

**AIRCRAFT NOISE MONITORING REPORT
WATSONVILLE MUNICIPAL AIRPORT
WATSONVILLE, CALIFORNIA**

BBA Report No. 15-305

PREPARED FOR

**THE CITY OF WATSONVILLE
WATSONVILLE MUNICIPAL AIRPORT
100 AVIATION WAY
WATSONVILLE, CALIFORNIA 95076**

PREPARED BY

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VISALIA, CALIFORNIA**

JUNE 22, 2015

INTRODUCTION

This report presents the findings of an aircraft noise monitoring study conducted by Brown-Buntin Associates, Inc. (BBA) for the Watsonville Municipal Airport in Watsonville, California. The study included aircraft noise monitoring over a week-long period in May of 2015. The objectives of the study were to document existing levels of noise from aircraft and other sources at representative locations around Watsonville Municipal Airport and to compare measured noise levels to the results of previous noise monitoring study.

The noise level descriptors used in this analysis are described in Appendix A. The primary descriptor utilized is the Community Noise Equivalent Level (CNEL), which is the energy average sound level for a 24-hour period determined after addition of penalties of 10 dB for aircraft operations at night between the hours 10:00 p.m. and 7:00 a.m. and 4.8 dB for operations during the evening between the hours of 7:00 p.m. and 10:00 p.m. The CNEL is calculated based upon the sound energy generated by individual aircraft events, the number of events occurring during a 24-hour period and the time of day in which the events occur.

As applied to the assessment of long-term (or cumulative) exposure to aircraft noise, the CNEL represents annual average noise exposure. This means that the noise exposure on a particular day is likely to be either higher or lower than the annual average for a given location. The State of California requires use of the annual average CNEL for the analysis of potential noise impacts associated with airport improvement projects.

Appendix B provides examples of noise levels from a variety of familiar sources along with a ranking of subjective loudness. The chart is useful when making a relative comparison of the noise levels reported by this analysis for maximum noise levels during aircraft single events to noise generated by other common sources within a developed area.

II. AIRCRAFT NOISE MEASUREMENT PROGRAM

Continuous measurements of noise from aircraft and other sources were conducted during the seven-day period of May 12-18, 2015 at five (5) locations using automated noise monitoring equipment. The noise monitoring sites were selected by BBA and the City of Watsonville to represent areas of the community potentially impacted by aircraft noise or where noise complaints have been received. Four (4) of the monitoring sites were previously utilized during the May 2013 noise monitoring period (Sites 1-4), and one (1) additional site (Site 5) was included in the current monitoring period. Short-term measurements of aircraft single event noise levels were also conducted at the sites.

Weather conditions during the noise measurement period consisted of mostly overcast skies in the morning hours, often becoming clear and sunny in the afternoon hours. Temperatures ranged from approximately 45°F during the early morning hours to approximately 65°F during the mid-afternoon. Winds were light to moderate with speeds of 5-10 miles per hour during most of the monitoring period. Humidity was in the range of 60-80%.

Noise Monitoring Locations:

Noise monitoring sites are described below. Site locations relative to the airport are shown in Figure 1.

Site 1 - This site was located in the backyard of a residence at 46 Buena Vista Drive, north of the airport. The site is exposed to aircraft noise from arrivals on Runway 20 and departures on Runway 02. The site is also exposed to vehicular traffic noise from Buena Vista Drive and Freedom Boulevard.

Site 2 - This site was located within a city-owned water tank property adjacent to the airport boundary. The site was located north of the approach to Runway 26. The site is exposed to noise from aircraft arrivals and departures on Runway 26 and aircraft making a downwind approach to Runway 20.

Site 3 - This site was located at a city-owned driving range south of the airport, and is surrounded by agricultural uses and open space. The site is exposed to noise from aircraft departures on Runway 20 and aircraft arrivals on Runway 02. The site is also exposed to noise from driving range maintenance activities, including pumping equipment near where the monitor was located.

Site 4 - This site was located west of the airport at a rural residential property located at 200 Grizzly Oaks Lane. The site is exposed to periodic aircraft and helicopter over-flights.

Site 5 - This site was located in the backyard of a residence at 23 Magnolia Court, southeast of the airport. The site is exposed to aircraft over-flights and noise from departures on Runway 20. The site is also exposed to vehicular traffic on South Green Valley Road.

Noise Monitoring Equipment:

Noise monitoring equipment consisted of Larson-Davis Laboratories Model LDL 820 sound level analyzers equipped with Brüel & Kjaer (B&K) Type 4176 ½" microphones. The monitors were calibrated with a B&K Type 4230 acoustical calibrator to ensure the accuracy of the measurements. Microphones were located on tripods or booms at approximately 5-10 feet above the ground. Microphones were situated so that they had an unobstructed view of the aircraft noise source and were as far as possible from reflective surfaces.

The LDL Model 820 sound level analyzers have the capability of measuring noise continuously for extended periods of time. The analyzers are programmed to distinguish between aircraft noise and noise from other sources using sound level and event duration thresholds. Typical noise measurement threshold settings for this study were 60-65 dBA for a minimum of 5 seconds. This means that the noise level had to equal or exceed the selected noise level threshold

for at least 5 seconds in order for the noise event to be considered aircraft-related. The LDL Model 820 analyzers are effective in discriminating between aircraft noise events and noise from other sources provided monitoring sites are carefully chosen and measurement thresholds are appropriate for the monitoring sites.

Cumulative Aircraft Noise Exposure:

Table I provides a summary of measured aircraft noise exposure at the noise monitoring sites as defined by the CNEL metric. Shown by Table I is the energy average aircraft CNEL values for the entire noise monitoring period and the range of daily CNEL values measured during the monitoring period.

The aircraft noise exposure values reported by Table I were determined from the noise event data collected by the LDL 820 sound level analyzers using the pre-programmed event noise level and duration thresholds. The noise event data collected by the instrumentation were further analyzed to remove noise level data that were clearly not aircraft-related. This procedure may be relied upon to define aircraft noise exposure at locations where there is a clear distinction between the noise levels caused by aircraft operations and the noise levels caused by other sources such as roadway traffic or commercial and/or construction activities.

Appendix C contains bar charts showing the *aircraft* and *community* (non-aircraft) CNEL values for each measurement day at the noise monitoring sites. Also shown by the bar charts are the *total* CNEL values for the measurement days. Community noise levels are determined by subtracting the aircraft CNEL from the total CNEL for a particular noise measurement day. As noted above, overall noise levels at Site 3 were affected by nearby pumping equipment that operated several hours per night during the noise measurement period. This resulted in a relatively large difference between daily community and aircraft CNEL values at that site.

TABLE I
SUMMARY OF MEASURED AIRCRAFT CNEL VALUES
WATSONVILLE MUNICIPAL AIRPORT

Site	Description	Dates	Measured Aircraft CNEL, dB ¹	
			Range	Mean
1	46 Buena Vista Drive	5/12/15-5/18/15	45.9-52.2	50.0
2	City-owned water tank property	5/12/15-5/18/15	40.8-53.4	46.6
3	City-owned driving range	5/12/15-5/18/15	55.5-57.7	56.5
4	200 Grizzly Oaks Lane	5/12/15-5/18/15	22.0-43.1	36.6
5	24 Magnolia Court	5/12/15-5/18/15	41.1-46.4	42.9

¹Shown are the range of daily aircraft CNEL values and the average aircraft CNEL for the entire noise measurement period.

Source: Brown-Buntin Associates, Inc.

Single Event Noise Level Measurements:

Appendix D summarizes the results of detailed single event noise level measurements at the noise monitoring sites. Detailed single event monitoring consisted of placing a trained observer at each site for approximately four (4) hours to record the type of aircraft, type of operation (arrival or departure), runway used, maximum noise level (L_{max}), sound exposure level (SEL) and azimuth for each observed flight. The azimuth is the angle between the aircraft flight path and the microphone at the point where the aircraft is closest to the microphone. An azimuth of 90° means the aircraft passed directly over the microphone.

The mean (L_{max}) values shown in Appendix D were determined by arithmetic averaging whereas the mean SEL values were determined by logarithmic (energy) averaging. The SEL for a particular aircraft noise event is a numerically higher number than the (L_{max}) for the same event because the SEL consolidates the energy of the entire noise event into a reference duration of one second. The SEL is not “heard”, but is a derived value used for calculation of cumulative aircraft noise exposure as defined by the CNEL.

COMPARISON OF PRESENT AND PREVIOUS AIRCRAFT NOISE STUDIES

Table II compares measured aircraft CNEL values from the May 2013 noise monitoring period to those obtained during the May 2015 noise monitoring period. It should be noted that Site 5 was not utilized during the May 2013 noise monitoring period and Table II compares noise levels at Sites 1-4.

Table II shows that the aircraft noise levels measured during the May 2015 noise monitoring period were lower than those measured during the May 2013 noise monitoring period at all monitoring sites. Aircraft noise levels measured during the May 2015 at Site 4 (200 Grizzly Oaks Lane) were significantly lower than levels measured in May 2013. However, aircraft noise levels measured at Site 3 (driving range) were only slightly lower than levels measured in May 2015. This indicates that in general, aircraft operations were similar between the two monitoring periods, but aircraft over-flights at Site 4 were less frequent than documented during the May 2013 study. At all noise monitoring sites, measured aircraft CNEL values were well below 65 dB. An aircraft noise exposure less than 65 dB CNEL is considered by the State of California and FAA as compatible with noise-sensitive land uses located in the vicinity of an airport for noise compatibility planning purposes.

TABLE II
COMPARISON OF MEASURED AIRCRAFT CNEL VALUES
MAY 2013 AND MAY 2015
WATSONVILLE MUNICIPAL AIRPORT

Site	Measured Aircraft CNEL, dB		
	Location	May 2013 Mean (Range)	May 2015 Mean (Range)
1	46 Buena Vista Drive	52.5 (49.2-57.6)	50.0 (45.9-52.2)
2	City-owned water tank property	49.7 (42.1-55.1)	46.6 (40.8-53.4)
3	City-owned driving range	57.1 (53.9-59.2)	56.5 (55.5-57.7)
4	200 Grizzly Oaks Lane	50.9 (51.0-54.0)	36.6 (22.0-43.1)

Source: Brown-Buntin Associates, Inc.

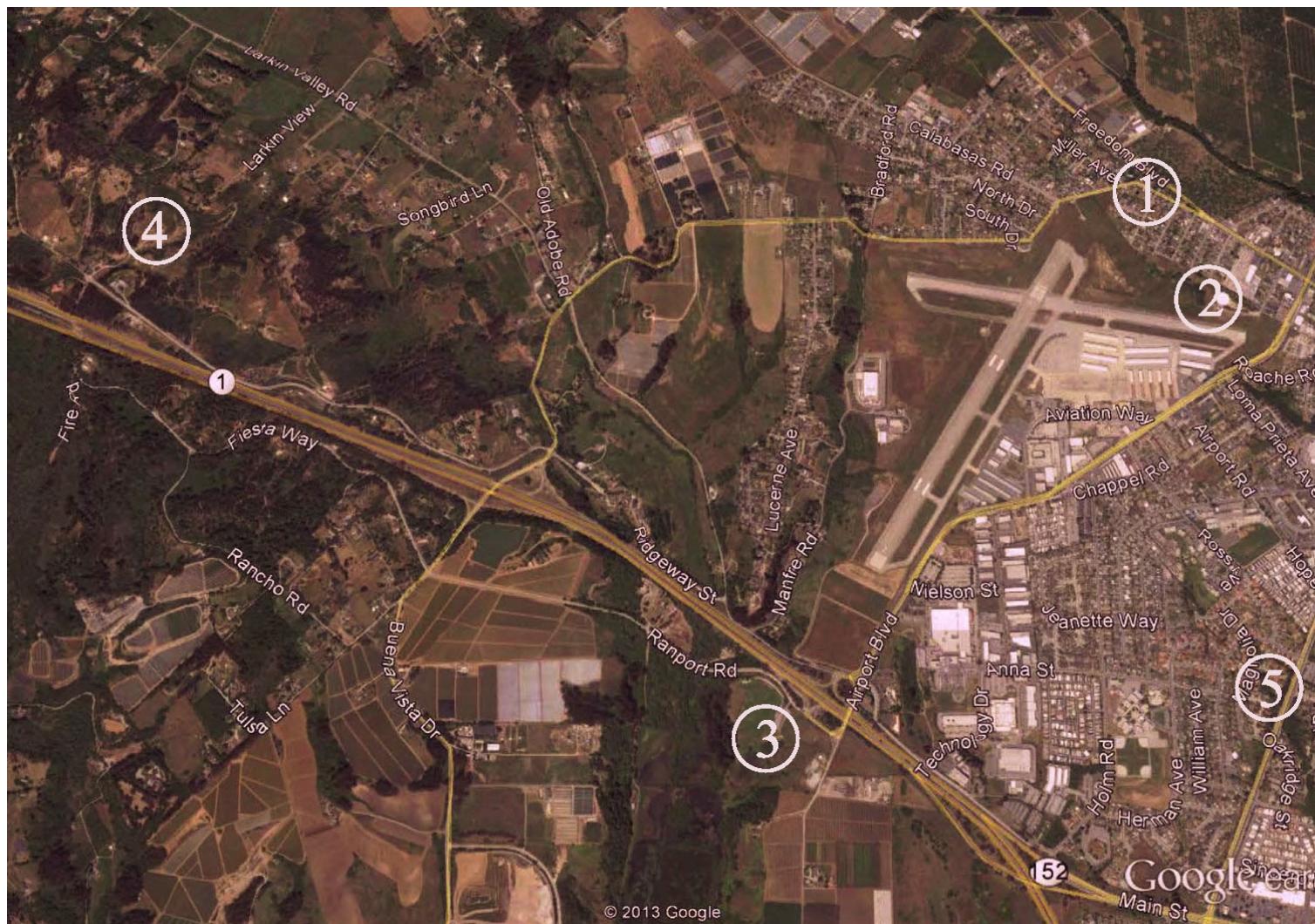
Changes in aircraft noise exposure may be expected over time due to fluctuations in the volume of aircraft operations, the aircraft fleet mix and runway use. Also, aircraft operators have introduced newer technology aircraft and older-technology aircraft have been retired, resulting in a generally quieter aircraft fleet mix.

DAILY FLUCTUATIONS IN AIRCRAFT AND COMMUNITY NOISE

Appendix E provides measured hourly noise levels for each of the five monitoring sites over each day of the monitoring period. For each full 24-hour measurement period, Appendix E provides measurement day and hourly maximum (L_{max}), energy average (L_{eq}), and selected (L_n) values. L_n values are statistical descriptors used to define noise levels exceeded “n” percent of the time during each hourly noise measurement period. For example, the L_{50} defines the noise level exceeded 50 percent of the time during each one-hour period (i.e. 30 minutes). The L_{90} describes the noise level exceeded 90 percent of the time during each hour, which is generally considered to represent the residual (or background) noise level in the absence of identifiable single noise events from traffic, aircraft and other local noise sources.

Data provided in Appendix E indicates that existing background (ambient) noise levels at Site 1, Site 3 and Site 5 are typically around 50 dB during the daytime hours, while background noise levels at Site 2 and Site 4 are typically around 40 dB during daytime hours. Site 1, Site 3 and Site 5 are exposed to vehicle traffic noise on local roadways, resulting in generally higher background noise levels than Site 2 and Site 4, which are not exposed to ongoing local roadway traffic noise.

Figure 1: Aircraft Noise Monitoring Sites



APPENDIX A
ACOUSTICAL TERMINOLOGY

APPENDIX A-1 ACOUSTICAL TERMINOLOGY

AMBIENT NOISE LEVEL: The composite of noise from all sources near and far. In this context, the ambient noise level constitutes the normal or existing level of environmental noise at a given location.

DECIBEL, dB: A unit for describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure, which is 20 micropascals (20 micronewtions per square meter).

CNEL: Community Noise Equivalent Level. The average equivalent sound level during a 24-hour day, obtained after addition of five decibels to sound levels in the evening from 7:00 p.m. to 10:00 p.m. and ten decibels to sound levels in the night from 10:00 p.m. to 7:00 a.m.

L_{eq}: Equivalent Sound Level. The sound level containing the same total energy as a time varying signal over a given sample period. L_{eq} is typically computed over 1, 8 and 24-hour sample periods.

NOTE: *The CNEL represents daily levels of noise exposure averaged on an annual basis, while the L_{eq} represents the average noise exposure for a shorter time period, typically one hour.*

L_{max}: The maximum noise level recorded during a noise event.

L_n: The sound level exceeded "n" percent of the time during a sample interval (L₉₀, L₅₀, L₁₀, etc.). For example, L₁₀ equals the level exceeded 10 percent of the time.

**NOISE EXPOSURE
CONTOURS:** Lines drawn about a noise source indicating equal levels of noise exposure. CNEL contours are frequently utilized to describe community exposure to noise for noise compatibility planning.



APPENDIX A-2 **ACOUSTICAL TERMINOLOGY**

SEL or SENEL:

Sound Exposure Level or Single Event Noise Exposure Level. The level of noise accumulated during a single noise event, such as an aircraft overflight, with reference to a duration of one second. More specifically, it is the time-integrated A-weighted squared sound pressure for a stated time interval or event, based on a reference pressure of 20 micropascals and a reference duration of one second.

SOUND LEVEL:

The sound pressure level in decibels as measured on a sound level meter using the A-weighting filter network. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the response of the human ear and gives good correlation with subjective reactions to noise.

