RPT No. UERL/VGA/VOBZ/11/003 dated.07/11/2025

The Study Report

Entitled

Noise Mapping and Declaration of Airport Noise Zones at Vijayawada Airport

भारतीय विमानपत्तन प्राधिकरण
AIRPORTS AUTHORITY OF INDIA
Vijayawada International Airport

Submitted in partial fulfilment of the requirements

By

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ACKNOWLEDGEMENT

We extend our deepest gratitude to **Mr. S. S. Prasad**, Dy. General Manager (Engg-Civil) at the Airport Authority of India, Vijayawada Airport, for his invaluable support and guidance throughout this study. His encouragement and insights played a pivotal role in the successful completion of our noise mapping survey at Vijayawada Airport.

Our sincere thanks also go to **Mr. V.V.S.S.U Mahesh Apparao**, Assistant General Manager (Engg-Civil) at the Airport Authority of India, Vijayawada Airport, for his assistance in organizing meetings and providing us with essential facilities and resources during the various phases of our work. His assistance was critical to the smooth execution of the survey.

Additionally, we are grateful to **Mr. V. Pavan Kalyan**, Junior Executive (Engg-Civil) at the Airport Authority of India, Vijayawada Airport, for his cooperation and timely provision of data, which formed the backbone of this study. His contributions were crucial to the success of our survey.

This study could not have been completed without the generous support of all the individuals mentioned above, and we are truly appreciative of their contributions.

SUMMARY

Aircraft noise has been recognized as a serious issue that affects the urban regions. Due to urbanization and industrialization, transportation in urban areas has increased. Air traffic density in India and the world at large is growing fast and posing challenging problems. The problems encountered can be parameterized as flight delay, workload of air traffic controllers and noise levels in and around aerodromes. Prediction and quantification of these parameters aid in developing strategies for efficient air traffic management. Noise prediction maps can be used to identify the impact of noise pollution. The objective of the study is to develop noise maps and a declaration of the noise zone of Vijayawada Airport.

Noise monitoring and mapping study has been done for Vijayawada. The noise maps are developed using a computer simulation model software, which was used to develop noise prediction contour maps as per DGCA guidelines. Data required to create noise maps, namely the number of flights, pattern of flights, schedule of flights, aircraft types & details, runway information, and meteorological data, were collected from Vijayawada, Airport Authority.

The results of the noise monitoring study depicted that the daytime & nighttime noise levels were within the prescribed limit of MOEF&CC, G.S.R 568 (E) dated June 18, 2018. Vijayawada International Airport (IATA: VGA, ICAO: VOBZ) is a public international airport serving the Andhra Pradesh Capital Region. The airport is located at Gannavaram 25 KM from Vijayawada, where National Highway 16 connecting Chennai to Kolkata pass through. To assess the noise impact of proposed aircraft operations, noise mapping was conducted using a noise modelling technique. A basemap of area of 9 km x 8 km encompasses the project site, along with noise monitoring locations and identified sensitive receptors. As per G.S.R. 751 (E), issued by the Ministry of Civil Aviation (Height Restrictions for Safeguarding of Aircraft Operations) Rules, 2015 published on September 30, 2015 the Airport Noise Zone has been declared within a 4 km radius of the airport.

Keywords: Aircraft Noise; Airport Noise Zone; ECAC 4th Edition Model; Equivalent Noise Level; Noise Mapping

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(Authorized Signatory)

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ABBREVIATIONS

CAR	Civil Aviation Requirements
CCZM	Colour-Coded Zoning Map
CPCB	Central Pollution Control Board
CDA	Continuous Descent Approach
CCO	Continuous Climb Operations
dB	Decibel
dB(A)	Decibel in “A” weighting network
DGCA	Directorate General of Civil Aviation
DNL	Day Night Average/ Equivalent Sound Level
ECAC	European Civil Aviation Conference
INM	Integrated Noise Model
ICAO	The International Civil Aviation Organization
IATA	International Air Transport Association
LAEQ	A-weighted equivalent noise level in dB(A)
LAEQD	A-weighted equivalent daytime noise level in dB(A)
LAEQN	A-weighted equivalent daytime noise level in dB(A)
Ldn	Day Night Average/ Equivalent Sound Level
LAMAX	Maximum A-weighted Noise level in dB(A)
MoCA	Ministry of Civil Aviation
MOEF & CC	Ministry of Environment, Forests and Climate Change
NMT	Noise Monitoring Terminal
NOCAS	No Objection Certificate Application System
SLM	Sound Level Meter
TDOA	Time Difference of Arrival

CHAPTER-1

INTRODUCTION

1.1 GENERAL

Sound is characterized as minute variations in air pressure relative to standard atmospheric pressure. Human auditory perception typically ranges from approximately 20 microPascals (μPa) to over 20 million μPa. Unwanted sound is commonly referred to as noise, which is often considered objectionable due to its disturbing or annoying nature. The objectionable characteristics of sound are influenced by both its pitch and loudness. Pitch, determined by the frequency of vibrations, affects how loud a sound is perceived by humans, with higher frequencies generally sounding louder. Loudness is defined by the intensity of sound waves in conjunction with the ear's reception characteristics. The three parameters that define noise include:

(i) Level: The level of sound is the magnitude of air pressure change above and below atmospheric pressure and is expressed in decibels (dB). Typical sounds fall within a range between 0 dB (the approximate lower limit of human hearing) and 120 dB (the highest sound level experienced in the environment). A 3 dB change in sound level is perceived as a barely noticeable change in outdoors and a 10 dB change in sound level is perceived as a doubling (or halving) of loudness.

(ii) Frequency: The frequency (pitch or tone) of sound is the rate of air pressure change and is expressed in cycles per second, or Hertz (Hz). Human ears can detect a wide range of frequencies from around 20 Hz to 20,000 Hz; however, human hearing is not as sensitive at high and low frequencies, and the A-weighting system, which measures what humans hear in a meaningful way by reducing the sound levels of higher and lower frequency sounds, is used to provide a measure in A-weighted decibels dB(A) that correlates with human response to noise. The A-weighted sound level has been widely adopted by acousticians as the most appropriate descriptor for environmental noise.

(iii) Time Pattern: Because environmental noise is constantly changing, it is common to condense this information into a single number, called the "equivalent" noise level (Leq). The Leq represents the changing noise level over a period, 1 hour, or 24 hours, in noise assessments. For aviation noise assessments, the Day-Night Noise Level (DNL or Ldn) is commonly used, incorporating a 10 dB penalty for nighttime noise to reflect its greater disturbance.

Loud noise can negatively impact humans, interfering with sleep, and communication, and even causing physiological problems. Noise-induced hearing loss (NIHL) is a significant concern, particularly from occupational noise exposure. Unlike continuous noise sources like road traffic, aircraft noise is intermittent, with significant noise during takeoff (mainly from engines) and landing (aerodynamic noise). Ideally, airports should be located away from human habitation, but urban development often occurs near airports. Consequently, people living near airports or under flight paths experience high noise levels, especially at night.

Vijayawada International Airport (IATA: VGA, ICAO: VOBZ) is a public international airport serving Andhra Pradesh Capital Region. The airport is located at Gannavaram 25 KM from Vijayawada, where National Highway 16 connecting Chennai to Kolkata pass through. To assess the noise impact of proposed aircraft operations, noise mapping was conducted using a noise modelling technique. A base map of the project site, along with noise monitoring locations and identified sensitive receptors within an area of 9 km x 8 km, is shown in **Figure 3.4**.

1.2 NOISE PREDICTION AND MAPPING

With the increasing number of flights and the continuous development of technology, aircraft noise has become a serious problem in terms of environmental protection. It is, therefore, necessary to conduct regular assessments to identify urban areas where there are high noise levels that exceed allowable noise limits. These assessments can be performed through on-site measurements or through predictions, using specially designed software. Noise prediction and mapping software is a professional tool, widely used by many experts from different backgrounds and with great experience in various applications, data, and software.

The manner of using the software is very important because it can affect the quality of the results in the noise mapping process. When it comes to the proper interpretation of the noise generated by aircraft, data processing software is very useful. Normally, all the software is based either on acoustic measurements or predictions, taking into account in case of aircraft noise, various aspects like aircraft type, schedule, altitude, flight path, etc. These two ways of analyzing noise can also go together by introducing data about the analyzed area and data concerning the measured noise. The noise map that can be generated after introducing all these parameters can provide later an overview of the analyzed area.

Noise maps are developed by a specialized computer simulation model that calculates the noise level in specific areas, showing how noise propagates from the considered sources. This software can also consider elements that affect the dispersion of noise like buildings, the shape of the land, and the capacity of an area to absorb noise or to reflect noise. They also take into account the obstacles in the area, which can be: barriers, the shape and the acoustical characteristics of the terrain, meteorological conditions, and more.

There are number of computer simulation models (software) available to map and model sound. These types of software support basic environment noise mapping tracing polygon on top of a bitmap are a general way of mapping the area. The process is easy for a small area, but it can be time-consuming to do this on a large scale.

The modelling process can be simplified to use readily available data and large areas can be mapped as easily and efficiently as the computing power available. Noise modelling can be done using various software available such as INM, LimA, CadnaA, and SoundPLAN. These noise software models can provide fast and precise noise impact assessment.

The noise maps created by the software show an overview of the explored area from the acoustic perspective. The noise maps highlight the areas in which noise levels are higher than the maximum allowable limits and provide simulations and animations showing clearly how noise propagates from a mobile noise source.

The propagation models and software are very useful to analyze the current situation of external noise. The software creates a noise map, which shows the complete information on the distribution of noise in a given area. Noise can be a combination of point sources and line sources. Thus, the development of noise maps based on measurements requires a large number of measurement data, propagation models, and software.

CHAPTER-2

OBJECTIVES

2.1 GENERAL

According to the scope of work, it is observed that a large number of people can be exposed to aircraft noise at different locations around the Vijayawada Airport. This chapter deals with the problem statement and objectives of the entire study.

2.2 PROBLEM STATEMENT

The noise produced by aircraft during operations around airports represents a serious social, ecological, technical and economic problem. The ability to assess and predict noise exposure accurately is an increasingly important factor in the design and implementation of airport improvements. Aircraft are complex noise sources. The number and intensity of noise sources vary with the type of aircraft and, in particular, with the type of engines incorporated in their power plants. Relationships between the acoustic characteristics of the main noise sources and the flight mode parameters (or engine mode parameters) must be known for the best evaluation of noise levels under the flight path for any type of aircraft at any stage of its flight. Therefore, aircraft noise modelling has been carried out to study the propagation of noise from aircraft movement along with field measurements. The noise maps can be developed using a computer simulation model.

2.3 OBJECTIVES

The objectives of this study are outlined below:

1. Noise monitoring study on and around Vijayawada Airport.
2. Declaration of airport noise zones.
3. To develop noise contour maps using a computer simulation model for Vijayawada Airport.

CHAPTER-3

METHODOLOGY

3.1 GENERAL

This chapter deals with methodology, instruments and software used for the study, site selection criteria, noise monitoring time, noise parameters, noise standards, and study area profile. Noise mapping and declaration of airport noise zones for the airport has to be carried out by the latest DGCA Aviation Environment Circular 01 of 2024.

3.2 METHODOLOGY

The methodology used for performing work is represented in **Figure 3.1**. A noise survey was carried out and analyzed on and around Vijayawada airport premises. This analysis included noise monitoring on selected locations, aircraft type & aircraft traffic volume, airport details, passenger statistics, and urban land use study. Noise monitoring was carried out continuously for 24 hours for one week as per the tender requirement guideline. Integration of the exhaustive data was done using a computer simulation model, to develop noise maps.

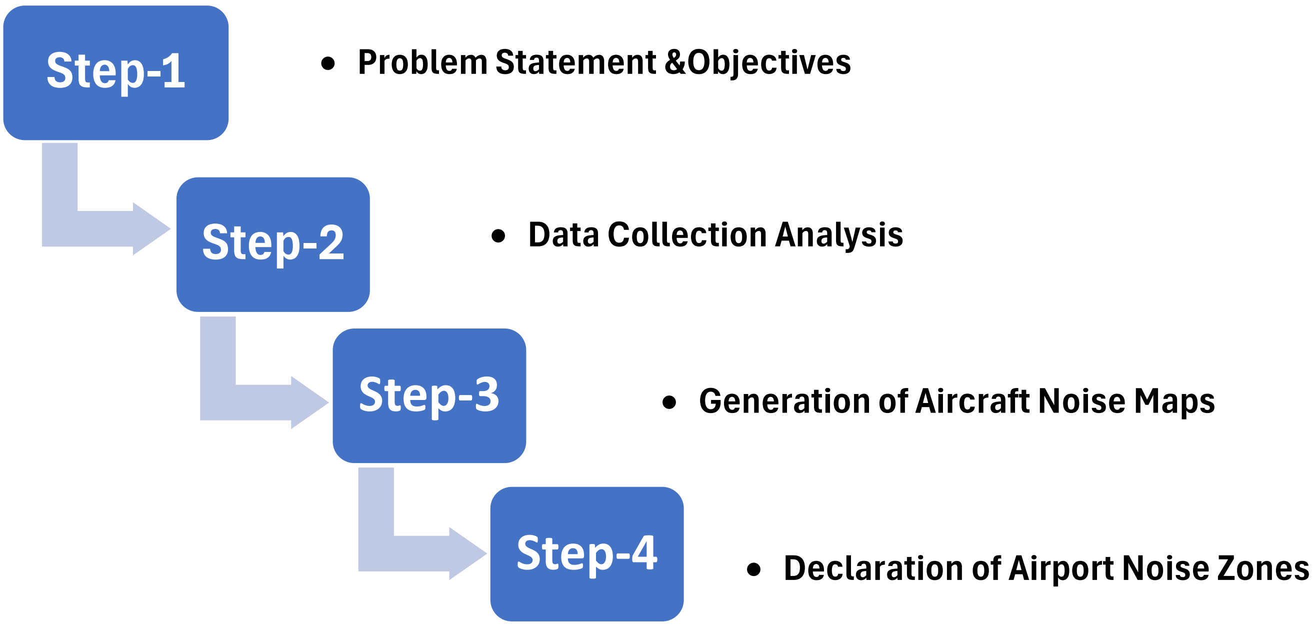


Figure 3.1: Flow Diagram of Methodology of Noise Mapping and Declaration of Airport Noise Zones

3.2.1 SITE SELECTION CRITERIA

The site was selected to minimize disturbances from other sources for proper event detection. The minimum A-weighted maximum sound pressure level from aircraft movements was at least 15 dB above the background noise level.

3.2.2 NOISE MONITORING

Noise monitoring shall be carried out continuously for 24 hours a day, 365 days a year in permanent stations. In temporary stations, noise shall be monitored continuously for seven days, as per tender requirements. The microphone height shall be at least 4 m, preferably 10 m, above the ground level.

3.2.3 TYPE OF MONITORING STATIONS

Monitoring stations should be permanent for all runway approaches. Mobile monitoring can be either mobile vans mounted or portable noise monitoring terminals that can be used as temporary stations.

3.2.4 NUMBER OF MONITORING STATIONS

At least two permanent stations shall be installed per runway. The permanent monitoring stations shall be located on both sides of the runway, at the nearest residential area/silence zone and as far as possible under the flight paths of the aircraft. In addition, temporary stations shall be used for specific monitoring activity under the flight paths, where noise levels are expected to be higher.

3.2.5 MONITORING TIME

Daytime monitoring has been carried out from 6.00 am to 10.00 pm and night-time from 10.00 pm to 6.00 am.

3.2.6 MONITORING PARAMETERS

During the noise survey, various noise indices such as LAeq, Lmax, Lmin, L10, L50, L90, LDay, and Lnight, have been recorded.

3.2.7 METEOROLOGICAL MEASUREMENT

Meteorological parameters such as wind speed, wind direction, relative humidity, air temperature and occurrence of rain were recorded.

3.2.8 AIRPORT NOISE NOTIFICATION DATED JUNE 18, 2018

Standards for noise levels are given in MOEF&CC, G.S.R. 568(E) dated June 18, 2018 for Ambient Air Quality Standards with respect to Noise in Airport Noise Zone and it is given in **Table 3.1.**

Sr.No.	Industry	Parameters	Standards	
1	2	3	4	
	Ambient Air Quality Standards with respect to Noise in Airport Noise Zone			
112	Airports	Type of Airports	Limits in dB (A) Leq	
			Day Time	Night Time
		Busy Airports	70	65
		All other Airports excluding the proposed airports	65	60

Based on the 2023–24 Traffic, Flight Tracks, and Corridors data, Vijayawada International Airport is classified as a non-busy airport. Noise monitoring data (as detailed in Chapter 4) showed that levels at the airport and surrounding residential areas were within the prescribed limits. At Approach Funnel Area–26, Lday and Lnight were 55.8 dB(A) and 45.3 dB(A), respectively; at Approach Funnel Area–08, 61.8 dB(A) and 58.5 dB(A); and in the Residential Scatter Area, 50.8 dB(A) and 43.1 dB(A). All values were below the permissible limits of 65 dB(A) (daytime) and 60 dB(A) (nighttime), confirming that ambient noise levels in and around Vijayawada International Airport comply with the prescribed standards.

3.3 INSTRUMENTS AND SOFTWARE

The instruments and software used for the study were a class-1 noise monitoring terminal & sound level meter with its kits for measuring noise and a computer simulation model for developing noise maps. Following is the list of equipment/instruments and software used for noise mapping:

3.3.1 SPOT NOISE MONITORING TERMINAL

Spot Noise Monitoring Terminal was used for noise data collection from the premises of the airport, which is shown in **Figure 3.2**. The Spot Noise Monitoring Terminal is an acoustic measurement instrument from Slovenia with the main features of a conventional and integrating-averaging sound level meter and analyzer with storage. It is available with a cloud-based server available in India.

Spot Noise Monitoring Terminal (NMT) has features like A-C-Z weighted noise level, equivalent continuous level (Leq), peak pressure levels, real-time analyzer by octave bands –31.5 Hz to 8 kHz, minimum and maximum noise level values, and statistical distribution of the measured values: LAEQ, LDEN, L10, L50, L90, Lmax, Lmin, Lday, Lnight and LApeak.

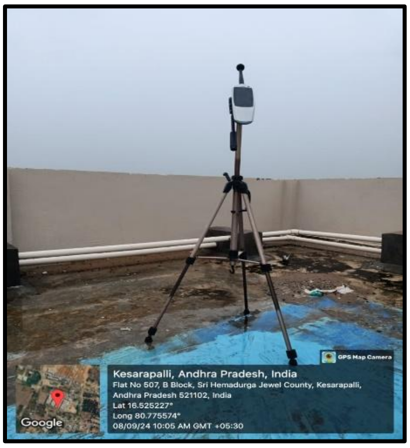
3.3.2 BEDROCK AM100 CLASS 1 SOUND LEVEL METER

The Bedrock AM100 is the most advanced class 1 / type 1 acoustic measuring instrument, which is shown in **Figure 3.2**.The BEDROCK AM100 SLM is an acoustic measurement instrument from the Netherlands with the main features of a conventional and integrating-averaging sound level meter and analyzer with storage.

3.3.3 PHOTOGRAPHS OF NOISE MONITORING STATIONS

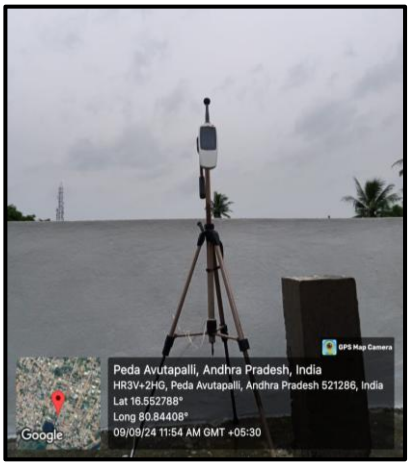
Vijayawada Airport Approach Funnel Area-08

Vijayawada Airport Approach Funnel Area-26



Kesarapalli Village, Andhra Pradesh

Sagarlapet Village, Andhra Pradesh



Peda Avutapalli Village, Andhra Pradesh

Allapuram Village, Andhra Pradesh

Figure 3.2: Noise Monitoring Terminal at Monitoring Location

3.3.4 COMPUTER SIMULATION MODEL

In this study, a specialized software suite, developed by professionals in noise pollution engineering, was utilized to simulate various noise scenarios. The software, designed specifically for noise modelling, offers comprehensive capabilities, including the modelling of aircraft noise. With more than 10 calculation standards integrated into the platform, it effectively meets the needs of noise control engineers and environmental consultants.

The software was employed in this case to develop detailed noise maps. Notably, it includes a dedicated single-document application tailored for aircraft noise, allowing standard noise cases to be processed quickly, efficiently, and cost-effectively. This feature significantly enhances the accuracy and usability of the tool in managing complex noise scenarios

3.3.5 RADAR TRACKING SYSTEM

Flightradar24 was used to avail the flight-related data. It is a global flight tracking service that provides you with real-time information about thousands of aircraft around the world. It has the largest ADS-B network in the world with over 40,000 connected receivers. Flightradar24's business account was subscribed to collect the radar tracking data.

