

A Structured approach to LFS-complaints in the Rotterdam region of the Netherlands

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In the working area of the DCMR Environmental Protection Agency (EPA) an increasing number of people have registered complaints because of low frequency sound (LFS). A 'protocol of low frequency sound' for use in the Rotterdam-area has been developed. The purpose of the approach on LFS is threefold: (1) to offer the several organisations involved a handle to work with, in order to clarify the nature of the LFS complaints and structure them in a procedure; (2) to register their experiences with LFS; (3) to possibly develop a policy on LFS. Conclusions are as follows. (a) The indications lead us to assume that LFS is a growing problem. (b) If the source is not found directly there are complex factors contributing to the LFS-annoyance. (c) Those whose quality of life and health are threatened by LFS need help. (d) The system introduced is a good start. (e) Periodic modifications should lead to an improvement in efficiency. (f) A necessary condition is a consistent, well-equipped and well balanced team of people with experience in handling LFS-complaints. (g) To improve the approach it is worthwhile gathering

1. Framework

The word 'sound' is used intentionally because most of the complainants do not use the word 'noise'. Hence, LFS instead of LFN. This paper clarifies the backgrounds, the systems used with the protocol, together with a report of experiences and a look into the future.

The Rotterdam region (Rijnmond) and its acoustic climate

The figures between brackets are a comparison with the Netherlands. Rijnmond is about 2700 km² (3%), with 1.2 million inhabitants (7%), about 25.000 companies, 200 industrial sites, and some 30% of the inhabitants are noise-annoyed. There are 18 municipalities in the Rotterdam region. Noise is coming from various sources: traffic (road, rail, water, air) and main sites (factories/harbours).

The Environmental Protection Agency (EPA; in Dutch: DCMR) has about 450 employees. One of the responsibilities is the registration and investigation of complaints, reports and incidents. Specialists are on duty 24 hours a day as telephone operators and field inspectors. Most of their incoming information is passed on to the enforcement-sections. They catalogue the information (in most cases on the next day) and arrange follow-up proceedings. The follow-up can consist of a visit to both the companies responsible for the noise annoyance and the complainants. Reports are made of all the activities following a complaint and this is added to the system MIRR [EPA97].

2. LFS-history in the Netherlands, especially in the Rotterdam region

LFS-annoyance is not predicted by the A-weighted levels [VRO, Per] and is not included in legislation, as this aspect was not important enough in relation to other environmental problems. Since then, justice sees the LFS problem as a case with 'probable special sensitivity of the receiver' which means that aggrieved conditions cannot yet be linked to a licence.

In 1995 and 1996, national meetings of the 'interdisciplinary panel LFS' took place, based on experiences of the Monitoring Network for Health and Environment (a non-governmental organisation of citizens/volunteers). The product was a bundle of 125 pieces of work [MGM96]. Several members of the panel have published their summaries.

In 1997, EPA was host to a National LFS-workshop [NSG97]. This was the starting point for a Dutch guideline on LFS. In the same period questions were asked in the Dutch Parliament by persistent LFS complainants. Together with MHS (the Environmental Health department of the Municipal Health Service, in Dutch: GGD/MMk), supported by the Municipality of Rotterdam, EPA started an ad-hoc co-operation to handle the LFS-complaints. Afterwards the City of Rotterdam ordered the EPA to officially handle LFS-complaints and to gather knowledge.

In the meantime, EPA participated in national LFS-studies for health symptoms and the indoor environment, resulting in the NSG-Guideline [NSG99]. In November 1999, a start was made with the establishment of a Dutch platform of approximately 60 LFS-sufferers.

Earlier, in December 1998, the EPA-protocol 'Handling of LFS-complaints in the Rijnmond region' was completed. The LFS-complaints persisted, sometimes accompanied with serious health and social problems, while similar difficulties were recognised in the rest of the Netherlands. Following from our experience, this paper is a clarification of the situation.

3. Reasons to deal with LFS-complaints

These are the following.

More attention is being given to the effect of nuisance on the environment [e.g. MGM99].