APPENDIX B
EXAMPLES OF SOUND LEVELS

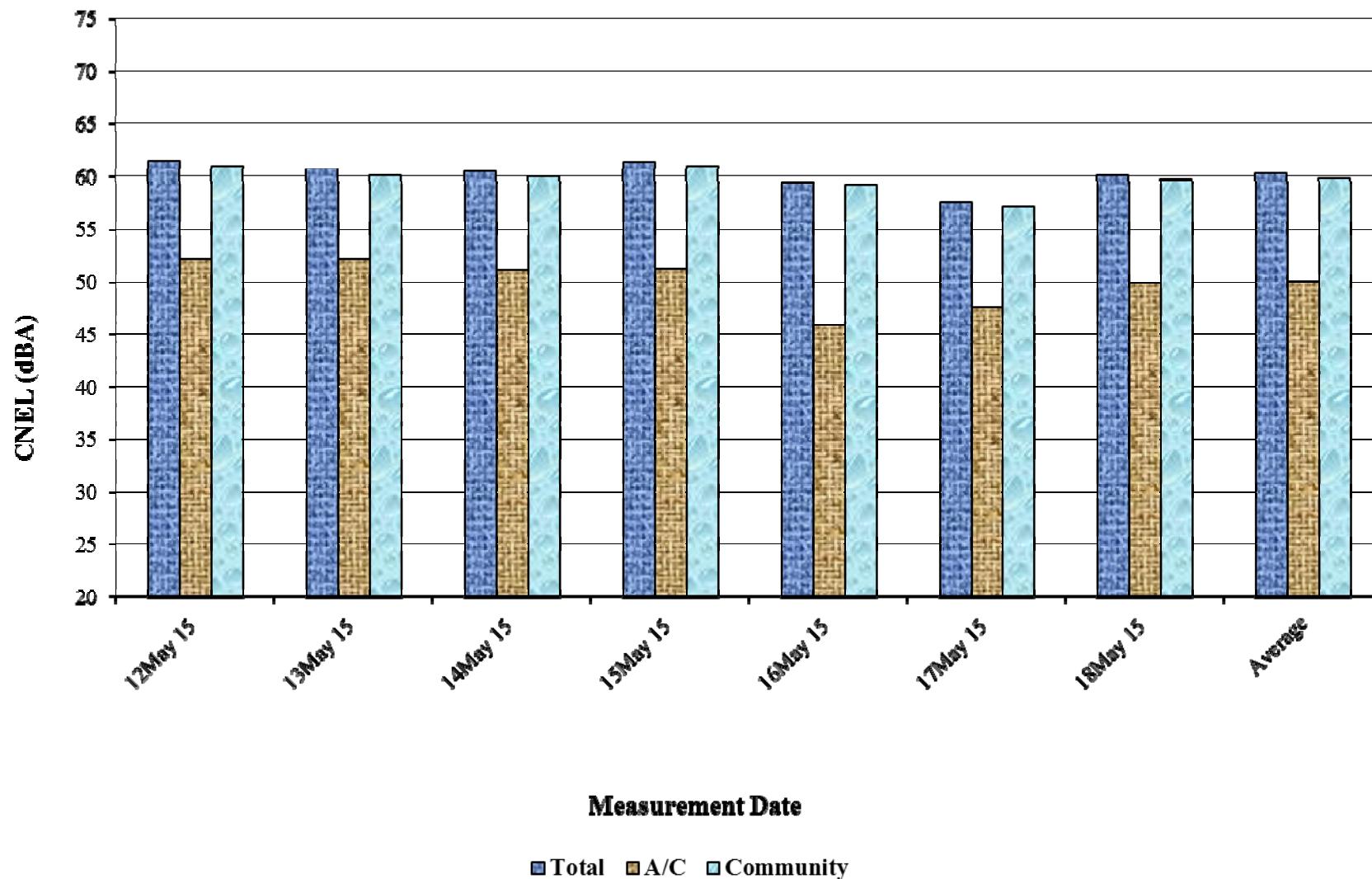
APPENDIX B
EXAMPLES OF SOUND LEVELS

<u>NOISE SOURCE</u>	<u>SOUND LEVEL</u>	<u>SUBJECTIVE DESCRIPTION</u>
AMPLIFIED ROCK 'N ROLL ▶	120 dB	
JET TAKEOFF @ 200 FT ▶	100 dB	DEAFENING
BUSY URBAN STREET ▶	80 dB	VERY LOUD
FREEWAY TRAFFIC @ 50 FT ▶	60 dB	LOUD
CONVERSATION @ 6 FT ▶	60 dB	
TYPICAL OFFICE INTERIOR ▶	40 dB	MODERATE
SOFT RADIO MUSIC ▶	40 dB	
RESIDENTIAL INTERIOR ▶	20 dB	FAINT
WHISPER @ 6 FT ▶	20 dB	
HUMAN BREATHING ▶	0 dB	VERY FAINT

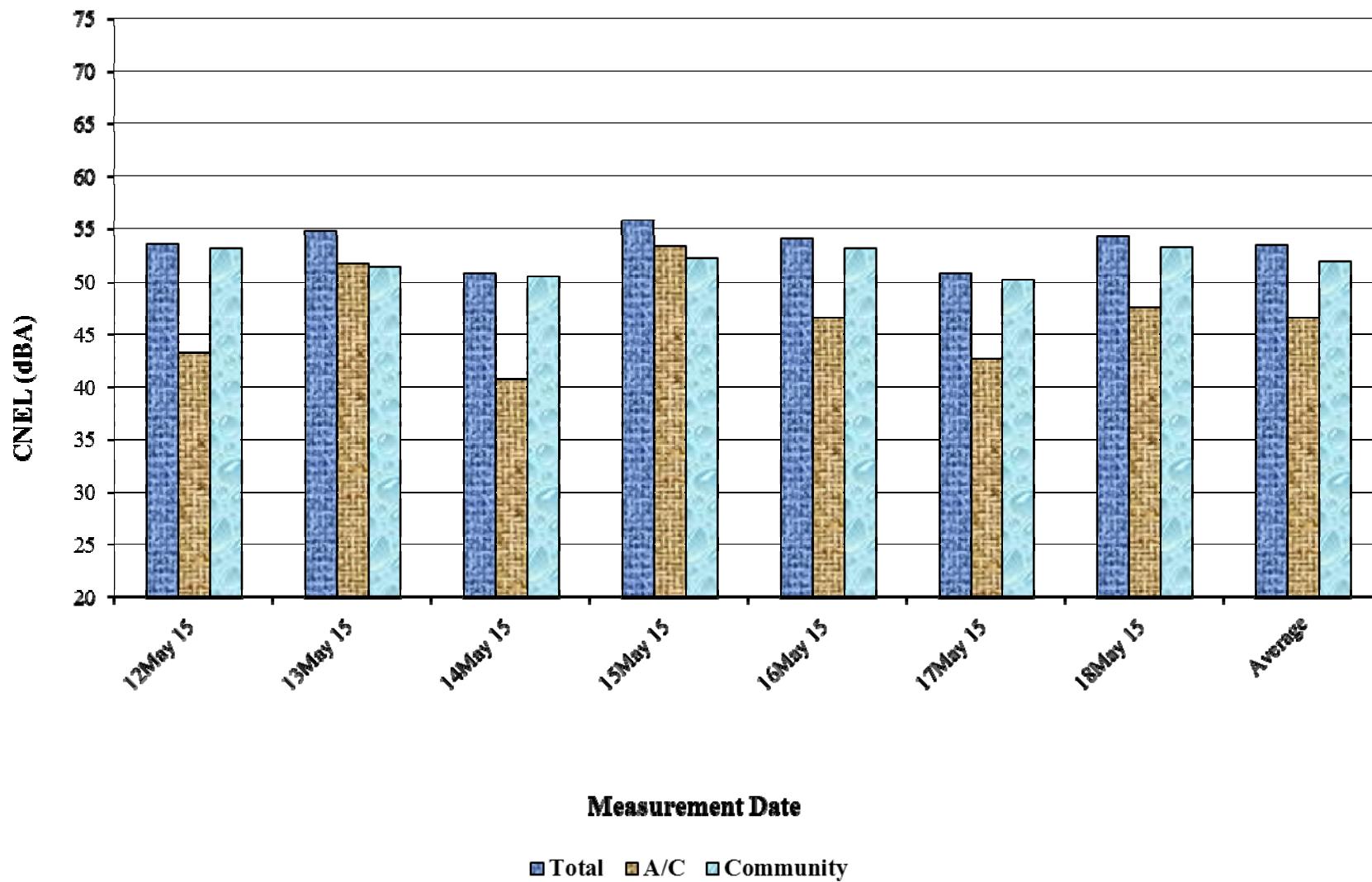
APPENDIX C

DAILY MEASURED CNEL VALUES MAY 12-18, 2015

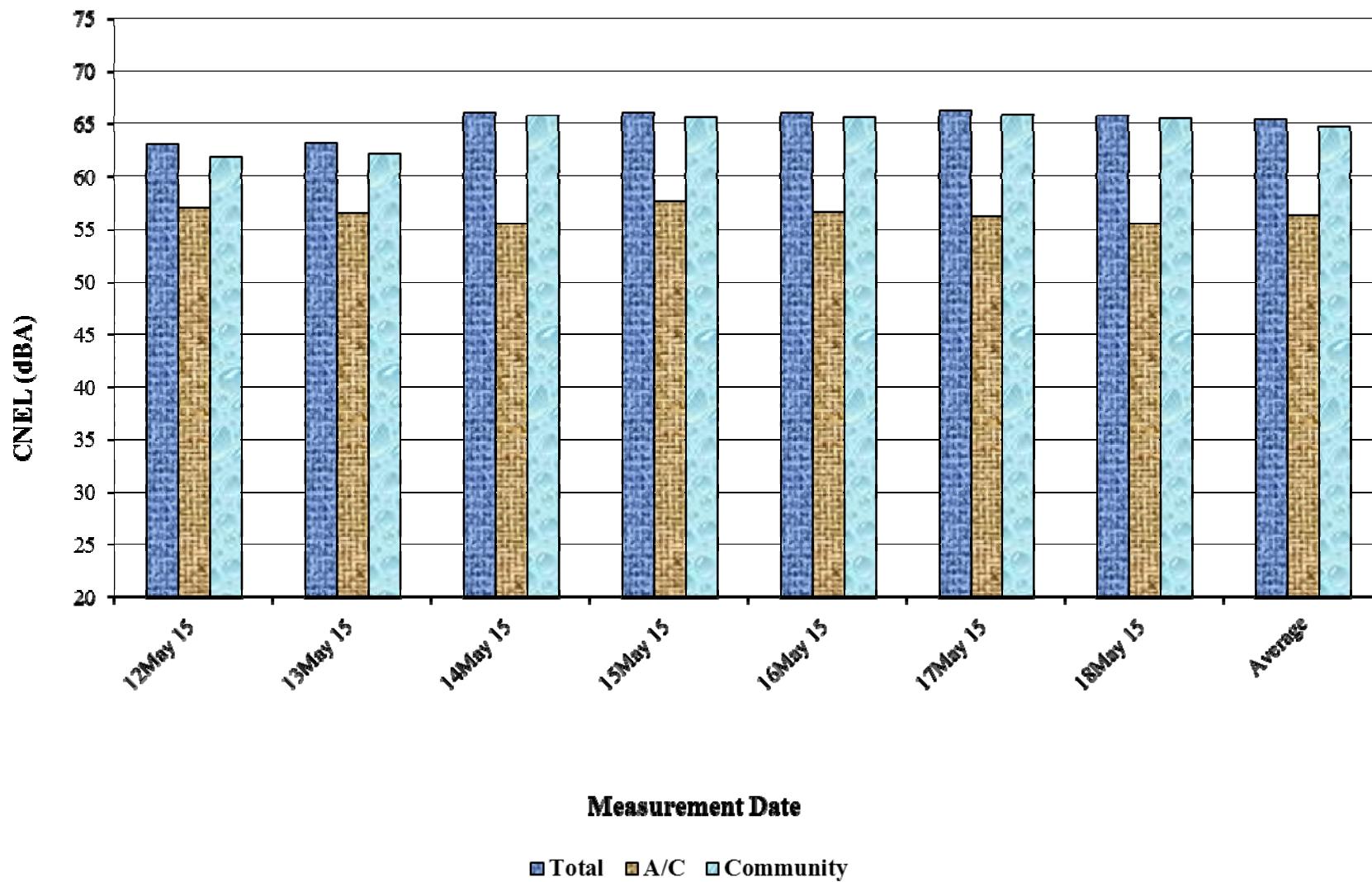
**Daily Measured CNEL Values
Watsonville Municipal Airport
Site 1: May 2015**



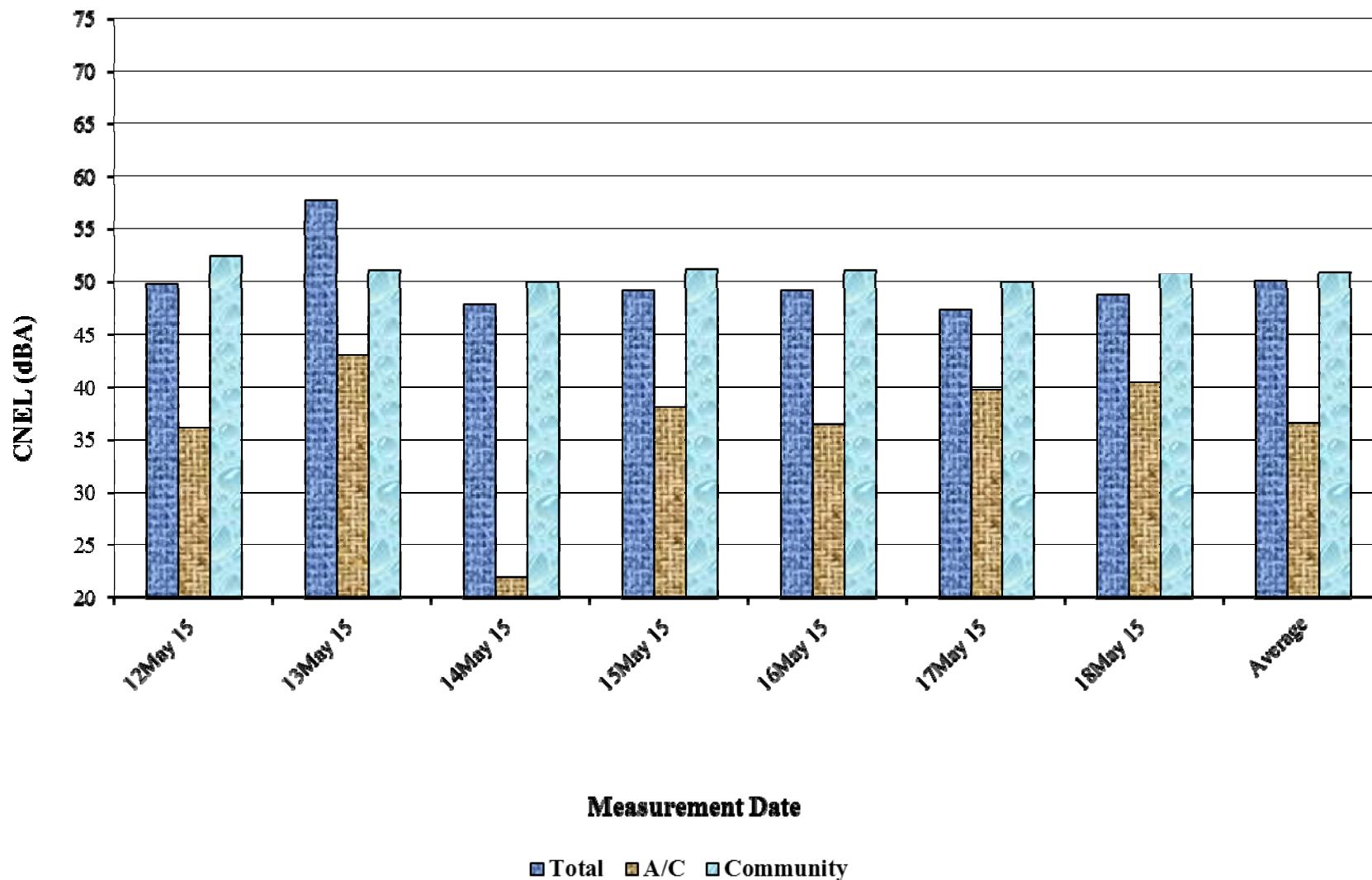
**Daily Measured CNEL Values
Watsonville Municipal Airport
Site 2: May 2015**



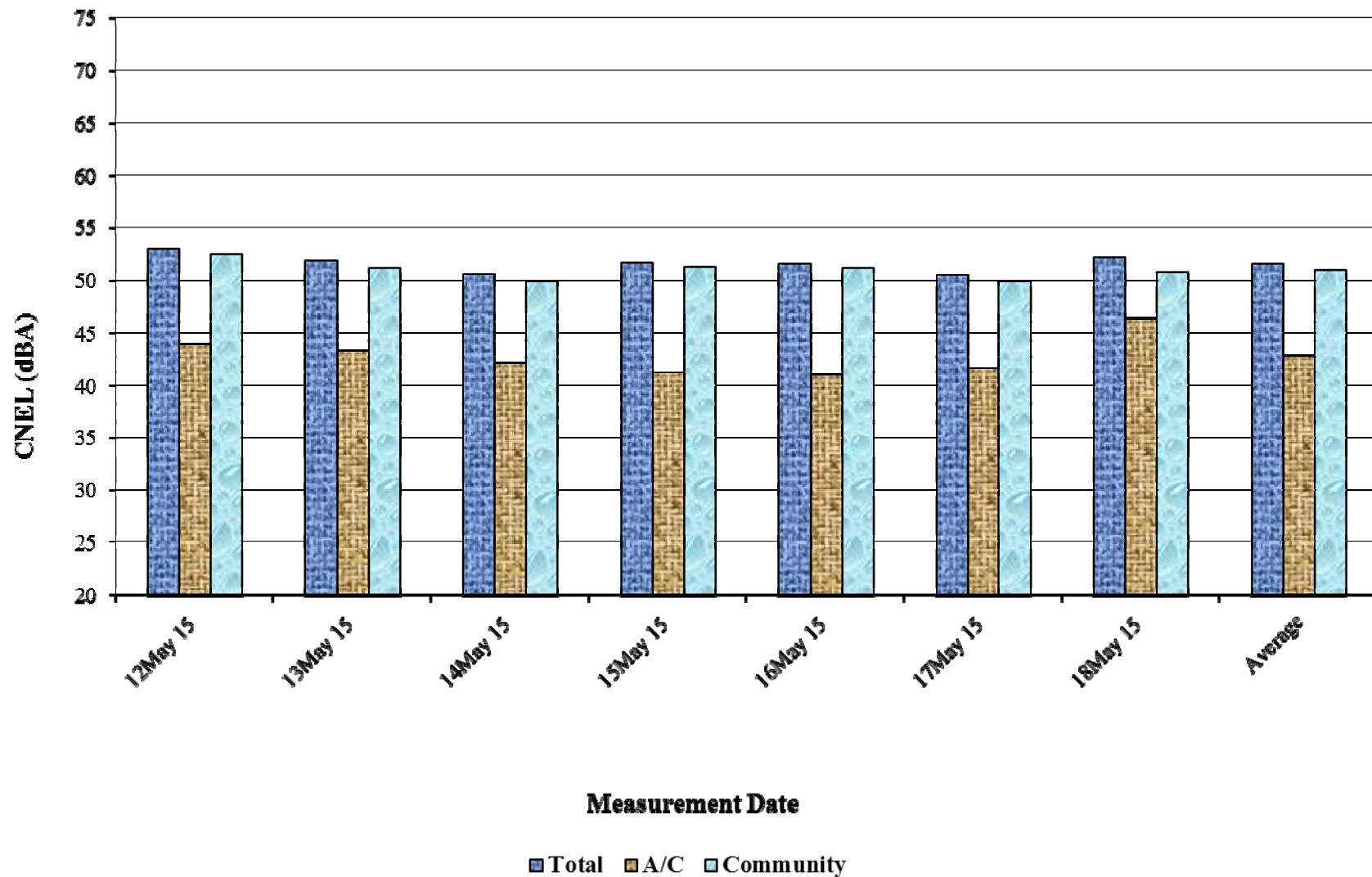
**Daily Measured CNEL Values
Watsonville Municipal Airport
Site 3: May 2015**



**Daily Measured CNEL Values
Watsonville Municipal Airport
Site 4: May 2015**



**Daily Measured CNEL Values
Watsonville Municipal Airport
Site 5: May 2015**



APPENDIX D

SUMMARY OF SINGLE EVENT NOISE LEVEL MEASUREMENTS MAY 12-18, 2015

APPENDIX D

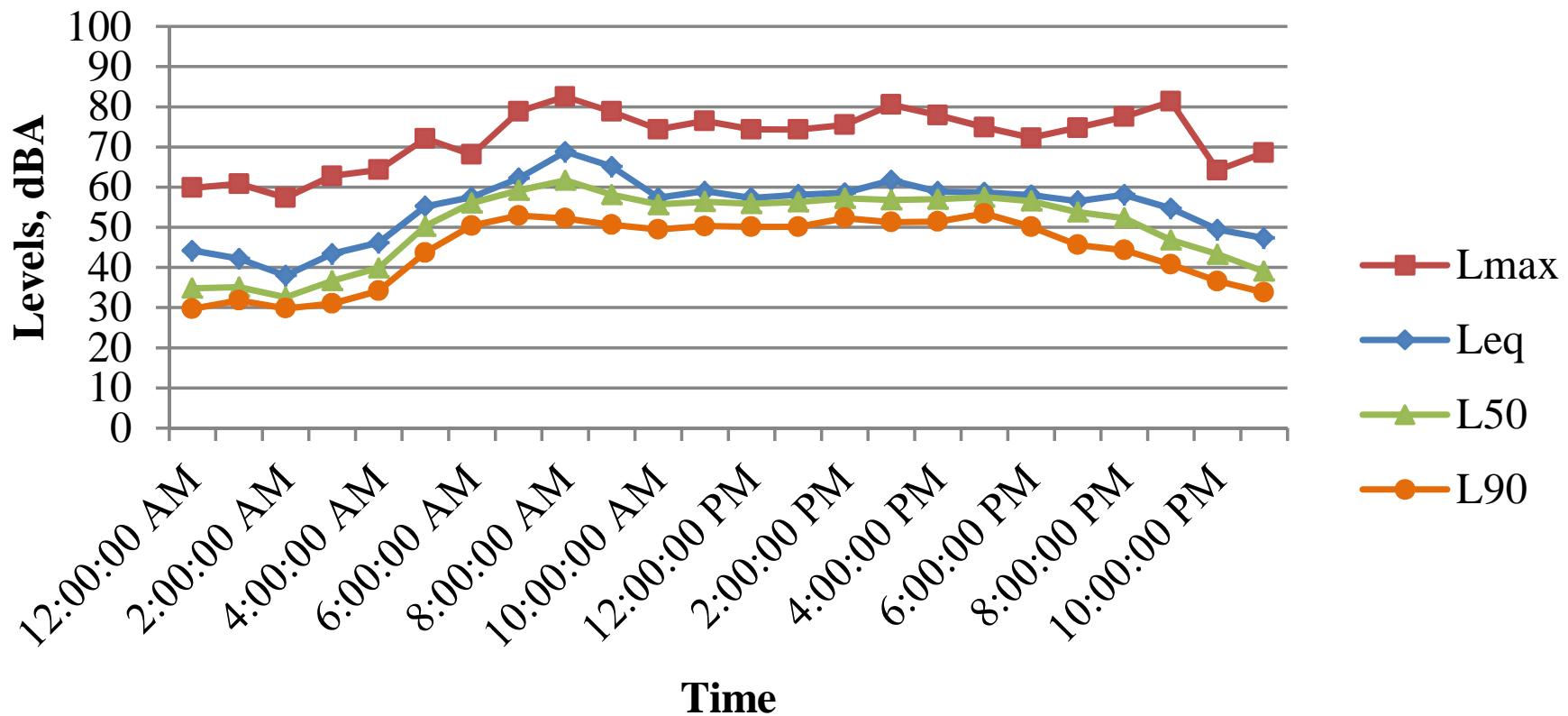
**SUMMARY OF SINGLE EVENT NOISE LEVEL MEASUREMENTS
WATSONVILLE MUNICIPAL AIRPORT
MAY 2015**

Aircraft Type	Number Sampled	SEL, dBA Mean (Range)	Lmax, dBA Mean (Range)	Azimuth
Site 1 - Arrivals on Runway 20 (5/12/15)				
Single Engine Prop.	13	74.7 (62.4-79.5)	64.9 (56.7-73.9)	30°NW-45°NW
Site 2 - Arrivals on Runway 20 (5/13/15)				
Single Engine Prop.	6	64.2 (56.8-70.2)	53.5 (49.8-59.1)	45°S-60°SW
Site 3 - Departures on Runway 20 (5/12/15)				
Bizjet	1	96.2	91.3	90°
Helicopter	1	80.5	71.1	45°S
Single Engine Prop.	16	88.4 (75.6-96.5)	78.8 (68.7-92.1)	90°-45°E
Site 4 – Overflights (5/18/15)				
Single Engine Prop.	4	70.5 (61.3-75.1)	57.1 (51.3-63.3)	30°S-45°N
Site 5 – Departures on Runway 20 (5/13/15)				
Single Engine Prop.	3	72.8 (63.7-76.2)	61.8 (55.5-67.4)	30°N
Single Engine Prop.	14	75.4 (62.7-82.8)	63.7 (55.2-73.2)	30°S-45°N
Source: Brown-Buntin Associates, Inc.				