3.4 STUDY AREA PROFILE

Vijayawada Airport (IATA: VGA, ICAO: VOBZ), is officially known as Vijayawada International Airport, in Andhra Pradesh, India. Vijayawada International Airport (IATA: VGA, ICAO: VOBZ) is a public international airport serving the Andhra Pradesh Capital Region. The airport is located at Gannavaram 25 KM from Vijayawada, where National Highway 16 connecting Chennai to Kolkata pass through.

Figure 3.3: Vijayawada International Airport, Andhra Pradesh

The airfield located at Gannavaram served as an army base during World War II, after which it was converted into a civilian airport. Air Deccan introduced a daily service between Hyderabad and Vijayawada in September 2003. Until 2011, the airport had only four flights a day operated by Kingfisher Airlines. In 2011, flag carrier Air India and private airlines SpiceJet and Jet Airways introduced direct flights to the airport, but the latter terminated its service. Air Costa, a regional airline started operations in October 2013, with Vijayawada as its operational hub, which later suspended services.

To cater to the increasing passenger traffic, the foundation stone for a new interim terminal building was laid in October 2015. The terminal, designed to handle two million passengers per annum was opened on 12 January 2017. It was expected to be sufficient for passenger needs for the next four years until a larger integrated terminal was built. After domestic operations were shifted to the interim terminal, the old airport terminal building was closed and was prepared to handle international services. The terminal was equipped with a customs and immigration section and additional facilities and security arrangements.

The airport has a single runway, oriented 08/26, measuring 3,360 m in length and 45 meters in width, with a parallel taxiway connecting to it, measuring 1,697 m (5,568 ft) in length. The interim terminal spreads over 12,999 square meters and includes a check-in area, arrival hall, meet-and-greet service staircase, aviation lounge, and baggage pick-up area. The lounge is spread over 3,613 square meters. The terminal can handle up to 500 passengers at a time and has 18 check-in counters. **Table 3.2** presents the statistics of passengers, while **Table 3.3** provides details about the noise monitoring locations.

Table 3.2: Statistics of Passengers

Year	Total
2022-23	929,765
2023-24	1,025,734

Table 3.3: Noise Monitoring Locations

Sr. No.	Coordinates	Locations Code	Location	Location Category
1	16°31'42.0"N 80°47'14.0"E	NMT-1_S07	Vijayawada International Airport Approach Funnel Area-08	Airport Premises
2	16°32'12.0"N 80°49'22.0"E	NMT-1_S08	Vijayawada International Airport Approach Funnel Area-26	Airport Premises
3	16°31'16.7"N 80°46'58.7"E	SMT-1	Kesarapalli, Andhra Pradesh	Resident
4	16°31'30.8"N 80°46'32.1"E	SMT-2	Sagarlapet, Andhra Pradesh	Resident
5	16°33'10.0"N 80°50'38.7"E	SMT-3	Peda Avutapalli, Andhra Pradesh	Resident
6	16°32'16.4"N 80°50'16.4"E	SMT-4	Allapuram, Andhra Pradesh	Resident

Figure 3.4 shows the Vijayawada Airport map with monitoring locations and identified receptors locations. A total of six monitoring locations were selected as per MoEF&CC, G.S.R. 568(E) dated June 18, 2018. These six locations include diversified activities of residence and village. Different types of land-use patterns have been seen along these locations. All locations are laid under the Vijayawada City.

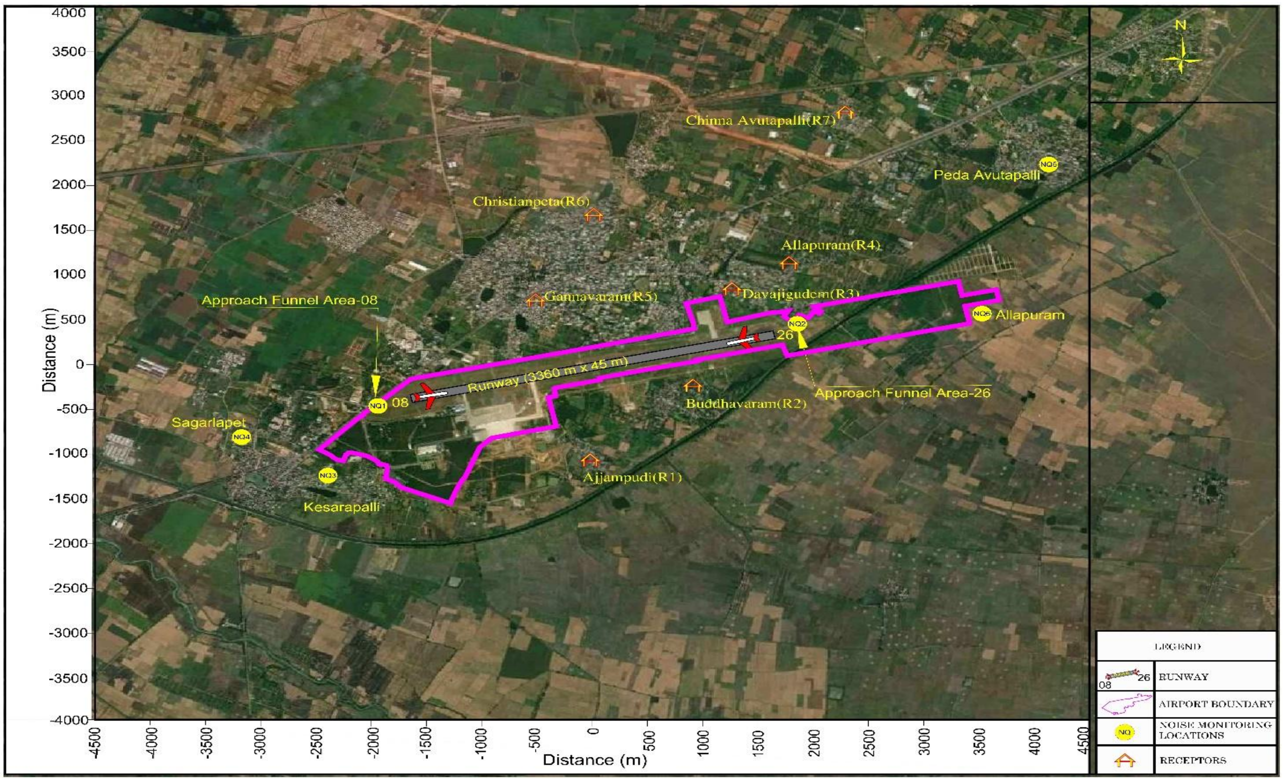
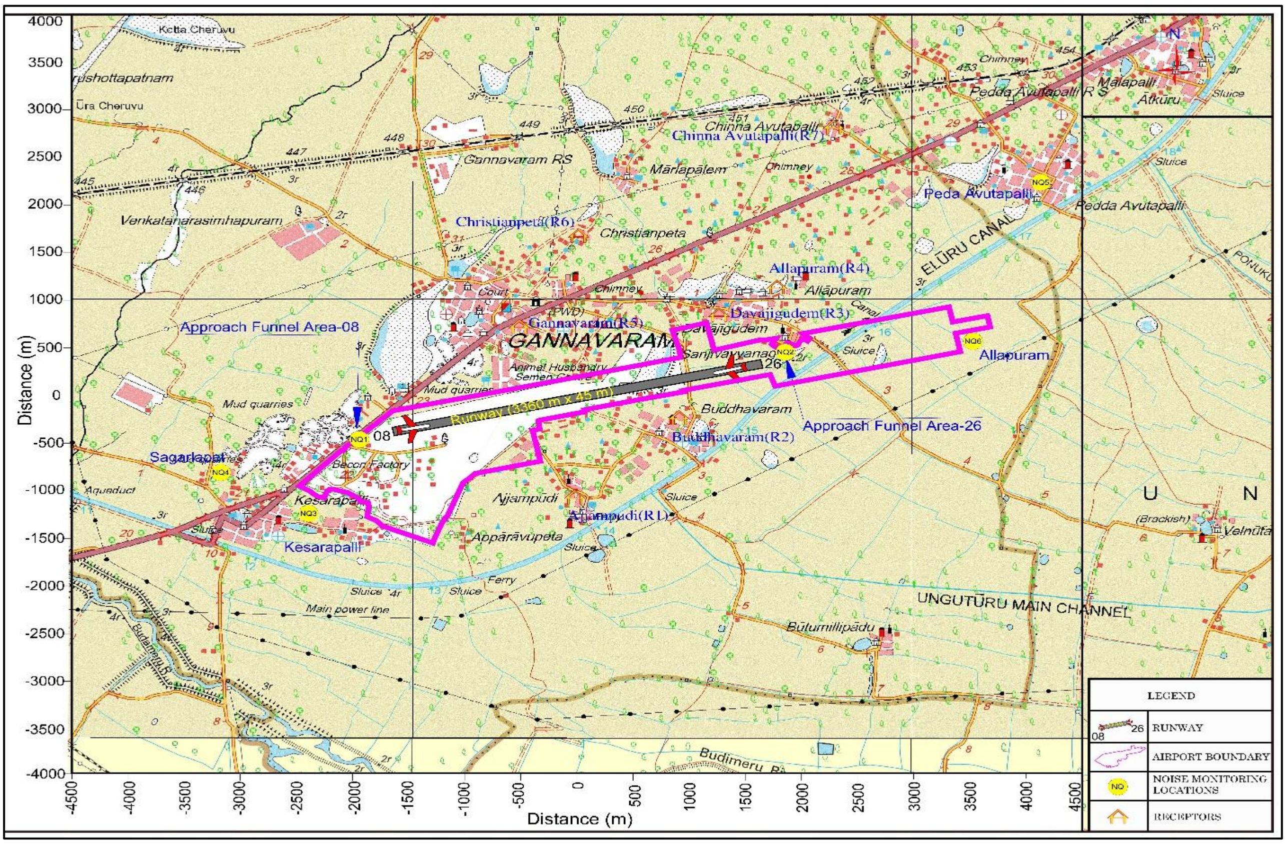


Figure 3.4: Base map of Vijayawada Airport with Monitoring & Receptor Locations



CHAPTER-4

DATA COLLECTION AND ANALYSIS

4.1 GENERAL

This chapter deals with data collection work of noise surveys, meteorological data, flight schedules, and aircraft-related data. The detailed observation of data collection is incorporated here. Noise data were collected as per MoEF&CC notification G.S.R.568(E), CPCB guideline, and DGCA Aviation Environment Circular 01 of 2024 for aircraft noise monitoring and mapping.

Noise monitoring was done at six different locations that were under the flight path. Residential, buildings are located under the flight path and these buildings are of a minimum of 3 storeys and a maximum of 13 storeys.

Noise measurements were carried out from 5 September 2024 to 11 September 2024. Field measurements have been taken by using Spot Noise Monitoring Terminal and Bedrock Class-1 Sound Level Meter for a 24-hour duration. Monitoring was divided into two parts as per CPCB guidelines, for daytime 6.00 am to 10.00 pm and night time 10.00 pm to 6.00 am. The noise monitoring terminal & sound level meter are calibrated before each measurement using a calibrator. The sound level meter is mounted at a height of 4 m above the floor level as per the CPCB guideline.

Noise levels (LAeq) and other noise indices (LDEN, L10, L50, L90, Lmax, Lmin, Lday, Lnight and LApeak) are stored in the automatic sound level meter and the Indian cloud-based server automatically generates a complete data sheet of all necessary noise data and statistics in a user-friendly way.

4.2 NOISE MONITORING SURVEY

Noise monitoring was conducted between 5 September 2024 to 11 September 2024 in airport premises and round Vijayawada Airport. Monitoring has been done at 6 locations which are laid under the flight path with aircraft traffic volume, meteorological data, and radar tracking data.

Noise monitoring was done on both sides of the runway, at the nearest residential/silent zone and as far as possible under the flight path of the aircraft using the Spot Noise Monitoring Terminal. Other temporary four stations were installed under the flight path where noise levels are expected to be high. This instrument was set for A-weighting continuous 24 hours and all the readings were taken as per CPCB protocol. Noise descriptors like LAEQ, LDEN, L10 L50, L90, Lmax, Lmin, Lday, Lnight and LApeak were assessed and are given in **Tables 4.1 to 4.3** for all locations.

Table 4.1: NMT-1_S07_Airport Premises Noise Level Readings (Approach Funnel Area-26)

Date	LAEQ	LMAX	LMIN	LAPeak	LDEN	L10	L50	L90	LDay	Lnight
05-09-2024	57.5	72.8	38.4	110.3	56.5	56.1	51.4	50.0	55.2	45.2
06-09-2024	53.9	79.5	38.4	137.7	55.1	52.2	48.0	46.7	53.4	47.1
07-09-2024	53.9	72.1	38.4	105.3	55.0	52.6	47.7	45.2	54.7	44.3
08-09-2024	54.6	92.4	37.2	108.7	55.1	52.9	47.8	45.4	54.4	44.6
09-09-2024	55.0	89.6	36.5	112.4	55.2	52.8	48.5	46.3	53.6	45.2
10-09-2024	54.6	84.6	34.0	91.6	55.9	51.8	46.3	43.5	55.5	44.9
11-09-2024	55.7	90.3	30.7	102.4	57.8	52.2	47.8	45.6	63.8	45.9

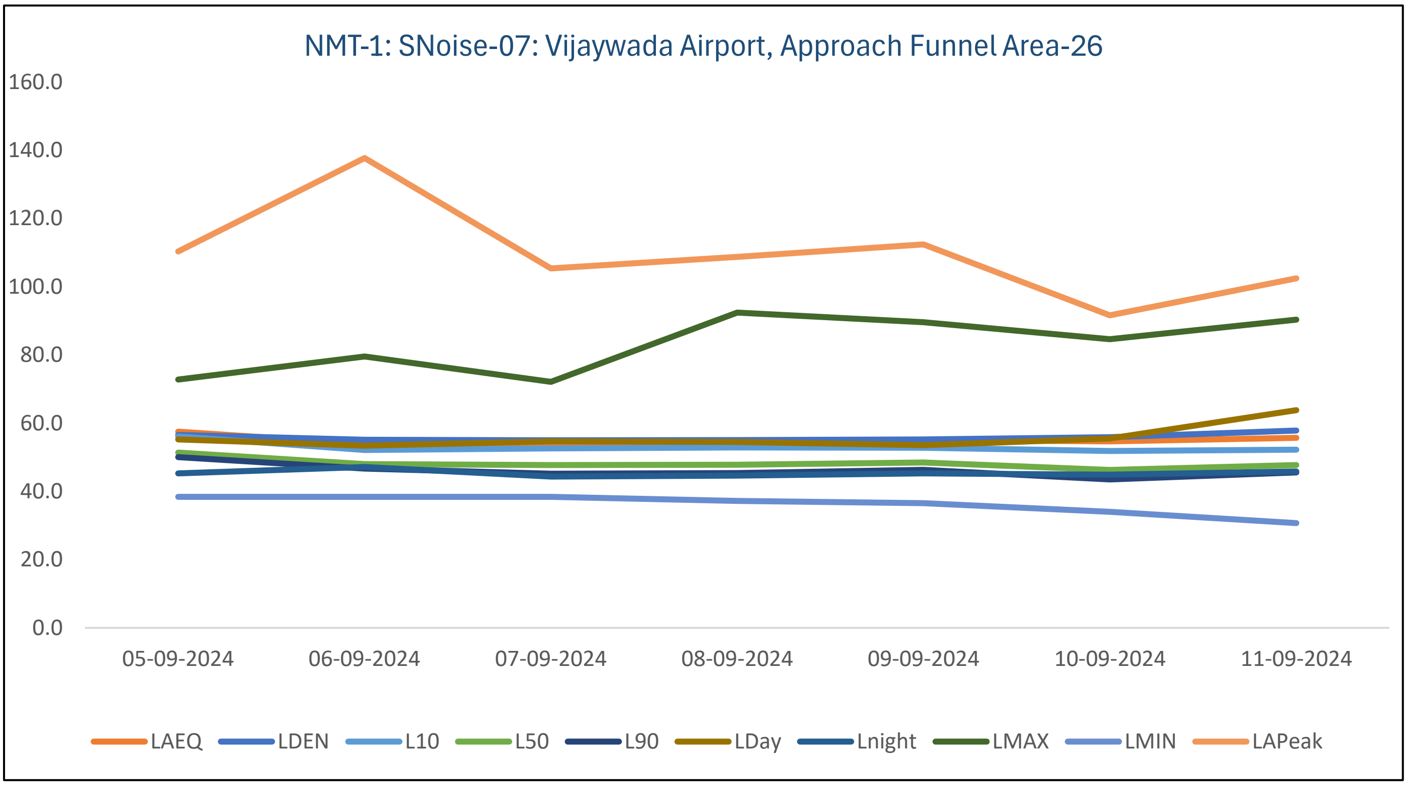


Figure 4.1: Airport Premises Noise Level Readings (Approach Funnel Area-26)

Table 4.2: NMT-2 S08_Airport Premises Noise Level Readings (Approach Funnel Area-08)

Date	LAEQ	LMAX	LMIN	LAPeak	LDEN	L10	L50	L90	LDay	Lnight
05-09-2024	65.6	93.4	33.3	107.6	71.8	67.7	63.0	58.2	62.2	57.3
06-09-2024	65.8	80.9	31.1	107.6	69.3	67.8	63.0	58.3	58.5	66.3
07-09-2024	64.6	86.4	32.4	108.3	64.9	66.9	61.9	57.1	61.5	58.3
08-09-2024	64.7	85.4	34.5	109.5	64.9	67.2	62.1	57.2	61.7	56.8
09-09-2024	63.8	96.2	37.0	110.7	64.1	65.9	61.0	56.7	60.3	56.7
10-09-2024	64.8	82.6	29.8	109.5	65.0	67.1	62.0	56.8	61.5	56.9
11-09-2024	66.2	81.6	31.6	108.4	65.2	67.1	63.2	57.9	67.2	57.0

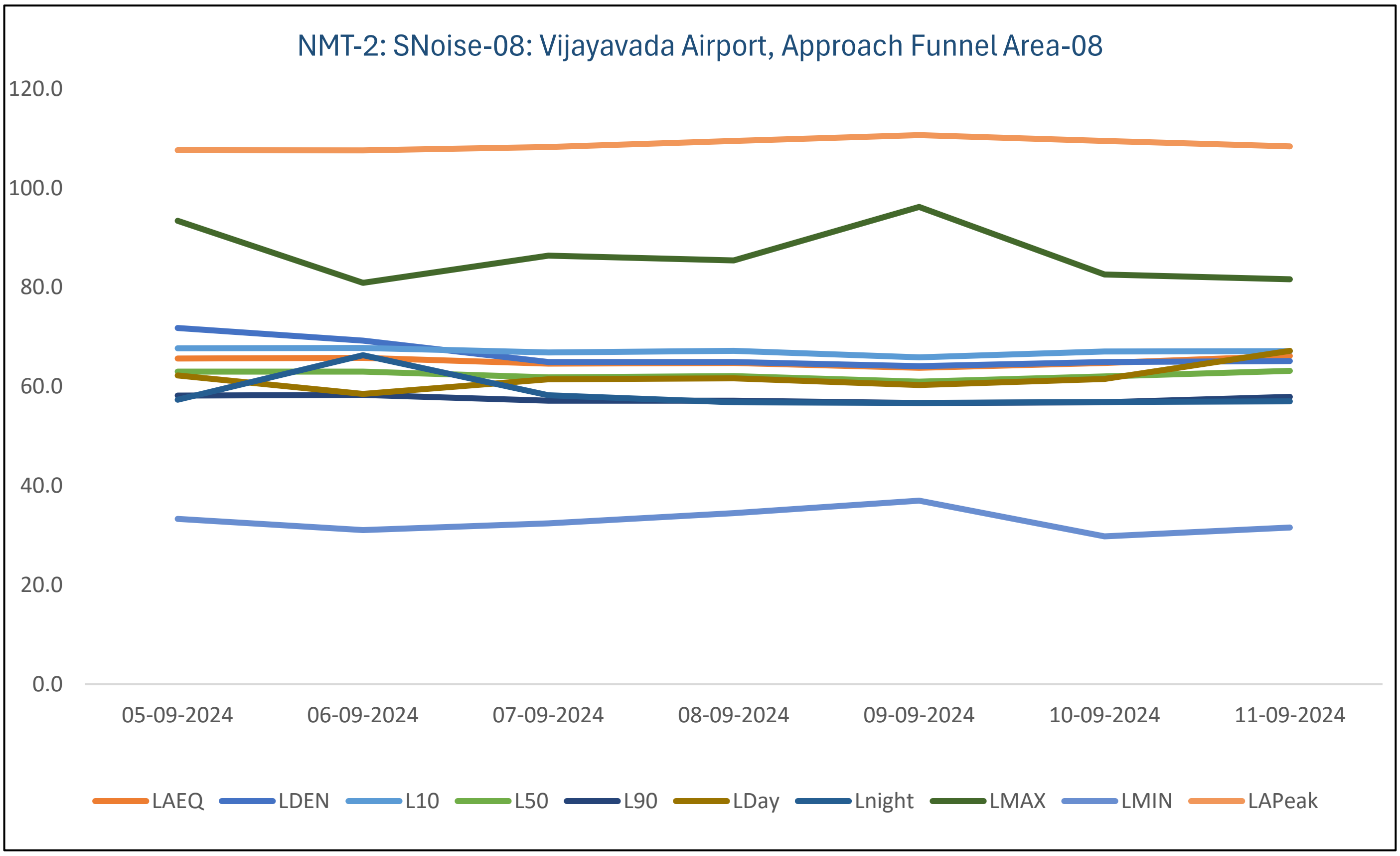


Figure 4.2: Airport Premises Noise Level Readings (Approach Funnel Area-08)