Social-economical motivation

- A district turns into a poor district when people with higher incomes are leaving the area. If people are leaving because of pollution, including LFS, it is bad advertising!
- Health complaints occur after a certain period of time. Waiting for epidemiological results is an unnecessary delay.
- To prevent mentally exhausting juridical procedures.

Social interest

- Sufferers who cannot find an ear for their problems, will seek medical help. Paying special attention to LFS-complainants, reduces their feeling of isolation.

Aid

- Minimise insecurity, dissatisfaction and fear of the sufferers.

Complainants get peace of mind, feeling their problem is seriously handled.

Acoustic climate

- From 1980 the spontaneous increase of levels of L_{Aeq} has stopped. However, the growing social activities within society are blocking things. Other kinds of noise pollution such as that related to L_{max} , LFS, are going to play a bigger role as a result of a growing number of 'special events'.
- Complaints are indicators. In general: the higher the quantity of complaints, the better the quality of the indicator.
- Raising of consciousness regarding LFS in those who are responsible for sources of sound, and civil policy makers as well.

Spatial planning

- Most noise-problems are in fact environmental planning-problems. Keeping a sufficient distance from sources can reduce the problem.
- Concern about the growing use of time and land with noisy activities.

4. Dealing with LFS-complaints

The EPA-protocol 'Approach to LFS-complaints'

The number of times that most of the acoustical or social workers come into contact with complaints arising from LFS is in fact minimal. In those cases they need support, such as that provided by a protocol, which is outlined in Fig 1.

Parties involved

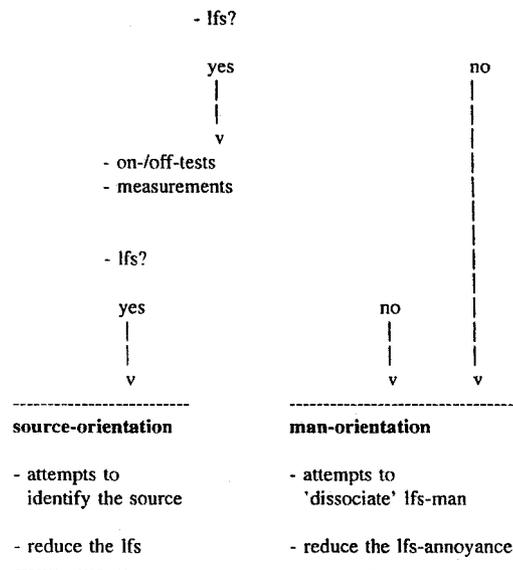
The complaints possibly related to LFS come in through different channels, so it is probable that more than one person handles the problem.

- Environmental Protection Agency Rijnmond: complaint-centre employee, enforcement co-

- receipt of lfs complaint
- administration / forming a team (ad hoc)

objectivating complaint

- intake-interview with complainant
- geographical-historical complaints-investigation
- making a survey



- message to complainant and teammates
- close file
- complaint dispatched

Figure 1. Main outline of the Protocol 'Dealing with lfs complaints'

ordinator, co-ordinator and manager of the Noise Section are involved. There are 6 EPA-enforcement departments, most of them divided into two groups.

- Environmental Health Department of the Municipal Health Service (MHS). There are four MHS's in the working area 'Rijnmond' of the EPA.
- Police: interim agents (reporters), environmental co-ordinator.
- Community or province (especially in case of written complaints): handling manager. In the working area of the EPA there are 18 municipalities. The municipality of Rotterdam is divided into 10 parts, each with a certain independence.

- Housing association: managing employee, caretaker, social worker. There are many of them. An enormous amount of reorganising and merging is going on.
- Monitoring Network for Health and Environment: the provincial agent. - Dutch Noise Annoyance Foundation (NSG): information-agent.

The collaboration with the Municipal health Service (MHS, psychological and social aspects) and EPA (technical aspects and management) is part of that protocol, together with a streamlining between the different branches of the EPA.