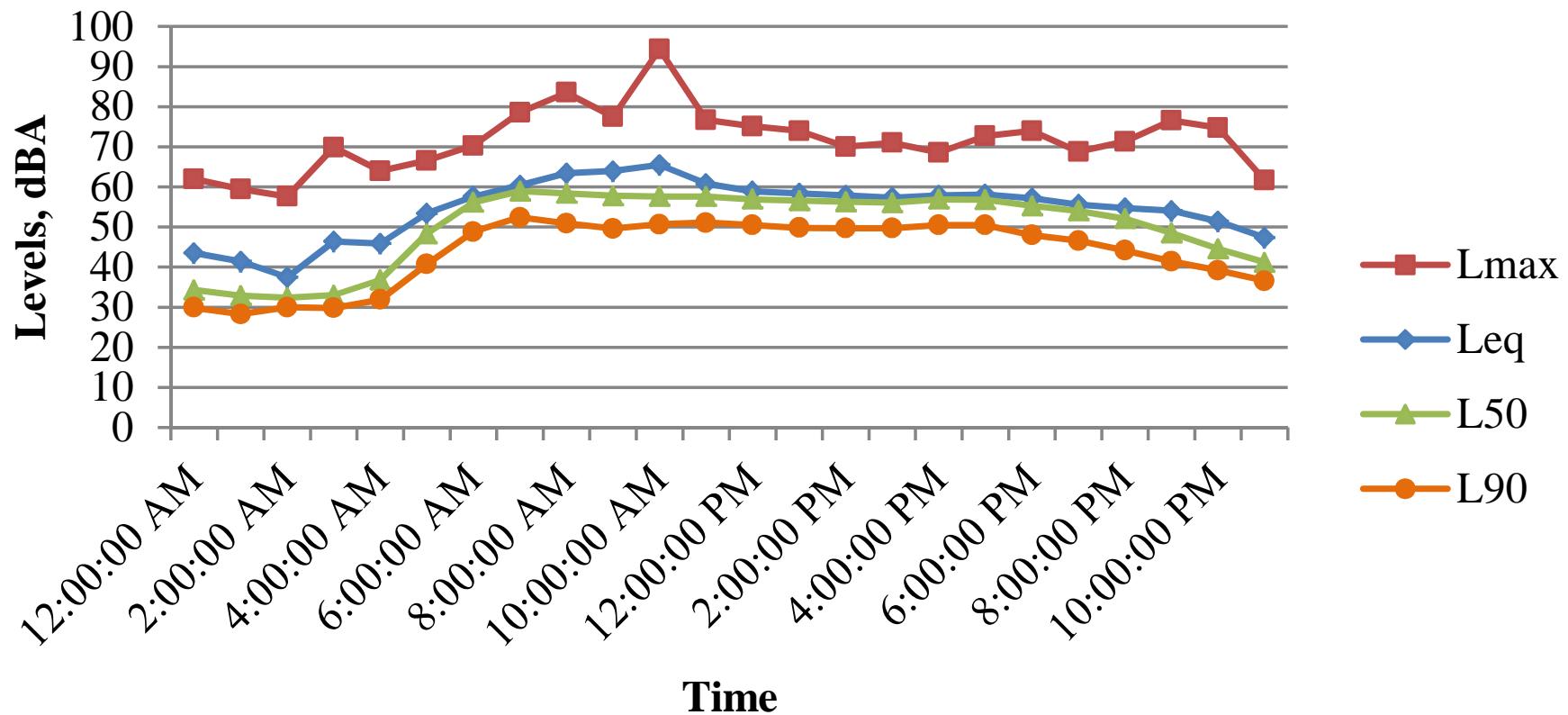
APPENDIX E

MEASURED HOURLY NOISE LEVELS
WATSONVILLE MUNICIPAL AIRPORT
MAY 2015

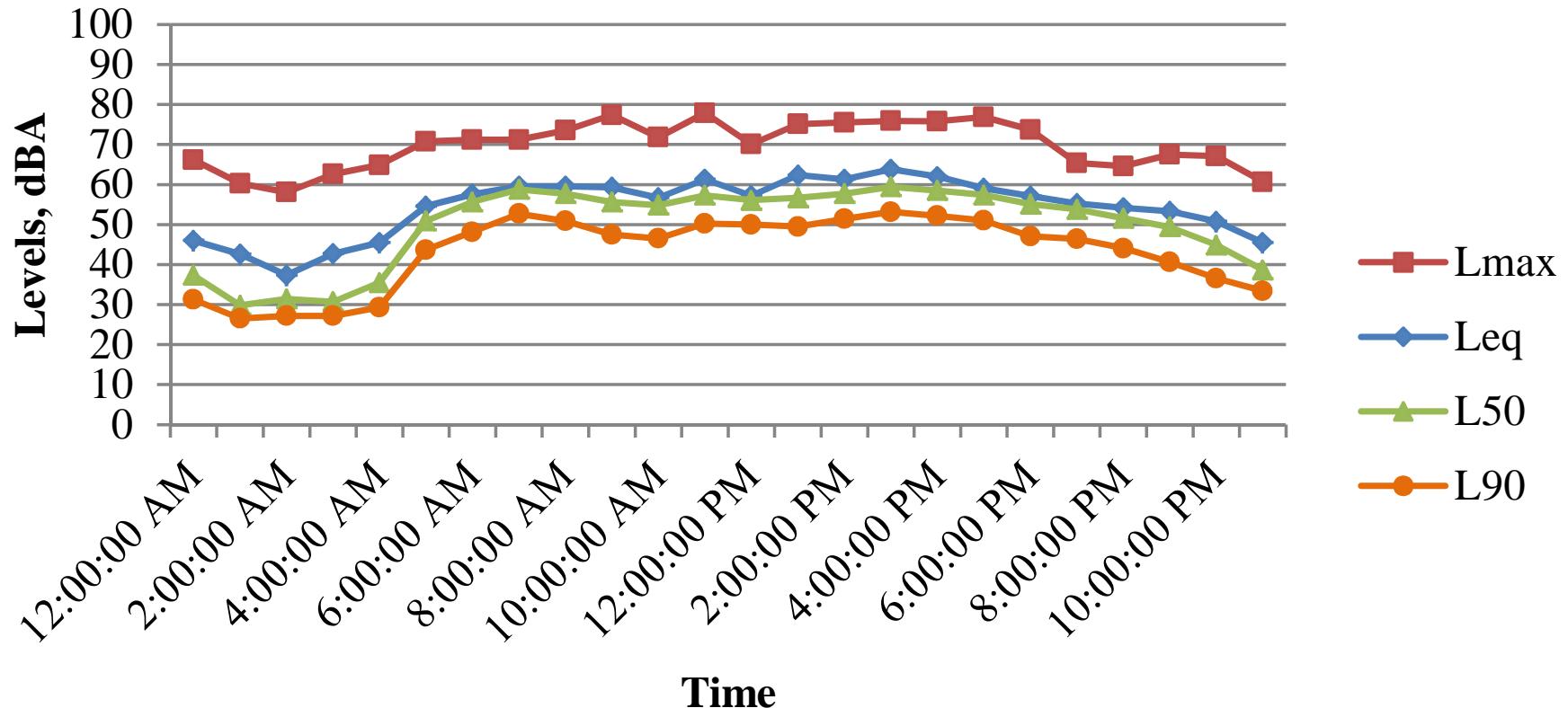
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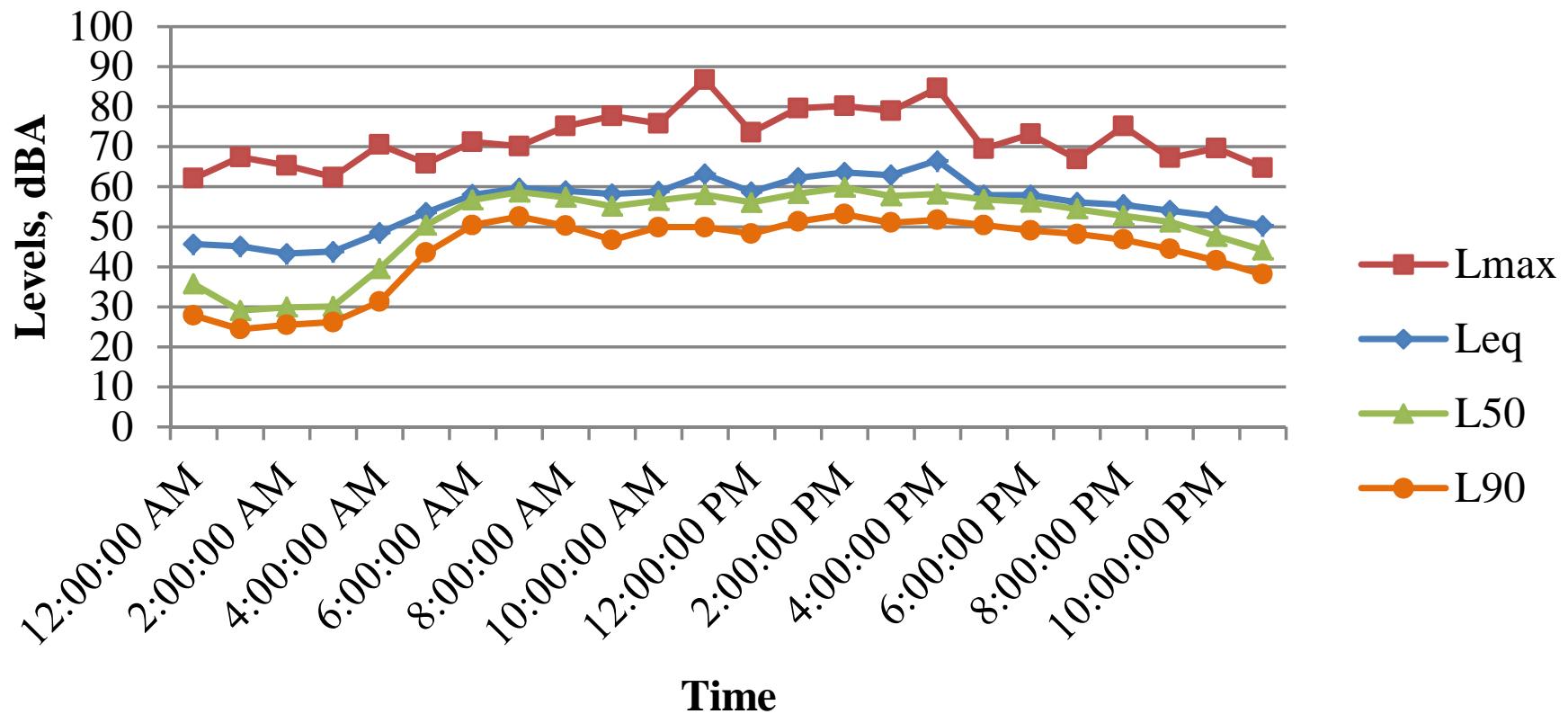
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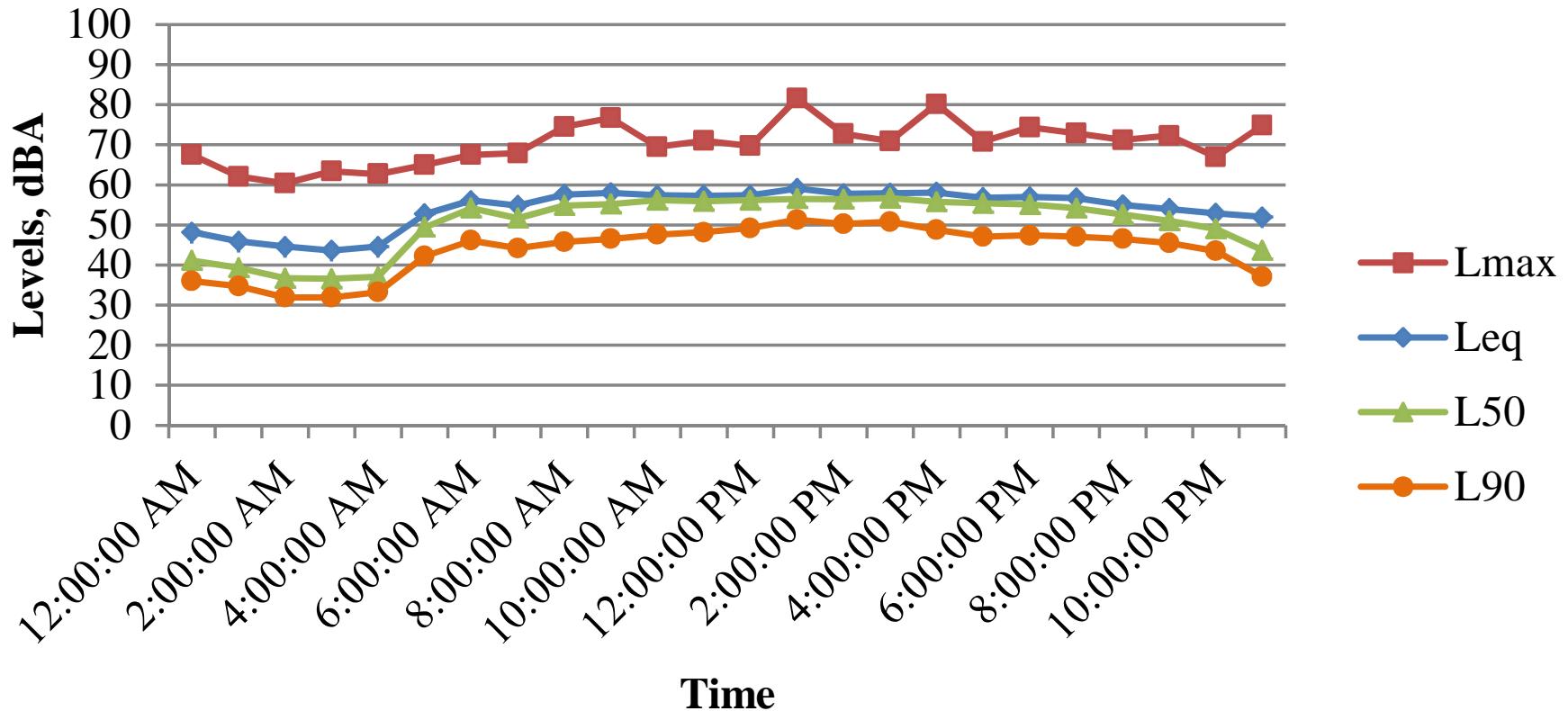
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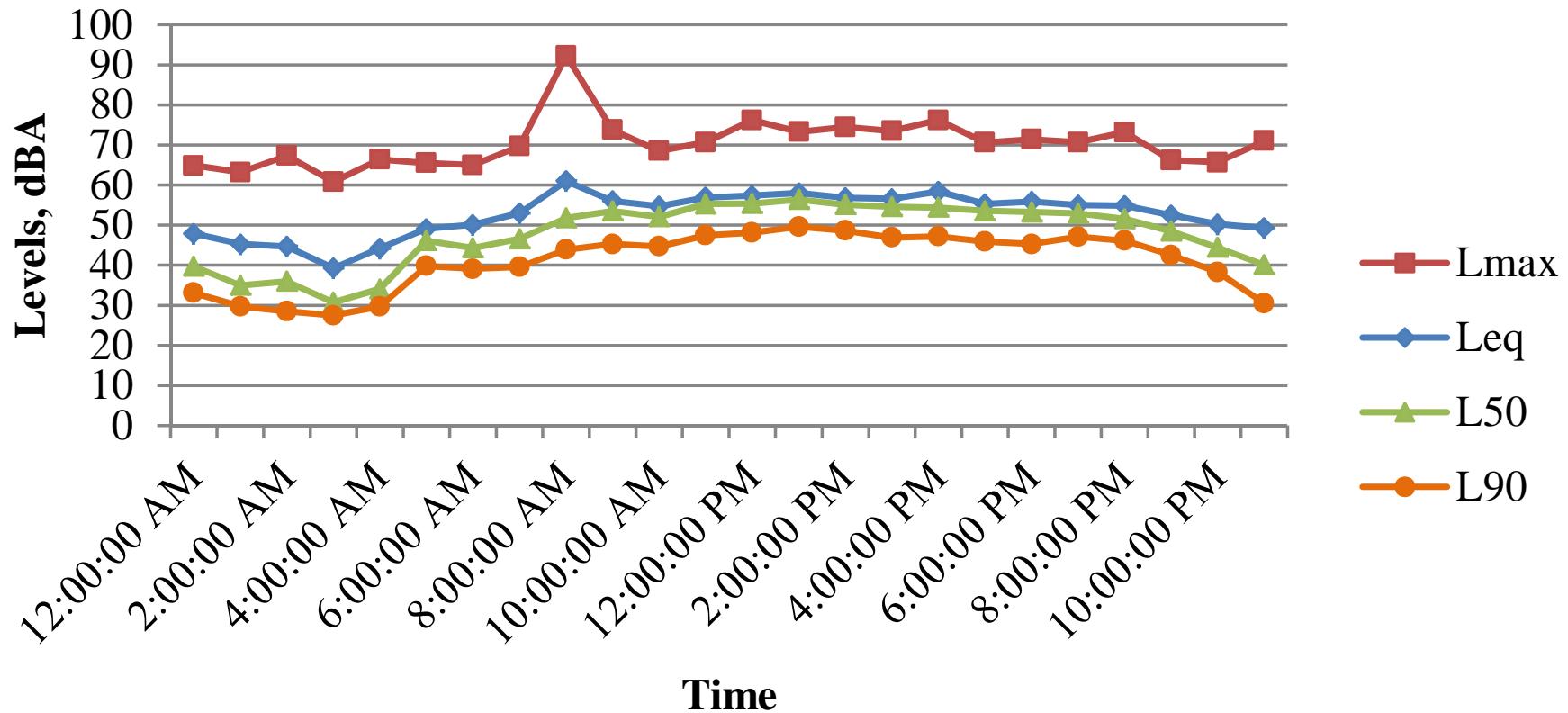
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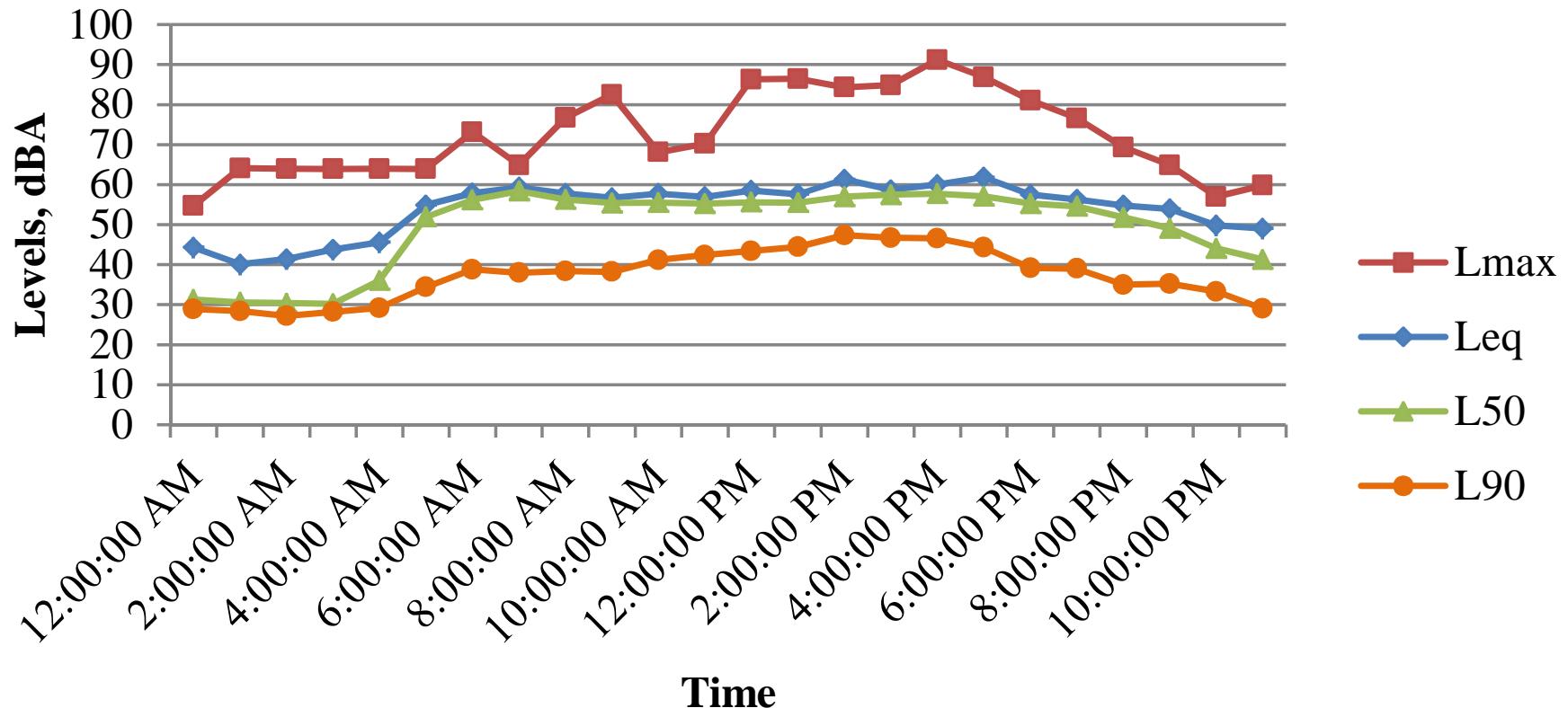
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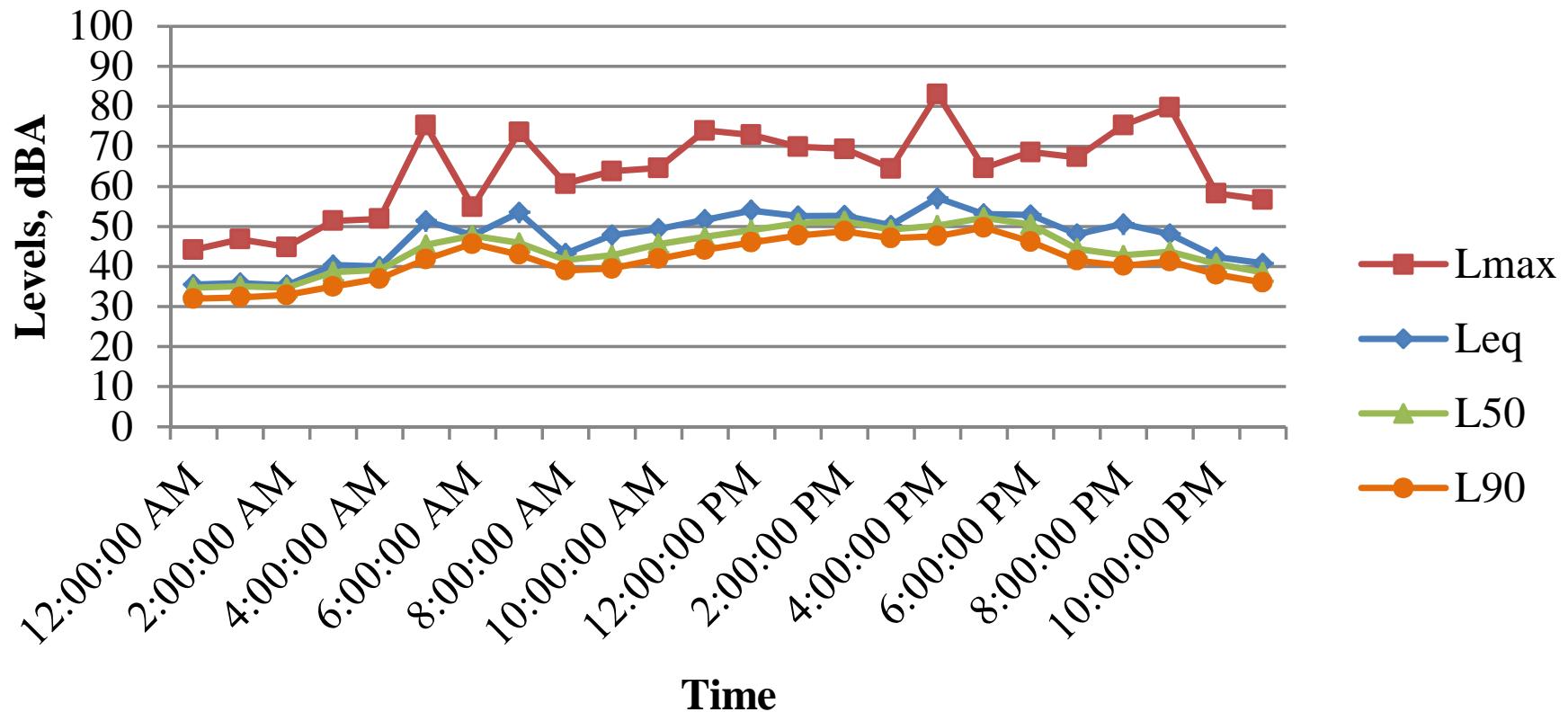
