



Mapping and distribution of noise using IDW interpolation algorithm in Thuan An city, Binh Duong province

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Article Info: Received June. 7th,2021, Accepted Nov. 25th,2021, Available online Dec. 15th,2021

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<https://doi.org/10.37550/tdmu.EJS/2021.04.258>

ABSTRACT

The study is conducted to assess the level of noise pollution from traffic activities in urban areas (in the case of Thuan An city, Binh Duong province) with the specific goal of applying geographic information systems. (GIS) in building noise pollution distribution maps in the study area. The research team collected noise data at peak hours and normal hours on weekdays and weekends using noise meters at 61 survey points. Noise measurement data was then interpolated using IDW (Inverse Distance Weighting) method to assess the spatial distribution of noise in Thuan An city. In addition, the study digitizes traffic routes and special areas (hospitals, schools, churches - pagodas) in the study area to identify areas affected by sound noisy. The results show that the areas near the main road are most affected by noise during rush hour, while areas in the small lane are noise level within the permitted range. In addition, the results also show the difference in noise level and noise time between weekdays and weekends.

Keywords: GIS, IDW, noise mapping, noise pollution, Thuận An city

1. Introduction

Over the past few years, the city Thuan An is always one of the localities leading in the industrialization of the province of Binh Duong, with the advantages of natural conditions, social, especially geographical areas, which have convenient roads to create an increase in enterprises, factories, production facilities. In addition to positive factors such as creating jobs, socio – economic development, Thuan An is facing a wide range

of environmental pollution problems, including noise pollution that has been affecting the health and community health.

The development of noise pollution caused by people's traffic over the city Thuan An is increasingly becoming increasingly complex and is a pressing issue, which is being addressed by mass media. Therefore, the overall environmental pollution assessment, especially noise pollution is the problem of concern. The assessment of noise pollution based on the previous method is only available at the level of data, in the sampling position, but today along with the strong development of GIS technology that allows us to assess the seriousness of pollution in the area, a general assessment of the overall picture of noise.

The establishment of noise maps from traffic in Thuan An city will help identify areas affected by noise sources. On that basis, managers can provide appropriate solutions to reduce noise pollution in their localities.

2. Contents and Methods of research

2.1. Research contents

- An investigation into the current state of noise generated from vehicles in Thuan An city
- To build maps and assess the status quo of noise pollution in Thuan An city

2.2. Methods

Research using the following major research methods:

2.2.1. Field survey and survey method

The study team noise measurement levels at 61 positions along the routes in the research area. The noise meter is SEW 2310SL and the Soundmeter application. The measurement conducted according to the method in TCVN 7878-2:2010 and circular 28/2011/TT - BTNMT: The regulation on environmental monitoring process around and noise. In experimental research, the results from the application in the phone are no big difference compared to the results from the specialized meter. The author has tested using the meter and the phone app, the noise deviation is from 3-6 db. The mobile app will give better results than a dedicated noise meter. This author found that did not have much influence on the measurement results of the study.

In positions of measurement, the study team measured the noise at 1.5m above the ground. At each location, measure noise levels within 30 minutes at different times of day, specifically:

- From 6:30am-7:30am: The high – school time period and a relatively large traffic concentration.
- From 10:30am-11:30am: The time of transportation has low density.

- From 16:30pm-17:30pm: The time to dissolve and finish the work of the workers, focusing relatively large traffic.

At each position, the measurement is measured in increments of each measurement of 10 minutes, within 30 minutes of 3 measurements, then take the average value of the measurements.

The actual observation time is conducted at the same time as noise measurement at measurements. The study team selected 2 times to carry out noise measurement: daily (weekdays) and weekend (Sunday) starting from 10/09/2020 to 02/12/2020.

2.2.2. IDW interpolation method

The inverse distance weighting algorithm is one of the most common techniques for introspection. The IDW method determines the value of unknown points by averaging the number of values of the known points in the vicinity of each point. The more likely the point is that the less valuable the value affects the calculation value, the closer the score is, the bigger the weight (Mitas & Mitasova, 1999).

With this tool we can easily implement the suy of adjacent points and accurately. IDW' s application in the study of noise levels is selected and evaluated as most appropriate, the most accurate results compared to the rest of (Sarah Eason, 2013).

2.2.3. Data processing method

The statistical study team digitized the software in The Microsoft Excel 2010 software, then link data from excel file into the ArcMap 10.2 application with a Join in the Join and Relate, which is available in ArcGIS to import data for each noise measurement in the shield network, then through the IDW suy tool to construct the noise map in the shield network.

After the results of the pollution map are available in each frame at the research area, the study team publishes products from the ArcGIS 10.2 software to a JPEG - formatted image file and inclusion in Microsoft Word 2010.

