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ENVIRONMENTAL NOISE AROUND ROTTERDAM

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ABSTRACT

In an effort to decrease the annoyance of noise in the Rotterdam area, a large noise survey was deducted. The area incorporated Hoek van Holland (near the North Sea) till the city of Rotterdam, including the Rotterdam harbour area. The total investigated area was about 600 square kilometres. The noise levels were calculated for aircraft, industry, roads (highways and main roads through the cities), trains and ships (moored and travelling). These noise levels were all summed according to the 'Miedema method' to investigate the annoyance. Secondly the annoyance was studied by the outcome of several questionnaires with noise aspects carried out in parts of this area. In this paper we present the calculated noise levels and annoyance combined with the results of the questionnaires. The paper, presented by Rob Maat of the Environmental Protection Organisation DCMR, will present more detail about the total project and the possibilities to reduce the annoyance in this area.

1 - INTRODUCTION

In an effort to decrease the noise annoyance in the Rotterdam area, a noise survey called "Deltaplan Geluid" was deducted for a territory of about 600 km². In this paper we present the calculated noise levels and annoyance, combined with the results of the poll that was used. The paper called "Noise investigations in the Rotterdam Area", presented by Rob Maat of the DCMR Environmental Protection Agency (which was in charge of this survey), will present the total project and the possibilities to reduce the annoyance in this area.

2 - CALCULATIONS

The noise levels were calculated for the following sources types:

- Aircraft coming from the "Rotterdam-The Hague Airport" in the north-east part, [1]
- Industry on larger industrial sites, located mainly along the waterways
- Trains and subways-tracks above ground level
- Roads, highways and main roads [2]
- Ships navigating on the waterways and moored along quays [3, 4]

These noise levels from the different sources were summed according to a slightly modified Environmental Cumulation Measure (ECM) [5] based on equal annoyance, see table 1.

Noise types	Weighting factor a_{type}
Road traffic and navigating ships ¹	1.00
Railway	0.82
Aircraft	1.31
Industry and moored ships ¹	1.21

Table 1: Weighting corrections for calculating equal annoyance ⁽¹⁾: the weighting factors for ships were assumed on basis of little complaints about noise caused by navigating ships and similarity of industrial sources cause by moored ships).

For the night time the total noise level is calculated by:

$$L_{night,ECM} = 10 \log \left[\sum_{types} \left[10^{(L_{Aeq,night}+30)/10} \right]^{a_{type}} \right]$$

The rating system based on the $L_{night,ECM}$ is given in table 2.

Levels (ECM)	Rating	Levels (ECM)	Rating
< 50	Good	60 – 65	Rather bad
50 – 55	Reasonable	65 – 70	Bad
55 – 60	Moderate	> 70	Very bad

Table 2: Rating of ECM levels.

The percentage of people that is annoyed, is calculated as follows:

1. Annoyed % = $0.179(L_{night,ECM}-30)^2 + 0.88(L_{night,ECM}-30)$

2. Highly annoyed % = $0.0340(L_{night,ECM}-35)^2$

The noise levels were calculated on a grid of 100 × 100 meters. The housing areas were modelled with screens of 8 meter high. No reflections were calculated. The terrain was assumed to be flat. The propagation methods were the standards used in the Netherlands.

3 - RESULTS OF NOISE CALCULATIONS

The calculation results for the investigated area for the present situation are given in figure 1 for the noise levels based on ECM levels. Figure 2 shows the normative source type for the ECM-weighted levels. In most residential areas the normative noise type is traffic.

In total 264.000 people are (highly) annoyed by noise, which is about 26 % of the total population in the investigated area. For 80 % of these (highly) annoyed people, traffic noise is normative.