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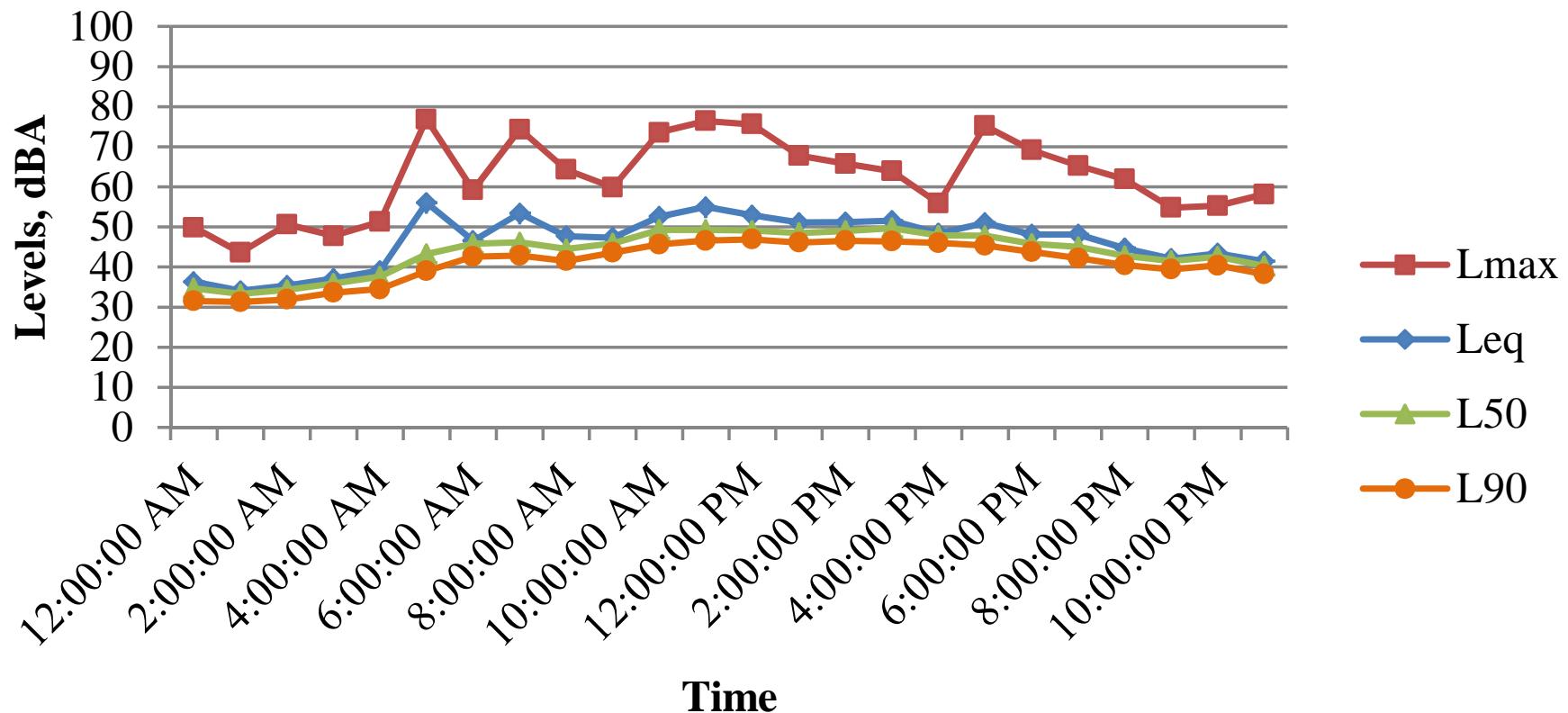
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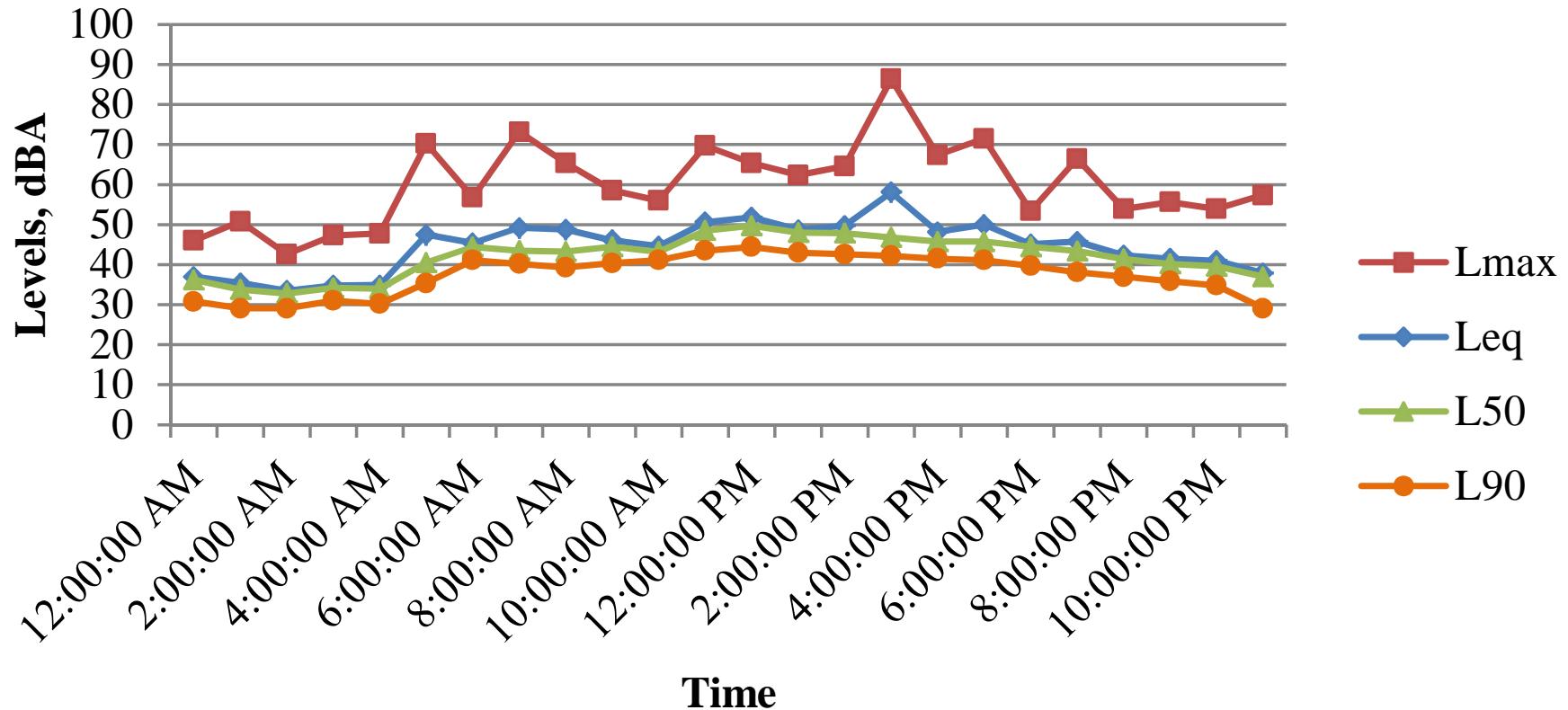
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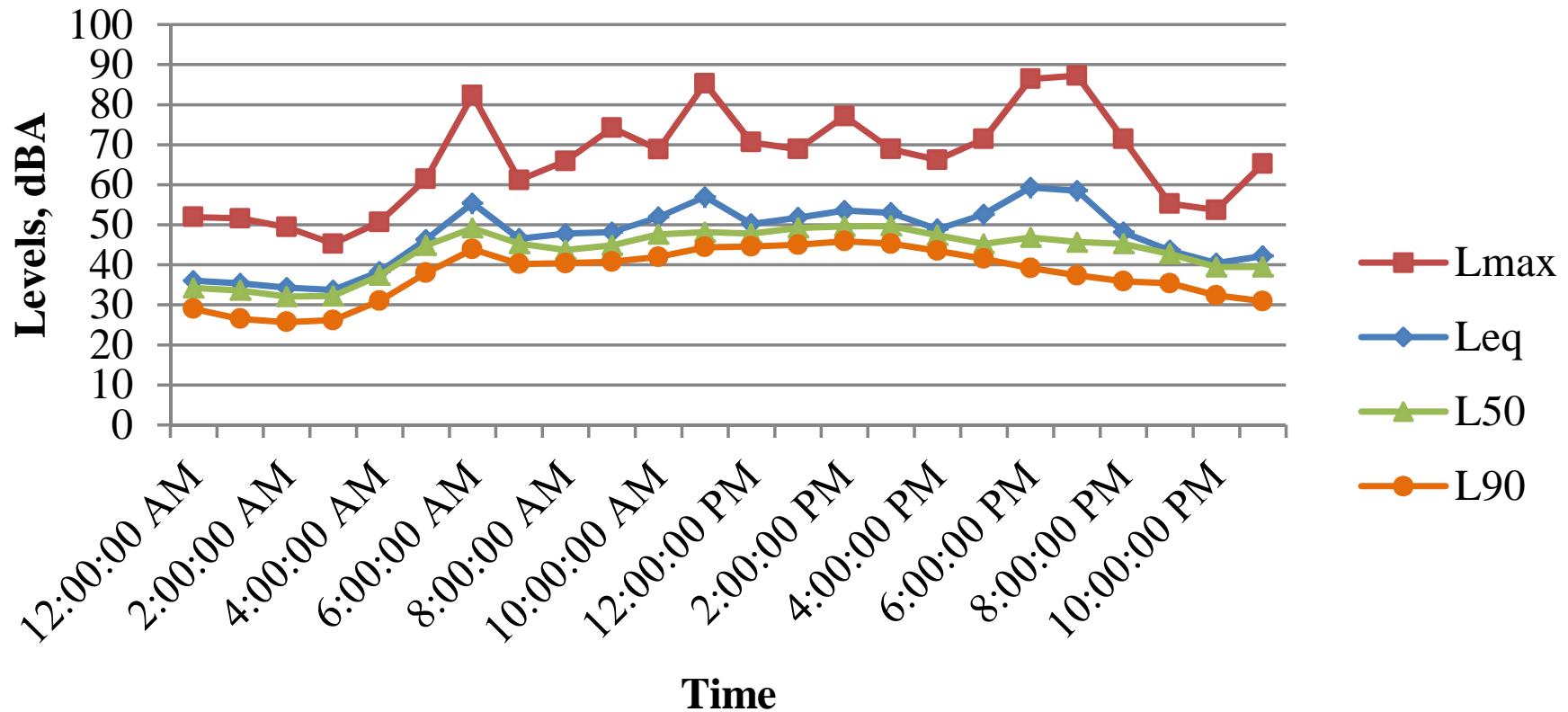
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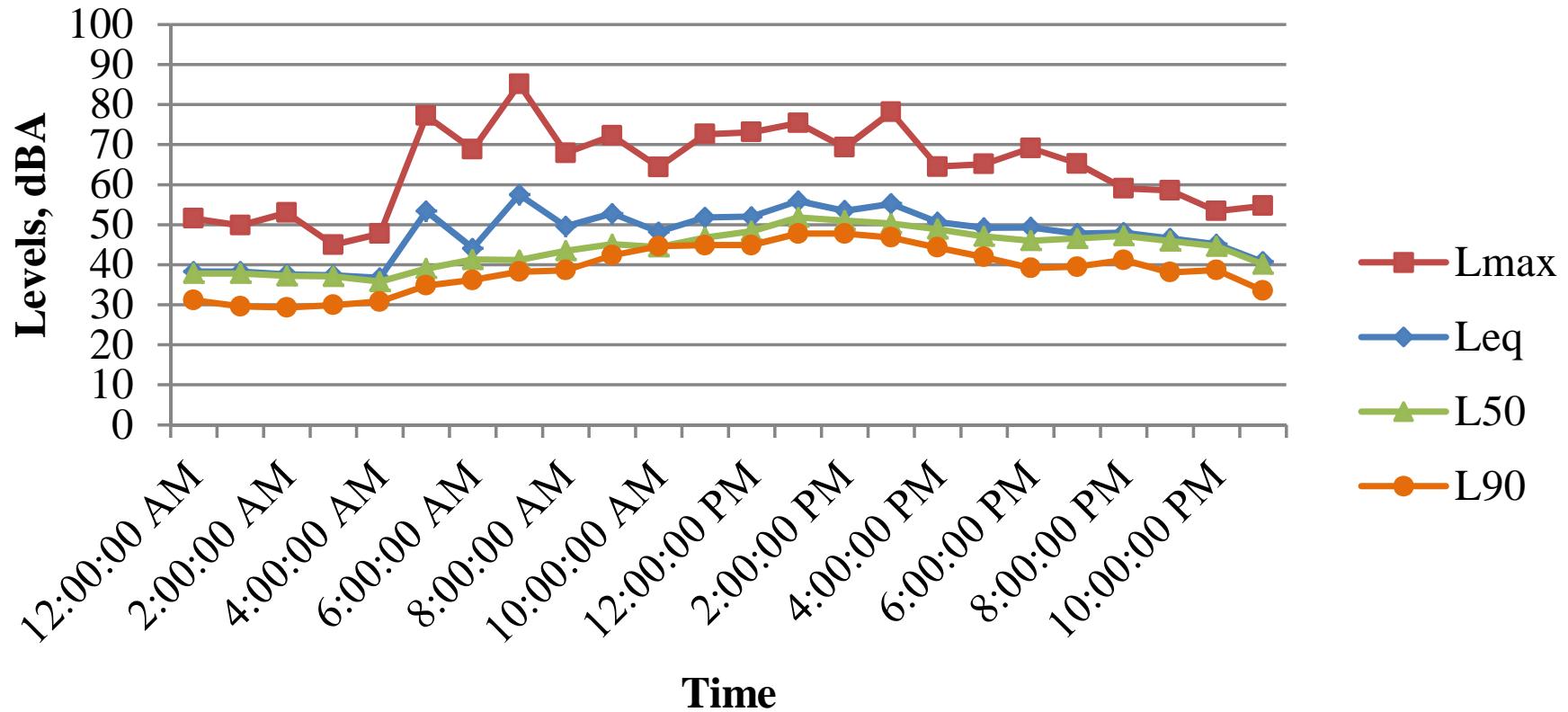
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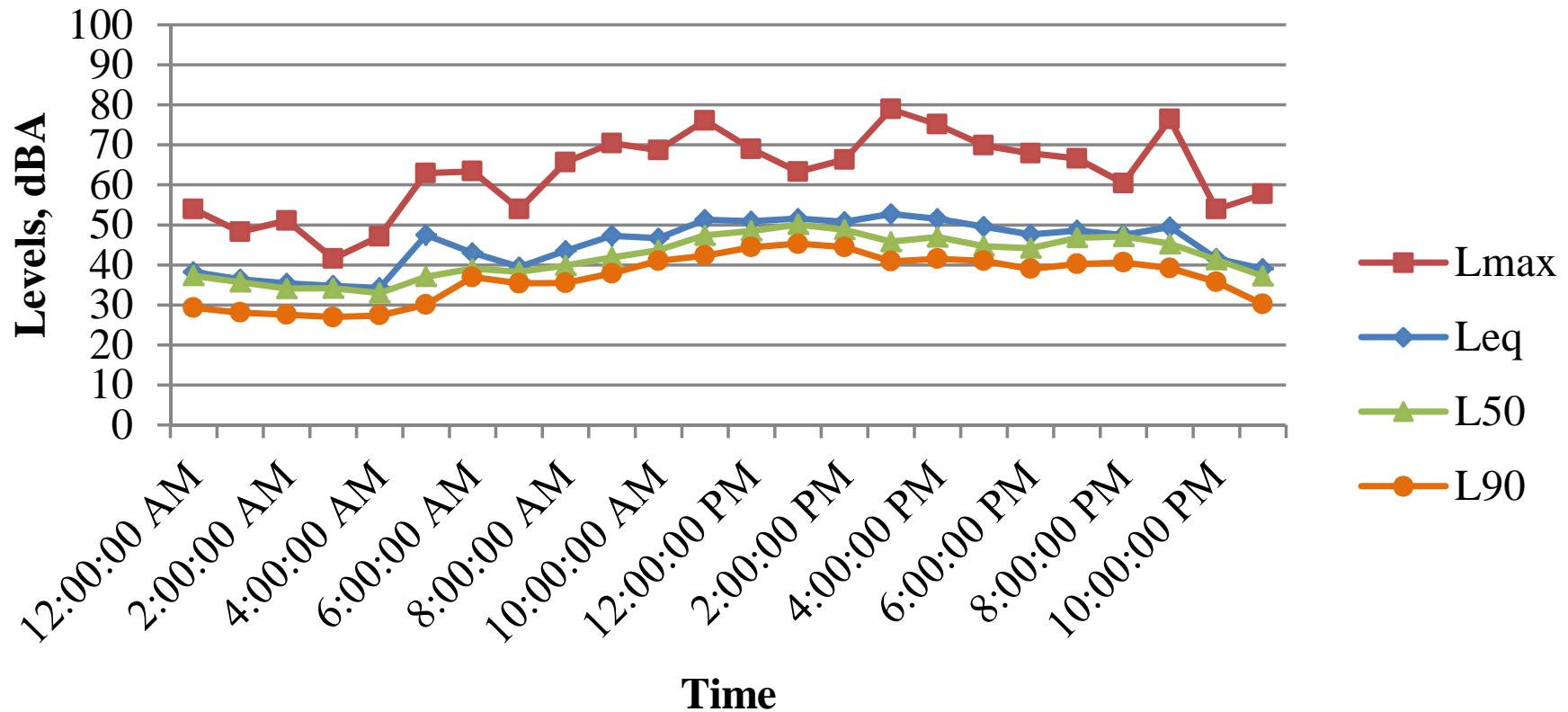
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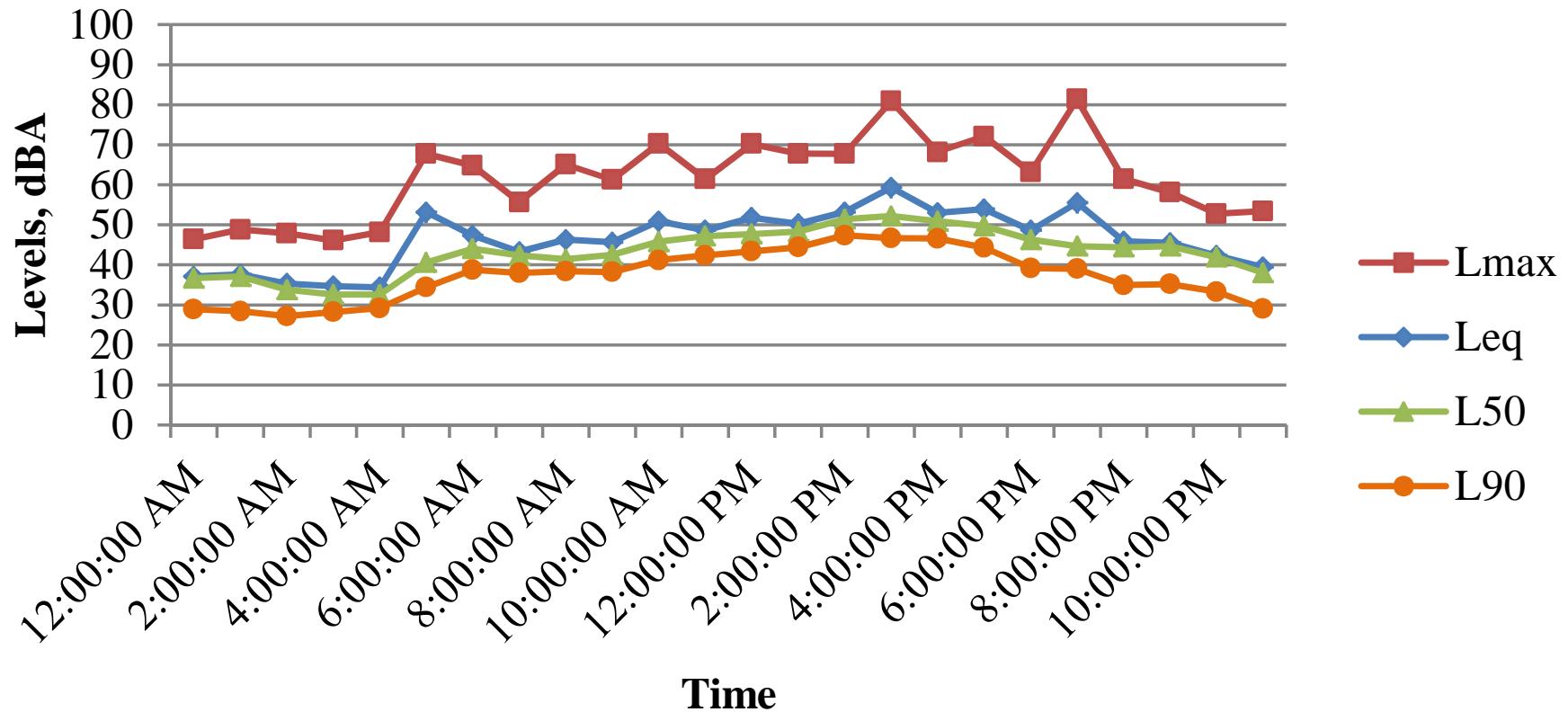