Table 4.3: NMT-3_ Residential Scatter Area Noise Level Readings

Date	Location	LAEQ	LMAX	LMIN	LAPeak	L10	L50	L90	LDay	Lnight
06-09-2024	Kesarapalli, Andhra Pradesh	55.0	89.4	40.2	118.4	67.2	51.2	42.3	51.4	46.2
08-09-2024	Sagarlapet, Andhra Pradesh	55.8	90.6	44.1	111.0	58.4	45.6	41.2	48.7	42.1
09-09-2024	Peda Avutapalli, Andhra Pradesh	64.2	84.7	42.1	104.1	57.1	50.8	40.3	46.8	41.4
10-09-2024	Allapuram, Andhra Pradesh	56.1	88.7	44.0	104.3	52.1	41.5	42.3	56.1	42.8

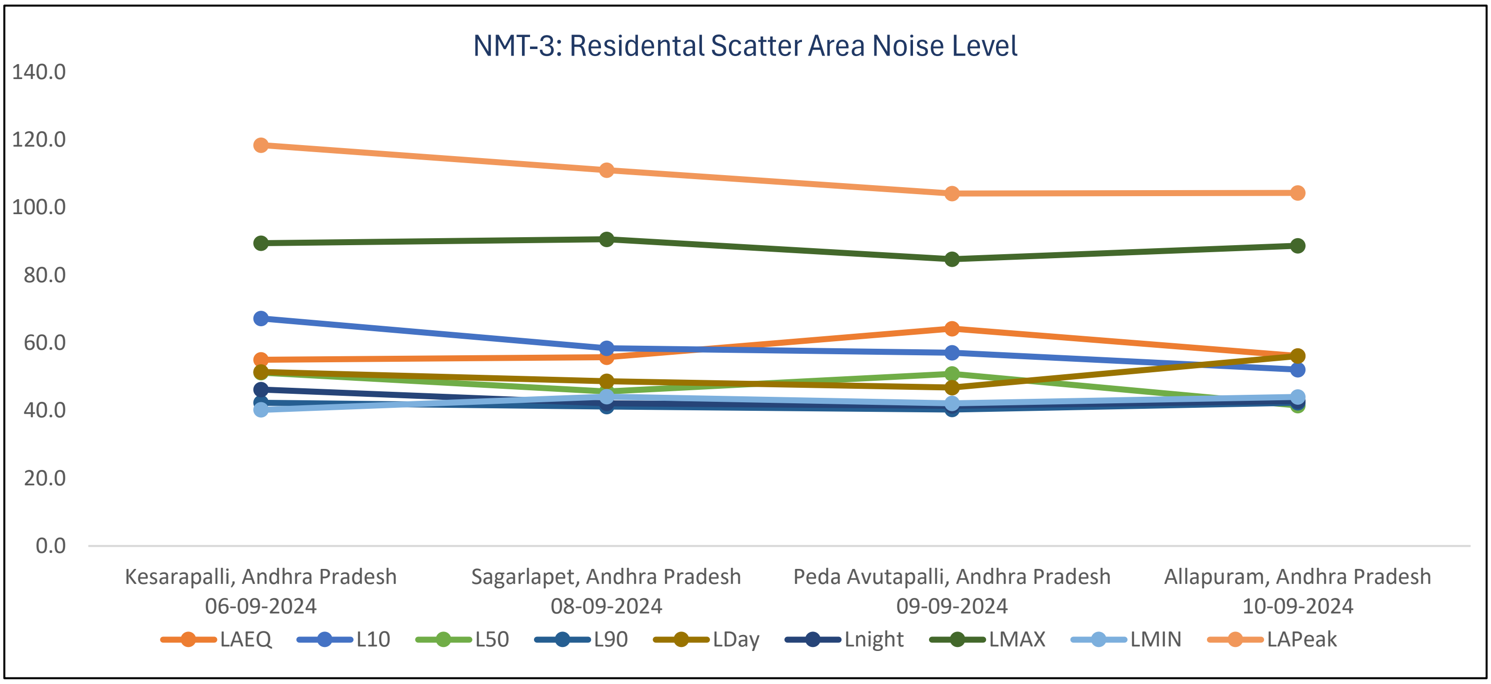


Figure 4.3: Residential Scatter Area Noise Level Readings.

Figures 4.1 to 4.3 illustrate the daytime and nighttime noise indices—LAEQ, LDEN, L10, L50, L90, LMAX, LMIN, LDay, LNight, and LAPeak—at three monitored locations: two within airport premises approach funnel areas (NMT-1 and NMT-2) and one in a nearby residential scatter area (NMT-3). The noise monitoring revealed notable differences in noise levels across these areas. NMT-2 (Airport Premises - Approach Funnel Area-08) exhibited the highest noise impact, with an average **LAEQ of 65.1 dB**, reaching a maximum **LMAX of 96.2 dB** and nighttime levels (LNight) up to **66.3 dB**. These elevated readings suggest significant and continuous noise exposure, likely from frequent aircraft operations. In contrast, NMT-1 (Airport Premises - Approach Funnel Area-26) recorded slightly lower levels, with an average **LAEQ of 55.0 dB** and **LMAX of 92.4 dB**, indicating a less intense but still prominent noise enironment. The NMT-3 (Residential Scatter Area) showed the lowest noise exposure, with an average **LAEQ of 57.8 dB** and occasional peaks, such as **LAPeak reaching 118.4 dB**. Despite its lower overall noise profile, these occasional peaks may impact community comfort and quality of life.

For example, as an aircraft approaches, the sound level rises sharply, reaching a maximum (LMax), before receding and blending into the background noise, which can vary due to factors such as chirping birds, wind, or passing vehicles. The LMax index is often used to represent such noise "events" due to its depiction of peak sound levels.

All recorded hourly LAEQ values were close to the prescribed limits set by the Ministry of Environment, Forest and Climate Change (MoEF&CC) under G.S.R. 568(E) for both daytime and nighttime. This proximity to the limit, especially during nighttime, suggests a risk of annoyance and potential sleep disturbances among residents, emphasizing the need for effective noise management strategies in high-exposure areas.

4.3 AIRPORT NOISE MAPPING DETAILED SURVEY

Vijayawada Airport (IATA: VGA, ICAO: VOBZ), is officially known as Vijayawada International Airport, in Andhra Pradesh, India. Vijayawada International Airport (IATA: VGA, ICAO: VOBZ) is a public international airport serving the Andhra Pradesh Capital Region. The airport is located at Gannavaram 25 KM from Vijayawada, where National Highway 16 connecting Chennai to Kolkata pass through. A basemap of the project site, along with noise monitoring locations and identified sensitive receptors within 9 km x 8 km noise impact zone was developed.

4.3.1 AIRPORT/RUNWAY DATA

1. IATA: VGA
2. ICAO: VOBZ
3. Location: Vijayawada, Andhra Pradesh, India
4. Co-ordinates: 16^0 31' 44" N, 80^0 47'45" E
6. Elevation: 82 ft / 25 m
7. Runway:

Direction	Geometry		Surface
	Length (m)	Width (m)	
08/26	3360	45	Asphalt

4.3.2 FLIGHT SCHEDULE

The detailed flight schedule, including aircraft type, was collected from the Airport Authority of India, Vijayawada, and verified with radar tracking data. Schedule domestic flights include Vijayawada (VOBZ) to Hyderabad (HYD), Bengaluru (VOBL), Delhi (VIDP), Mumbai (VABTB), Chennai (VOMM), Shirdi (VASD), Tirupati (VOTP), Vishakhapatnam (VOVZ). Vijayawada (VOBZ) and Kadapa (VOCP) and one scheduled international light to Sharjah (OMSJ).

Table 4.5: Schedule Domestic Flight Arrival

AIRLINE	FLIGHT#	ORIGINATES	OPERATES	AIRCRAFT'S TYPE
IndiGo	6E7152	Hyderabad	Daily	B38M
IndiGo	6E7201	Hyderabad	Daily	B38M
IndiGo	6E7208	Hyderabad	Daily	B38M
IndiGo	6E7211	Hyderabad	Daily	B38M
IndiGo	6E7213	Hyderabad	Daily	B38M
IndiGo	6E7283	Hyderabad	Daily	B38M
IndiGo	6E7391	Hyderabad	Daily	B38M
Air India Express	IX1882	Hyderabad	Daily	B38M
Alliance Air flight	9I501	Bengaluru	Daily	AT76
IndiGo	6E7071	Bengaluru	Daily	AT76
IndiGo	6E7134	Bengaluru	Daily	AT76
IndiGo	6E7224	Bengaluru	Daily	AT76
IndiGo	6E7701	Bengaluru	Daily	A320, A20N
Air India Express	IX1516	Bengaluru	Weekly	B38M
Air India Express	IX2516	Bengaluru	Daily	B38M
Air India Express	AI459	Delhi	Daily	A321, A21N, A319, A20N, A320
Air India Express	AI467	Delhi	Daily	A321, A20N, A320
IndiGo	6E2119	Delhi	-	No flights during this period
IndiGo	6E936	Mumbai	Daily	A20N, A320
Air India	AI598	Mumbai	Daily	A320
IndiGo	6E7084	Chennai	Daily	AT76
IndiGo	6E7411	Chennai	Daily	AT76
IndiGo	6E7441	Shirdi	Daily	AT76
IndiGo	6E7379	Tirupati	Daily	AT76
IndiGo	6E7129	Visakhapatnam	Daily	AT76
IndiGo	6E7282	Kadapa	4 times a Week	AT76

Table 4.6: Schedule Domestic Flight Departure

AIRLINE	FLIGHT#	DESTINATION	OPERATES	AIRCRAFT'S TYPE
IndiGo	6E7153	Hyderabad	Daily	AT76
IndiGo	6E7206	Hyderabad	Daily	AT76
IndiGo	6E7209	Hyderabad	Daily	AT76
IndiGo	6E7214	Hyderabad	Daily	AT76
IndiGo	6E7284	Hyderabad	Daily	AT76
IndiGo	6E7297	Hyderabad	Daily	AT76
IndiGo	6E7392	Hyderabad	Daily	AT76
Air India Express	IX1883	Hyderabad	Daily	AT76
Alliance Air flight	9I502	Bengaluru	Daily	AT76
IndiGo	6E7072	Bengaluru	Daily	AT76
IndiGo	6E7133	Bengaluru	Daily	AT76
IndiGo	6E7423	Bengaluru	Daily	AT76
IndiGo	6E7704	Bengaluru	Daily	AT76
Air India Express	IX2517	Bengaluru	Daily	AT76
Air India	AI460	Delhi	Daily	A321, A21N, A319, A20N, A320
Air India	AI468	Delhi	Daily	A321, A20N, A320
IndiGo	6E2178	Delhi	--	No flights during this period
IndiGo	6E943	Mumbai	Daily	A20N, A320
Air India	AI599	Mumbai	Daily	A320
IndiGo	6E7046	Chennai	Daily	AT76
IndiGo	6E7139	Chennai	Daily	AT76
IndiGo	6E7379	Shirdi	Daily	AT76
IndiGo	6E7379	Shirdi	Daily	AT76
IndiGo	6E7441	Tirupati	Daily	AT76
IndiGo	6E7441	Tirupati	Daily	AT76
IndiGo	6E7128	Vishakhapatnam	Daily	AT76
IndiGo	6E7269	Kadapa	Sunday, Monday, Friday, Wednesday	AT76

Table 4.7: Schedule International Flight Arrival

AIRLINE	FLIGHT#	ORIGINATES	OPERATES	AIRCRAFT'S TYPE
Air India Express	IX976	Sharjah	Twice times in a Week	B738

Table 4.8: Schedule International Flight Departure

AIRLINE	FLIGHT#	DESTINATION	OPERATES	AIRCRAFT'S TYPE
Air India Express	IX975	Sharjah	Tuesday, Saturday	B738

4.4 TRAFFIC, FLIGHT TRACKS AND CORRIDORS

Flightradar24 platform was used to collect real-time flight details. It shows real-time aircraft flight tracking information on a map. It is a global flight tracker that shows live air traffic from around the world. It combines data from several data sources including ADS-B, MLAT, satellite, and radar data. This positional data is aggregated with schedule and flight status data to create the flight tracking experience. The primary technology that Flightradar24 uses to receive flight information is called automatic dependent surveillance broadcast (ADS-B). ADS-B technology is the long-term air traffic management replacement for radar technologies, especially in areas with limited radar coverage, such as remote areas and oceanic airspace. Aircraft broadcast a series of data points at regular intervals, including data on their position, altitude, speed, and much more. These signals are received by our network of ADS-B ground receivers, the largest such independent network in the world.

Flightradar24 also have the facility to calculate positions of non-ADS-B equipped aircraft with the help of Multilateration (MLAT), by using a method known as Time Difference of Arrival (TDOA). By measuring the time, it takes to receive the signal from an aircraft with an older Mode S transponder, it's possible to calculate the position of these aircraft.

Figures 4.4 & 4.5 flight tracks for arrival and departure. Flight tracks are specific to a runway. The tracks consist of the track name, the landing/take-off direction, a glide path and a detailed description of the flight path. The traffic data (how many planes for day/night) are also associated with the flight track. Flight tracks are usually followed up to a 10-kilometer influence radius. Aircraft do not follow a road or railway line; they are determined by air traffic control personnel who advise pilots to turn to a specific heading and fly in a certain direction for a specified time.

The exact time and turn radius are at the pilot's discretion and therefore the flight tracks can be described as corridors rather than lines. Flight operations and weather conditions also add to the variability. Around the airport, there are mandatory reporting points, usually associated with a radio beacon that aircraft tend to fly over. For the calculation, the standards determine how the flight corridor is represented by individual line sources.

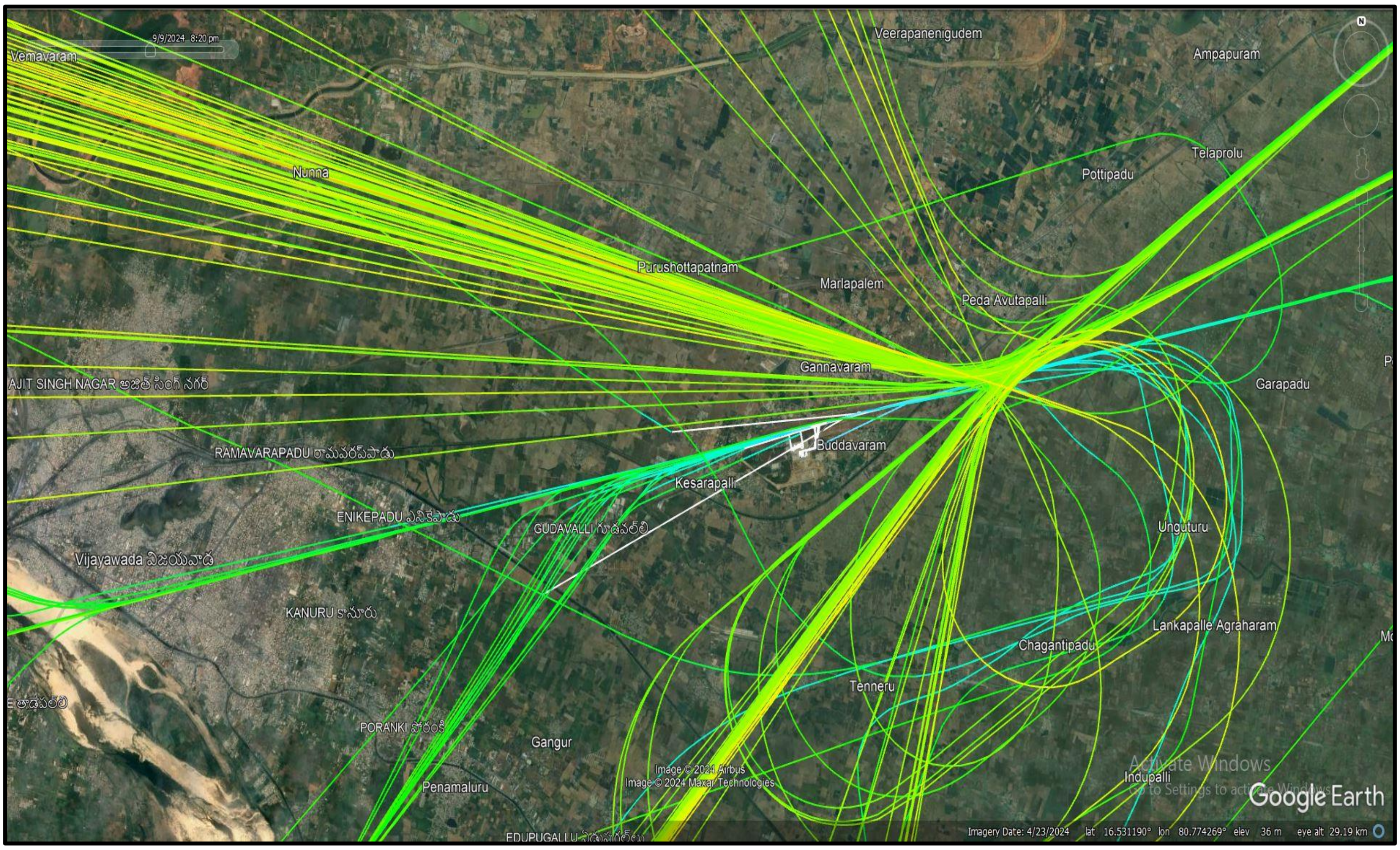


Figure 4.4: Arrival Flight Tracks

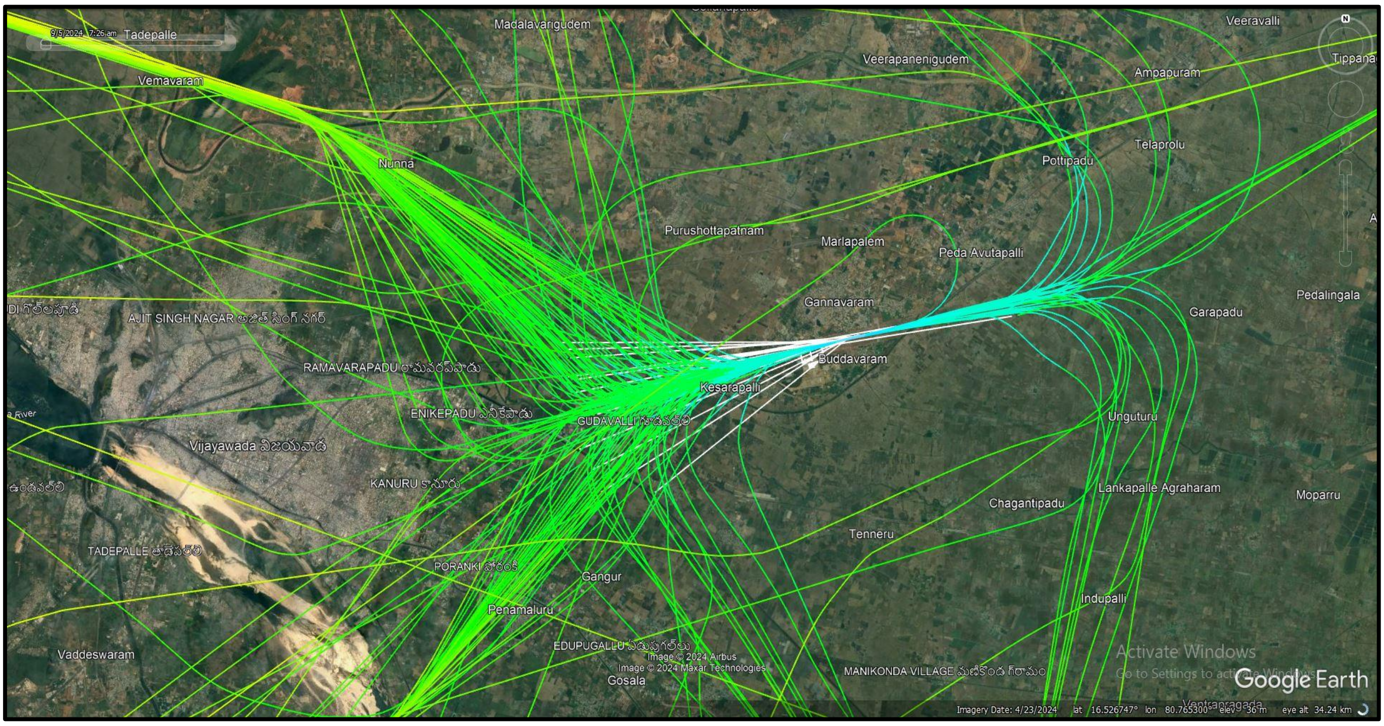


Figure 4.5: Departure Flight Tracks

Based on the Traffic, Flight Tracks and Corridors data for the year 2023–24, Vijayawada International Airport has been classified as a non-busy airport. Accordingly, for such airports, excluding proposed airports, the prescribed ambient air quality standards with respect to noise in the airport noise zone are 65 dB(A) Leq for daytime (06:00–22:00 hrs) and 60 dB(A) Leq for nighttime (22:00–06:00 hrs).