Possible steps to take

The course of action a complainant usually follows is:

EPA-complaint centre, one of the enforcement inspectors, assistant section Noise. That section will contact one of the departments of the MHS's in the area. The protocol guides the different partners in the process of assistance. The protocol is not a plan, but a description of experiences until 1998. It is also not a blueprint, but a guide. To find LFS-sources, the EPA-protocol may help, but it does not specify methods by which to identify them.

Ending a case

It depends upon the degree of involvement whether EPA or MHS end a procedure on their own. Examples of such cases are:

- source found (EPA starts negotiations with the one who is responsible),
- sufferer is a confused person (MHS guides to another kind of help). In many cases EPA and HMS deliberate.

A case may also be ended if:

- the measured sound levels are extremely low, to find a specific source would take very much effort,
- there is no possibility of reducing the sound (e.g. traffic),
- in similar cases there is no prospect of solution,
- LFS is one of the (many) problems of the complainant, but not one of the important ones,
- The complainant refuses (further) co-operation or wants to sell his house.

5. Other aids besides the Protocol

The protocol is a good basis but more aid is welcome. We developed the following.

Forms

Several of them support the procedure as a help to gather information (about situation and circumstances) for filing.

- The one-page communication form. Every involved party gets a copy of a communication form, to enable them to see working procedures and who has to be informed. The form gives the complainant, e-mail addresses, telephone numbers/fax numbers and the addresses of all parties.
- The four questionnaires A, B, C and D give a clear picture of the situation. Form A focuses on the basic circumstances. When the EPA-inspector pays the informant a visit after he has investigated the environment 'B' is used. Form 'C' focuses on the acoustical aspects. Form 'D' is personal, meant for the MHS-assistant.

Files of complaints, factories and acoustic climate

To start the process the EPA-complaint

centre does geographic-historical investigations. The register of all complaints enables one to find similarities. The EPA also has the vast system 'MIRR' [EPA97] in which most of the information about institutes is filed. It is a help to find sources of noise. The section Noise has rough indications of the acoustic climate of most of the dwellings and what kind of noise (traffic, airport, factories) is dominant. But field research is always necessary, the information mentioned above is just a help.

Complaint follow-up system (CFS) on LFS

About two years ago, the growing number of complaints became too many to be memorized, so a simple system was constructed to keep those who were involved informed. Administrative details are: name and place of informant/complainant, dates of complaining, first action (e.g. house call), in put MHS date of measurements and report, case-code, provision of the evaluation forms. The dates immediately give a survey of the time-scale involved. The characters of the case-code are the entrance to a subsystem, a log in which the main points of the process are kept.

The CFS requires the user to keep it up to date. Otherwise the consequence will be that one has to ask around and to search through files. The CFS contains four categories: A= active, processing (34), W = waiting, for new facts or a sign from the complainant (9), P = predicted (3), X = finished (66). The figures between brackets are the numbers for February 2000. In the year 1999 the section Noise handled about 40 cases. In a quarter of them measurements have taken place. From the LFS-complaints reported through the complaint centre, about a half of them will be put through to the Noise section. Those are inserted in CFS and are probably the most difficult ones.

noise

City pays up for airport noise

Denver will pay Adams County and four of its cities \$34.3 million to settle five years of aircraft noise violations near Denver International Airport (DIA). Under terms of the settlement, the county and Commerce City, Brighton, Aurora and Thornton will use the money to help shield residents near DIA from plane noise by insulating homes, adding new doors and windows, and possibly buying out homeowners closest to airport runways. The county and cities have not determined how much money each jurisdiction will receive or set a timetable for giving homeowners the payments, said Adams County Attorney Jim Robinson. The agreement comes only days before a trial was to begin in Jefferson County District Court over serious noise violations recorded near DIA after the airport's first year. Denver lost an earlier court case and paid Adams County and the cities \$6.3 million for noise violations in 1995, DIA's first year of operation. The settlement announced Thursday covers more than 50 serious aircraft-noise violations that were recorded near DIA between 1996 and 2000. A 1988 agreement between Denver and Adams required that the airport would be liable for a \$500,000 payment for each serious noise violation, determined by a computerised flight-tracking system.