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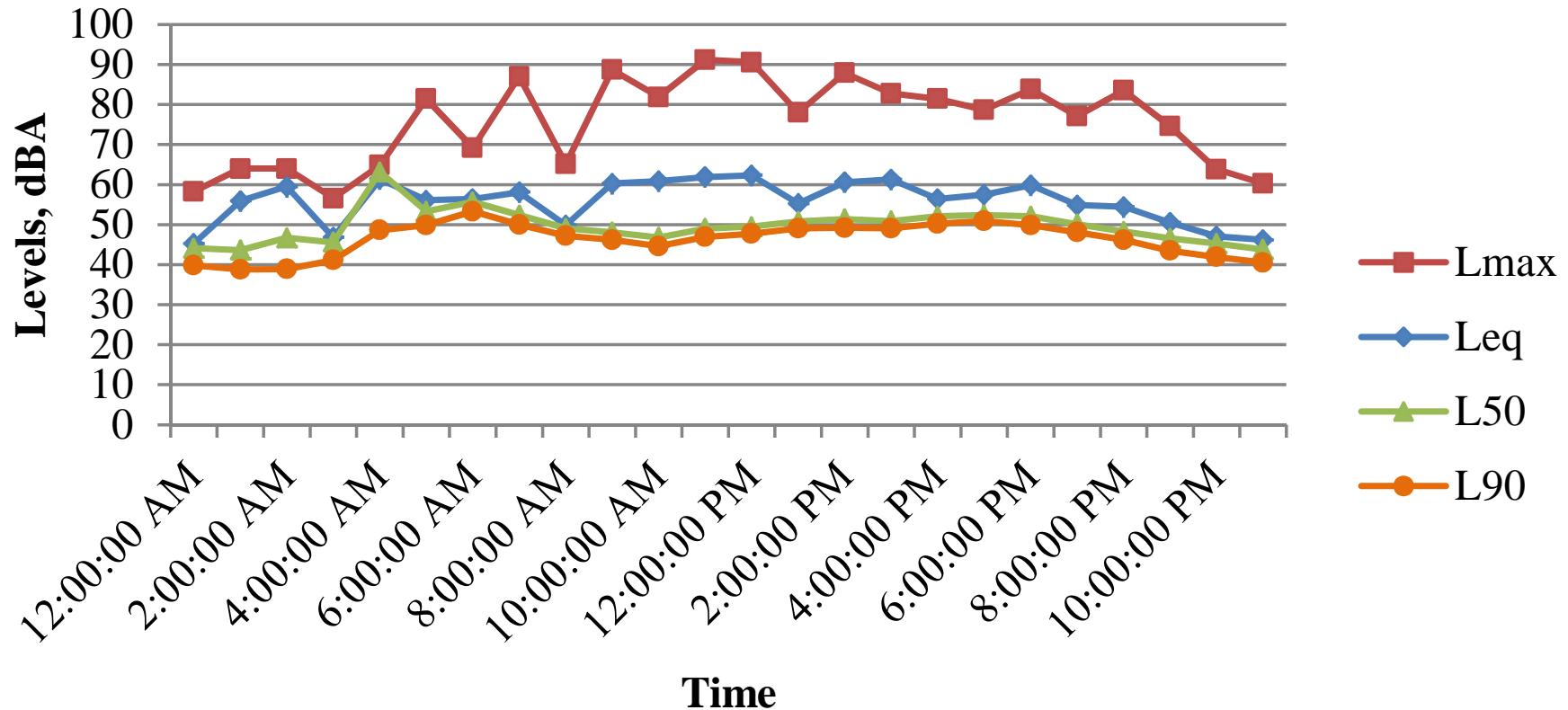
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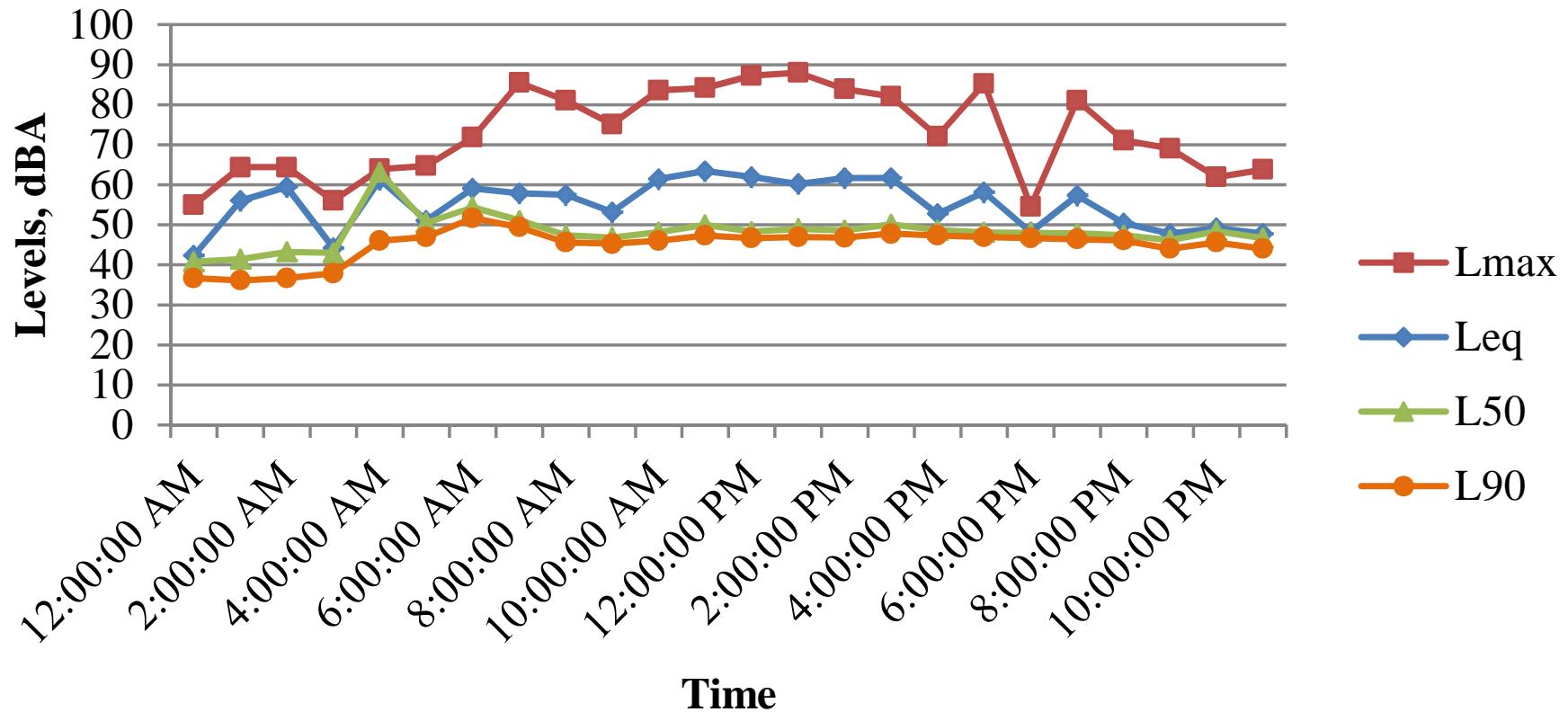
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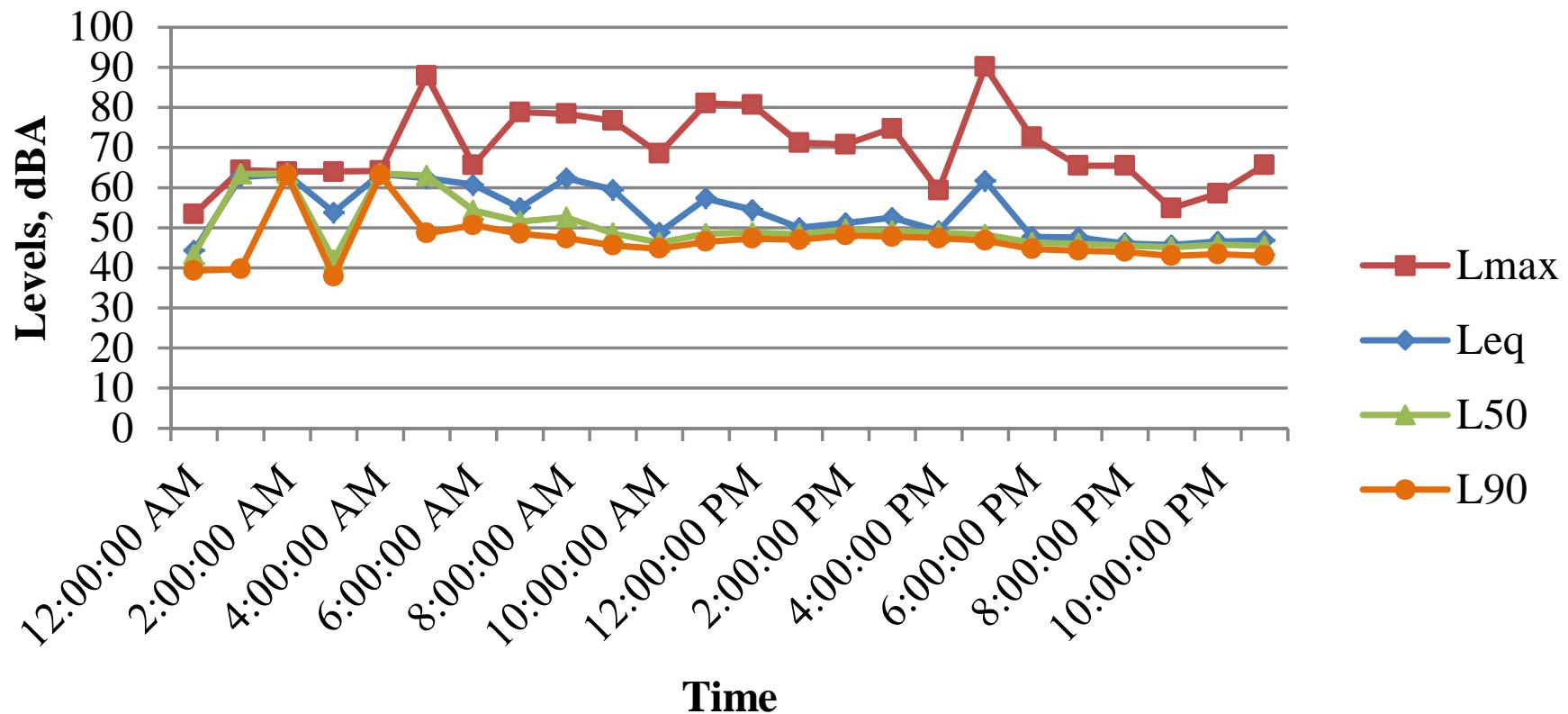
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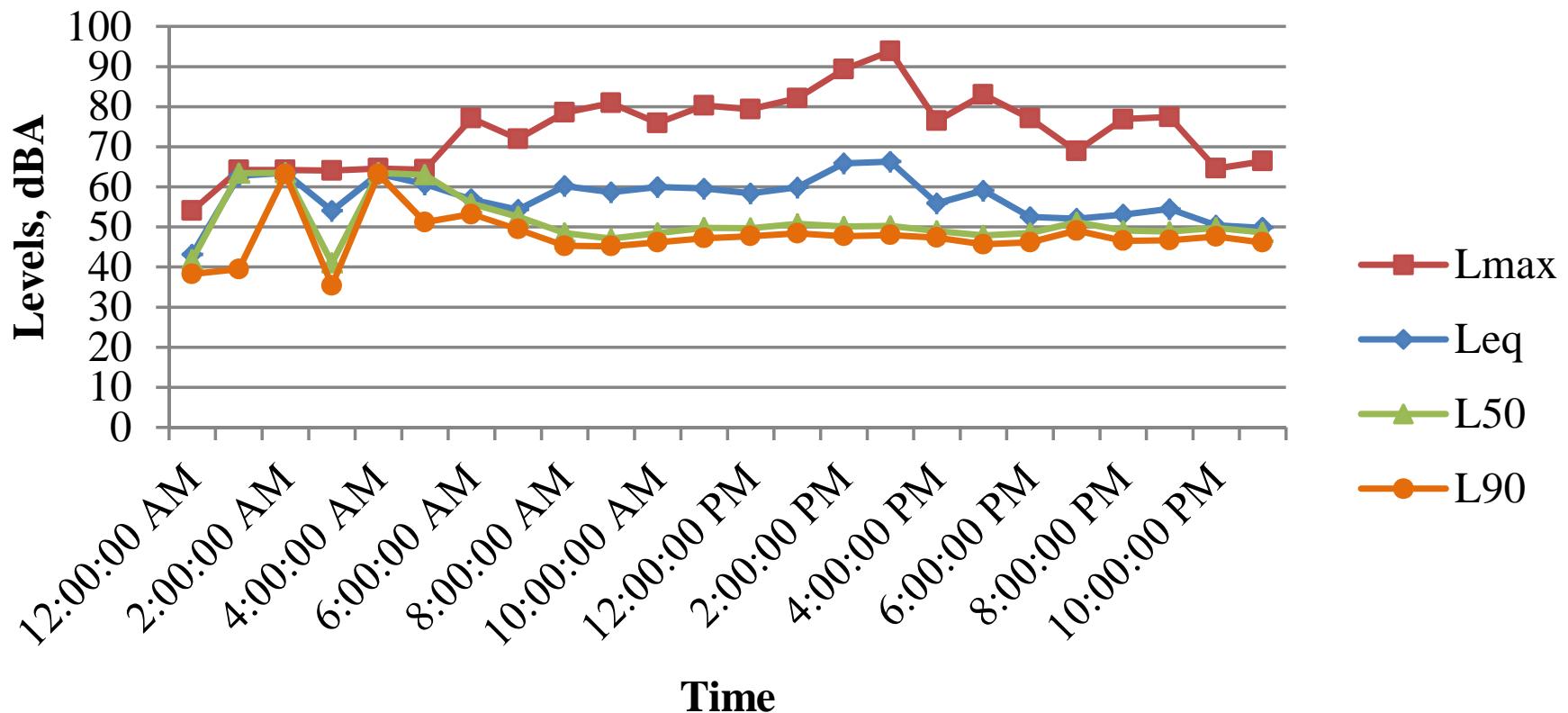
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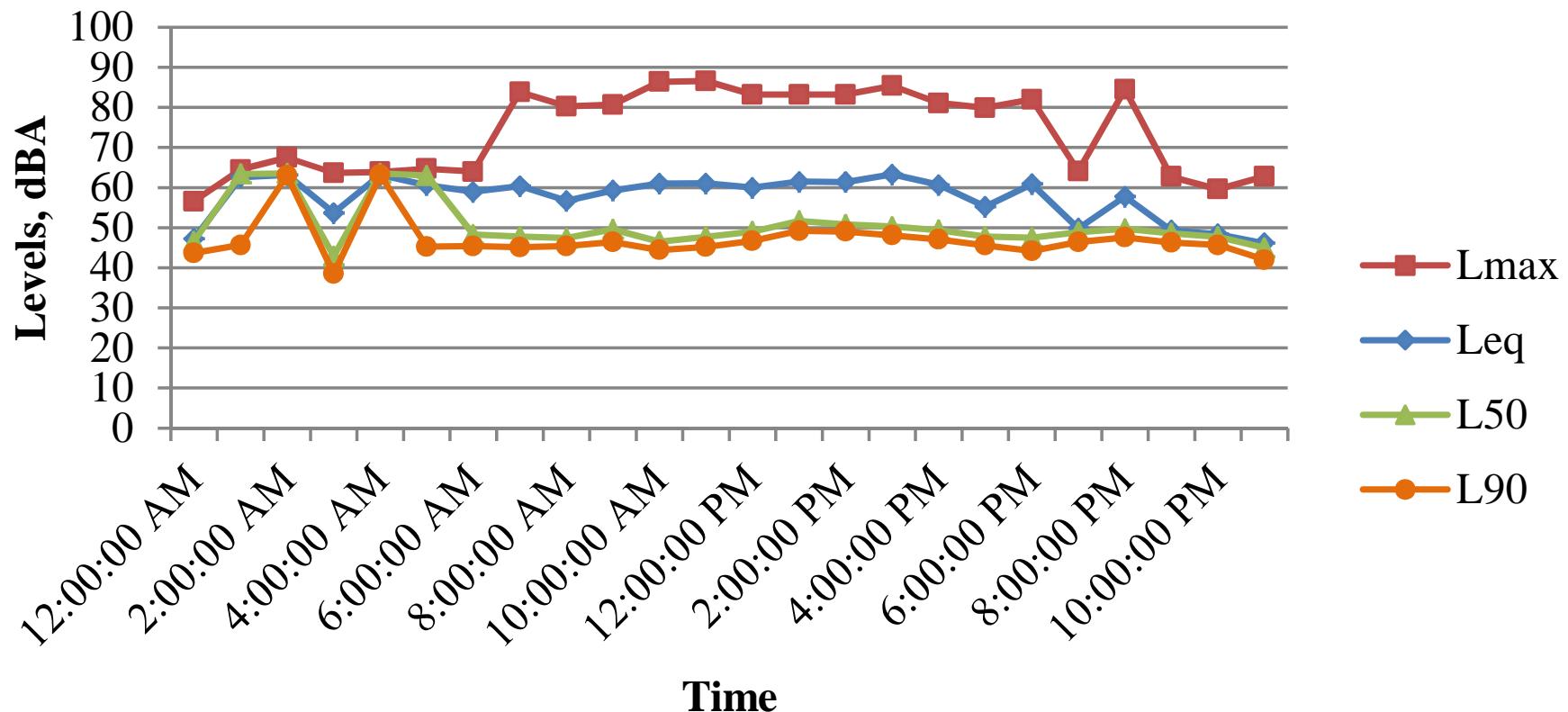
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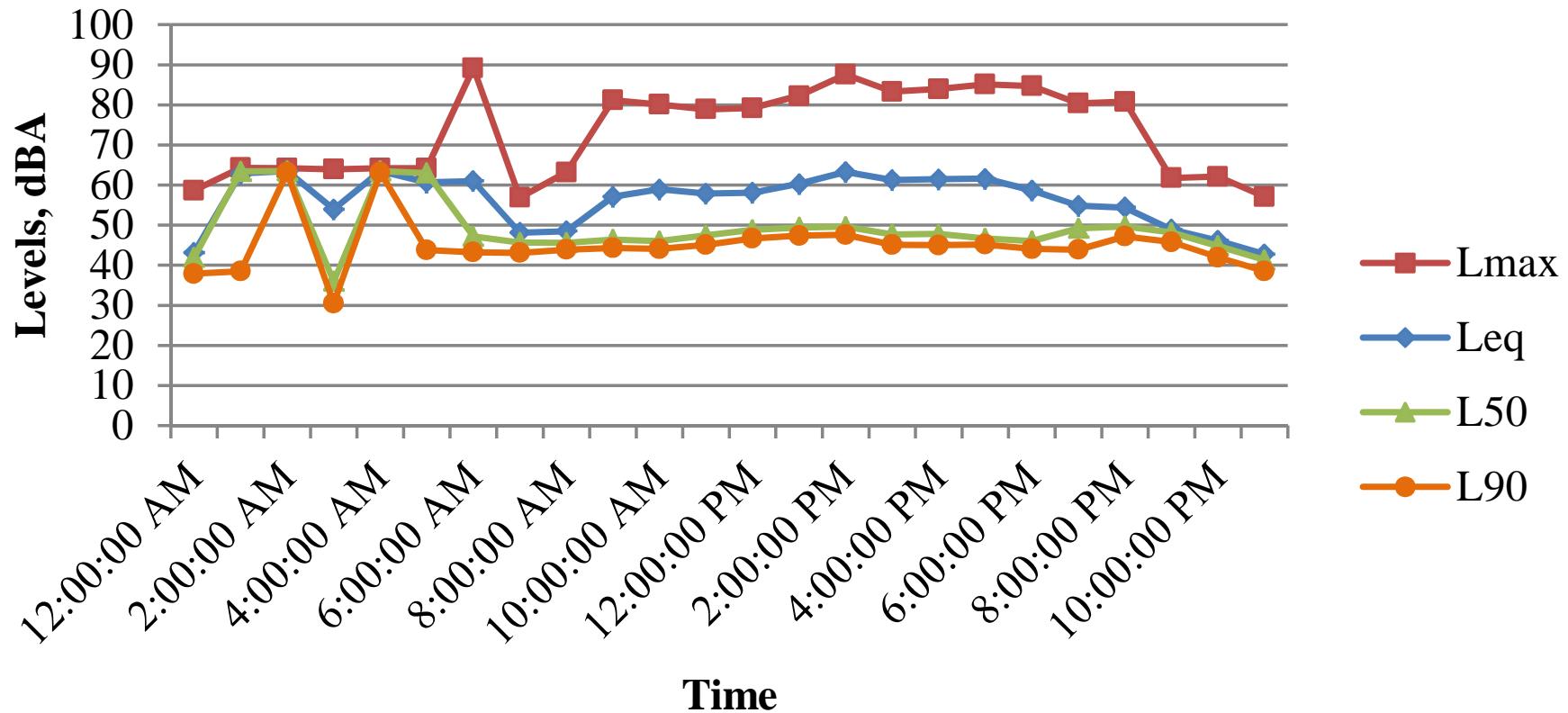