Sr.No.	Industry	Parameters	Standards	
1	2	3	4	
	Ambient Air Quality Standards with respect to Noise in Airport Noise Zone			
112	Airports	Type of Airports	Limits in dB (A) Leq	
			Day Time	Night Time
		All other Airports excluding the proposed airports	**65**	**60**

The measured noise levels at various monitoring locations around Vijayawada International Airport indicate compliance with the prescribed standards for non-busy airports. All observed values were below the permissible limits of 65 dB(A) during daytime and 60 dB(A) during nighttime. This demonstrates that the ambient noise levels in and around Vijayawada International Airport are well within the regulatory standards, with no exceedance of noise limits observed during the monitoring period.

Location	Measured Value		Prescribed Limit as per non-busy airports		Compliance Status
	Lday dB(A)	Lnight dB(A)	Lday dB(A)	Lnight dB(A)	
Airport Premises – Approach Funnel Area-26	55.8	45.3	**65**	**60**	Within Limit
Airport Premises – Approach Funnel Area-08	61.8	58.5	**65**	**60**	Within Limit
Residential Scatter Area	50.8	43.1	**65**	**60**	Within Limit

4.5 METEOROLOGICAL DATA

Noise propagation is affected by meteorological parameters like wind velocity & direction, temperature, air pressure, and humidity were collected from the Indian Meteorological Department. This meteorological data also becomes one of the input parameters for software. **Table 4.9** depicts data such as temperature, humidity, air pressure, and headwind of Vijayawada Airport City in September- 2024.

Table 4.9: Meteorological Data

Humidity (%)	Air pressure (mmHg)	Headwind (km/hr)	Temperature (^{O}C)
78.8	752.6	8	28.6

CHAPTER-5

NOISE MAPPING AND PREDICTION

5.1 GENERAL

This chapter highlights the noise mapping concept and noise mapping of the study area. Noise maps were developed for Vijayawada Airport using a computer simulation model

5.2 CONCEPT OF NOISE MAPPING

A noise map is a map of an area, which is coloured according to the noise levels in the area. Sometimes, the noise levels may be shown by contour lines, which show the boundaries between different noise levels in that area. The noise levels over an area will be varying all the time. For example, noise levels may rise as the aircraft approaches, and reduce again after it has passed. This would cause a short-term variation in noise level. In the longer term, wind, weather and season all affect noise levels. This means that it is not possible to say with confidence what the noise level will be at any particular point at any instant in time, but where the noise sources are well-defined, such as road or rail traffic, or aircraft, then it is possible to say with some confidence what the long-term average noise level will be.

It may be thought that the best way of doing this is by measurement. A long-term average must be measured over a long period (24 hours). Secondly, to obtain complete coverage of an area, measurements would have to be made on private property, where access might be difficult, and thirdly, measurements cannot distinguish the different sources of noise, so they would not be able to give information on how much noise was being made by each of the sources in an area. For these and other reasons, noise mapping is usually done by calculation based on a computerized noise model of an area, although measurements may be appropriate in some cases.

A further benefit of having a noise map is that it can be used to assess the effects of transportation and other plans. Thus, the effect of a proposed new airport/existing airport can be assessed and suitable noise mitigation can be designed to minimize its impact. This is particularly important in noise action planning, where a cost-benefit analysis of various options can be tested before a decision is made.

5.3 NOISE PREDICTION

The noise impact assessment study for Vijayawada Airport analyzed predicted noise levels from proposed aircraft operations using the Integrated Noise Model (INM) software, a widely recognized tool for assessing aircraft noise impacts near airports. Input parameters, including atmospheric temperature, pressure, and average headwind speed, were utilized to calculate noise levels for each operation. Noise levels in the surrounding community were evaluated based on the characteristics of the noise source, time of occurrence, and location relative to receptors.

Predicted noise levels at six monitoring locations (NQ1-NQ6) were assessed using four standard noise metrics: LAEQ (equivalent continuous sound level), LAEQD (daytime equivalent level), LAEQN (nighttime equivalent level), and LAMAX (maximum sound level). During the study period from September 5 to 12, 2024, a worst-case flight operation scenario was analyzed and maximum aircrafts traffic movements were observed on September 9 &10. A total of 47 flights occurred during daytime hours (06:00 to 22:00), with only one flight during nighttime hours (22:00 to 06:00) on September 9, 2024. Maximum flight movements, including the highest number of ATR 72-600 flights, were observed on September 9, exceeding those on September 10, 2024, and predominantly utilized runway end 26.

The assessment considered two operational scenarios: Scenario-I, in which runway end 26 was used for both arrivals and departures, including one daytime arrival from the runway end 08, and Scenario-II, conducted as an additional study, where runway end 08 flight operations mirrored those of runway end 26. The same aircraft traffic movement data was applied to runway end 08 to ensure a consistent analysis of potential noise impacts across both runway orientations.

The objective of this additional study for runway end 08 was to better understand noise levels at key monitoring and receptor locations around the project site under different operational configurations. Measured and predicted noise levels for both scenarios are presented in **Tables 5.1 to 5.4**, while **Figure 5** illustrates predicted and observed noise levels at the six monitoring locations. Deviations in noise levels were observed, potentially due to temporal and environmental variations during the study period.

The noise model integrates three critical elements: noise generation, propagation, and reception. Noise source data includes aircraft type, engine type, and flight path, while propagation data considers the receiver's perpendicular distance from the source, propagation height, ground characteristics, viewing angle, and nearby reflective surfaces. Receptor data accounts for location, height, viewing angle, and adjacent reflective surfaces.

For this study, noise map generation spanned operations between 06:00 and 22:00 hours. Model results were validated against actual noise measurements taken at monitoring points around the airport. **Tables 5.1 to 5.4** display predicted and measured noise values, and **Figures 6.1 and 6.2** depict noise levels as contours. These contours, outlined per MoEF&CC notification G.S.R. 568 (E), highlight areas with significant noise exposure, providing a valuable tool for assessing noise impacts across various runway and flight corridor configurations.
The aircraft noise map generation for this study required significant data inventory, covering operations between 06:00 and 23:00 hours. Noise model results were validated against actual noise measurements taken at monitoring points near the airport. Predicted Noise levels within residential zones are within permissible limits of

55 dB(A) for daytime and 45 dB(A) for nighttime as per the applicable Ambient Noise Quality Standards (ANQS) with marginal exceedance at two locations NQ4 & NQ6 under funnel area during day time. However, these two Locations are well within with respect to noise in Airport Noise Zone daytime Standard 65 dBA and 60 dBA for Nighttime applicable for Vijayawada airport.

Table 5.1: LAEQ Measured Value and Predicted Values

Locations	Measured Value	Predicted Values (Scenario-I)	Predicted Values (Scenario-II)
	LAEQ	LAEQ	LAEQ
NQ1 (Runway End-08)	64.3	59.0	64.2
NQ2 (Approach FA-26)	54.8	61.3	58.6
NQ3 (Kesarapalli)	55.0	51.5	43.8
NQ4 (Sagarlapet)	55.8	53.7	55.9
NQ5 (Peda Avutapalli)	64.2	33.1	42.1
NQ6 (Allapuram)	56.1	54.4	52.7

Table 5.2: LAEQ Daytime Measured Value and Predicted Values

Locations	Measured Value	Predicted Values (Scenario-I)	Predicted Values (Scenario-II)
	LAEQD	LAEQD	LAEQD
NQ1 (Runway End-08)	60.9	60.8	66.0
NQ2 (Approach FA-26)	54.6	63.1	60.4
NQ3 (Kesarapalli)	51.4	53.3	45.5
NQ4 (Sagarlapet)	48.7	55.5	57.6
NQ5 (Peda Avutapalli)	46.8	34.9	43.8
NQ6 (Allapuram)	56.1	56.1	54.4

Table 5.3: LAEQ Nighttime Measured Value and Predicted Values

Locations	Measured Value	Predicted Values (Scenario-I)	Predicted Values (Scenario-II)
	LAEQN	LAEQN	LAEQN
NQ1 (Runway End-08)	56.8	32.5	22.5
NQ2 (Approach FA-26)	45.1	26.1	32.5
NQ3 (Kesarapalli)	46.2	28.6	27.8
NQ4 (Sagarlapet)	42.1	29.7	17.4
NQ5 (Peda Avutapalli)	41.4	15.4	24.5
NQ6 (Allapuram)	42.8	16.9	29.2

Table 5.4: LAMAX Measured Value and Predicted Values

Locations	Measured Value	Predicted Values (Scenario-I)	Predicted Values (Scenario-II)
	LAMAX	LAMAX	LAMAX
NQ1 (Runway End-08)	89.4	96.5	106.3
NQ2 (Approach FA-26)	87.1	100.6	96.2
NQ3 (Kesarapalli)	89.4	87.7	76.0
NQ4 (Sagarlapet)	90.6	90.9	92.7
NQ5 (Peda Avutapalli)	84.7	60.8	76.8
NQ6 (Allapuram)	88.7	90.3	90.1

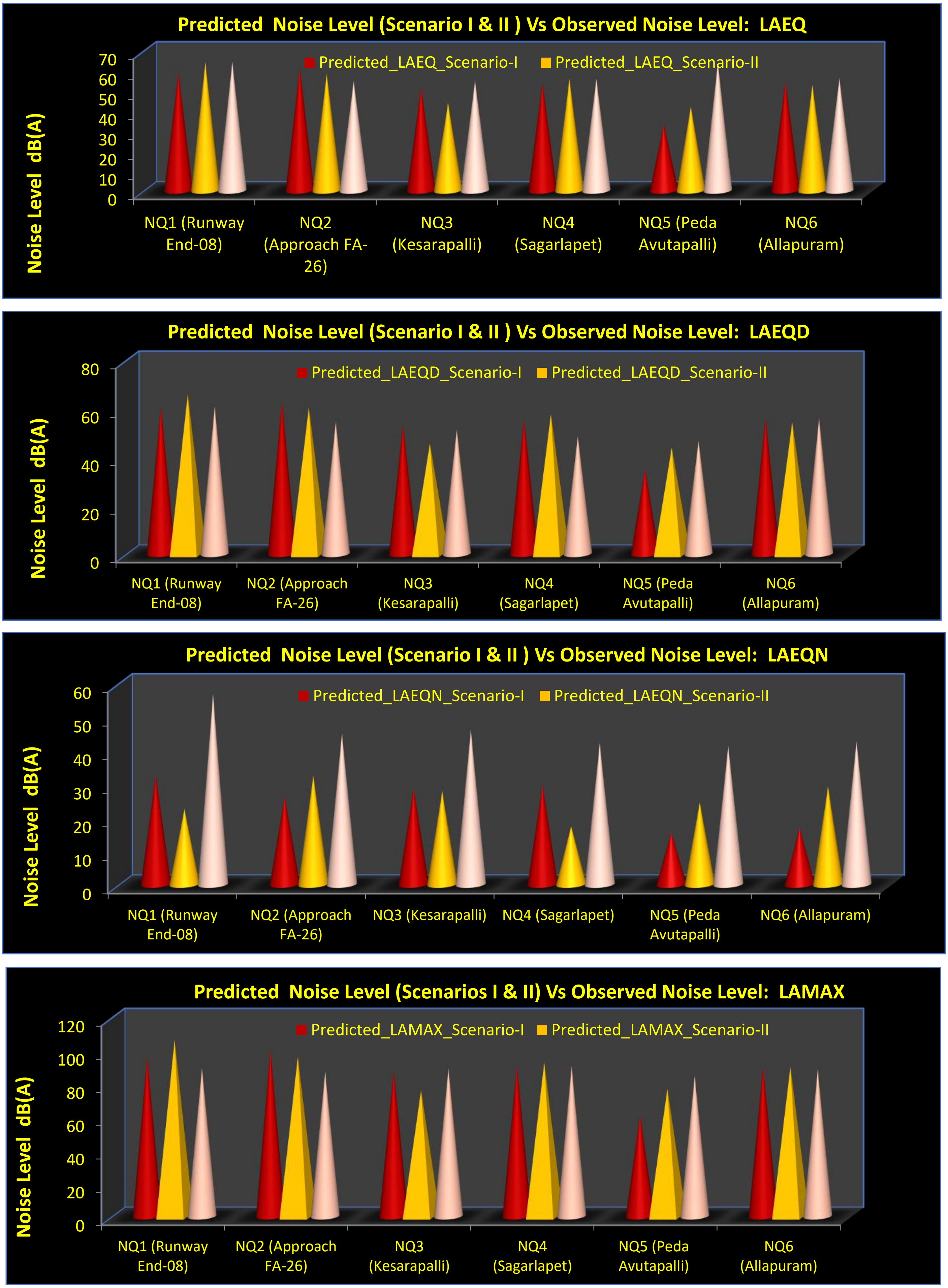


Figure 5.0: Predicted Vs Observed Noise Level Metrics

5.3.1 VALIDATION OF NOISE PREDICTIONS

To ensure the accuracy of the noise prediction model for Vijayawada Airport, validation was conducted by comparing measured noise levels with predicted noise levels at key monitoring locations. This comparison focused on noise indices including LAEQ, LAEQD, LAEQN, and LAMAX, with values from actual field measurements compared against the predictions generated by the noise mapping software for both scenarios under study.

The results indicate a close alignment between the measured and predicted values, confirming the reliability of the prediction model in assessing noise impacts around the airport. Minor discrepancies in noise levels observed are likely due to real-time variations in conditions, such as flight patterns, meteorological factors, monitoring dates and times, and local environmental influences. These variations underscore the importance of ongoing, simultaneous noise monitoring to further refine predictions and maintain model accuracy. Regular updates to the model, incorporating real-time noise data, will improve the robustness of noise management strategies.

This validation process plays a crucial role in confirming that the noise contours and proposed mitigation measures are appropriately tailored to the noise impact zone, ensuring that Vijayawada Airport adheres to the prescribed noise standards.

CHAPTER-6

DECLARATION OF NOISE ZONE AND MAPPING

6.1 GENERAL

The purpose of aircraft noise modelling is to generate the noise contour maps for an existing or planned airport or to show the variations in contours for different operations/plans / future aircraft /noise abatement restrictions and so on. Parallel to the graphical representation of the noise contours, it is possible to get details of the noise zone in the form of noise maps. Aircraft noise contour maps can be used to calculate the total areas, residential populations affected, numbers of schools and hospitals, or other potentially noise-sensitive locations, geographically located within defined aircraft noise contour bands.

6.2 DECLARATION OF NOISE ZONE

The Airport Noise Zone Area for Airport is defined as noise contour for day and night periods based on existing GSR 751 (E), issued by the Ministry of Civil Aviation (Height Restrictions for Safeguarding of Aircraft Operations) Rules, 2015 published on September 30, 2015 as amended from time to time on Height Restriction for Safeguarding of Aircraft Operation considering all approach and departure funnels and Instrument Flight Procedures (i.e. Instrument Approach Procedures, Standard Instrument Departure & Standard Terminal Arrival Route).

International Civil Aviation Organization (ICAO) and DGCA have defined Obstacle Limitation Surfaces (OLS) in and around the airports for safe and efficient operations of the flights. Accordingly, the Ministry of Civil Aviation (MoCA) has issued a Statutory Order (S.O. 84 E) dated January 14, 2010 to protect these surfaces.

In line with the world best practices and based on the Committee recommendations, set up by MoCA for regulating the building construction around airports, MoCA (vide its letter dated October 15. 2012) has directed AAI to prepare the Colour Coded Zoning Map (CCZM) in grid form of all the civil airports, certify them and give a copy of such maps to Local/Municipal Bodies.

CCZM of all the airports has been prepared and issued to the Local Bodies. The whole of the area around the airport has been divided into geo-referenced grids of 1 minute by 1 minute (approximately 3 Square km) for easy readability and implementation. The Local, Municipal or Town Planning and Development authorities can plan their development as per the CCZM.

CZM can be used to locate and identify the home grid, where the plot/site lies. The local authorities co-relate the colour of the home grid with the colour legend, available in CCZM and check the permitted top elevation in Above Mean Sea Level (AMSL). If the colour of the home grid is red then the applicant shall file an application to AAI through NOCAS at the AAI website for issuance of NOC. The maximum elevation that can be approved through CCZM is up to 150 m, and where the requested top elevation is above 150 m, an applicant must apply online on NOCAS. The effective utilization of an airport is considerably influenced by natural features and man-made constructions inside and outside its boundary. These may result in limitations on the distances available for takeoff and landing of aircraft. For these reasons, certain areas of the local airspace must be regarded as integral parts of the aerodrome environment. Also, there is a need to protect the airport environment so that future airport expansion plans are smoothly implemented.

6.3 NOISE PREDICTION & CONTOURS MAPPING

The predicted noise levels from proposed aircraft operations were modeled using the Integrated Noise Model (INM), developed by the Federal Aviation Administration (FAA). This model is widely recognized for assessing aircraft noise impacts in areas surrounding airports. The noise levels in the community were evaluated based on the noise source characteristics, time of occurrence, and proximity to receptors. The study analyzed noise under two worst-case flight operation scenarios I & II, conducted during the study period from September 5 to 12, 2024.

In scenario-I, runway end 26 was used for both arrivals and departures, including one daytime arrival from runway end 08. In scenario-II, runway end 08 was used for operations, mirroring the flight operations of Scenario-I. The same traffic data applied to ensure consistency in the analysis of potential noise impacts for both runway orientations. Scenario-I recorded 47 daytime flights (06:00 to 22:00) and one nighttime flight (22:00 to 06:00).

Aircraft noise exposure was assessed using the Day-Night Average Sound Level (DNL) metric. It is proposed that Day-Night Average Sound Levels (DNL) shall be used to know the sound exposure on people / residents due to aircrafts and for land use planning around airports. Day-Night Average Sound Levels (DNL) is the Energy-Averaged Sound Level (Leq) measured over a period of 24 hours, with a 10 dB penalty applied to night-time (10:00 PM and 6:00 AM) sound levels to account for increased annoyance during the night hours. Noise contours were generated for DNL values in 5 dB(A) increments, ranging from 40 to 75 dB(A), and are illustrated in **Figures 6.1 and 6.2** for the two scenarios. The highest noise levels occurred near the runway and along aircraft take-off and descent paths, with noise decreasing as the distance from these areas increased.

The predicted Day-Night Average Sound Level (DNL) is expected to comply with the daytime Ambient Noise Quality Standard (ANQS) of 55 dB(A) within a range of approximately 0.38 to 0.61 km on either side of the runway, measured perpendicularly from its center. Similarly, it is expected to meet the nighttime silence zone standard of 40 dB(A) within a range of 1.54 to 2.44 km on either side, also measured perpendicularly from the runway's center. Furthermore, the maximum A-weighted sound levels (LAMAX) have been assessed, with the compliance ranges illustrated in **Figures 6.3 and 6.4**.