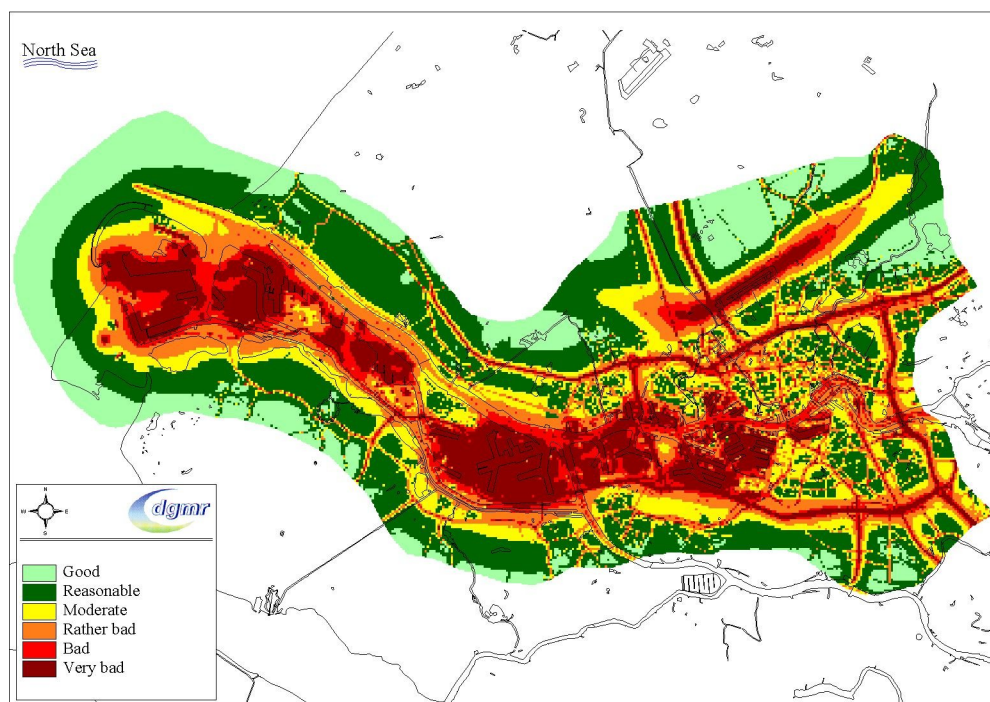


Figure 1: ECM – weighted noise levels around Rotterdam.

4 - ANNOYANCE POLL

Secondly the annoyance was studied by the outcome of the poll with noise aspects carried out in this area by the Province of South-Holland [6]. Figure 3 shows the outcome for the traffic noise annoyance

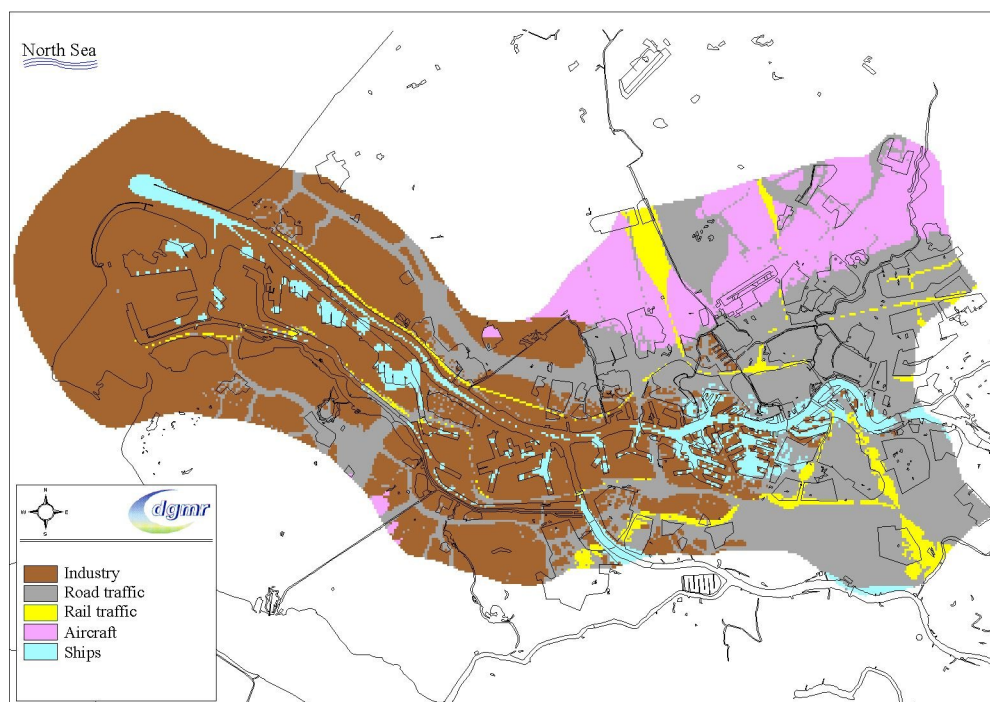


Figure 2: Most normative ECM-weighted source type.

in the residential areas. In most residential areas the highest calculated source type is traffic noise. This matches the results of the poll. The differences in calculations and polls are mostly found around the airport. Based on the poll there is more annoyance by aircraft than would be assumed, based on the calculations. The cause may be an underestimation of aircraft noise in the ECM-method.

5 - COMPLAINTS

Thirdly the noise complaints the DCMR Environmental Protection Agency received were investigated Environmental. The number of complaints per 1.000 inhabitants per year (1998) is showed in figure 4 for aircraft noise. The total number of noise complaints varies with the years, with an average of about 12.000 a year. Aircraft originates about 75 %. Industrial noise is second with only 6 %. The number of complaints about traffic noise is less than 2 %. These figures are not comparable with the outcome of the calculated and questioned annoyance further away from the airport. This is in line with one of the starting-points of this study. The complaints were only to be used as a support to map the annoyance in the area.

6 - CONCLUSIONS

In the large industrial area of Rotterdam, traffic noise is the main source of annoyance. This is the outcome of calculated noise levels and a noise annoyance poll. Complaints, mostly about aircraft noise, give little information of the overall noise situation.