Implementation means: ArcGis 10.2 software, Microsoft Excel and Microsoft Word 2010.

In addition, the study used some other methods such as the method of studying theoretical facilities, data collection methods, data.

3. Results and Discussion

3.1. Traffic noise levels during the day

The survey level at 61 positions 3 different times during the day (6:30am-7:30am; 10:30am-11:30am; 16:30pm-17:30pm) on weekend (sunday) and weekdays, with a higher average value than QCVN 26:2010/BTNMT (from 6am to 21pm is 70 dBA).

Noise collected in the study area is shown in table 1 and figure 1.

TABLE 1. The noise data collected (dBA)

Measurements	CDS1	CDS2	TD1	TD2	CDC1	CDC2
The average value	75	75	73	71	77	77
Standard deviation set	4.64	5.13	6.13	6.52	3.68	3.32
Confidence interval	1.17	1.30	1.55	1.65	0.93	0.84

Notes:

CDS1: morning rush hour (weekdays)

CDS2: morning rush hour (weekend)

CDC1: peak hour afternoon (weekdays)

CDC2: peak hour afternoon (weekend)

TD1: off-peak hours (weekdays)

TD2: off-peak hours (weekend)

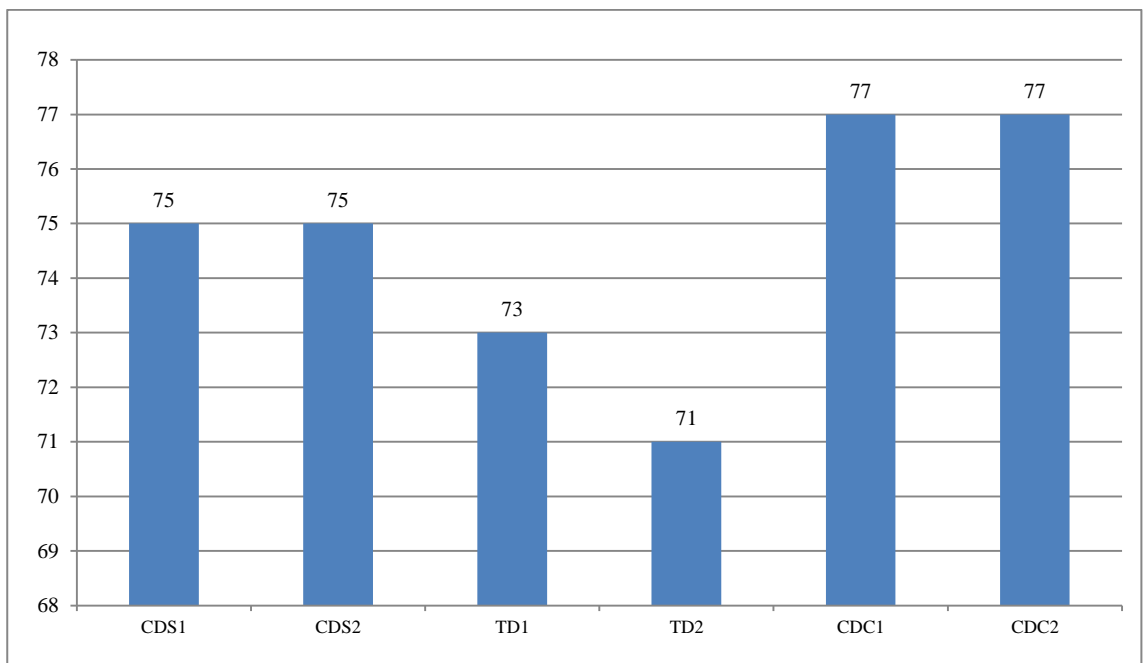


Figure 1. The average value chart of noise at intervals

It is possible to see average noise levels at peak (6:30am-7:30am, 16:30pm-17:30pm) which is the same as the same time falling around 75 ± 1.3 and 77 ± 0.9 dBA. While maximum noise levels allow QCVN 26:2010/BTNMT (6am-21pm) is only 70dBA. Since the city has favorable conditions for trade, there is an industrial zone, densely populated population between the weekdays and weekends seem to have no big differences in traffic and the time of the highest noise is the period of 16:30pm-17:30pm. In both weekdays and weekends, around 10:30am to 11:30am noise gap tends to mitigate.

3.2. A map of noise pollution in the period of time

Based on the IDW interpolation tool integrated in the ArcGIS section and the noise data surveyed at 61 points on the streets in Thuan An city, the map of the noise level is

shown at a time in figure 2, 3, 4, 5, 6, 7.