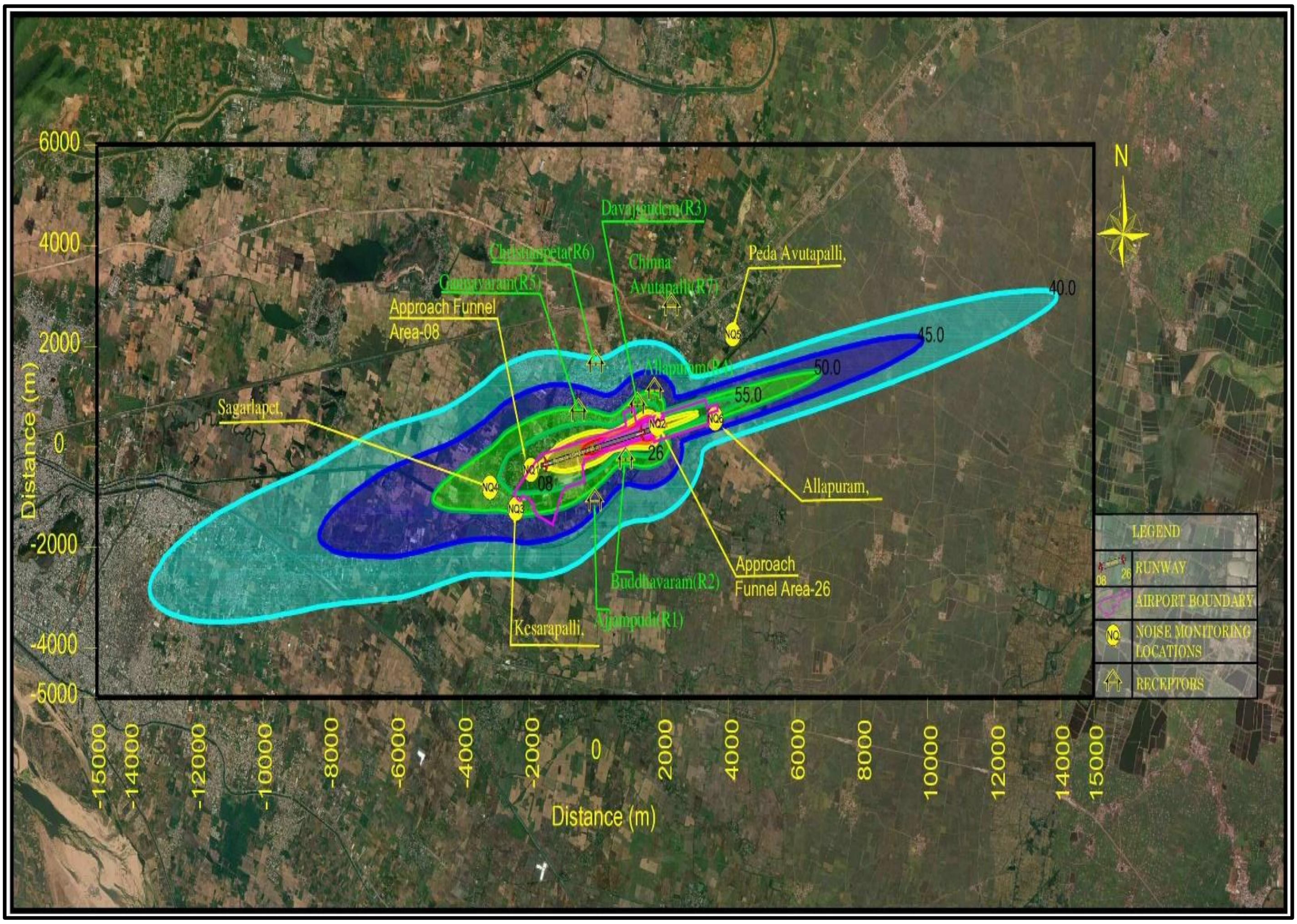
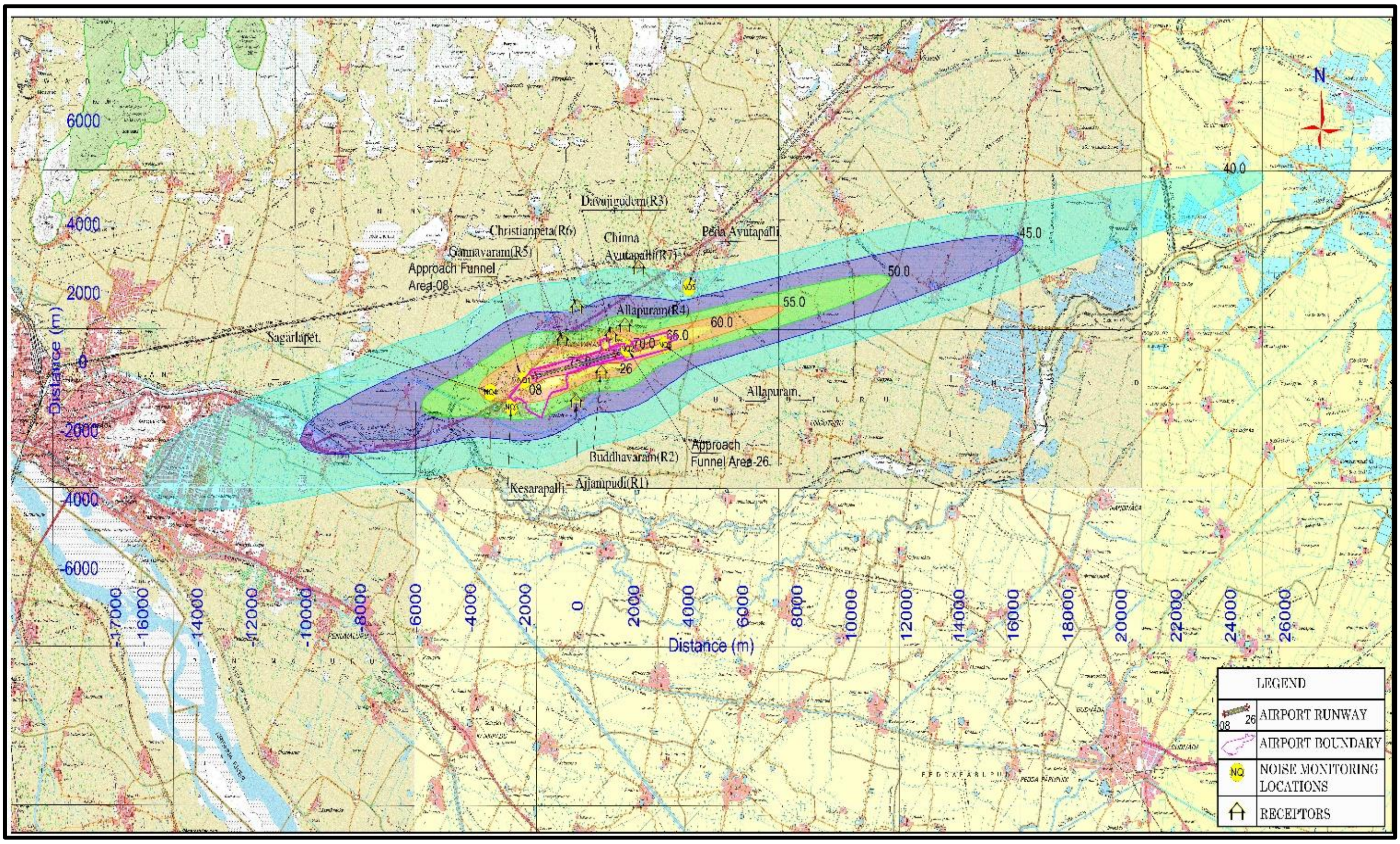


Figure 6.1: Predicted Noise Level (DNL) Contours Map: Scenario-I Flight Operation RWY-26 (App & Dep)



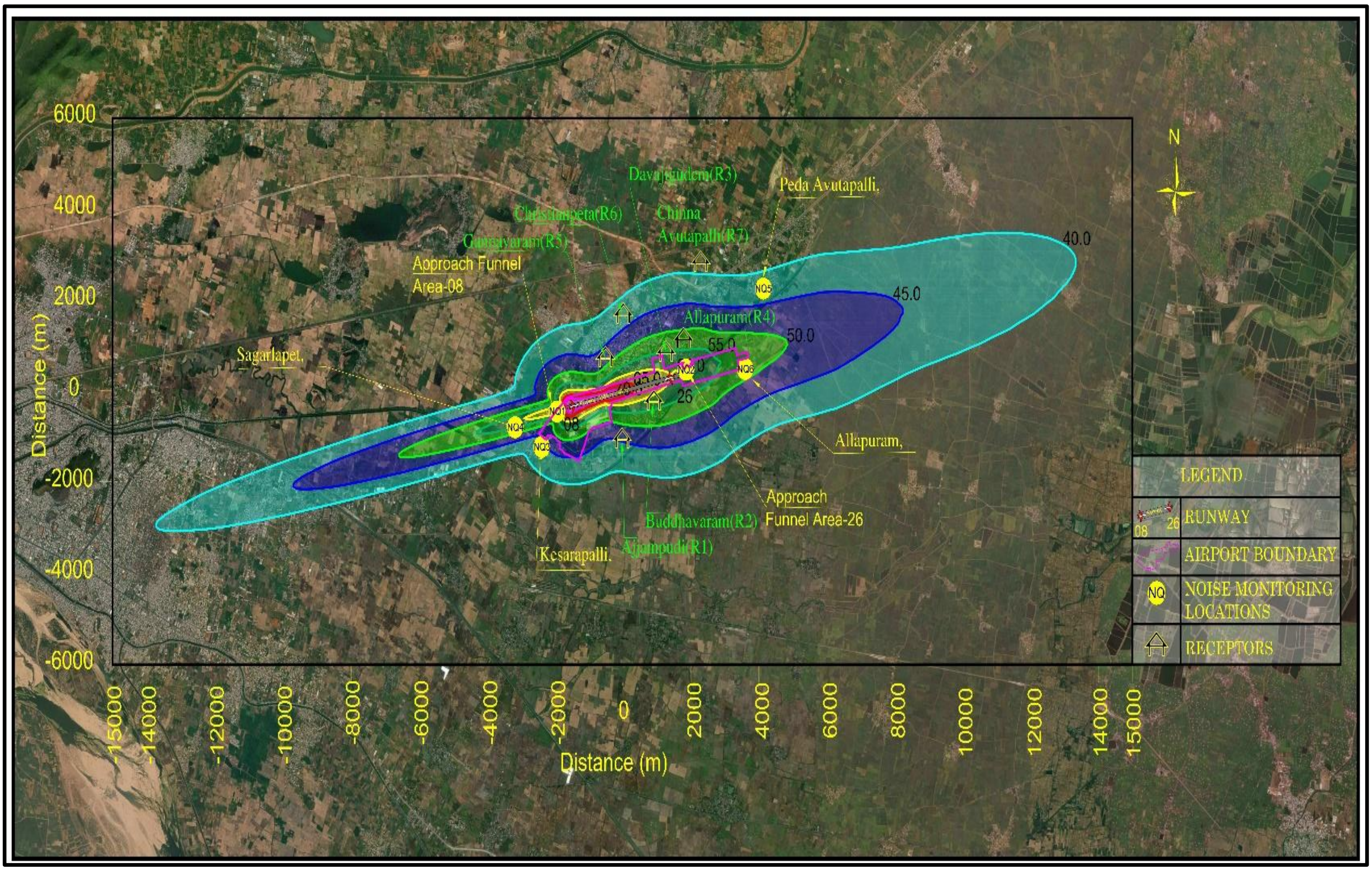
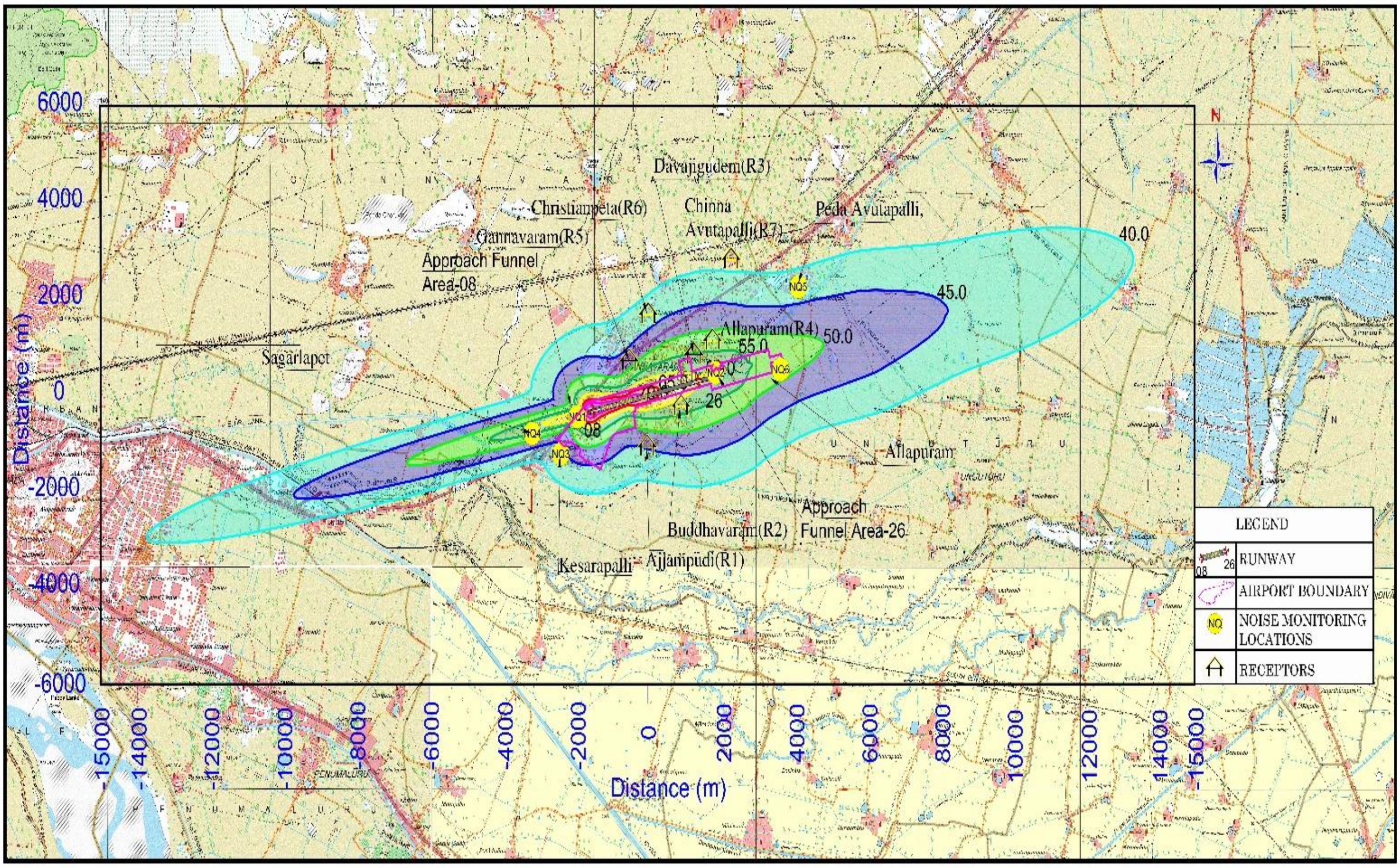


Figure 6.2: Predicted Noise Level (DNL) Contours Map: Scenario-II Flight Operation RWY-08 (App & Dep)



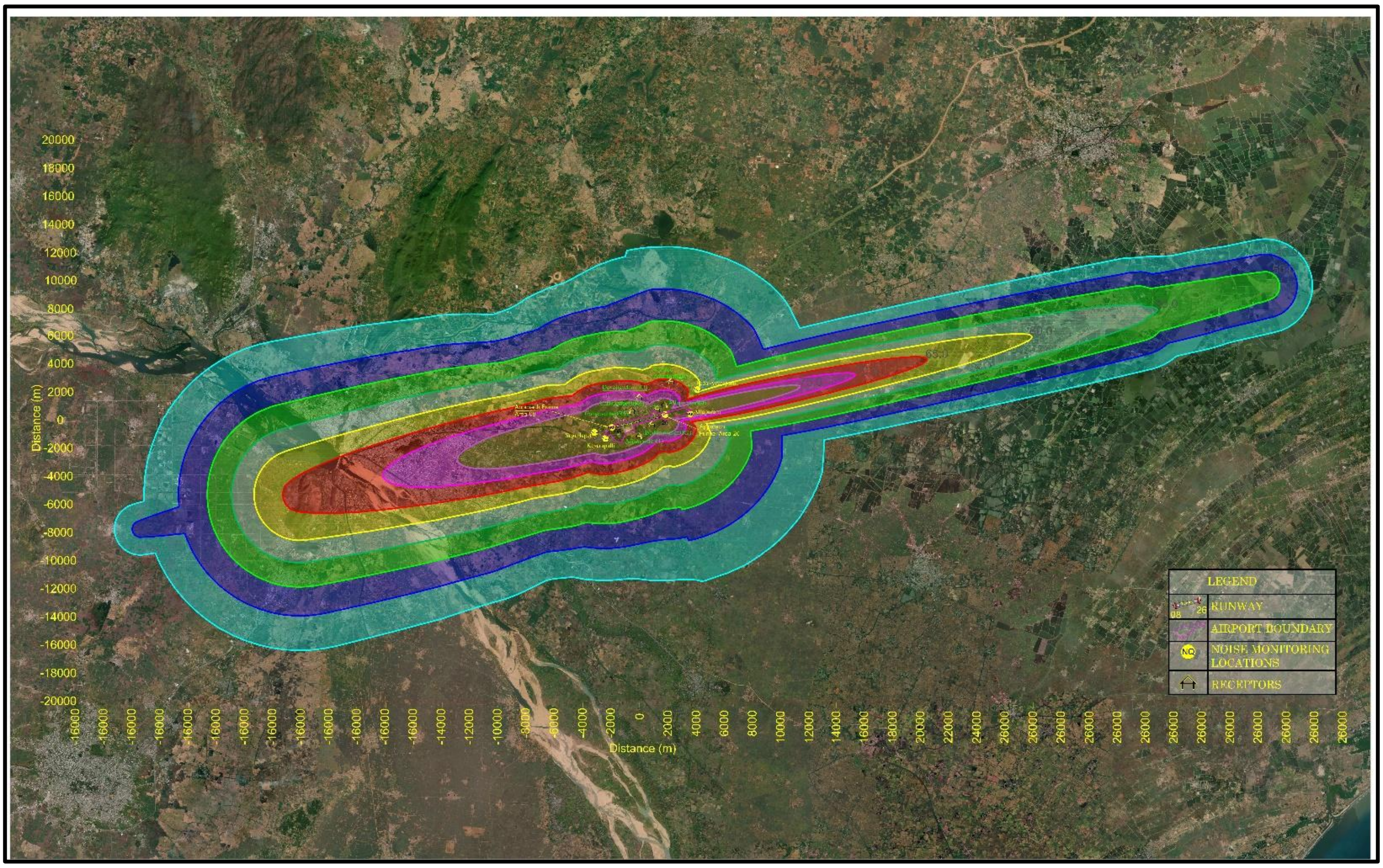
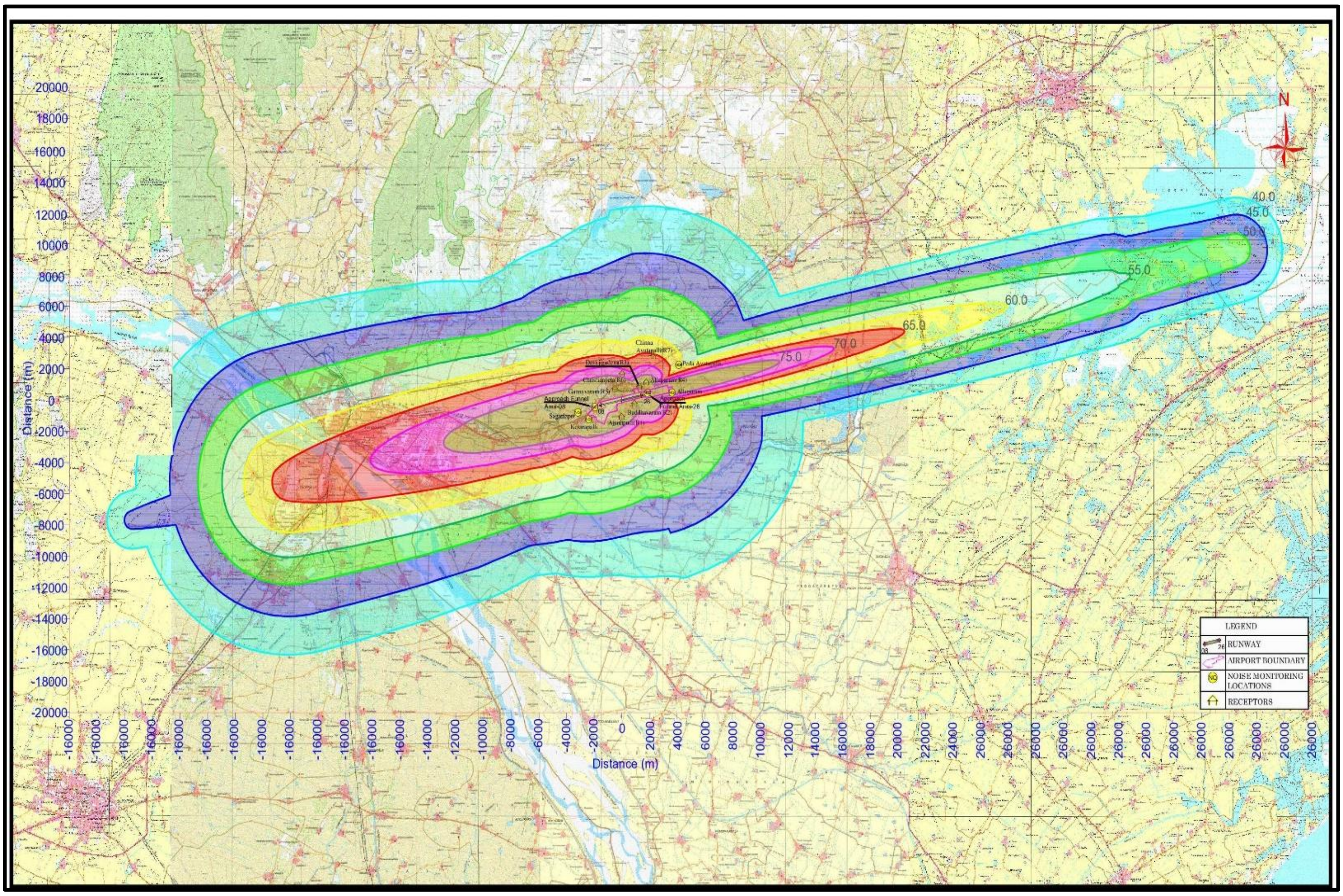