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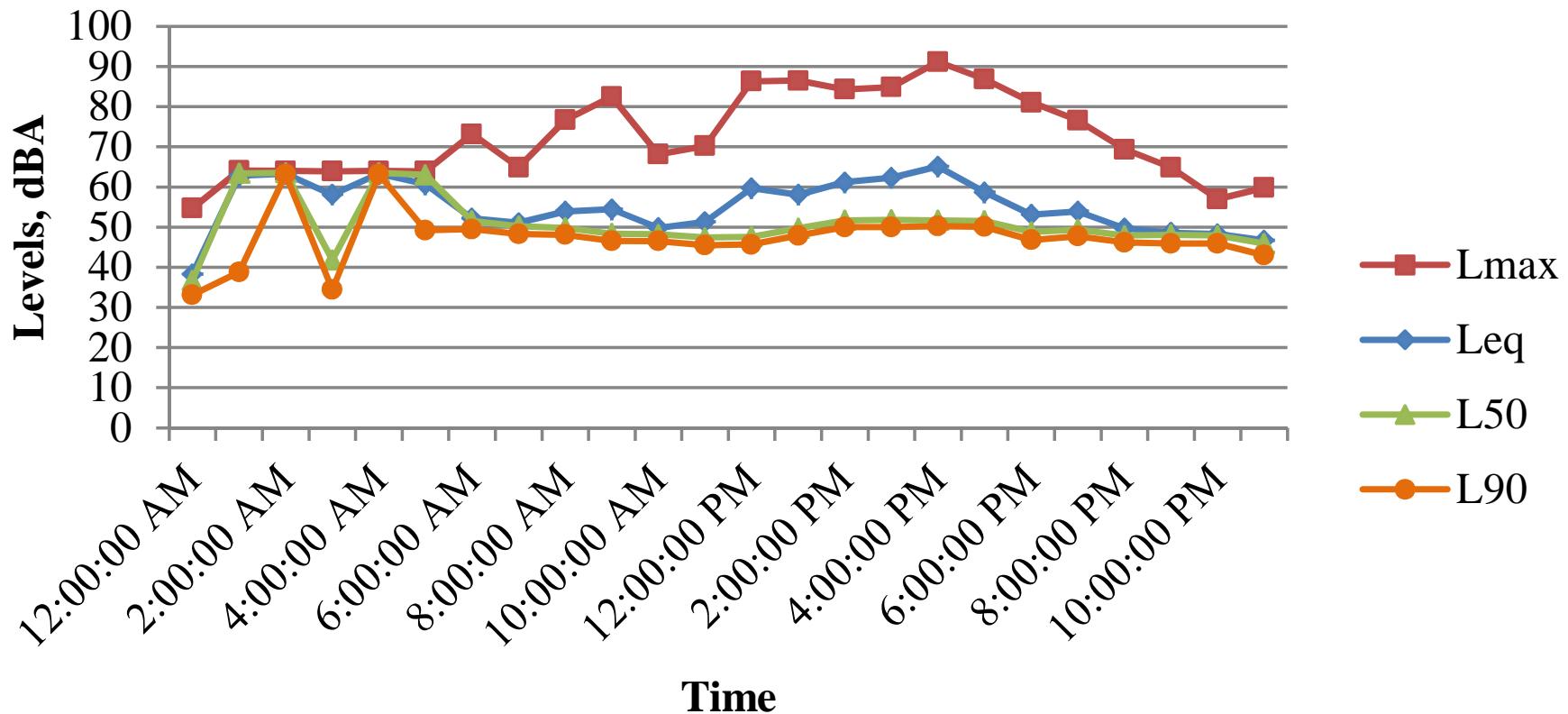
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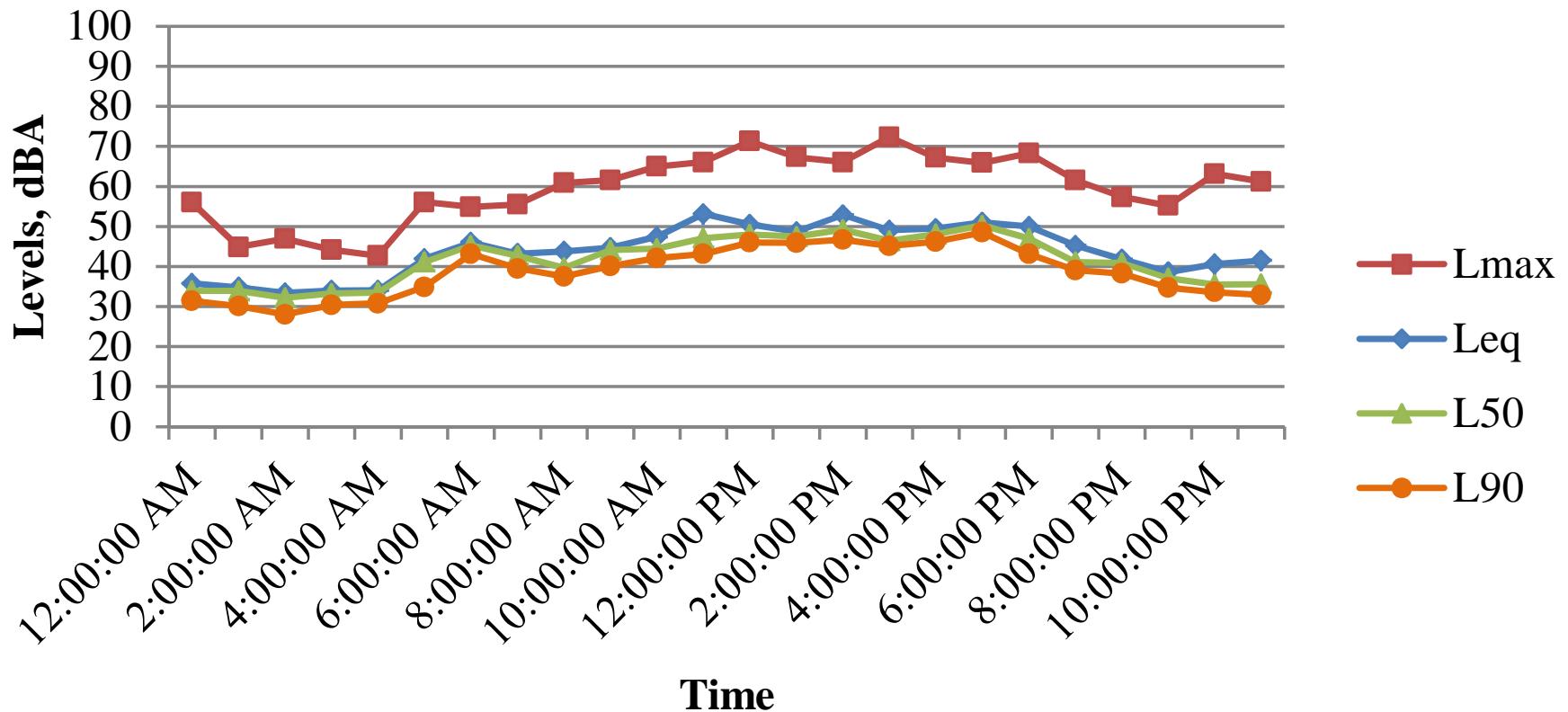
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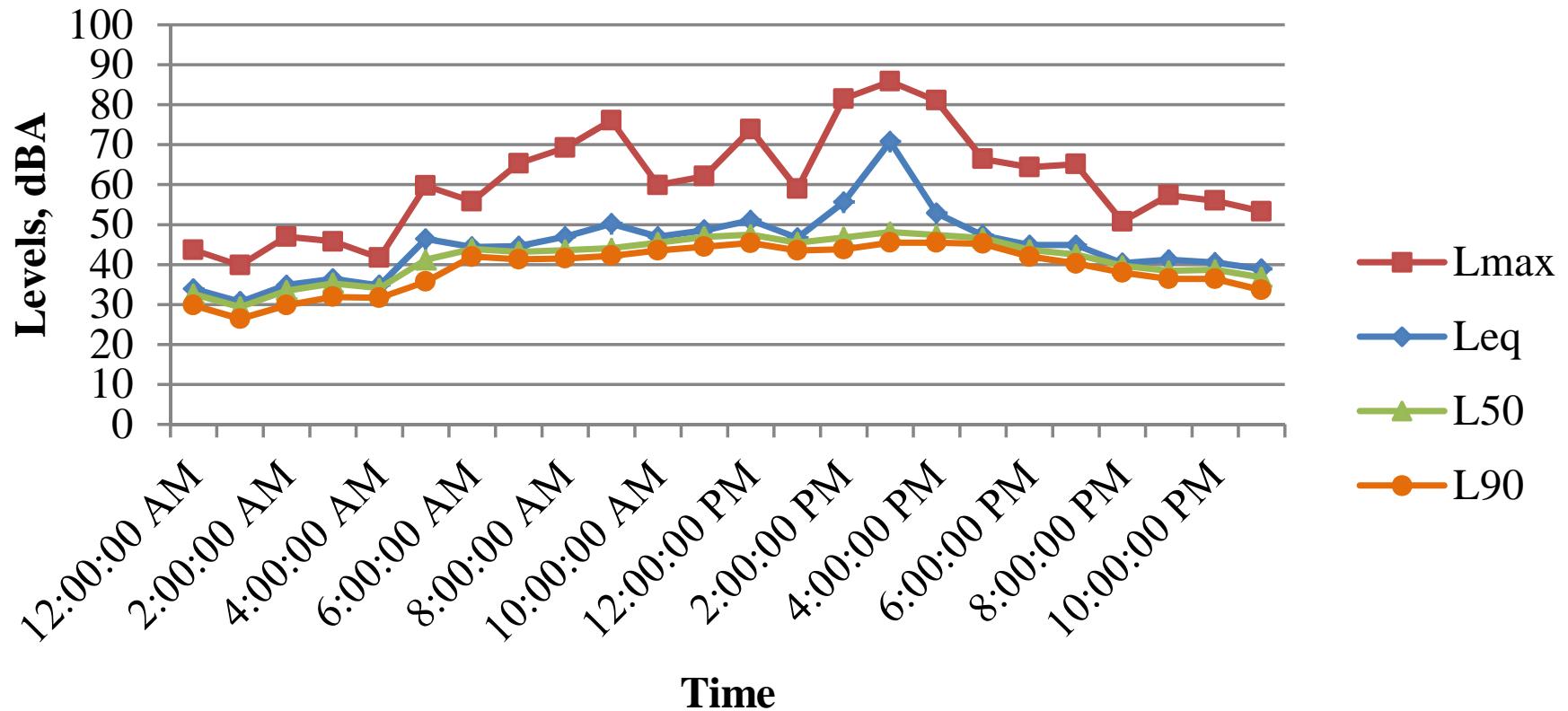
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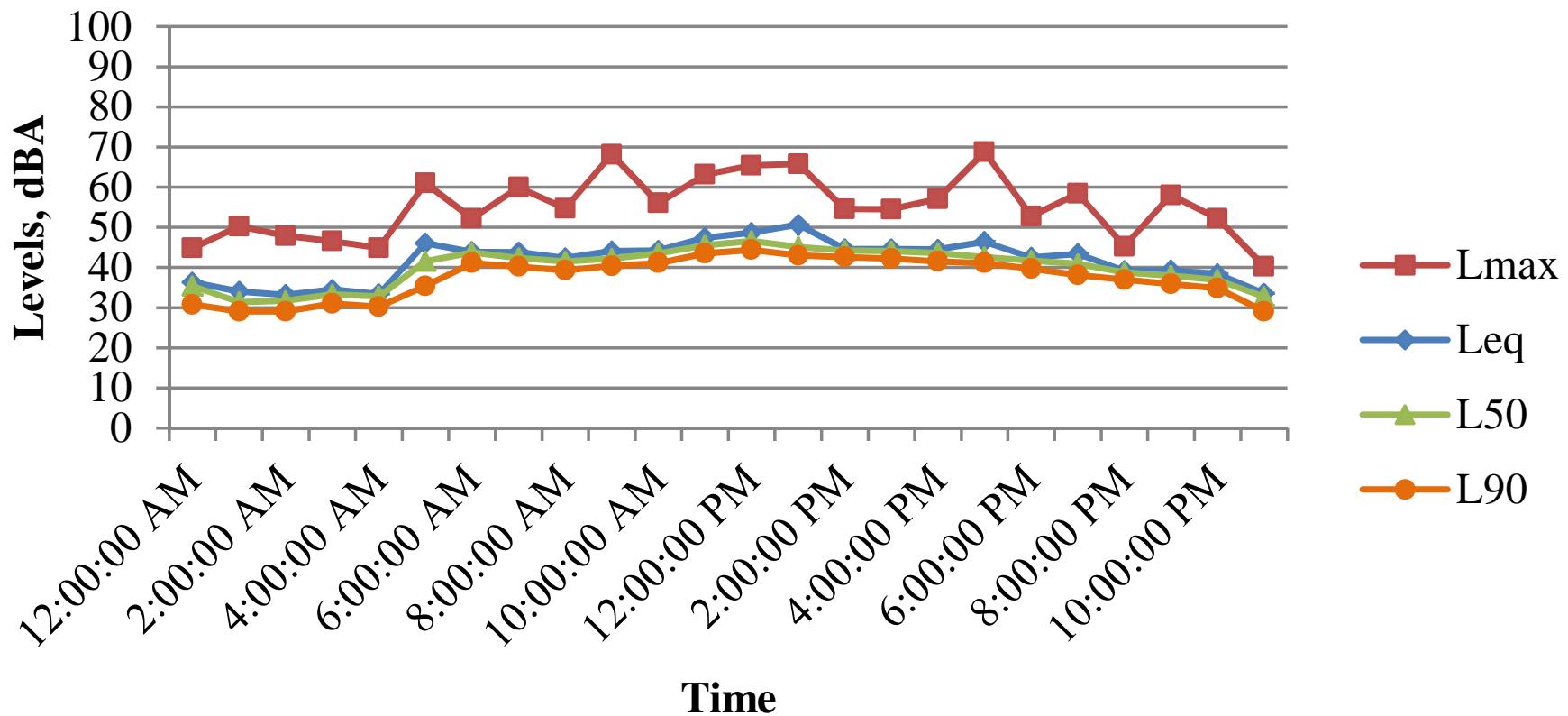
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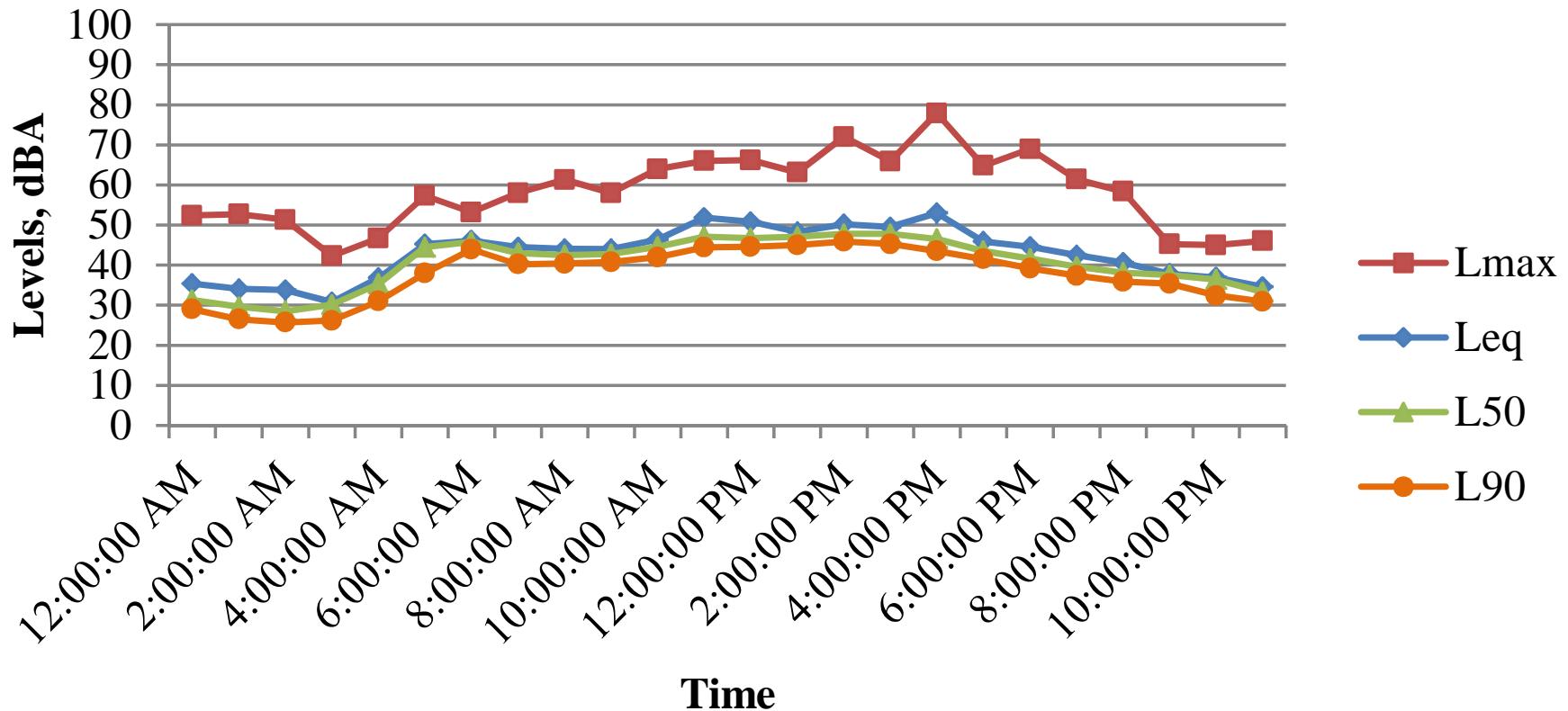
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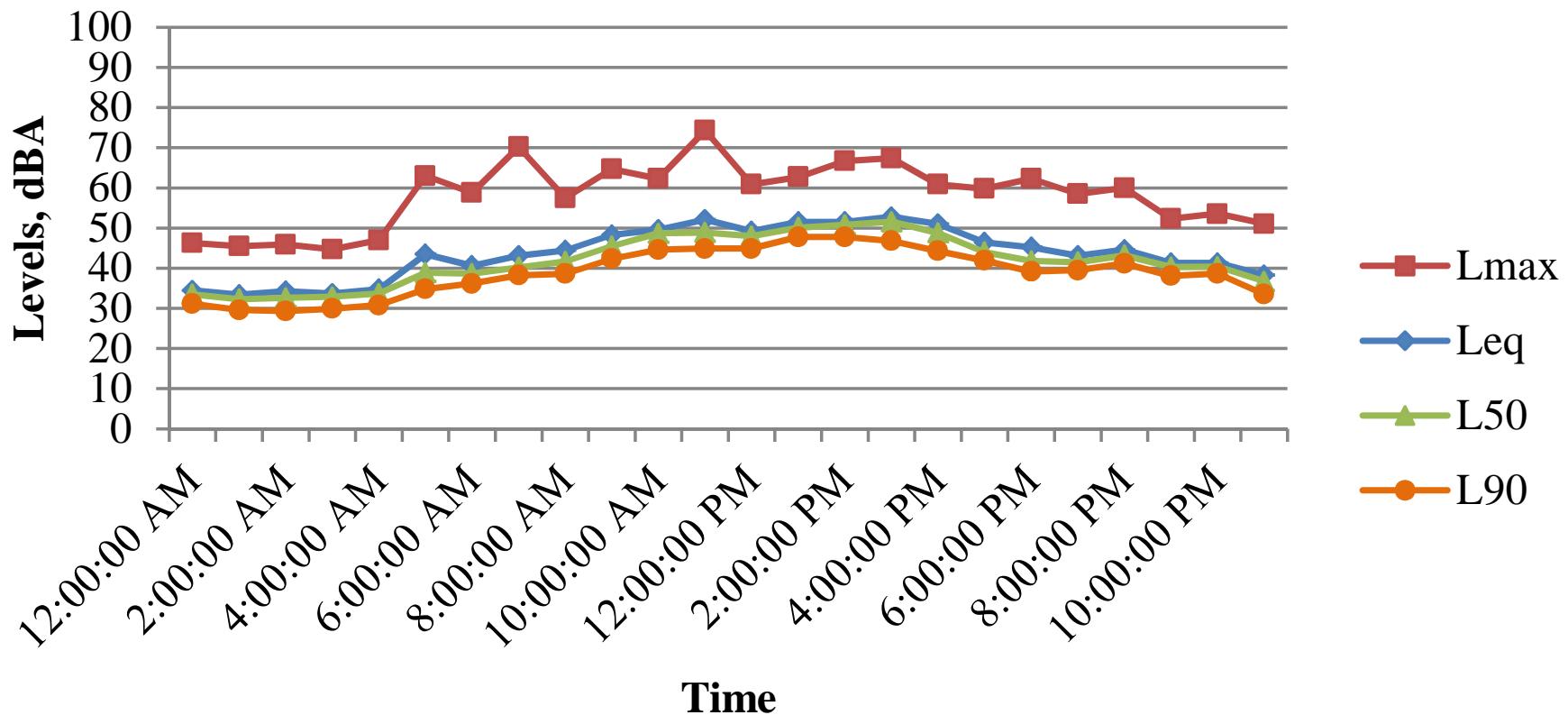
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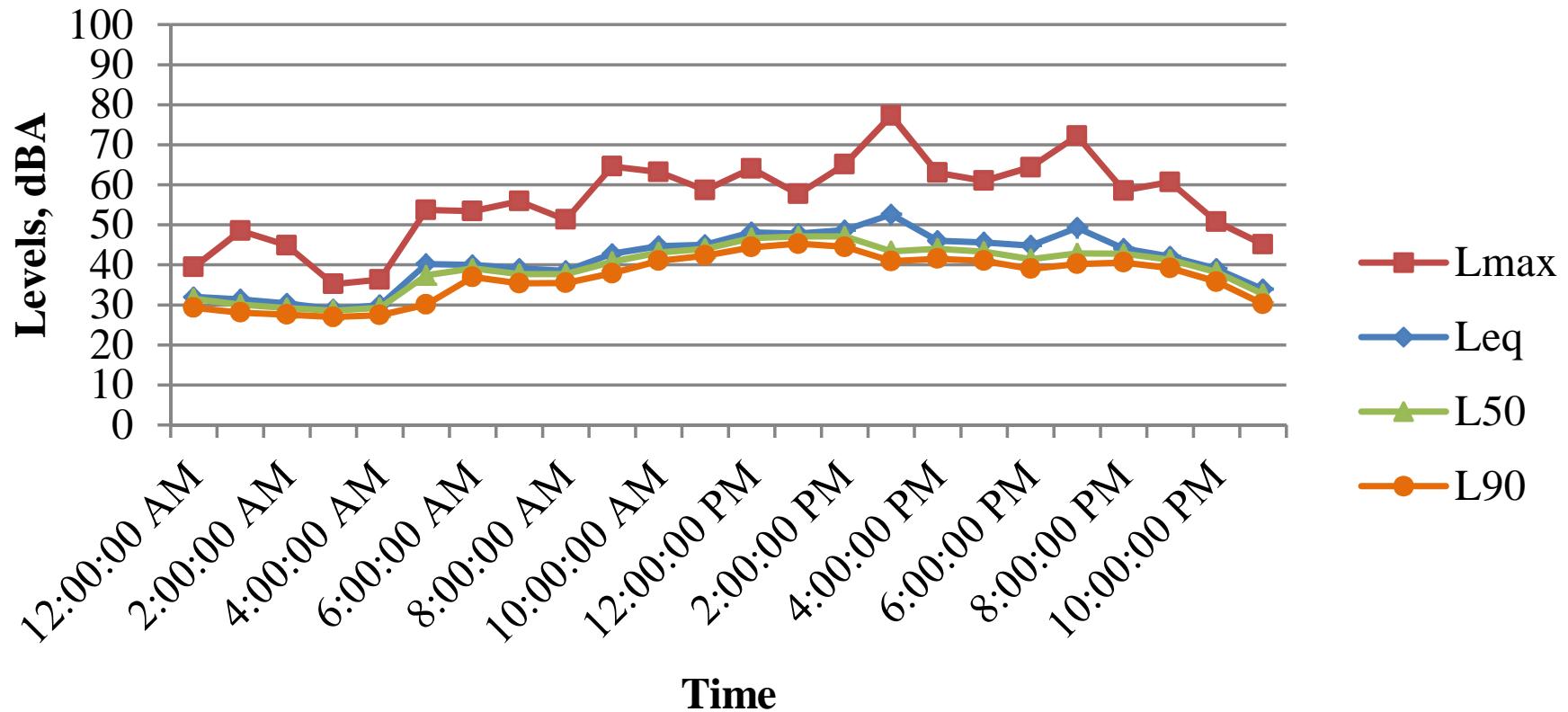