notes

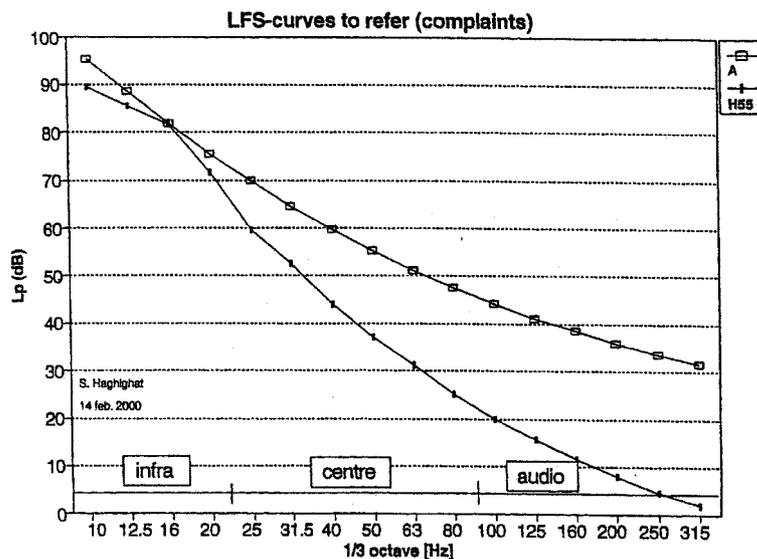


Figure 2. Checking of lfs measurement results (Protocol curves). Legend: see figure 3

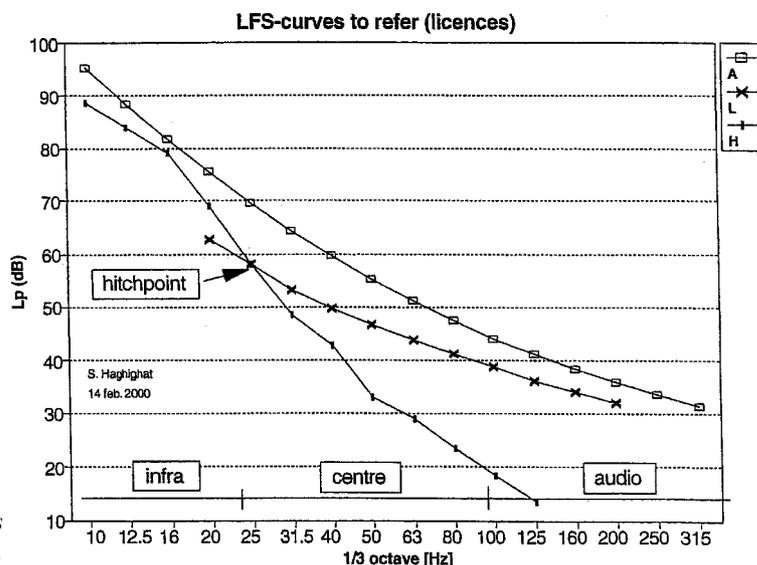


Figure 3. Proposal to use in licences (P. Sloven. 2.2.2000 to be discussed)

- Just in the most aggravating circumstances.
- For the present: situations within homes at night.
- More are less continuous and normal lfs limiting extra annoyance (tonal banging characteristics combination with tangible vibrations).
- To be judged more severe in case of combination with tangible vibrations and in case of lfs with a clear banging character

Above the x-axis the parts of the lfs-frequencies.

The y-axis: equivalent unweighted 1/3 octave band sound levels.

Lfs-curves intended for use by permit granters [SloOO] and the EPA-Protocol.

A = 25 dB(A); all sound-energy concentrated in one 1/3-octave.

L = Lfs-limit. Above that curve there is excessive annoyance. To use as license-limit from 25 Hz.

H = HTL5 = Hearing Threshold Level that can be experienced by 5% of the average Dutch. To use as license-limit up to 25 Hz.

H55 (figure 2) = Hearing threshold level to be heard by 5% of the most important group of complainants those who are aged about 55 years. [Pas].