The results showed that at 6am-7:30am, it was time for workers, students to go to school, go to market. So traffic on very large routes, especially roads and intersections such as An Son crossroads, Binh Chuan crossroads, Mieu Ong Cu crossroads, An Phu rotation, 550 crossroads, Cau Ong Bo crossroads, Thu Khoa Huan street, DT743 street, DT743A street, No13 Highway, center of Lai Thieu ward, residential area next to the dumping ground of Hoa Lan Hamlet 2 noise levels ranging from 75-80dBA. The remaining routes area in Hung Dinh ward, Binh Nham ward, An Son Commune as the DT745 street, HL9 street, Thanh Quy street, Cau Tau street, Bung church street an area with no large trucks, mainly motorcycles and cars so the noise level only ranges from 67 to 70dBA (figure 2).

At the height of the afternoon from 16:30pm to 17:30pm, this is the time to dissolve the number of workers, students, students who participate in very crowded traffic and transport vehicles with large loads of goods and motor vehicles that have a large load of heavy weight in the city at the time of 70-81dBA. Particularly the DT743, DT743A, No13 Highway sections of the Lai Thieu ward, Vinh Phu often occurs in traffic congestion, with high levels of vibration from 77-83dBA (figure 4).

At 10am-11:30am traffic on all the streets of Thuan An city has been significantly reduced, this time is the afternoon so only the small transport vehicles should be route from 65-73dBA. Except for a number of main roads and routes in the industrial cluster such as DT743, DT743A, No13 Highway, ..., the average noise level ranged from 73-82 dBA. The routes belonging to the drivers sections of the Lai Thieu ward, Vinh Phu have relatively high levels of noise due to the region's regional areas focused on development service industries, strong trade with the leased goods from HCMC on (figure 3).

The results obtained on the weekend at the corresponding time periods also have no big differences due to the population here, although on a part of the day off, the students are entitled to a drop in school but the service activities, the transport of entertainment, entertainment, and entertainment services are strongly promoted. Compared to the date of the week, at the end of the week at a higher level of noise levels in the area of the major industrial zones, such as Binh Chuan crossroads, Mieu Ong Cu crossroads, DT743A street, Hoa Lan crossroads, No13 highway sections of the Lai Thieu ward, Vinh Phu, Ong Bo Bridge crossroads there is still a high average noise level due to the shipping activities of the tractor - laden vehicles in large still noise levels at these routes fluctuate around 74-79 dBA (figure 5) and 74-82 DbA (figure 6) và and 74-83 dBA (figure 7).

Routes in industrial parks have relatively high levels of noise, but traffic jams fall more than the days of the week.

