band filters.

Frequency Filter – Weighted: A special frequency filter that adjusts the amplitude of all parts of the frequency spectrum of the sound or vibration unlike band pass filters.

A-Weighting: A filter that adjusts the levels of a frequency spectrum in the same way the human ear does when expose to low levels of sound. This weighting is most often used for evaluation of environmental sounds.

C-Weighting: A filter that adjusts the levels of a frequency spectrum in the same way the human ear does when expose to high levels of sound. This weighting is most often used for evaluation of equipment sounds.

Flat-Weighting: A filter that does not adjust the levels of a frequency spectrum. It is sometimes an alternative selection for the frequency-weighting selection.

Z-Weighting: Similar to a flat-weighting curve, this is a bandpass filter with a passband from 10 Hz to 20 kHz.

Level (dB): A descriptor of a measured physical quantity, typically used in sound and vibration measurements. It is attached to the name of the physical quantity to denote that it is a logarithmic measure of the quantity and not the quantity itself. When frequency weighting is used the annotation is often expressed as dB(A) or dB(B).

Measurement Duration (T): The time period T of measurement.

Microphone: A device for detecting the presence of sound. Most often it converts the changing pressure associated with sound into an electrical voltage that duplicates the changes.

Noise: Typically, it is unwanted sound. The response of humans to the physical phenomenon of sound.

Ambient Noise (Random): The all-encompassing sound at a given location caused by all sources of sound. It is generally random.

Background Noise: The all-encompassing sound at a given location caused by all sources of sound, but the source to be measured. It is essentially the sound that interferes with a measurement.

Single Event Noise Exposure Level (SENEL, LAX): The total sound energy over a specific period. It is a special form of the Sound Exposure Level where the time period is defined as the start and end times of a noise event such as an aircraft or automobile pass by.

Sound: Is any air pressure variation that the human ear can detect. A sound source creates the sound power in watts and the sound energy is transmitted by sound waves, which in turn generate the sound pressure in pascals we hear.

Sound Exposure (SE): It is the total sound energy of the actual sound during a specific time period. It is expressed in Pascals-squared seconds.

$$SE = \int_{T_1}^{T_2} p_A^2(t)dt$$

Sound Exposure Level (SEL, LE): Is the constant sound level that has the same amount of energy in one second as the original noise event. A-weighted sound exposure levels.

$$SEL = 10log_{10}\left[\frac{\int_{T_1}^{T_2} p^2(t)dt}{p_0^2 T}\right]$$

Sound Pressure: Is the change in the local air pressure when a sound wave passes through. The air particles 'assist' the transmission of the sound wave and then return to their original state i.e. no net movement of any media particles after the sound transmission and is measured in Pascals (Pa).

Moving Average: The averaging process is continually accepting new data, so it is similar to an exponential moving average.

Fixed Average: The averaging process is over a fixed time period. The sound pressure is squared and averaged over a fixed time period. Unlike the moving average, the sound pressures in all time intervals are equally weighted.

Sound Pressure Level (SPL, L_p): Measure of sound at a specified reception points of the effective pressure of a sound relative to a reference value, defined in dB.

$$L_P = 20log_{10}\left[\frac{p_{rms}}{p_0}\right] \qquad p_{rms} = p_0 10^{L_p/20} \qquad p_0 = 20\mu Pa$$

Sound Power (W): The sound power emitted by a sound source. It is measured in Watts.

Sound Power Level (SWL, PWL, Lw): Total acoustic energy that a machine, or piece of equipment, radiates to its environment, defined in dB.

Sound Speed: The speed at which sound waves propagate. It is measured in meters per second. It should not be confused with sound or particle velocity which relates to the physical motion of the medium itself.

Spectrum (Frequency Spectrum): The amplitude of sound or vibration at various frequencies. It is given by a set of numbers that describe the amplitude at each frequency or band of frequencies. It is often prefixed with a descriptor that identifies it such as sound pressure spectrum. It is generally expressed as a spectrum level.

Lmax: is the maximum sound level, during a measurement period or a noise event, Often includes other descriptors, for example L_{AFmax} and sometimes written as Max dB(A).

L_{min}: is the minimum sound level, during a measurement period or a noise event. Often includes other descriptors, for example L_{AFmin}, and sometimes written as Min dB(A).

Percentile Levels (Ln Values): Ln, where n may be anything from 1 to 99, is that noise level exceeded for n% of the measurement time. By definition of percentiles, L1 must be greater than or equal to L2, which must be greater than or equal to L3, etc.

L1: is the noise level exceeded for 1% of the time of the measurement duration.

L10: is the noise level exceeded for 10% of the time of the measurement duration. This is often used to give an indication of the upper limit of fluctuating noise, such as that from road traffic.

L50: is the noise level exceeded for 50% of the measurement duration. It is the middle point.

L90: is frequently taken as the L_p of the background level. L10-L90 is often used to give a quantitative measure as to the spread the sound was.

Time Weighting: The response speed of the detector in a sound level meter. There are several speeds used. Slow: The time constant is 1 second (1000 ms). This is the slowest and is commonly used in environmental noise measurements. Fast: The time constant is 1/8 second (125 ms). This is a less commonly used weighting but will detect changes in sound level more rapidly. Impulse: The time constant is 35ms for the rise and 1.5 seconds (1500 ms) for the decay. The reason for the double constant is to allow the very short signal to be captured and displayed.

• Instruments and calibrations

All equipment was checked before and after use with a pure-tone electronic calibrator. None of the equipment used during this survey showed drift of more than 0.1dB during the survey. Calibration standards are checked regularly and are traceable via DKD – DakkS.

Results are presented adjusted in accordance with the calibration to the nearest 0.1 dB.