

The Historical and Current Challenge of Environmental Noise Nuisance

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ABSTRACT

Acoustic and noise have been important issues throughout the history of mankind. In the modern world, noise nuisance remains the most significant source of environmental complaints. This paper examines a range of environmental nuisance data from medieval times through to modern day records. Based on these data sources, the significance of noise complaints as a subset of environmental nuisance over the last 700 years is identified. Possible reasons for the current prevalence of noise nuisance in developed societies are explored in the context of historic and current issues, environmental regulation and planning approaches intended to prevent environmental nuisance arising, and in the context of new technologies and the potential for change in the future.

1. INTRODUCTION

Throughout history, acoustics and noise issues have been important considerations for human societies. Evidence to demonstrate this includes the following:

Acoustics and Sound Quality:

- Acoustic studies of caves containing prehistoric wall paintings have identified that the paintings coincide with areas of acoustic resonance in the caves, suggesting a linkage to ceremonies that included speech and music that made use of natural resonance and amplification, and an early appreciation of the importance of acoustic quality (Till, 2014).
- In ancient Greece and Rome, amphitheatre design included consideration of acoustics, with sound absorption and diffraction effects being incorporated into the design to result in acoustic amplification and speech clarity throughout the audience (Borgia, 2009).

Noise Nuisance Legislation:

- The first documented noise ordinance was issued by Julius Caesar in 44 BC when he controlled the time at which wagons could enter Rome. This was to prevent the clanking of wagon wheels on cobble stone streets during business hours (Department of Highways, 1972).
- Rule 30 in London's The Lawes of the Market in 1595 states that:
'No man shall after the houre of nine at Night, keep any rule whereby any such suddaine out-cry be made in the still of the Night, as making any affray, or beating hys Wife, or servant, or singing, or revyling in his house, to the Disturbance of his neighbours' (Goldsmith, 2012)

Land use Planning:

- The City of Sybaris, Greece in the 6th Century BC banned potters, tinsmiths and other tradespeople from working within the city walls due to noise impacts. Roosters were banned too (Mazer, 2010).
- Mediaeval cities used land use planning to address the issue of the incompatibility of noisy industry and the general community by locating noisy trades, such as blacksmiths and carpenters, in the same area (Cybulskie, 2016).

Occupational Noise:

- In the 5th Century BC, Hippocrates identified the phenomenon of tinnitus, and that it was caused by long term exposure to noise (Kraft, 1998).

- In 1713 Bernadinni Ramazzini identified that noise exposure of copper smiths resulted in deafness (Franco, 1999).

Transport Noise Management:

- Early noise control devices were incorporated into the design of some chariots, with grease pods being installed to reduce wheel-axle noise (Seireg, 1998).
- In medieval Europe, horse carriages and horseback riding were not allowed at night in some cities. During daytime, straw was strewn on the streets as a noise control measure to muffle the sound of hooves and wheels (L Goines, 2007).
- In 1717 the church of Mary-Le-Strand in London was designed and constructed without windows on the ground floor to prevent the impacts of road traffic noise (Goldsmith, 2012).
- In the US during the late 1800's wooden blocks were sometimes used instead of cobble stones in high density urban areas to help reduce the clank of the wagon wheel (American Concrete Pavement Association, 2009).

These examples demonstrate a clear understanding and appreciation of acoustic quality, the potential health impacts of noise, the significance of nuisance noise impacts and road traffic noise in particular throughout the history of civilisation.

Where noise, or unwanted sound, causes impacts or complaints, this is generally described as 'noise nuisance'. The term 'nuisance' is defined as interference with the enjoyment of land, including interference with use and enjoyment of land by water, fire, smoke, smell, fumes, gas, noise, heat, electricity or any other similar thing which may cause an interference. Environmental nuisance is a sub-set of the broader definition of nuisance, and is generally considered to include those interferences that are apparent to the human senses – sight, sound, touch, and smell. As a result, the issues of noise, odour and dust are the primary forms of environmental nuisance.