Figure 6.3: Predicted Noise Level (LAMAX) Contours Map: Scenario-I Flight Operation RWY-26 (App & Dep)



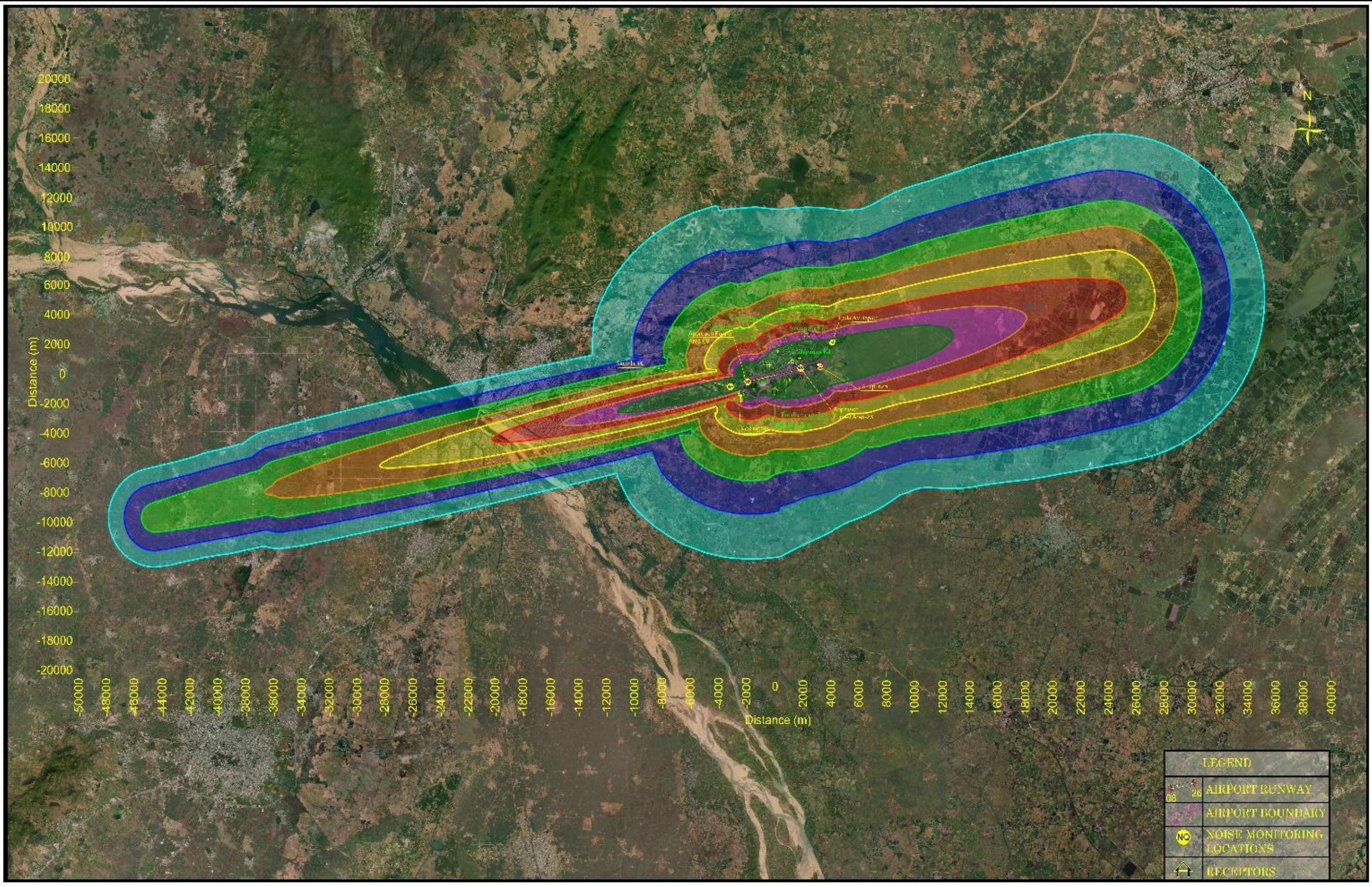
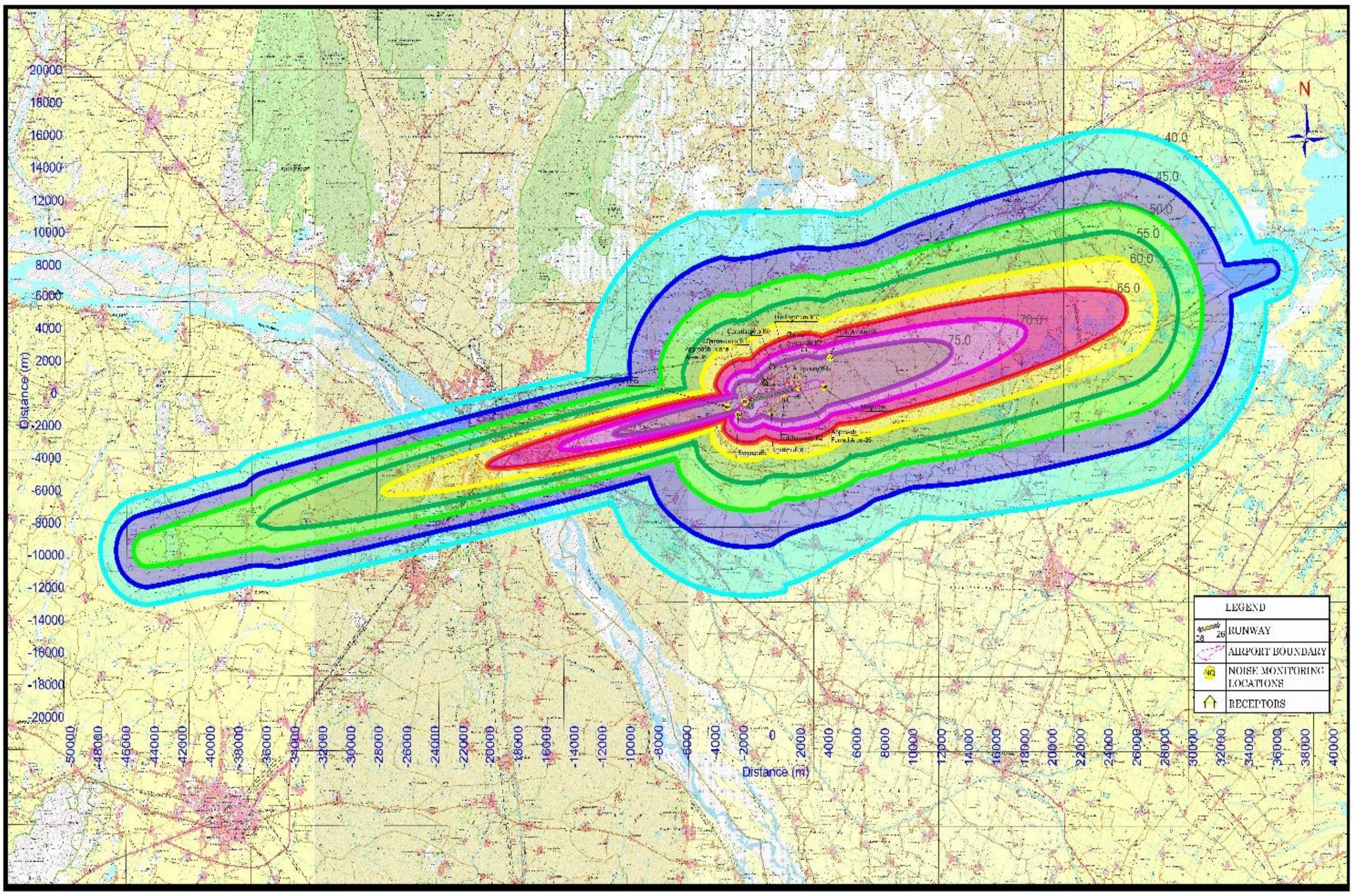


Figure 6.4: Predicted Noise Level (LAMAX) Contours Map: Scenario-II Flight Operation RWY-08 (App & Dep)



6.4 AIRPORT NOISE ZONE DEMARCATIONS

Airport Noise Zones are designated areas surrounding an airport that experience elevated noise levels from aircraft operations. These zones are classified based on noise exposure levels and divided into daytime and nighttime periods to provide a more precise assessment of noise impacts.

To delineate the daytime (55 dBA) and nighttime (50 dBA) noise zones, a noise modelling study was conducted using a conservative approach. Scenario I examined operations at Runway end 26, where all arrivals and departures occurred on this runway end, except for a single daytime arrival from Runway 08. The study utilized LAEQD and LAEQN noise indices to represent daytime (06:00 to 22:00) and nighttime (22:00 to 06:00) conditions, respectively. The model accounted for 47 daytime flights and 1 nighttime flight. The modelling contours reveal that noise zone level (50 dBA) could extend up to 0.94 km from 0.61 km perpendicular to the runway centerline

Figures 6.5 and 6.6 illustrate the resulting daytime and nighttime noise zones, while **Figure 6.7** presents a combined view of nighttime zones, including an additional contour for the 45 dBA level that could extend up to 1.54 km from 0.94 km perpendicular to the runway centerline.

6.5 NOISE ALONG THE AIRPORT BOUNDARY

Noise levels at 157 points along the project boundary were predicted to range from 47.8 to 71.4 dB(A) and 44.3 to 68.4 dB(A) using the Day-Night Average Sound Level (DNL) metric under conservative operational Scenarios I and II, respectively. These variations are illustrated in **Figures 6.8 and 6.9** for Scenarios I and II and are summarized in **Table 6.1**. Higher noise levels are expected near the airport boundary, particularly in areas parallel to the runway and within the approach and departure funnels. As the study is based on a conservative flight movement scenario, actual noise levels are likely to be lower than the projected values.

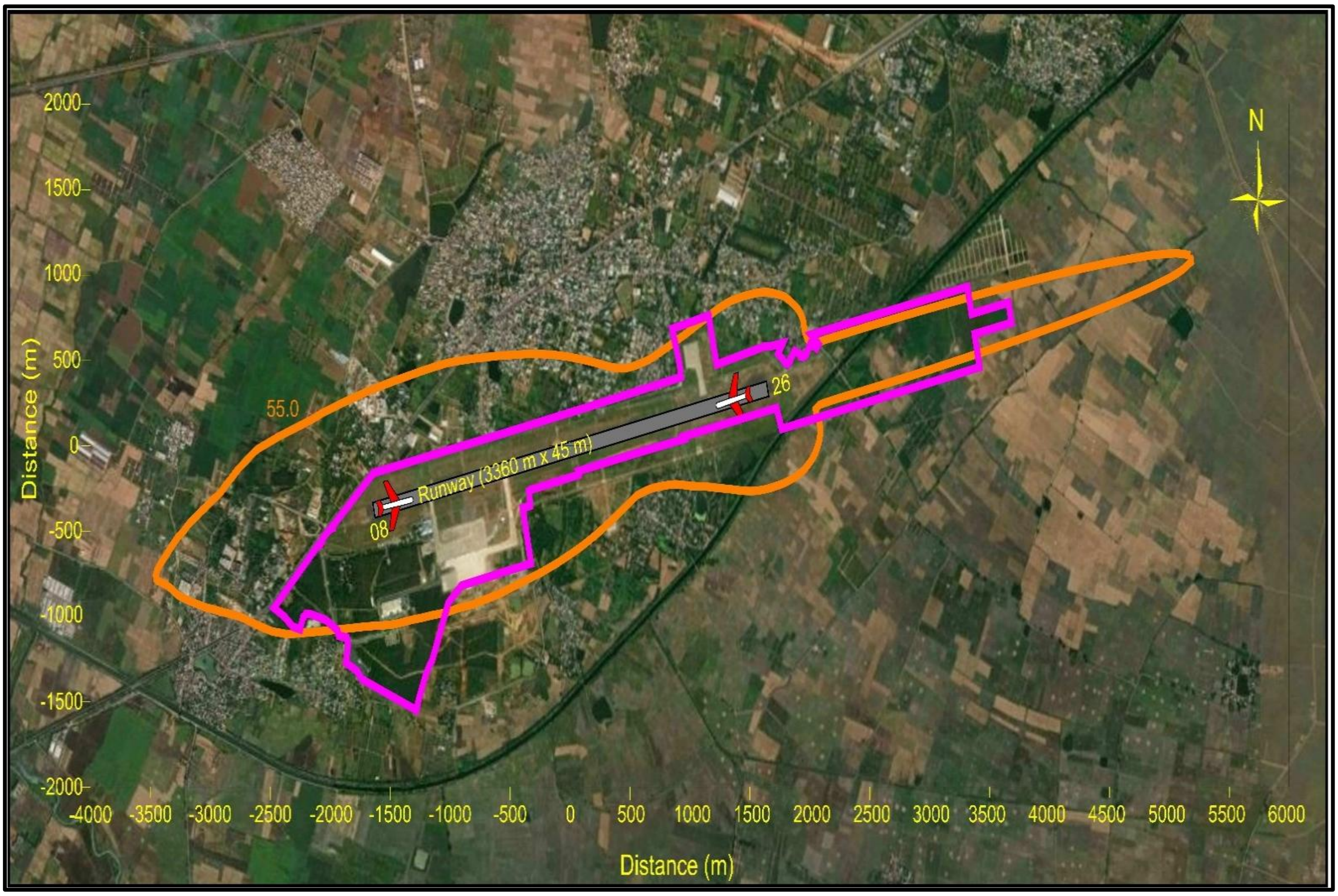
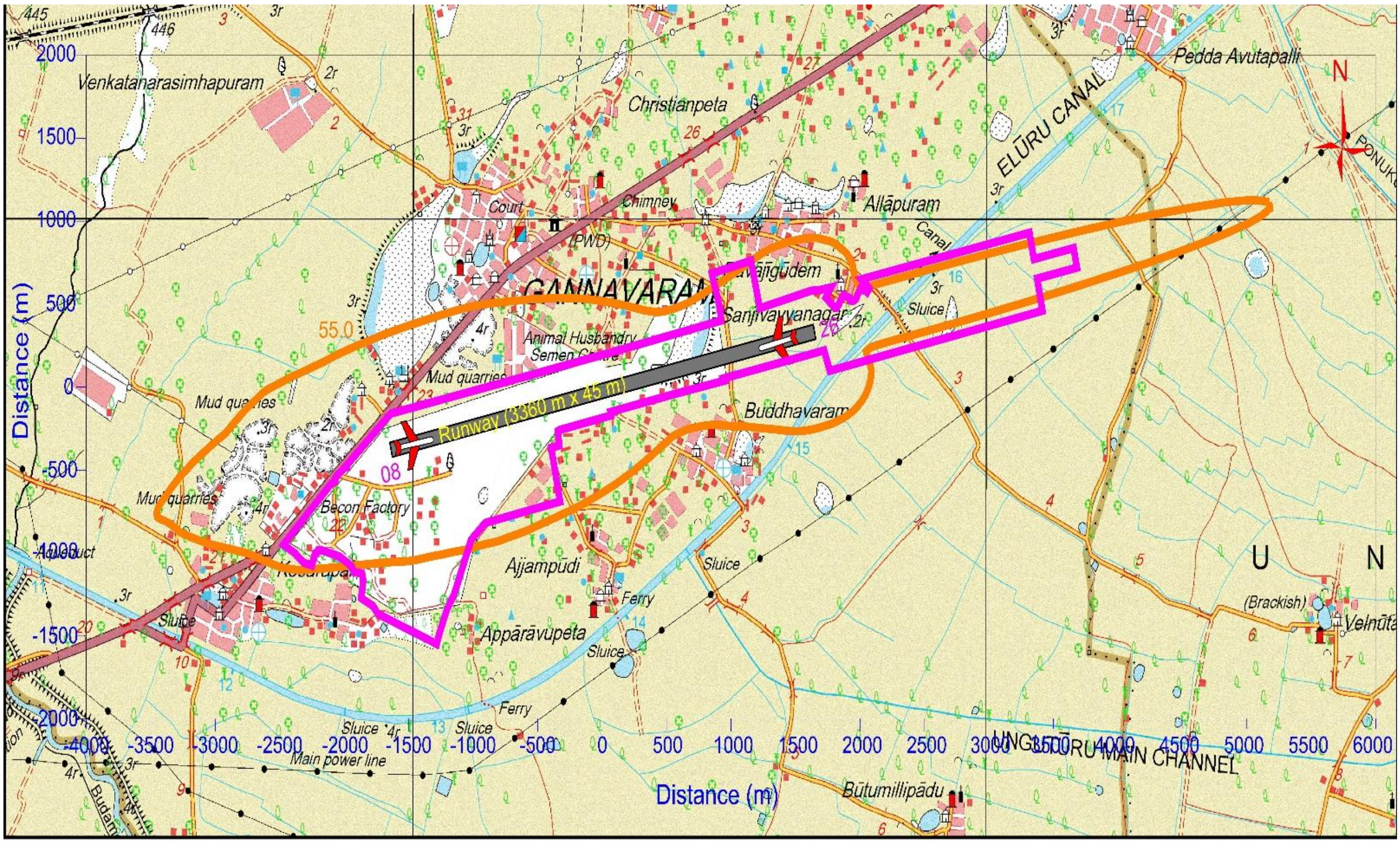


Figure 6.5: Airport Daytime Noise Zone (LAEQD_55 dBA)