Measurements

The preparations for measuring and the making of the reports take a lot of time. This is done only if necessary. Sometimes, for certain cases in which measurements are combined with on-off tests, a measuring-scheme is devised. Semi-automatic measurements are also made by the complainer. The circumstances and the facts as to what exactly should be measured are not always clear. If possible we allow time for the measurements and sample exclusively the sounds of interest. Experience is that it takes much more time in the cases where disturbances are traced and sifted after the event.

Measurements are assessed in relation to Figs 2 and 3.

We use a list to memorise what machines should be turned off in the house, and also to remind us what to put on again afterwards (refrigerator, alarms, heating system-pump etc.).

The measurements are made at the time that the complainant hears the sound best, very often at night and in the complainer's bedroom. But to gather more information, the measurements also take place at other places in the house.

The files of complainants

The Noise section of the EPA makes work files, titled by the main complainant's name. The work files are ordered geographically. The official aim of this is because the way EPA works geographically. The acoustical aim is to recognize similar sources and cases in the neighbourhood, even if the time between cases is several years.

Communication

We have developed several ways to communicate with the people dealing with the LFS-problems: complainants, EPA + MHS, other relief workers.

With complainants

Ambition: sincerity, honesty, and – last but not least – clarity. In many cases there is dialogue with MHS. Sometimes it is found that there are personal problems not caused by LFS. To draw attention to the sub-problem and to enlarge it that way is not appropriate. That is a reason to end the complaint handling with a letter, written by EPA and/or MHS, which explains why the investigations have been stopped and what can be done next or instead. In 1999 a brochure was prepared and distributed through town halls, libraries, pharmacies, hospitals and medical doctors in the Rotterdam-region.

Between EPA and MHS

The EPA-section Noise and the Environment Health Department of the MHS have almost daily contacts to deal with one or more LFS-cases. In order to discuss general aspects, lines of policy, changes in the way we work and to keep each other well-informed, the LFS assistants of the Noise-section and assistants of MHS's have periodical meetings on LFS and meet about three times a year.

With other relief workers

The experiences, results of research in literature, information and possible ways to prevent LFS or to reduce the nuisance, and the quantitative state of LFS case-handling are gathered in quarterly reports. This is a way of sharing knowledge, to keep people informed and to use with the general quarterly reports made by EPA.

6. Results

Although in the acoustical view not many cases lead to a solution, there is considerable success in fulfilling the aims formulated under 'Reasons to deal with LFS-complaints'.

Denser housing brings more sound insulation

Tough sound insulation rules are expected to be introduced for new houses in the UK amid fears that proposed high density developments will send complaints about noise soaring. The changes, which will require builders to use much more stringent sound proofing, run alongside John Prescott's plans to ease the south-east's housing crisis through the construction of closely grouped houses. The density of housing developments in the south-east is currently 25 dwellings per hectare on average. But new government guidelines will require developers to build at a density of 30 dwellings per hectare. The fear in Whitehall is that more closely bunched homes will accentuate the problem of noise, which already dominates the workload of environmental health departments. More than two-thirds of all complaints received relate to some form of domestic noise. Ministers fear their flagship proposals to ease the south-east's housing crisis could be undermined by concerns about noise. In the first step towards a tightening of regulations, Chris Leslie, minister for building regulations, has told the House Builders' Federation to work on a solution for sound insulation to apply to all new houses, flats, hostel and hotel accommodation whether newly built or converted. The HBF has asked Napier University's Building Performance Centre to investigate new methods of sound proofing, which will be presented to the government next year. "We are living much noisier lives," said Pierre Williams of the HBF. "Building at higher densities makes the need for excellent sound insulation even more important for homeowners."

The annoyed, the society and the EPA

Nowadays there is a new attitude, showing respect, and that the attitude, the experiences and the knowledge of the sufferers is an important part in case-handling. It gives them back their self-confidence and enables them to gain perspective on the situation. The EPA really works for the empowerment of citizens. We give them our expert support. The internal co-operation at EPA has improved; other authorities have learned where to find us.