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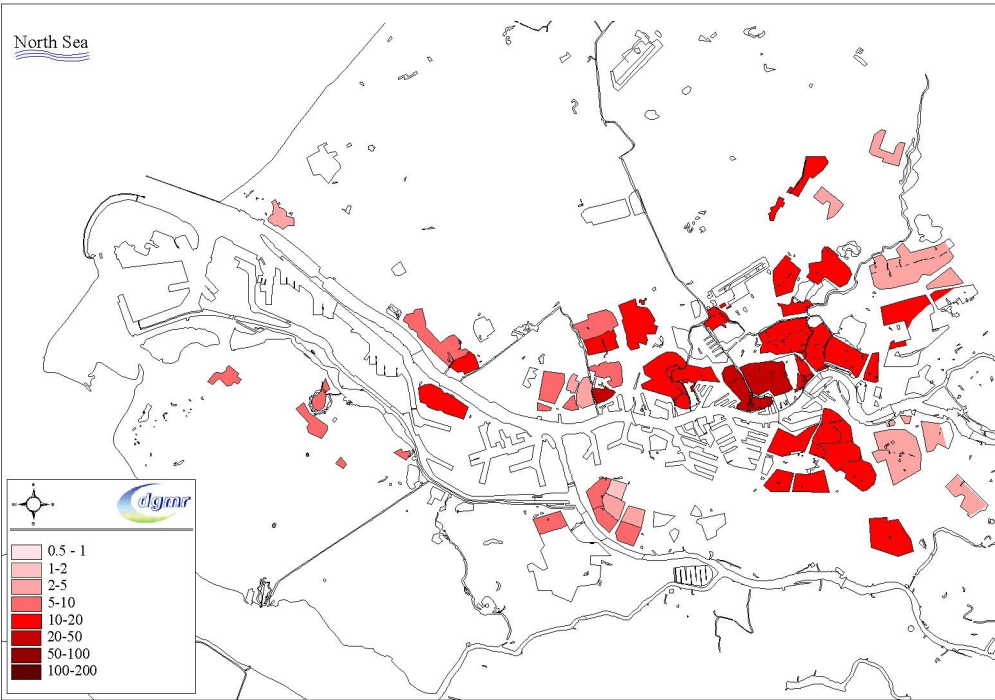


Figure 3: Number of highly annoyed people per 10.000 m² in residential areas for traffic noise based on noise annoyance poll.

6. Province of South-Holland, *Environmental poll of South-Holland 1998, 1999*

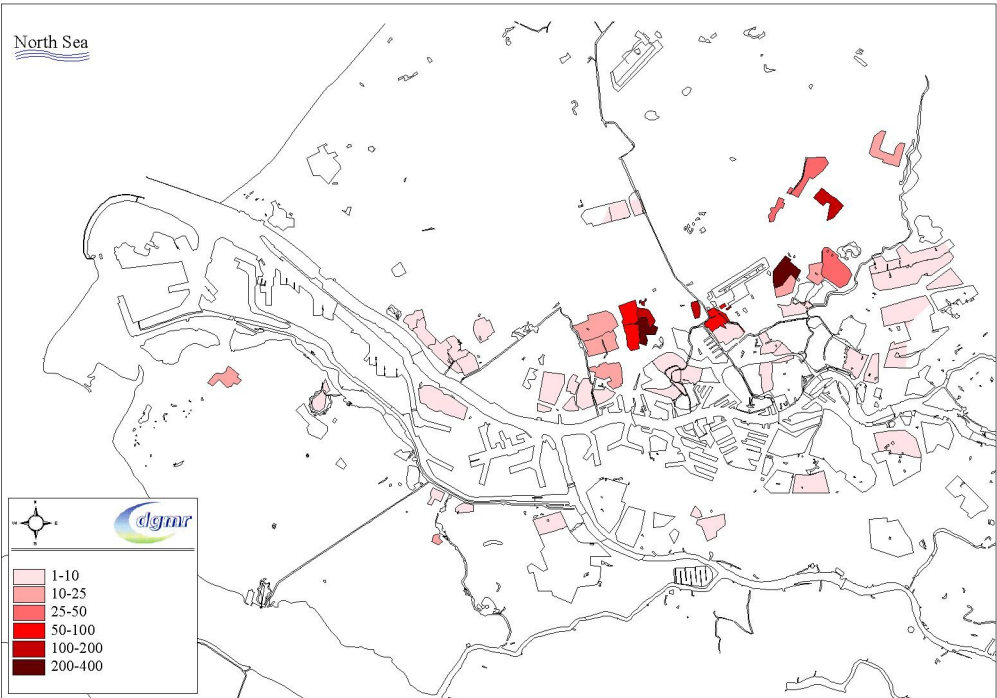


Figure 4: Number of complaints per 1.000 persons in residential areas for aircraft noise.