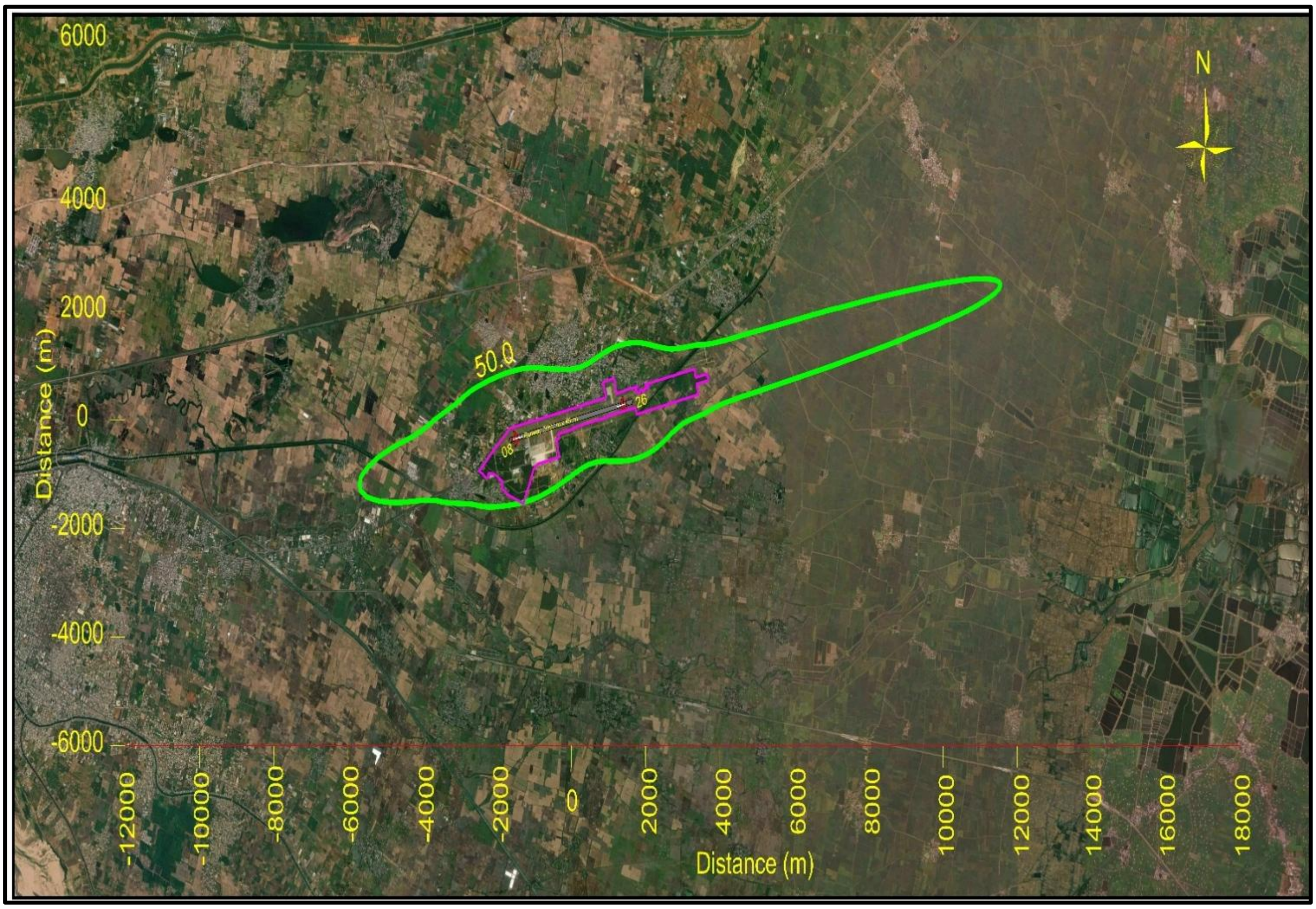
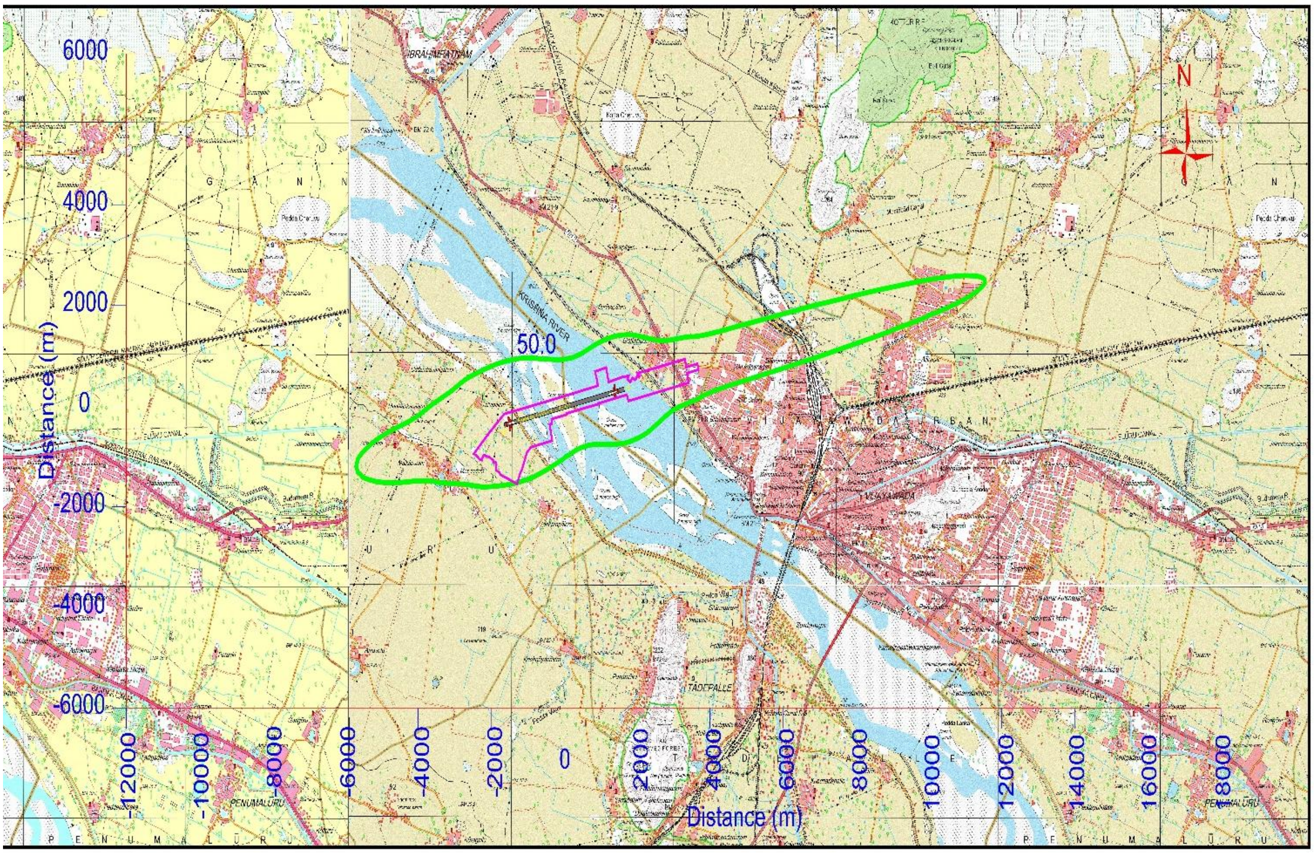


Figure 6.6: Airport Nighttime Noise Zone (LAEQN_50 dBA)



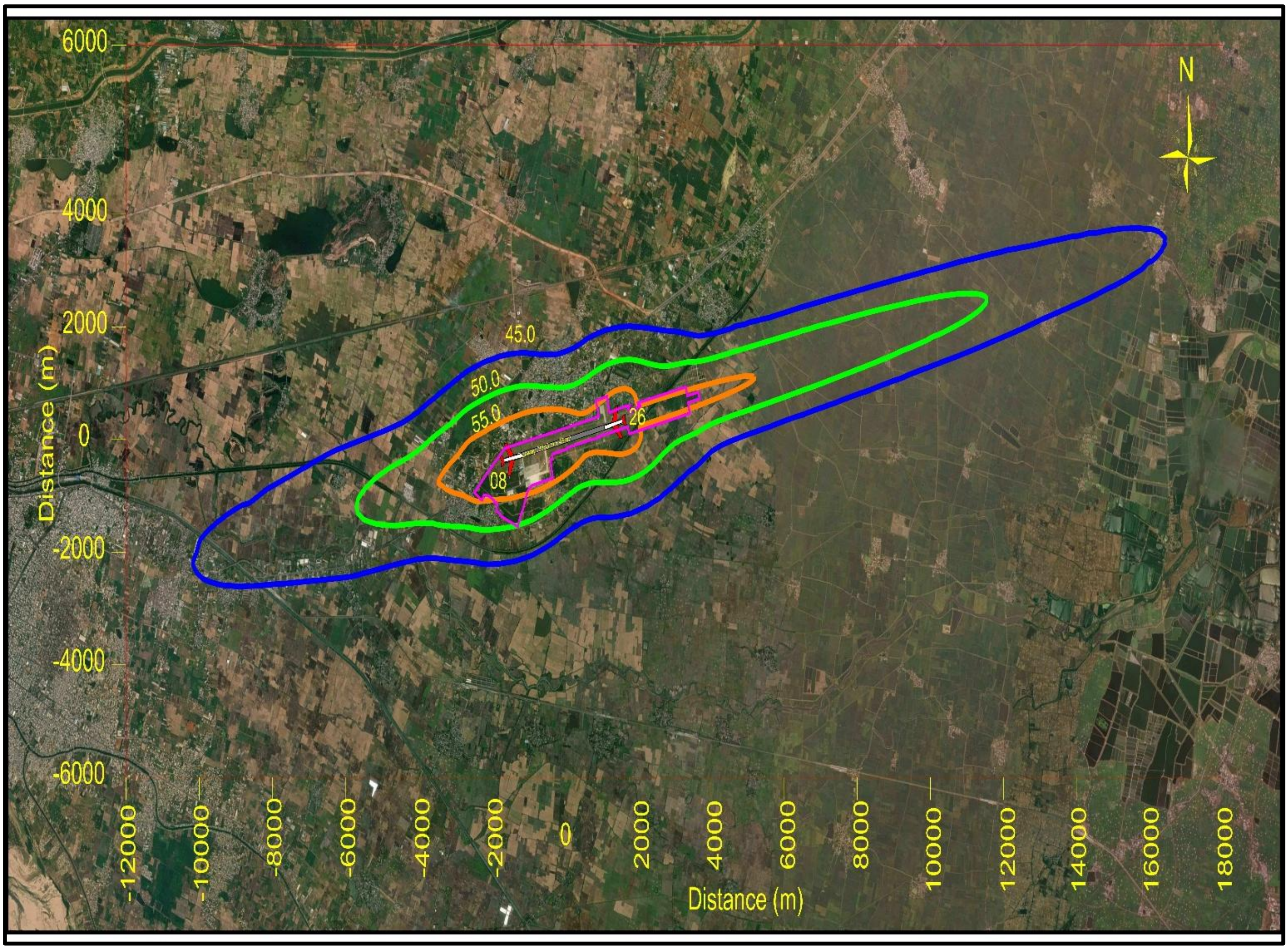
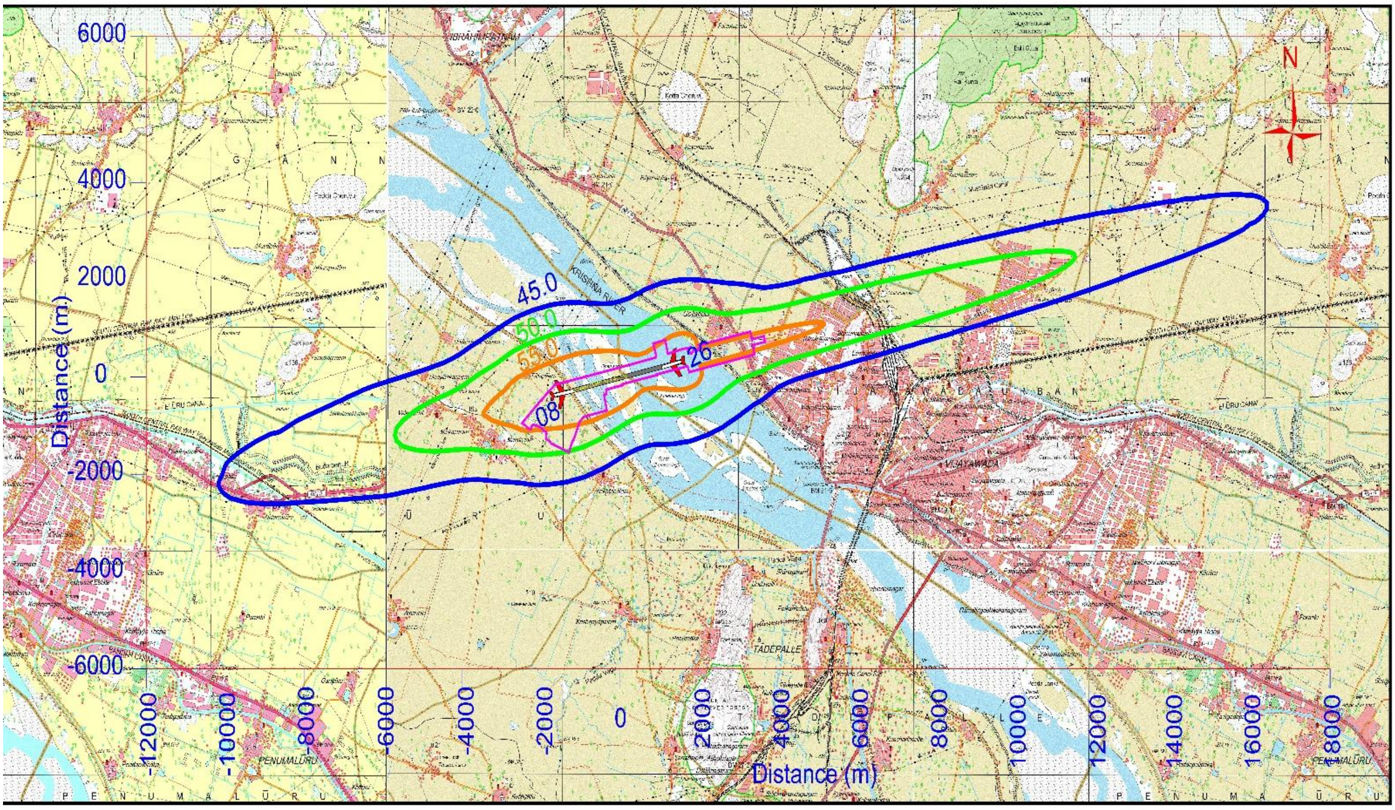


Figure 6.7: Combined Airport Noise Zones (LAEQD_55 dBA, LAEQN_45 & 50 dBA)



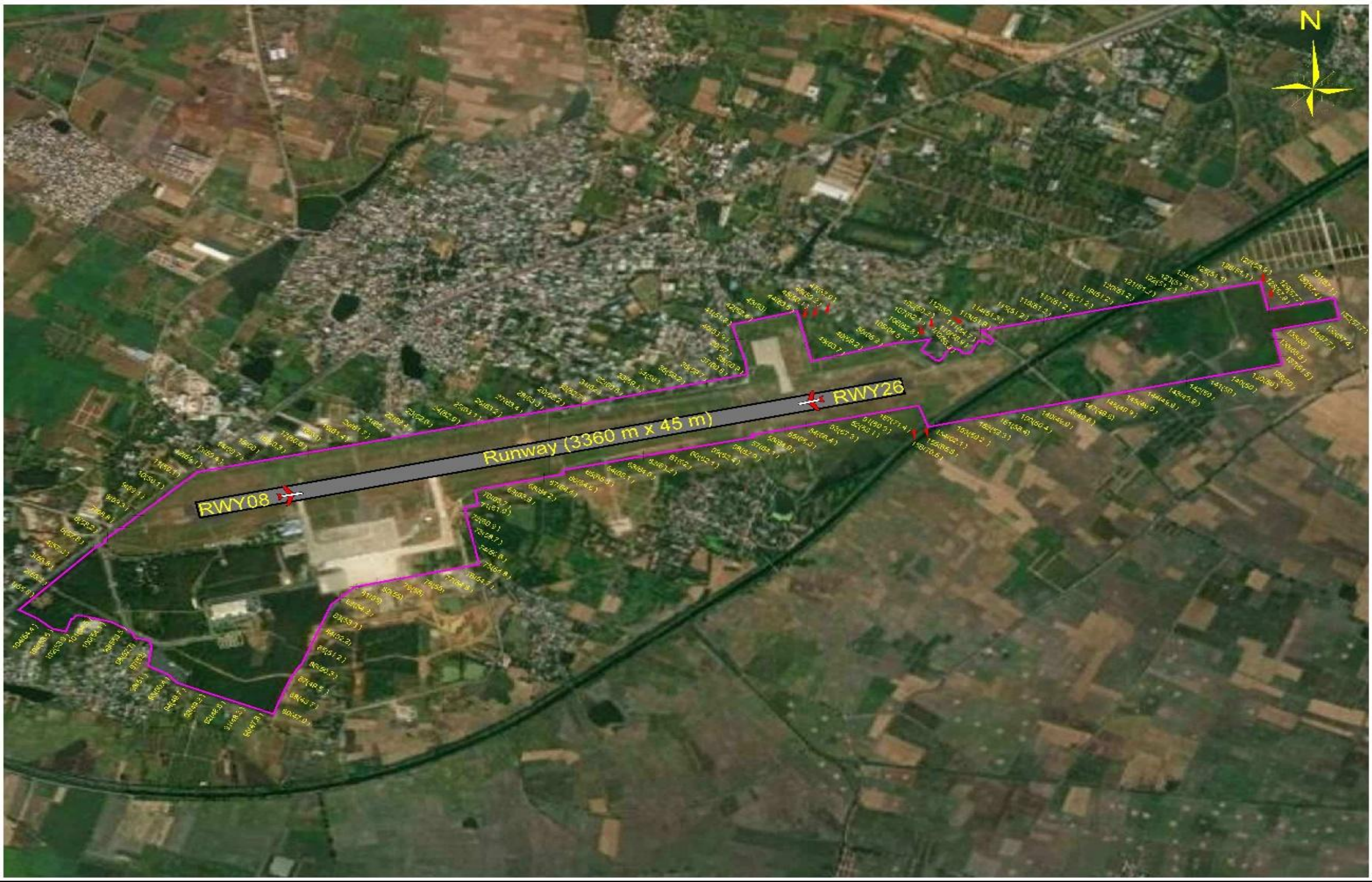
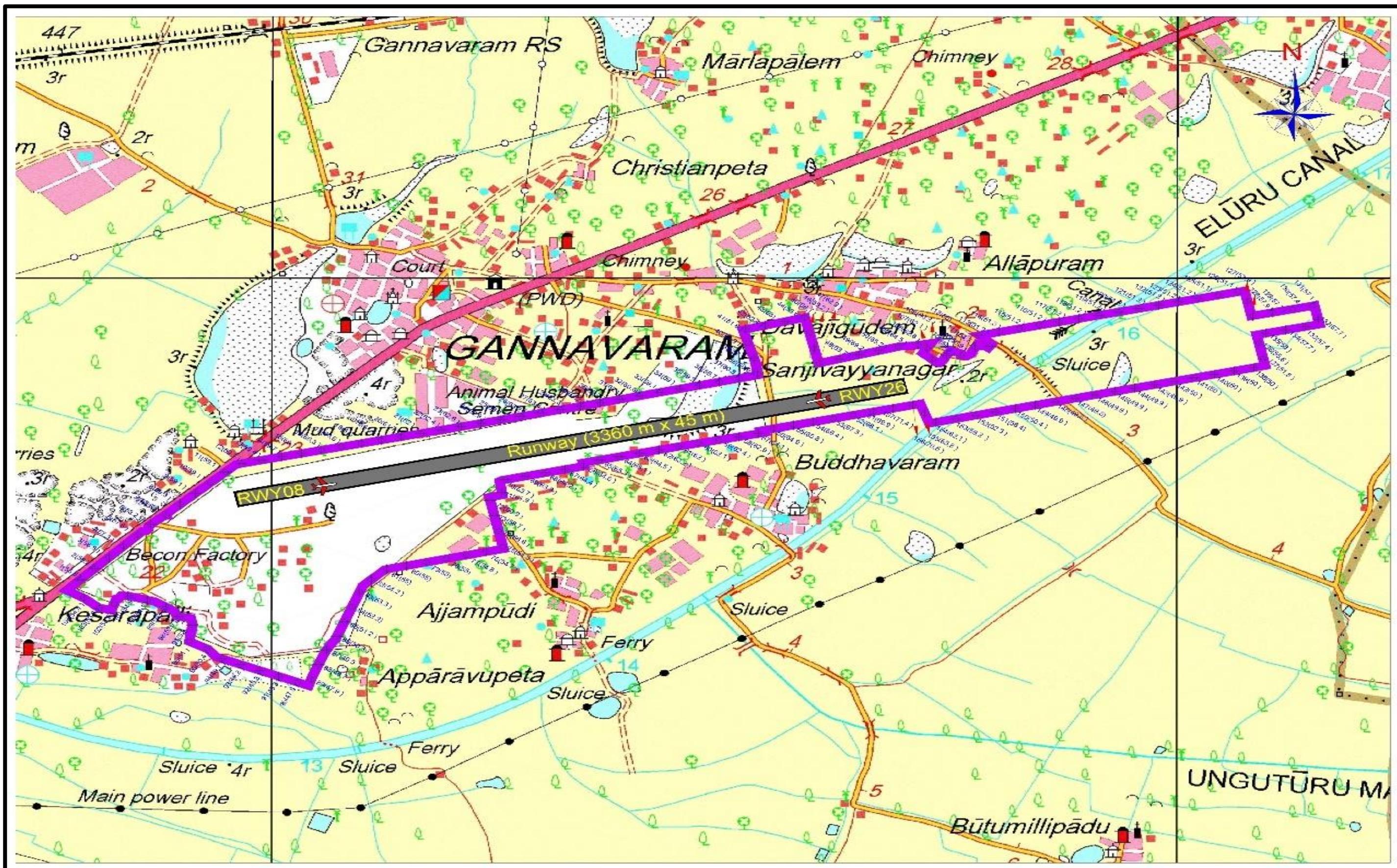