Experiences

Thanks to the intensive way of dealing with the LFS-problems much useful experience has been gained [e.g. SLO99]. The most important aspects are the following.

Sources of noise

- In many cases no obvious sources were found. Further investigation is not likely.
- Most of the cases don't have specific 'major source'.

Measurements

- Of particular importance in assessing the complaint are tests in which the suspected source is turned on and off. The complainant has to tell the investigator when and what differences are heard. Other simple aids to get any impression about the hearing of the complainant are whispered speaking whilst watching

reactions, turning the volume knob of a television or tuner, using sound generators.

- In most cases analyses of third-octave bands from 40Hz upwards are enough. Maybe in future a simple rough quick scan, in octaves, starting with the 31Hz octave, under ideal circumstances, will give enough information to make further decisions.
- Up to now, we judged vibration-measurements necessary in only three LFS cases.

Acoustic LFS-references (indoors, at night)

- The (normally-used) 25 dB(A)-limit, is not sufficient to recognize complaints.
- Nor is the general rule 'LFS, if $L(C) - L(A) > 20$ dB (German)' [DIN]. If that indicator is exceeded, then the LFS-nuisance is almost certain.
- In cases where the investigators also experience some of the LFS, the A-weighted level was usually 21 dB(A) or higher.
- There is no indication that many cases are dealing with audible tonal sound [PSI].
- The threshold-curves do not explain the LFS-nuisance felt by all the sufferers, but are a help in comparing the measurement results.
- Telling the complainer the percentage of people that can hear his or her measured sound is valuable.

The commonest occupational disease

The American College of Occupational and Environmental Medicine says hearing loss is the most common occupational disease in the United States and the second-most reported occupational illness or injury. Impaired communication, tinnitus and lost worker productivity can all result from workplace-related hearing loss. More than 30 million American workers are exposed to hazardous noise.

Attitude in way of working

- Involving citizens in the process of watching has the advantage that the dealing-process goes faster. Besides such citizens are keeping you awake.
- Do not trust the certainties of the sufferer, nor your own preconceptions.
- Work systematically.
- Provide documentation: for your own good, and for authorities, other parties involved and sufferers.
- Although the numbers are too small for statistical use, it is obvious that the reporting of complaints until now is not uniform. Per quarter, in which the months of May + June + July are the first quarter, the relation is 6 : 3 : 2 : 3.
- EPA- assistants, are inclined to forget the step 'calling in MHS'. Very often, we made that mistake which then needs to be corrected.

Status of 'assistance' (relief worker)

- Be prepared for resistance. Dealing with LFS-complainants might be seen as dealing with 'losers' and with non-quantifiable results.
- The LFS principle of open dealing results in many and unexpected contacts with both complainants and colleagues. Take enough time to communicate, every day.
- In many cases a combination of aspects complicates the investigation.

LFS-sufferers

- Sufferers are not different from the ordinary-Hollander. Mostly they are normal-hearing alert people; women and the elderly are over-represented. [compare MGM96]
- The EPA-LFS files give following results: (a) average age 55; half of them living alone, (b) 2/3 female, 1/3 male (exactly in accordance with [Gie98]). But: note that a small group in the complaint centre of EPA learns that for all kinds of complaints coming in (20,000/year) also 70% are female and the estimated average age is 55 as well! In this respect the pattern of LFS-complainants is not very special.
- The impression is that the wishes of the LFS-sufferers about quiet are high. They seem to respect and to like silence; in many cases there is a lack of indoor sound.
- The results of other investigators [e.g. Per] are confirmed that in many cases there is a relation between the personal expression of susceptibility and the reactions to LFS.

The public spread of information about LFS

- Due to the complexity of complaint handling and our own lack of experience, it is useful to keep the tools used like questionnaires, letters and procedures, up to date.
- In several cases EPA and MHS 'took a risk' and asked publicly for help. There were no resulting floods of complaints.

noise notes

Fat necks

45 per cent of adults snore occasionally and 25 per cent are habitual snorers. Women, particularly pregnant ones, snore too, but men are eight times more likely to do so. According to studies by the Edinburgh Western General Hospital, this is because men have more muscle and fat around their necks, which relaxes at night and can partially restrict breathing. Snoring occurs when there is an obstruction to the free flow of air through the passages at the back of the mouth and nose, mostly caused by an enlarged soft palate and uvula.