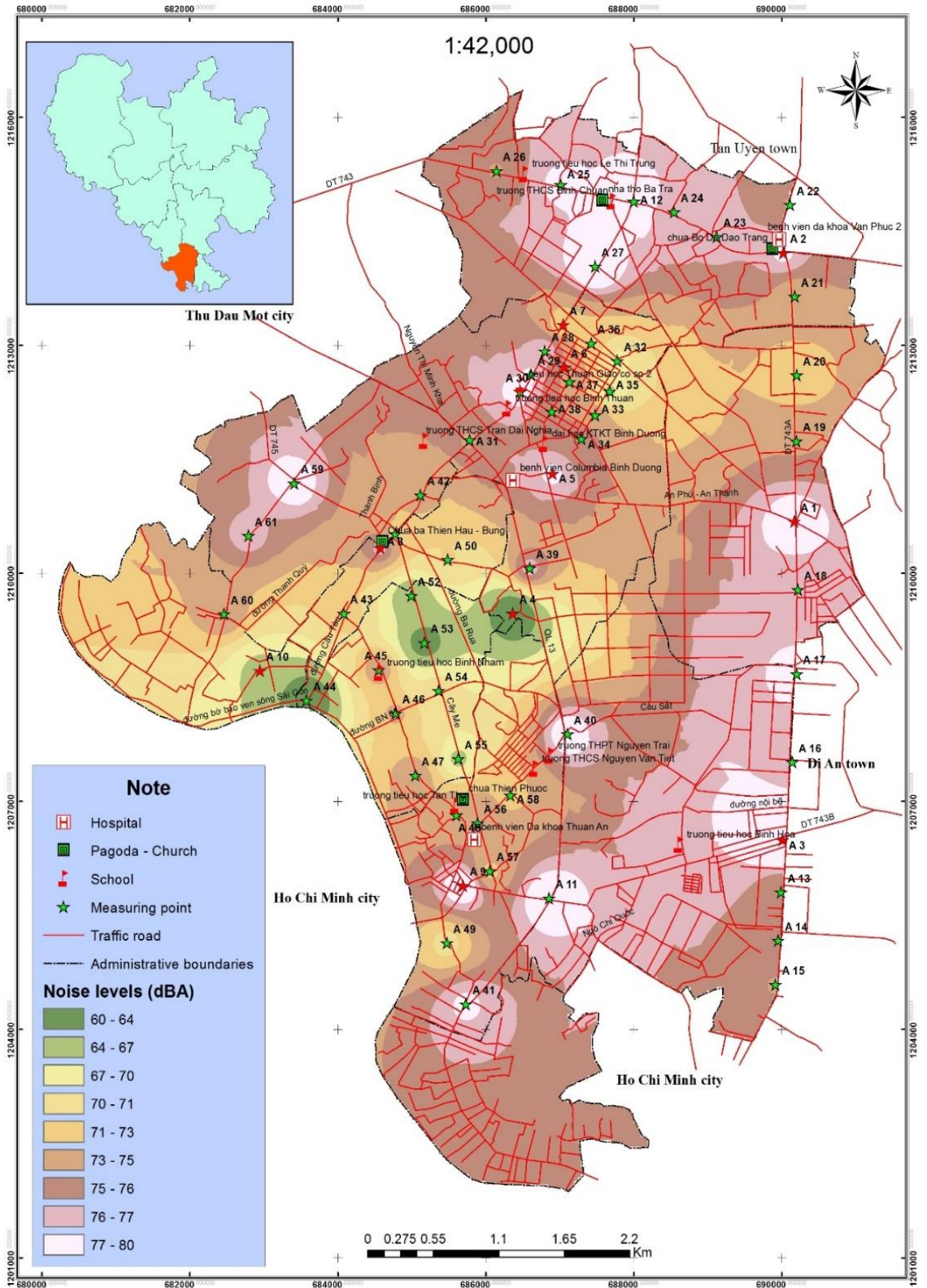


Figure 2. The noise level of 6:30am-7:30am is for weekdays

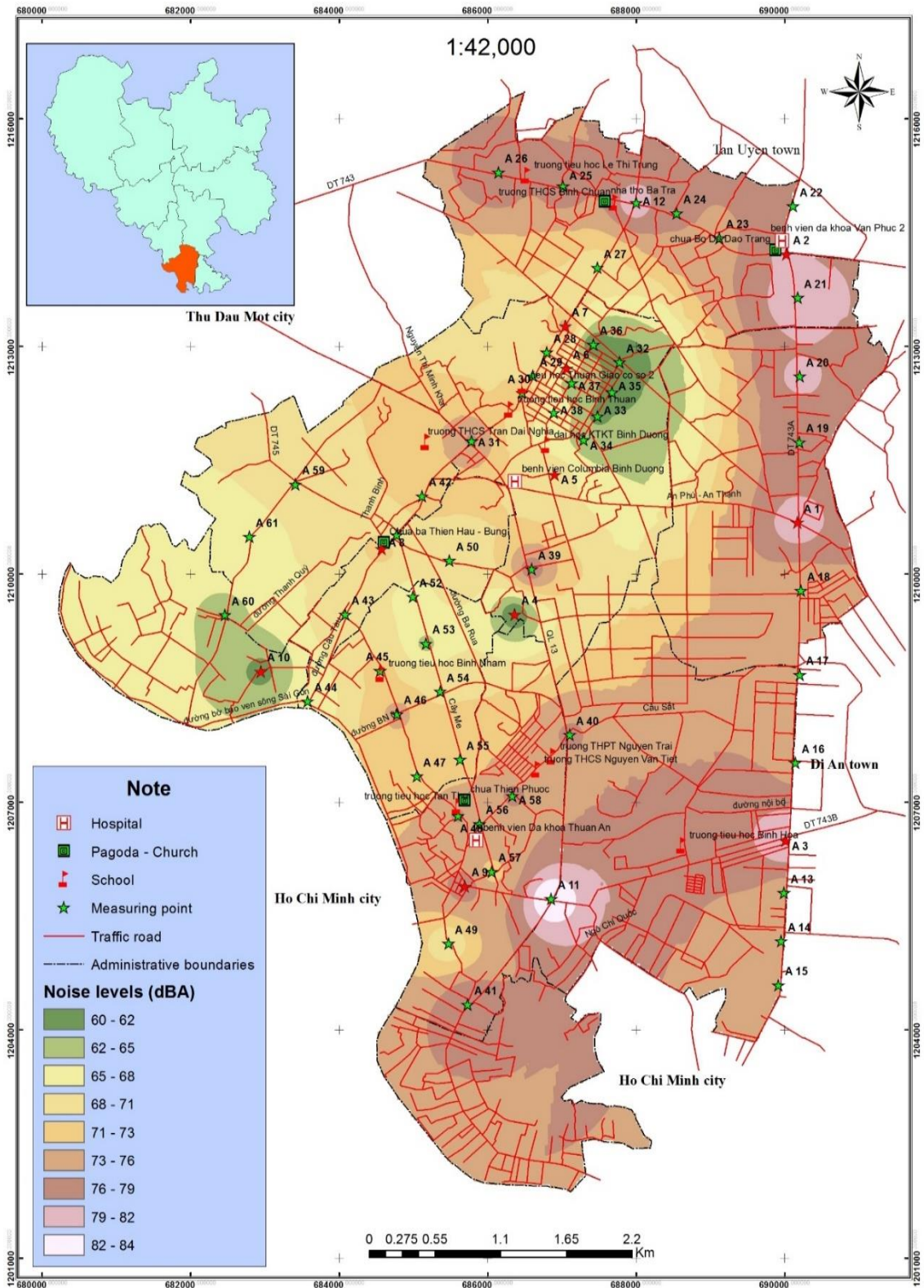


Figure 3. Map of noise level from 10:30am to 11:30am for weekdays

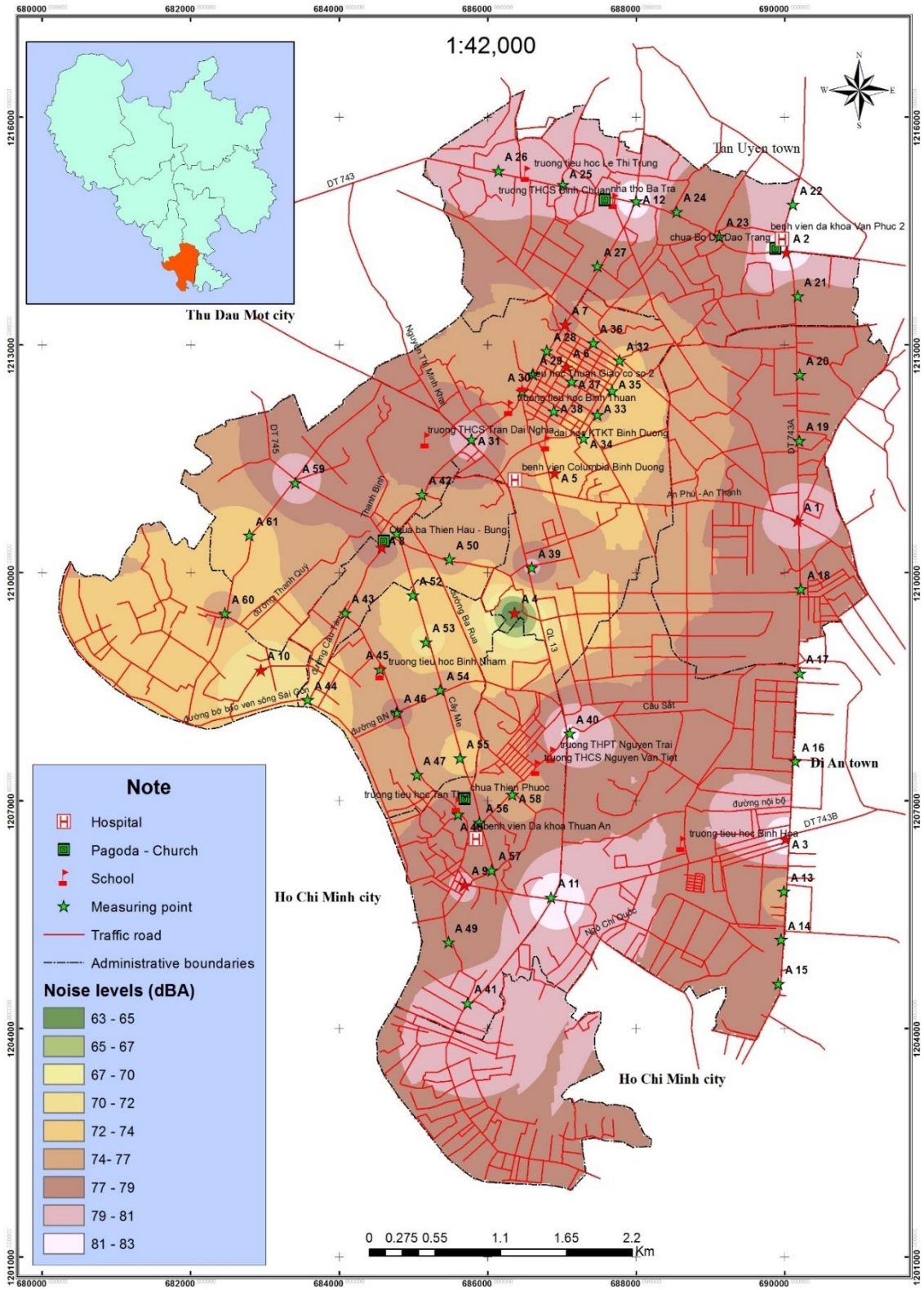


Figure 4. Map of noise level from 16:30pm to 17:30pm for weekdays

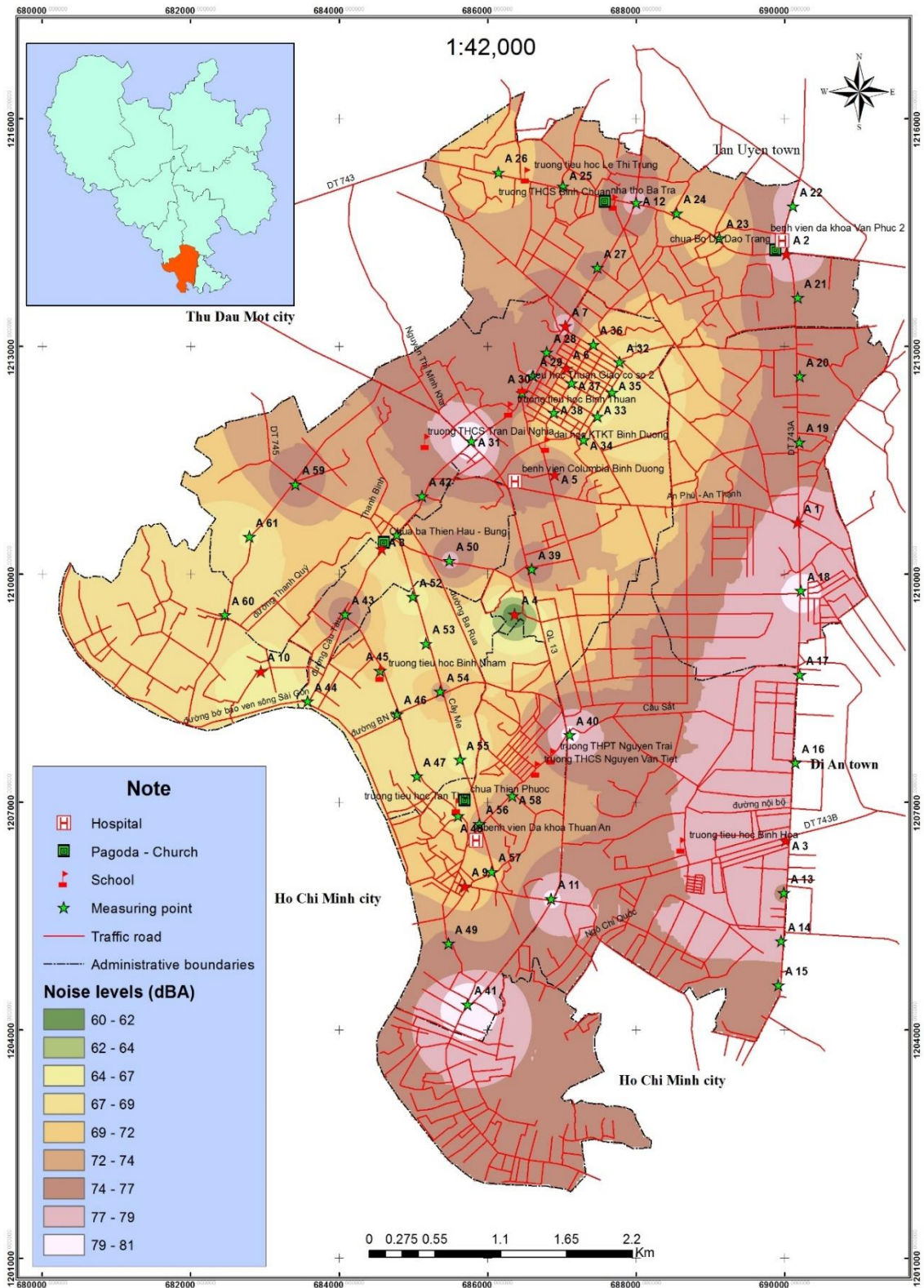


Figure 5. Map of noise level from 6:30am to 7:30am for weekends

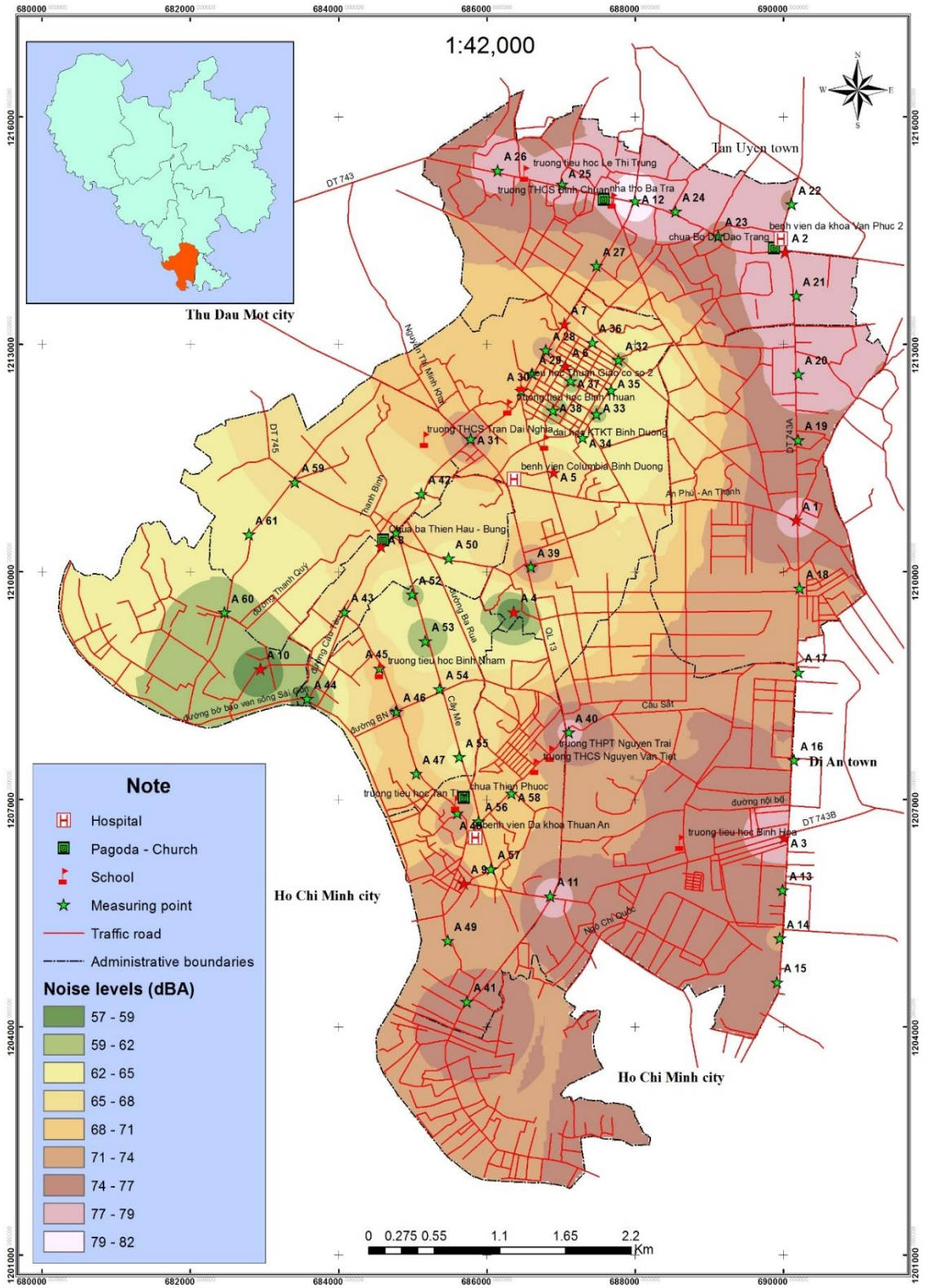


Figure 6. Map of noise level from 10:30am to 11:30am for weekends

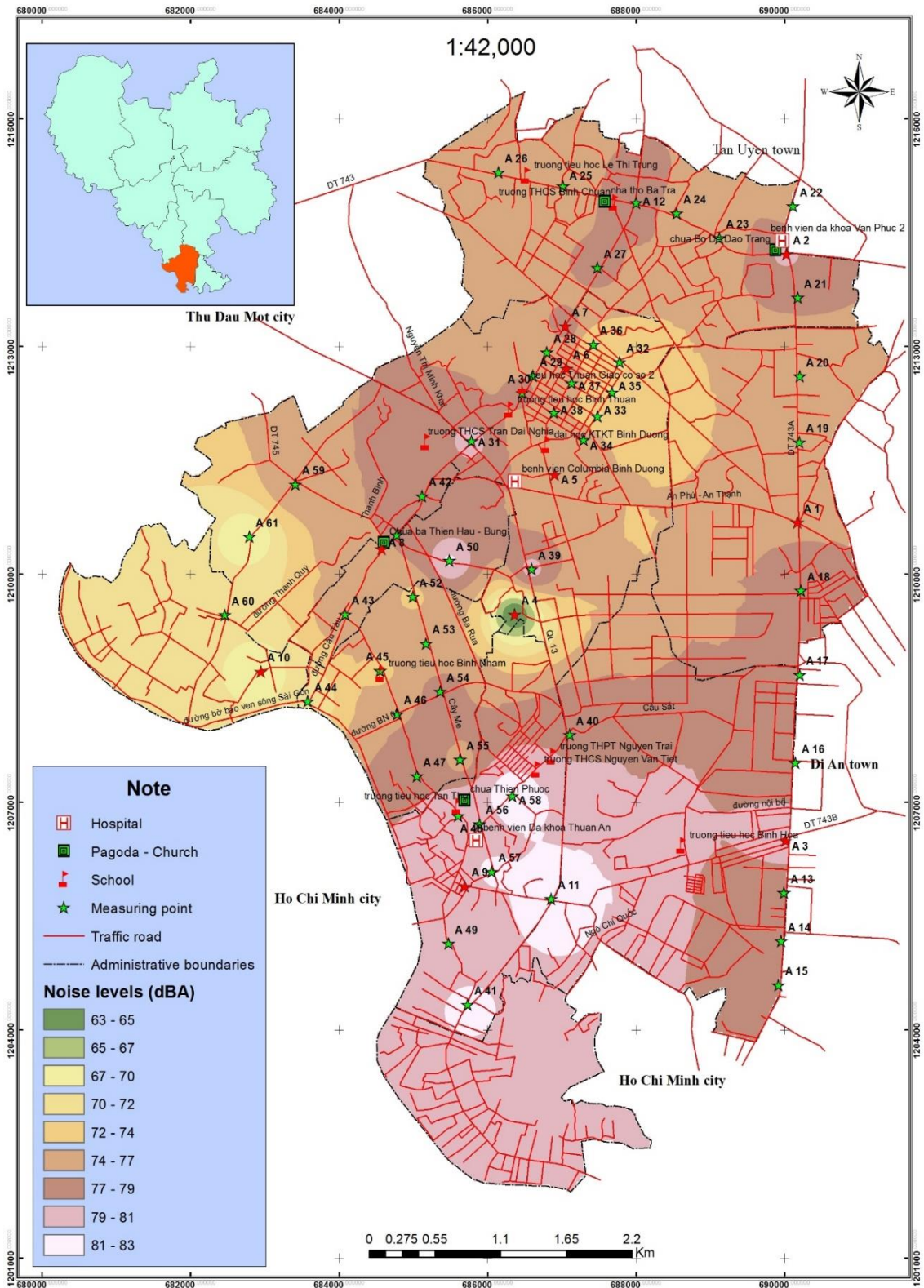