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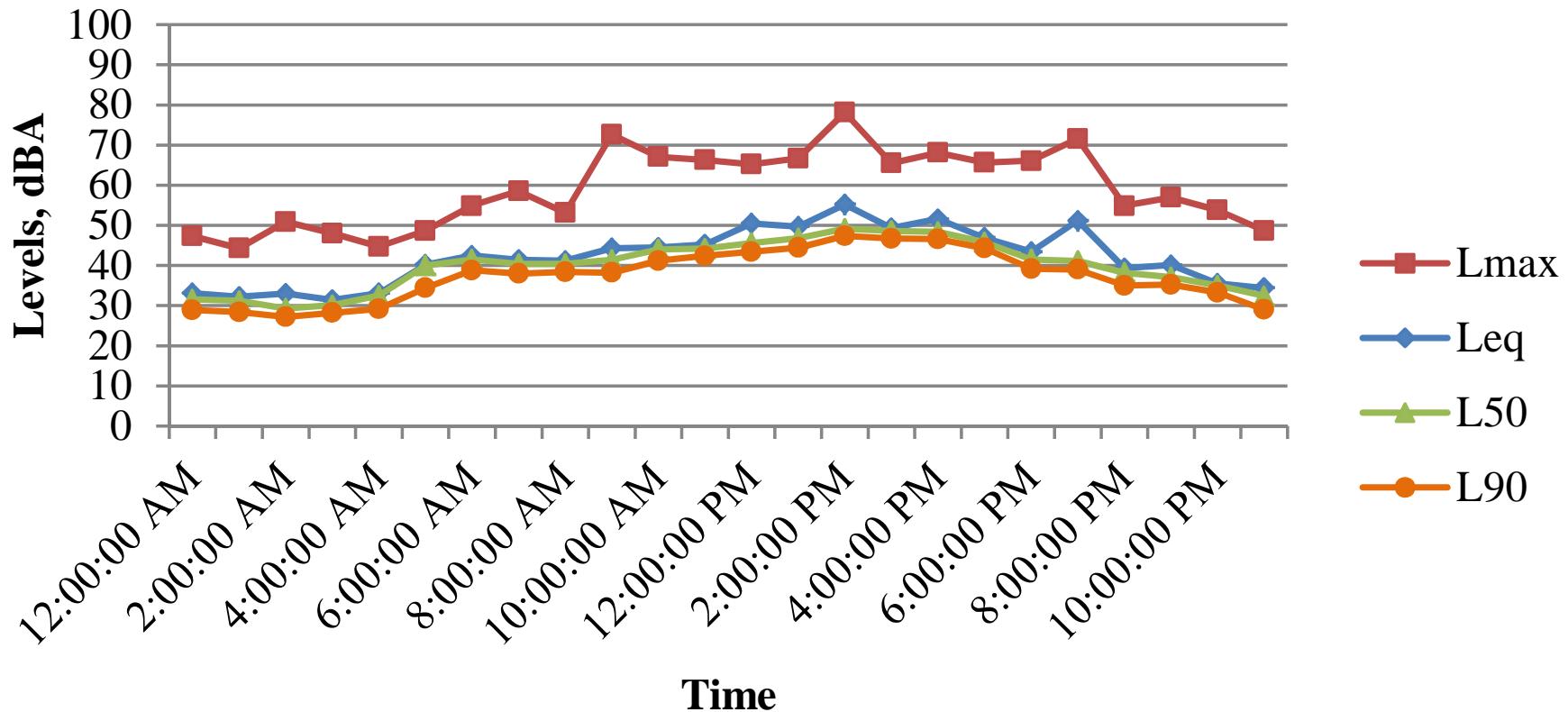
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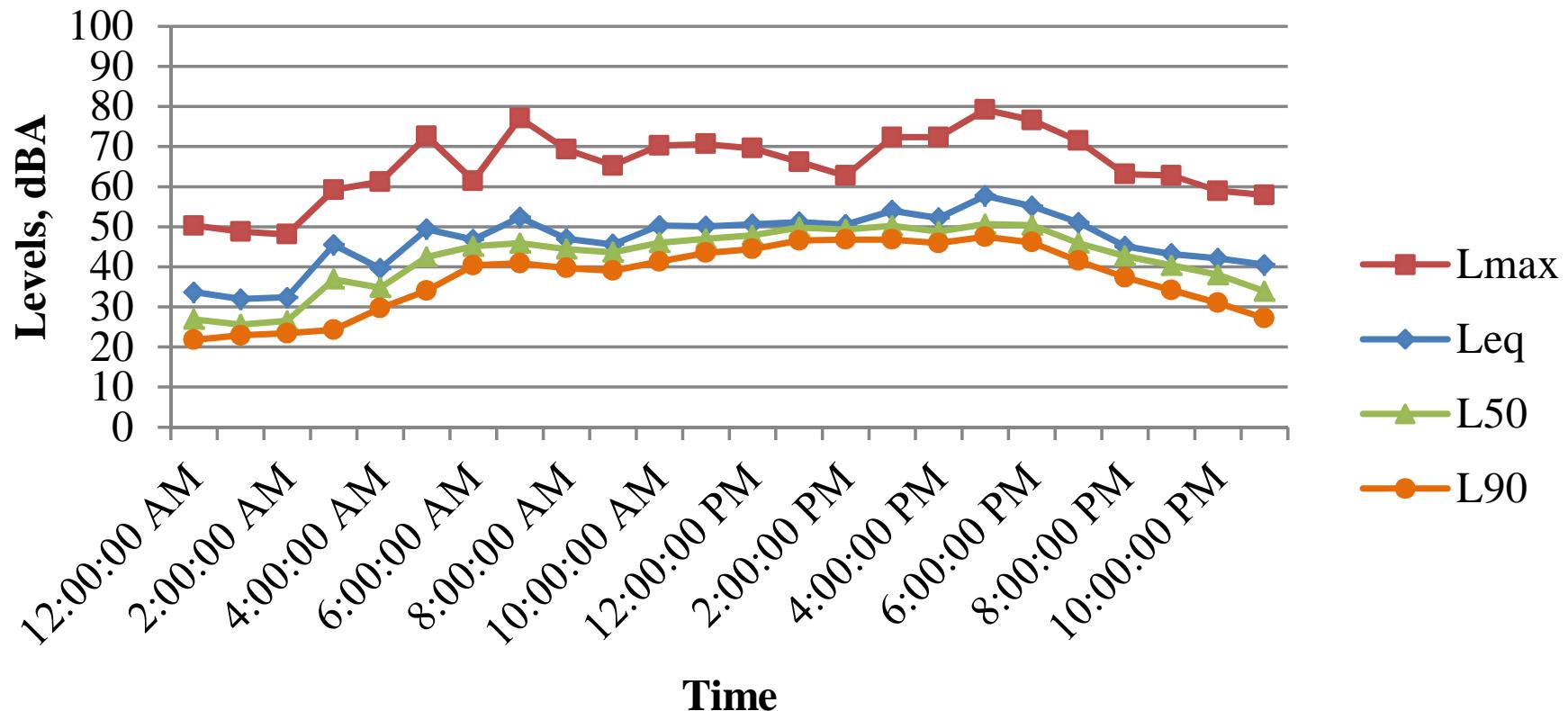
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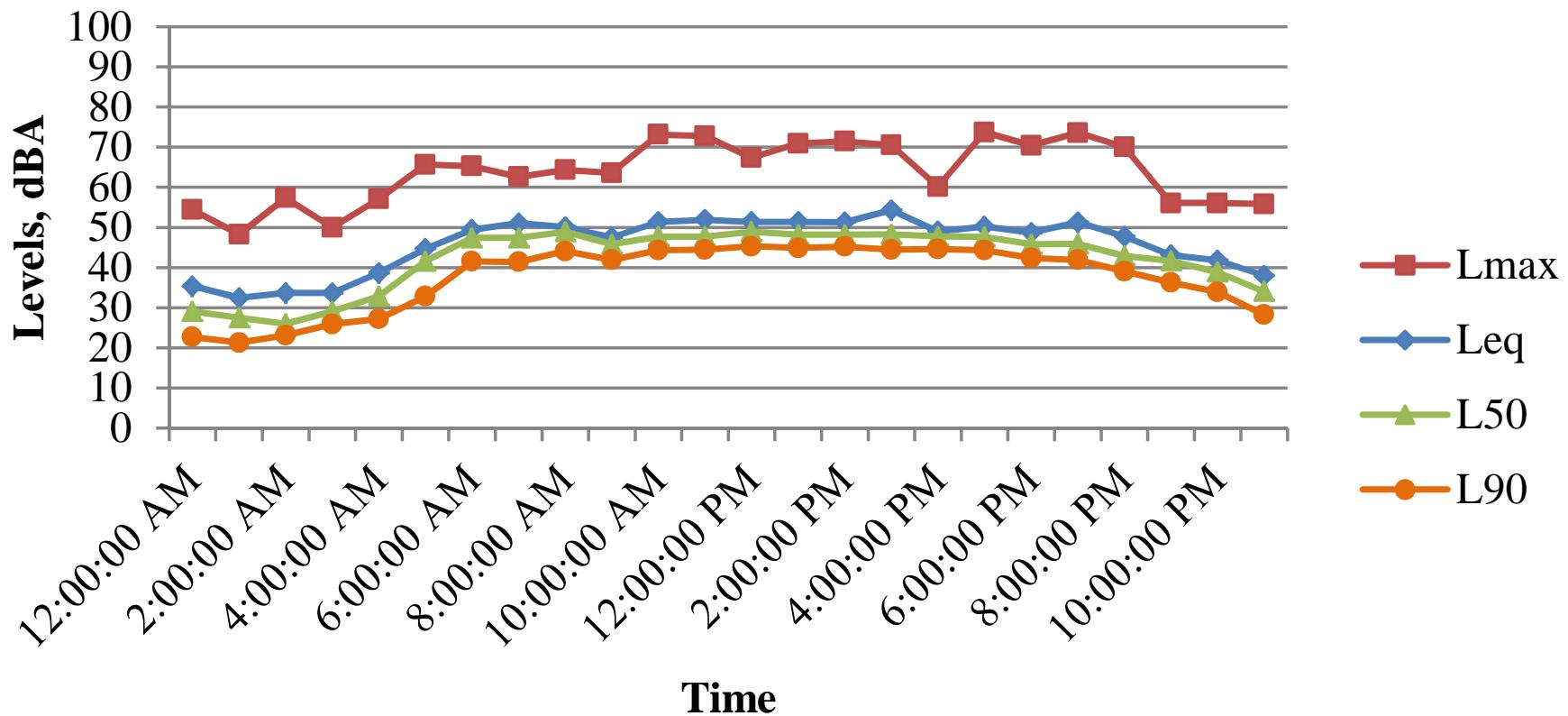
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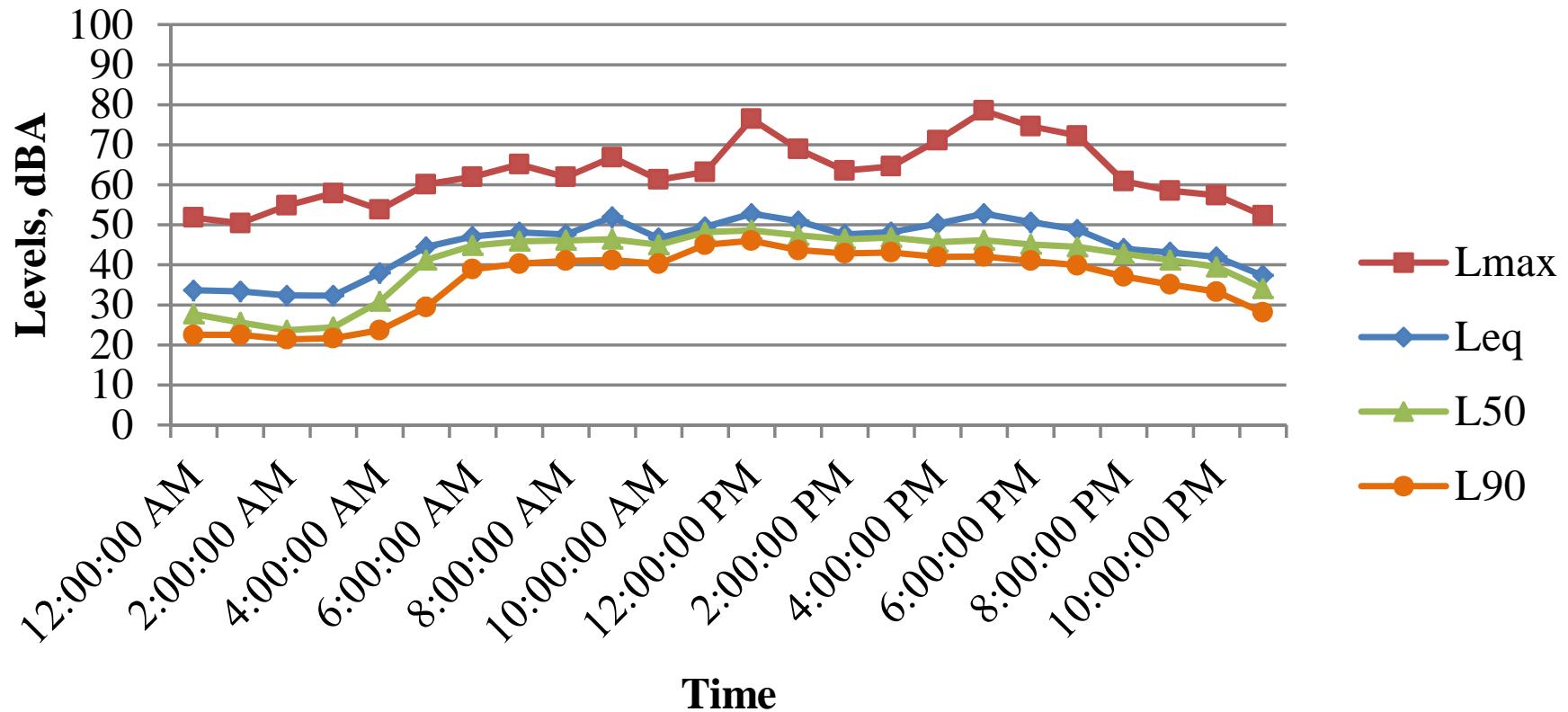
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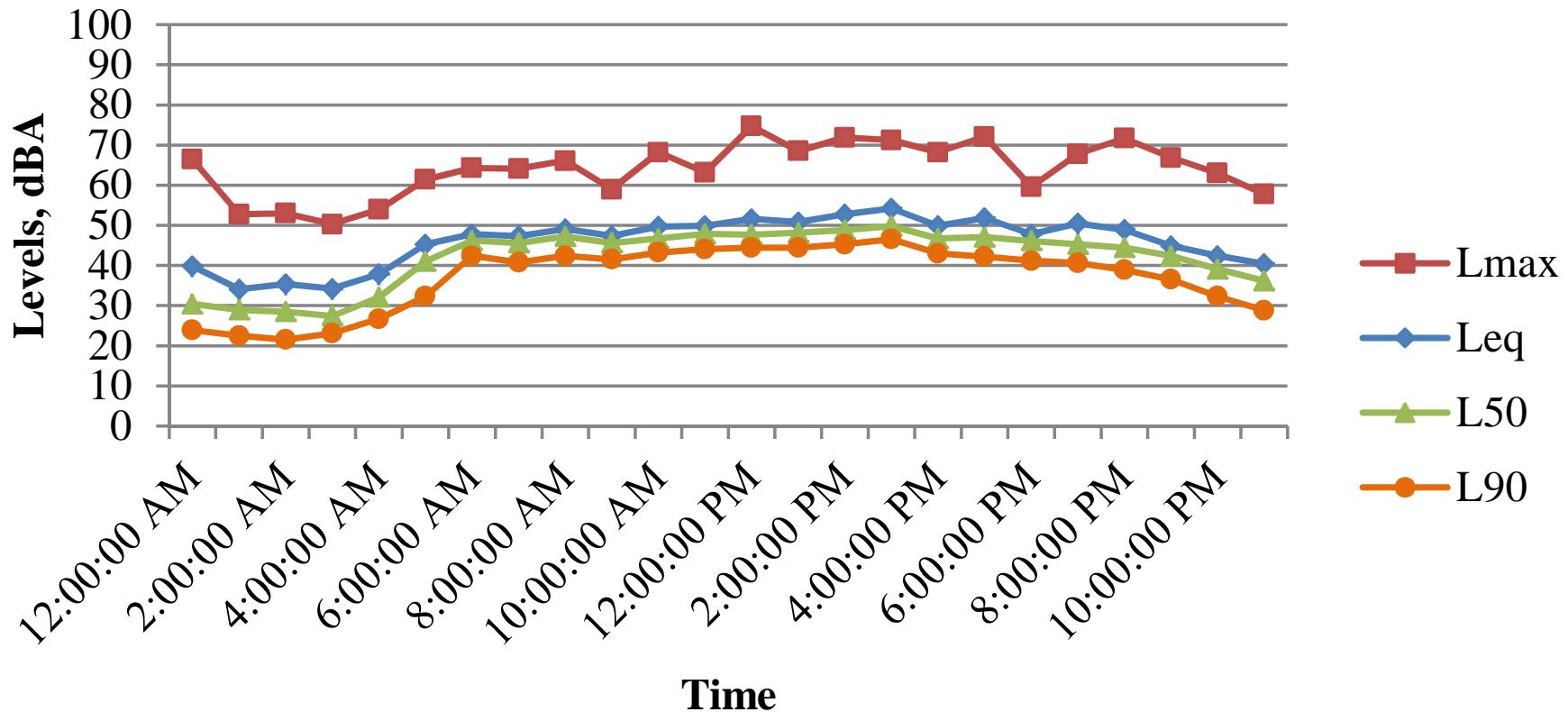
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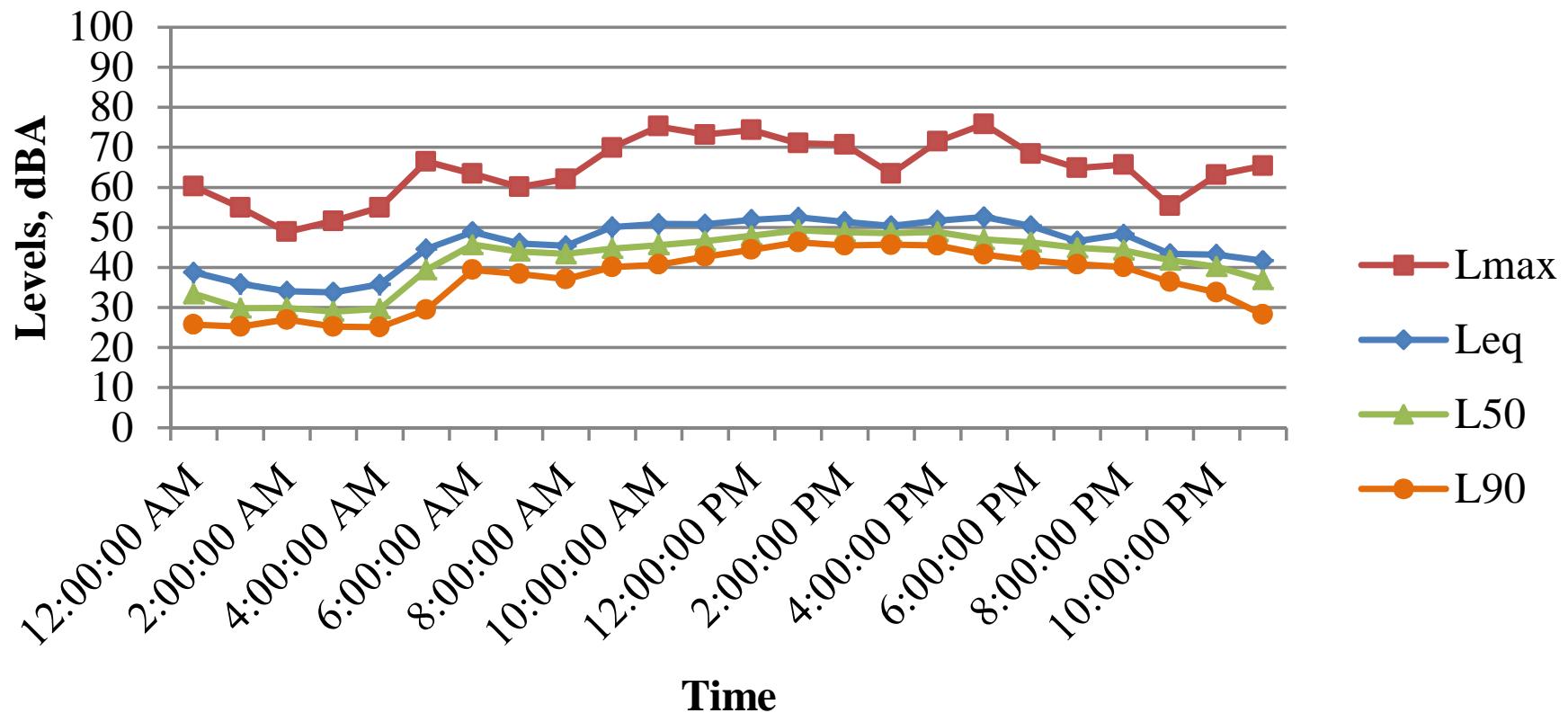
Site 5
May 14, 2015