7. A Look in the future

Expectations

In relation to the handling of LFS-complaints, gradual changes will take place.

- In 15 years 1/3 (1/2 in all Holland) of the Rotterdam inhabitants will be over 55 years of age. At the moment most of the LFS-complainants are in this age group.
- The shared use of buildings for 'industrial' and 'living' purposes is increasing.
- Ventilation systems, heating systems and air-conditioning etc. can cause problems.
- At the moment only 3% of Dutch homes are provided with climate control installations. Those are sources of LFS and the numbers will grow.
- Due to the lack of building space more underground infrastructure is being developed. Vibrations caused by traffic result in LFS via the foundations of residential buildings.

- Within a few years in the Netherlands there will be new legislation for noise and urban planning [Wig97, Wig98]. The municipalities will then have the right to more independence regarding the setting of noise level limits. Due to the prohibitive cost of space this will in some cases result in excessive noise taxation, particularly LFS.

To achieve a higher return from complaint handlers in relation to the resources used, a shortened procedure is in some cases required. The original procedure will only be adhered to if: 1) the informant can substantiate the complaint (eg. witness testimony), or if a quick-scan of the complaint by one of the researchers provides a clear cause in the first instance. 2) a justifiable request by a member of a social assistance agency is received (from housing association to general practitioner).

Memory and aircraft noise

The loud noise that accompanies the take-off and landing of airplanes may be more than an inconvenience for people living near airports. New study findings suggest regular exposure may also dampen children's memory. "Aircraft noise impairs learning and memory, in particular, of difficult texts," said lead study author Dr. Staffan Hygge, of the University of Gavle in Sweden. "Language-based cognitive skills are more vulnerable to noise than other cognitive skills," The study, begun in Germany before the opening of the new Munich International Airport and the closing of the old airport, involved 326 children who lived near either the old or new airport sites. The findings appear in the September issue of Psychological Science. Children who lived within close range of the old airport experienced improvements in both their long- and short-term memory and their reading after the airport closed, the investigators report. Those newly exposed to aircraft noise when the new airport opened, however, showed a deterioration in their long-term memory and reading abilities. This finding "provides strong causal evidence for the vulnerability of central language processing to noise exposure, and the reversible nature of the impact," the authors stated. Children who lived near the new airport also showed deterioration in their speech perception – the ability to hear spoken words when there's background noise. And a similar dip among children who lived near the old airport did not improve after the airport closed, the researchers note.

noise notes

8. Things to do in the future To improve the approach

- Continually improving the data on LFS will make it possible to handle the gradually increasing number of complaints more efficiently and shorten processing time without compromising the original aims.
- Development of source-detection methods: sound intensity, microphone-array, intelligent signal analysis, on-off tests, panel of LFS-sensitive people?
- To find a way to deal with licenses that is acceptable to most of those involved, (authorities, judicial reviewers, companies and permit granters). Such rules must be communicable (relatively simple) and not too severe (business activities must be possible).

More knowledge about house-front insulation, noise-transfer, spread in thresholds of audibility/sensitivity, stress aspects eg serotonin, degrees of annoyance.

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World beating snorer

A new survey, conducted by CNS, Inc., makers of Breathe Right nasal strips and new Breathe Right Snore Relief throat spray, found that typical snoring is loud at best and ear-splitting at worst. The survey also revealed that people will try just about anything to stop the snoring. More than half of snorers and their bed partners surveyed rated the average loudness of the snoring as a seven or above on a scale of one to 10. Forty-six percent of respondents described the snoring as "loud enough to wake someone from their sleep" forcing 41 percent of sufferers to sleep in a different room from their snoring partners. The Guinness Book of World Records lists Melvin Switzer of Southampton as the record holder for the loudest snore. At 92 decibels, Switzer's snore could be compared to the roar of heavy traffic at a busy intersection.