Figure 6.8: Predicted Noise Level (DNL) Along Airport Boundary: Scenario I



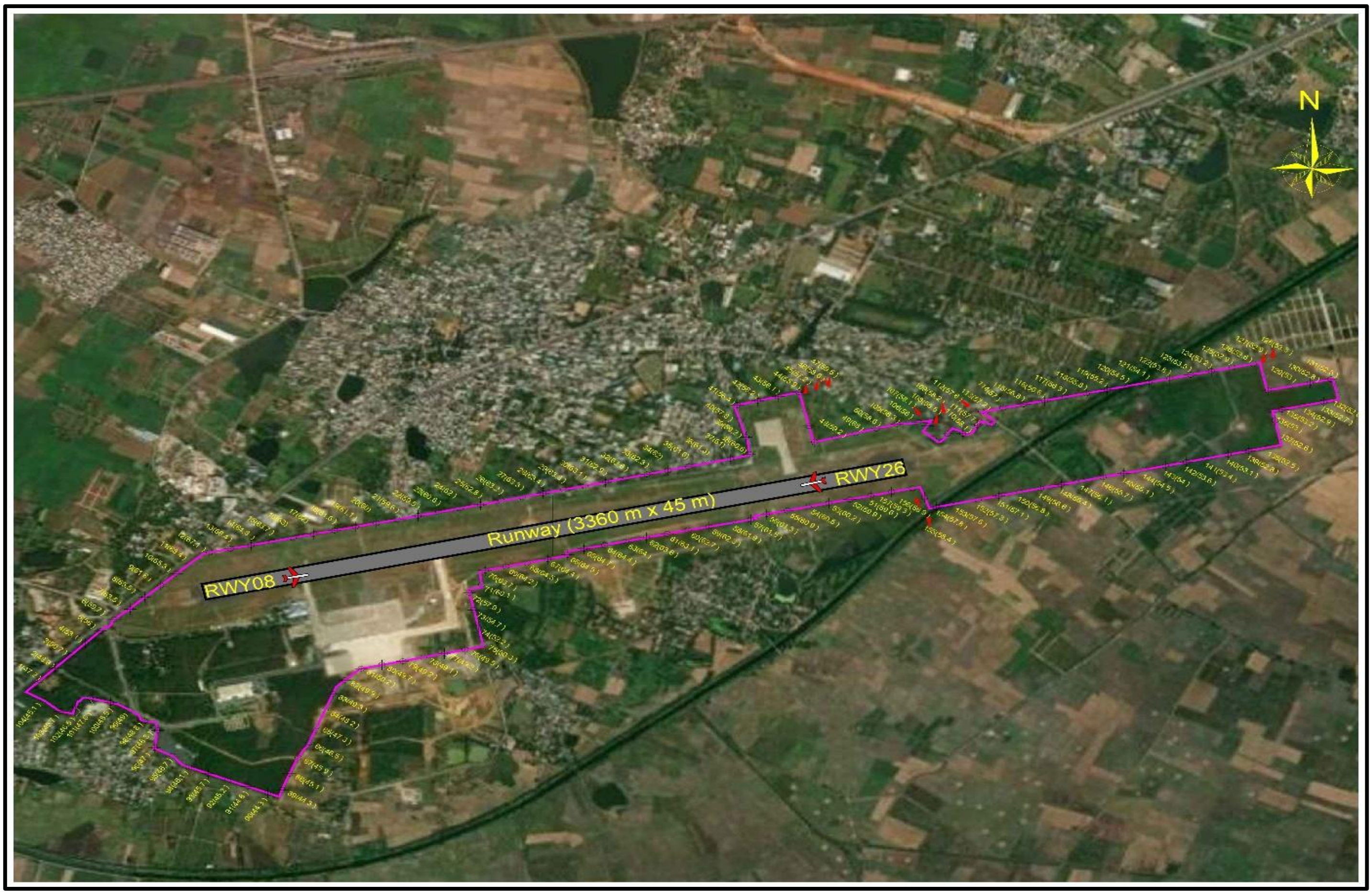


Figure 6.9: Predicted Noise Level (DNL) Along Airport Boundary: Scenario II

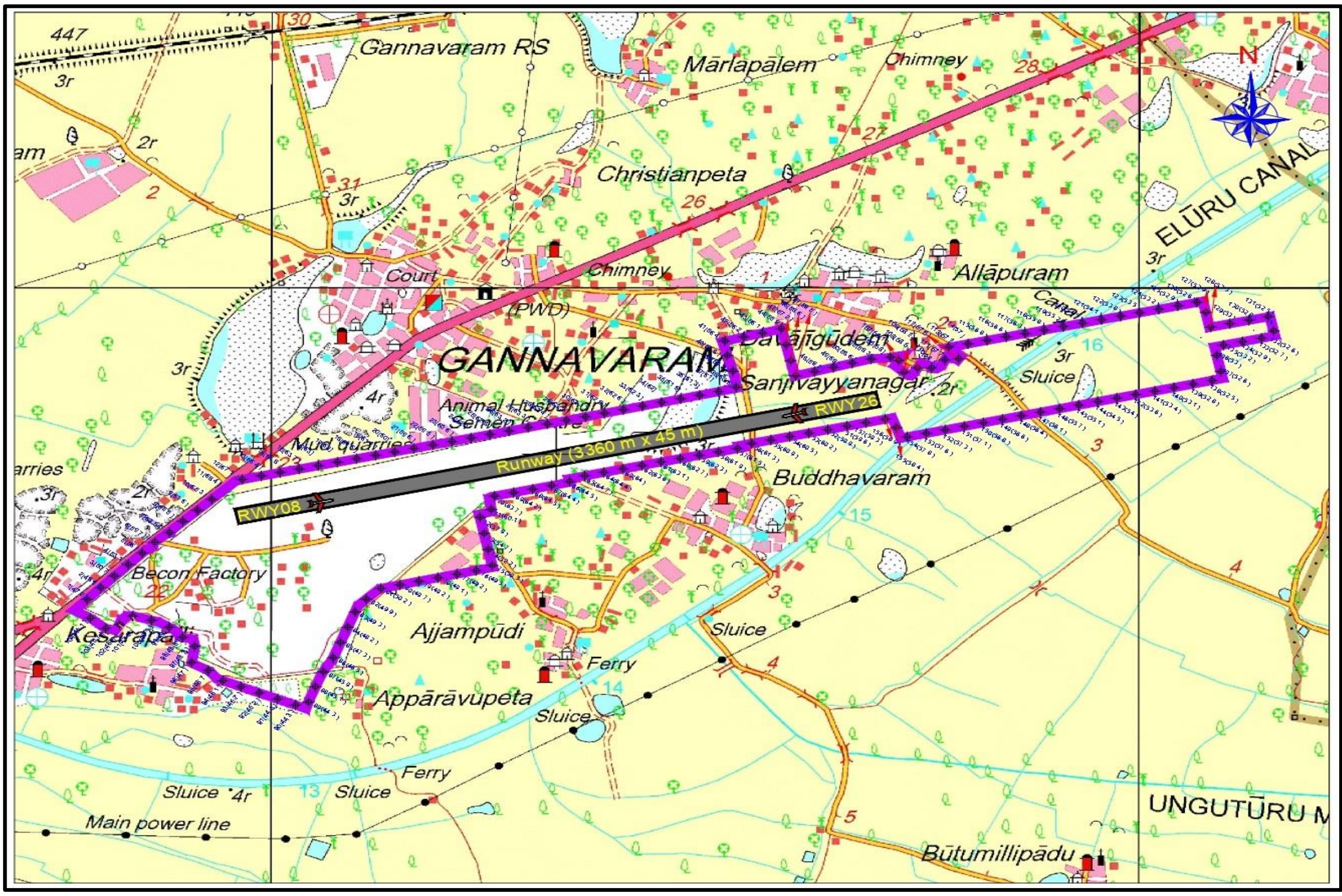


Table 6.1: Predicted Noise Level (DNL) at the Airport Boundary under Scenarios I & II

Boundary Points #	Scenario I: Noise Index (DNL) 26	Scenario II: Noise Index (DNL) 08
1 BDP	55.6	47.2
2 BDP	56.2	48.9
3 BDP	56.8	50.7
4 BDP	57.3	53.1
5 BDP	57.8	56
6 BDP	58.2	59.7
7 BDP	58.8	63.5
8 BDP	59.3	65.5
9 BDP	59.1	61.6
10 BDP	59.1	65.3
11 BDP	59.1	68.4
12 BDP	59.1	67.1
13 BDP	59.4	66.4
14 BDP	59.7	64.8
15 BDP	60	63.7
16 BDP	60.3	63
17 BDP	60.6	62
18 BDP	61	61.6
19 BDP	61.4	61.1
20 BDP	61.7	60
21 BDP	62	59.6
22 BDP	62.4	59.5
23 BDP	62.6	60.6
24 BDP	62.9	62
25 BDP	63.1	62.8
26 BDP	63.2	63.2
27 BDP	63.4	63.3
28 BDP	63.3	63.4
29 BDP	63.2	63.3
30 BDP	62.7	63.1
31 BDP	62	62.9
32 BDP	60.6	62.6
33 BDP	59.1	62.3
34 BDP	59	62
35 BDP	59.2	61.6
36 BDP	59.7	61.3
37 BDP	60.8	61
38 BDP	60.9	60.6
39 BDP	57	59.2
40 BDP	53.9	57.8
41 BDP	51.8	56.4
42 BDP	52.4	56.2
43 BDP	53	56.1
44 BDP	53.6	55.9
45 BDP	56.1	57.2
46 BDP	59.2	58.6

Boundary Points #	Scenario I: Noise Index (DNL) 26	Scenario II: Noise Index (DNL) 08
47 BDP	62.9	59.5
48 BDP	63.7	59.2
49 BDP	69.2	68
50 BDP	65.2	58.6
51 BDP	69.9	59.6
52 BDP	68.1	59.9
53 BDP	67.3	60.2
54 BDP	66.4	60.5
55 BDP	65.8	60.9
56 BDP	64.9	61.3
57 BDP	64.1	61.5
58 BDP	62.9	61.9
59 BDP	62.4	62.3
60 BDP	62.1	62.7
61 BDP	62	63.1
62 BDP	63.2	63.6
63 BDP	64.5	64
64 BDP	65.1	64.4
65 BDP	65.3	64.7
66 BDP	64.6	64.5
67 BDP	64.4	64.4
68 BDP	64.2	64.5
69 BDP	63.9	64.2
70 BDP	63.7	63.7
71 BDP	61.9	60.1
72 BDP	60.9	57.9
73 BDP	58.7	54.7
74 BDP	56.6	52.2
75 BDP	54.8	50.3
76 BDP	54.7	49.5
77 BDP	54.8	49.2
78 BDP	55	49.1
79 BDP	55	49.2
80 BDP	55	49.7
81 BDP	55	50.2
82 BDP	54.2	49.9
83 BDP	53.3	49.3
84 BDP	52.2	48.2
85 BDP	51.2	47.3
86 BDP	50.3	46.5
87 BDP	49.5	45.9
88 BDP	48.7	45.1
89 BDP	47.9	44.3
90 BDP	47.8	44.3
91 BDP	48.3	44.8
92 BDP	48.8	45.2
93 BDP	49.2	45.7

Boundary Points #	Scenario I: Noise Index (DNL) 26	Scenario II: Noise Index (DNL) 08
94 BDP	49.7	46.1
95 BDP	50.4	46.7
96 BDP	51	47
97 BDP	52	48.3
98 BDP	52.7	48.8
99 BDP	53.5	49
100 BDP	54.1	48.5
101 BDP	54.5	47.6
102 BDP	53.9	46.5
103 BDP	53.6	45.7
104 BDP	54.4	45.1
105 BDP	64.5	58.3
106 BDP	62.8	58
107 BDP	62.1	58.1
108 BDP	60.2	58.5
109 BDP	56.9	58.2
110 BDP	56.9	58.1
111 BDP	54.7	57.7
112 BDP	55	57.6
113 BDP	51.9	57.2
114 BDP	51.3	57
115 BDP	51.2	56.8
116 BDP	51.2	56.6
117 BDP	51.2	56.3
118 BDP	51.2	55.8
119 BDP	51.2	55.2
120 BDP	51.2	54.5
121 BDP	51.2	54.1
122 BDP	51.2	53.8
123 BDP	51.2	53.5
124 BDP	51.2	53.2
125 BDP	51.1	52.9
126 BDP	51.1	52.6
127 BDP	53.9	52.9
128 BDP	57.9	53.3
129 BDP	57.7	53
130 BDP	57.4	52.8
131 BDP	57.1	52.5
132 BDP	57.7	52.6
133 BDP	57.4	52.7
134 BDP	57.7	52.9
135 BDP	58	53.2
136 BDP	55.8	53
137 BDP	51.5	52.6
138 BDP	50.0	52.5
139 BDP	50.0	52.8
140 BDP	50	53.1

Boundary Points #	Scenario I: Noise Index (DNL) 26	Scenario II: Noise Index (DNL) 08
141 BDP	50	53.4
142 BDP	50	53.6
143 BDP	49.9	54
144 BDP	49.9	54.5
145 BDP	49.9	55.1
146 BDP	49.9	55.7
147 BDP	49.8	56.1
148 BDP	49.8	56.4
149 BDP	49.9	56.6
150 BDP	50.4	56.8
151 BDP	52.3	57.1
152 BDP	55.9	57.3
153 BDP	59.2	57.6
154 BDP	62.1	57.8
155 BDP	65.8	58.4
156 BDP	70.5	58.9
157 BDP	71.4	59.3
Maximum	**71.4**	**68.4**
Minimum	**47.8**	**44.3**

6.6 KEY ZONES AND SENSITIVE RECEPTORS FOR VIJAYAWADA AIRPORT

- **High Noise Zones:**

Primarily along the runway approaches where aircraft take-off and landing operations which lies under the flight path experience higher noise levels.

- **Moderate Noise Zones:**

Areas slightly farther from the airport, where noise levels are lower but still noticeable.

- **Sensitive Receptors:**

Residential areas, schools, and hospitals near the airport are identified as sensitive receptors and are subject to close monitoring to ensure compliance with limits.

CHAPTER-7

CONCLUSION & NOISE MANAGEMENT ACTION PLAN

7.1 CONCLUSION

The noise monitoring and mapping study at Vijayawada Airport was aimed at understanding the noise pollution impacts due to aircraft operations. Using advanced computer simulation models, noise contours were developed for both daytime and nighttime operations, indicating that noise levels generally comply with prescribed limits by the Ministry of Environment, Forests and Climate Change (MoEF&CC) and relevant standards.

Key findings include:

- Predicted Noise levels within residential zones are within permissible limits of 55 dB(A) for daytime and 45 dB(A) for nighttime as per the applicable Ambient Noise Quality Standards (ANQS) with marginal exceedance at two locations NQ4 & NQ6 under funnel area during day time. However, these two Locations are well within with respect to noise in Airport Noise Zone daytime Standard 65 dBA and 60 dBA for Nighttime applicable for Vijayawada airport.

- The predicted Day-Night Average Sound Level (DNL) is expected to comply with the daytime Ambient Noise Quality Standard (ANQS) of 55 dB(A) within a range of approximately 0.3 to 0.5 km on either side of the runway, measured perpendicularly from its center. Similarly, it is expected to meet the nighttime silence zone standard of 40 dB(A) within a range of 1.2 to 1.8 km on either side, also measured perpendicularly from the runway's center.

- Daytime noise zone could extend up to 0.521 km perpendicular to the runway centerline, while the nighttime noise zone might reach up to 0.119 km.

- Noise levels at 157 points along the project boundary were predicted to range from 47.8 to 71.4 dB(A) and 44.3 to 68.4 dB(A) using the Day-Night Average Sound Level (DNL) metric under conservative operational Scenarios I and II, respectively.

- The noise zones were declared in compliance with G.S.R. 751 (E) guidelines, providing necessary data for urban planning and development to mitigate noise impacts in the future.

- According to the Traffic, Flight Tracks & Corridors data, and the Airport Noise Notification dated June 18, 2018, Vijayawada Airport is categorized as a non-busy airport. For such airports, excluding proposed airports, the noise limits to be followed are 65 dB during the daytime and 60 dB at night.

- The predicted noise levels and noise mapping presented here are based on a conservative flight operations scenario without accounting for any noise mitigation measures. However, under normal flight operations with the implementation of noise mitigation measures (if any), the actual noise levels are expected to be lower.

- The present noise mapping study for Vijayawada International Airport has been carried out considering the projected aircraft traffic, flight operations, and airport activities for the next ten (10) years. This ensures that the noise prediction, contour mapping, and management plan reflect both current and anticipated future operational conditions, providing a reliable basis for long-term compliance and planning.

7.2 NOISE MANAGEMENT ACTION PLAN

Airport operator can develop the following noise abatement procedures specific to their airport, jointly with AAI/ATC to reduce/minimize the noise generated through aircraft operations at their airports when the noise limits exceed:

- **Temporary Monitoring Stations:**

Set up mobile or temporary monitoring stations in high-exposure areas for specific durations, especially during peak traffic hours or when new flight paths are introduced.

- **Public Communication:**

Develop a system for public access to noise data, informing the local population about current noise levels and the airport's efforts to maintain compliance with noise regulations.

- **Flight Path Optimization:**

Collaborate with the airport authority to optimize flight paths to reduce noise exposure in highly sensitive areas, particularly near residential zones and schools.

- **Time-based Noise Control:**

Introduce restrictions or penalties for flights during late-night hours to minimize nighttime noise pollution.

- **Building Construction Regulations:**

Implement noise-reduction measures for buildings within the declared noise zone, such as soundproofing for new constructions, particularly for schools, hospitals, and residential complexes.

- **Review and Update of Noise Zones:**

Regularly review the noise zones to ensure they reflect any changes in air traffic patterns, fleet mix, and other operational factors. Update the noise contour maps accordingly to keep track of the noise levels and plan mitigations.

- **Noise Abatement Procedures:**

Encourage airlines to adopt noise abatement procedures such as Continuous Descent Approaches (CDA) or Continuous Climb Operations (CCO) to minimize noise impacts during critical stages of flight.

ATTACHMENT-I

MINUTES OF MEETING

SUBJECT: Minutes of meeting for Noise Study Report for "Noise mapping and declaration of Airport Noise zones at Vijayawada Airport".

VENUE OF MEETING: Conference Hall, O/o APD on 20/11/2024 at 11:00 Hrs

MEMBERS/STAKE HOLDERS PRESENT: Attached as Annexure – I.

The Airport Director Shri M.L.K. Reddy welcomed all members/stake holders in the meeting and directed Dr. Manoj Kumar Mishra, Environmental Consultant for M/s Unistar Environment and Research Labs Private Limited to brief on the draft report about the Noise mapping and declaration of Airport Noise Zone at Vijayawada Airport to all the Members present in meeting. Accordingly, Dr. Manoj Kumar Mishra, presented draft report & explained about the objectives of Noise mapping and declaration of Airport Noise zones as per CAR, and about the methodology adopted in Noise Mapping, data collection and analysis, noise maps and prediction, declaration of noise zone, conclusion and noise management action plan.

To comply the mandatory requirement of Ministry of Forest and Environment and Climate Change (MOEF & CC) and DGCA, noise mapping is required at Vijayawada Airport and this work is being done by the agency M/s. Unistar Environment and research labs Pvt. Ltd, Vapi.

Shri S.S. Prasad, DGM (Engg-C) explained to the stake holders about the requirement of conducting pre plan meeting to comply the mandatory requirement as per CAR F. No. 04-01/2010-AED (Vol. II) & that of DGCA.

Dr. Manoj Kumar Mishra, Environmental Consultant for M/s Unistar Environment and Research Labs Private Limited explained that Noise measurements were carried out during 05-09-2024 to 11-09-2024. Field measurements have been taken by using Spot Noise Monitoring Terminal and Bedrock Class-1 Sound Level Meter for 24-hour duration at both approaches of Runway i.e., 08 & 26 side. Monitoring was divided in two parts as per Central Pollution Control Board (CPCB) guidelines, day time 6.00 am to 10.00 pm and night time

22/11/2024
DGM (E-C)

10.00 pm to 6.00 am. The noise monitoring terminal & sound level meter is calibrated prior to each measurement using a calibrator. Sound level meter is mounted on height of 4 m above the floor level as per the CPCB guideline. After carried out above study in details, a draft report has been submitted by the executing agency.

Shri S.S. Prasad, DGM (Engg-C) requested to all Members present in the meeting to give feedback, any suggestion for mitigation of Noise by Aircraft at Vijayawada Airport.

Dr. Manoj Kumar Mishra, Environmental Consultant for M/s Unistar Environment and Research Labs Private Limited replied to queries raised by stakeholders and informed that the Draft report will now be submitted to DGCA for clearance and approval.

The meeting ended with vote of thanks by the Airport Director, Vijayawada Airport.

22/11/2024
DGM (Engg-C)
Airport Authority of India
Vijayawada Airport
उप महाप्रबंधक (अभि-सिविल)
Dy.General Manager (Engg-Civil)
भा.वि.प्रा, विजयवाड़ा हवाई अड्डा
AAI, Vijayawada Airport-521102

ANNEXURE - 1

Dt:20.11.2024

Attendance Sheet

Noise Mapping and Declaration of Airport Noise Zones at Vijayawada Airport

Sl No	Name of the Official	Designation	Signature
1	MLK REDDY	APD	[signature]
2	S.S. PRASAD	DGM (E-C)	[signature]
3	ANKIT JAISWAL	AGM (OPS)	[signature]
4	B. Srikanth	AGM(CNS)/ Safety Manager	[signature]
5	N V P S Vamsi Krishna	AGM(ATM)	[signature]
6	ADIGARLA RAMANA	Mgr(ATM)	[signature]
7	Bharanidharan S	AM (FS) / CSO	[signature]
8	G. VINODH KUMAR	Ex (OPS) Agile	[signature]
9	NIKHIL CHAND PUTRA	INDIGO SAFETY INCHARGE	[signature]
10	S. Dharmadhikari	OFFICER-SEC	[signature]
11	P. VINAY RAJA	DM- AIR INDIA	[signature]
12	K. SUDHEER	SEC-INCHARGE	[signature]
13	MEESALA NARSING RAO	STATION MANAGER ALLIANCE AIR	[signature]
14	D.V. VEERANJANEYULU	JT. OFFICER-CUSTOMER SERVICES AIASL	[signature]
15	V. Pavan Kalyan	JE(E-C), AAI	[signature]
16	Ranjith. B	SM (E-C), AAI	[signature]
17	M.V. Subrahmanyeswar	SM. Air India Express	[signature]

Dt:20.11.2024

Attendance Sheet

Noise Mapping and Declaration of Airport Noise Zones at Vijayawada Airport

Sl No	Name of the Official	Designation	Signature
18	Koushik Bishal	APM 6E	[signature]
19	Jaivife Tand	Unistar, manager operations	[signature]
20	Dr. Manoj Mishra	Consultant for Unistar	[signature]
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******* End of Report*******