Figure 7. Map of noise level from 16:30pm to 17:30pm for weekends

Thus, with data on noise levels collected by the research team at the research area, it is possible to see that people living in the Thuan An city are suffering from a noise level, which is subject to a constant level of noise, especially in the main roads, (as No13 Highway, DT743 street, DT743A street, ...), focus a large number of vehicles from neighboring provinces (as Ho Chi Minh city, Dong Nai). This will affect the health of people living around the region due to exposure for a long time.

TABLE 2. Synthesis of points with noise levels that allow

Ward	Excessive points	Stretch of road	Average noise level (dBA)
An Thanh	A59, A61	DT745, HL9	77 ± 4
	A8, A51, A42	DT745, Bung church street	74 ± 3
Hung Dinh	A43, A50	DT745, Chom Sao street	75 ± 4
Binh Nham	A44, A52, A53, A55	B184, DT745 (Cau Tau)	74 ± 2
	A43, A45-47, A54, A56	DT745, B184	73 ± 4
Lai Thieu	A9, A41, A48, A49, A56-58	Trung Nu Vuong street, No13 Highway, DT745 street, Phan Dinh Phung street, B184, 3/2 street, Nguyen Van Tiet street	76 ± 4
Binh Chuan	A2, A21-A27	DT743, DT743A, Thu Khoa Huan street	78 ± 3
An Phu	A17-A20	DT743A street	77 ± 4
Thuan Giao	A6, A32-A38	Branch road in residential area Binh Thuan 2	72 ± 4
	A7, A28-A31	Thu Khoa Huan street	75 ± 3
Binh Hoa	A3, A11, A40, A13-A16	DT743A street, No13 highway	82 ± 5
An Son	A60	HL9 street	72 ± 3

4. Conclusion

So with the results of the survey data, along with the use of the Arcgis support software, the study of the current level of noise pollution at different intervals in the study area.

From the map, it is possible that most of the areas in the city are in the state of noise pollution and the main reason is that the vehicles, and the areas that are especially (hospitals, schools, churches - pagodas) are in the area of noise - level noise, which are affected by the noise - level noise sector.

With the results of noise - level maps at different intervals in the research area, managers can use to support warnings, information to relevant subjects and people affected by traffic noise in the region, and use as a basis for proposing mitigation measures in the region.

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