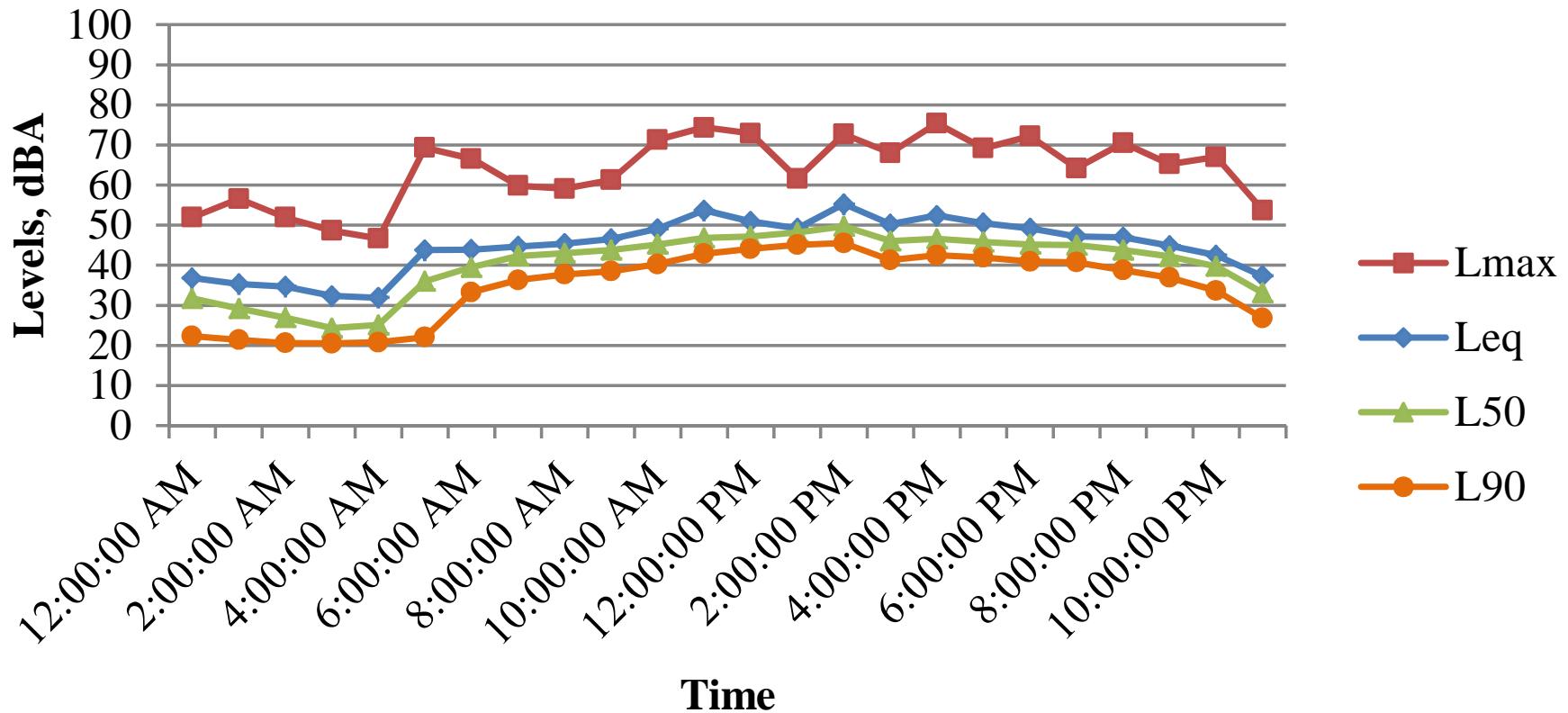
Site 5
May 15, 2015



Site 5
May 16, 2015



Site 5
May 17, 2015



Site 5
May 18, 2015