2. PRE-INDUSTRIALISATION

There is little published data relating to environmental nuisance and noise complaints from the pre-industrialised era. The exception to this are the 700 year old records of the London Assizes of Nuisance (Institute of Historical Research, 2015). These legal documents, written in abbreviated Latin, record legal sittings that dealt with nuisance issues. The records have been translated and provide a detailed insight into the nuisance issues of concern to citizens of London during the period 1301 – 1409. Over 660 records of legal action taken with respect to nuisance issues are recorded in the Assizes. An example of one of the typical entries is presented in Figure 1.

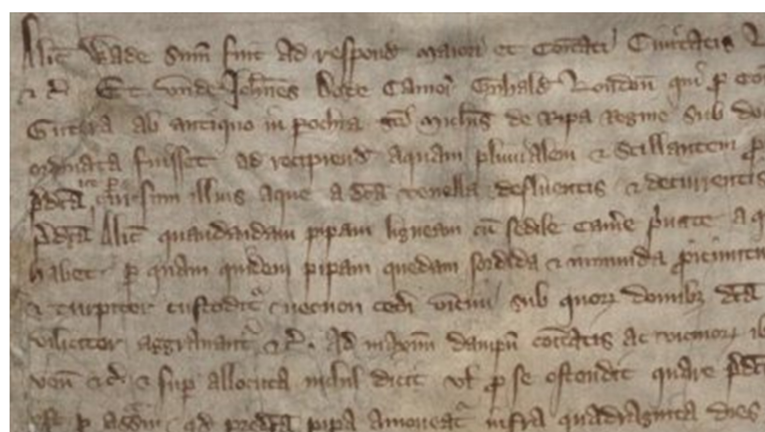


Figure 1: Example of Nuisance Case from the Assizes of Nuisance

The translation of the case documented in Figure 1 is as follows:

"The mayor and commonality, by John Dode, chamberlain, complain that whereas of old in the parish of St Michael Queenhithe, a gutter running under certain of the houses was provided to receive the rainwater and other water draining from the houses, gutters and street, so that the flow might cleanse the privy on the

Hithe, Alice Wade has made a wooden pipe connecting the seat of the privy in her solar with the gutter, which is frequently stopped by the filth therefrom, and the neighbours under whose houses the gutter runs are greatly inconvenienced by the stench. Judgement that she remove the pipe within 40 days."

This case describes how Alice Wade connected her private toilet to a stormwater drain running underneath adjoining houses that was used to clean the public toilet on the Hithe. Unfortunately, Alice Wade's toilet waste blocked the stormwater drain causing an obnoxious stench to adjacent houses. The blockage also prevented water flushing the public toilet. Alice was ordered to remove the pipe within 40 days. There were only 8 public toilets in the City of London at the time – serving a population of 100,000 – hence maintaining the functionality of the public toilet on the Hithe was clearly an important issue.

Another example of a classic environmental nuisance case is recorded in 1377. An armourer named Geoffrey Chadenesfeld built a forge 40 ft. from the road, of which the chimney was 12 feet lower than allowed under the City requirements. Furthermore, the forge was built of timber and earth, and not built of plaster and stone as was required by the City legislation. Because of the poor construction, the complainant argued that the blows of the sledge-hammers when the iron was being wrought into 'brestplates', 'quysers', 'jammers' and other pieces of armour, shook the adjacent houses 'so that they are in danger of collapsing'. The noise and vibration was identified as disturbing the neighbouring property owners and their servants, day and night, and was causing the wine and ale in their cellars to spoil. The stench of the smoke from the sea-coal used in the forge penetrated the hall and chambers of the Complainant's house, significantly reducing the rental value.

In response, the armourer argues that the complainant built their house more recently than the forge, and built it too high with windows facing the forge. Because of this, the house was more significantly affected by the noise and smoke emissions than the house it replaced, which was lower and had no windows overlooking the forge. This particular case has a number of aspects that are very familiar today:

- Vibration impacts with a potential to cause disturbance to neighbours.
- Inappropriate hours of operation causing noise nuisance during the day and night.
- Reduced economic return for affected properties.
- Inappropriate buffer separation.
- Non-compliance with structural building requirements, and use of materials with poor acoustic insulation.
- The order of occupancy was identified as a potentially relative consideration.
- Use of building orientation and positioning of windows to reduce noise impacts.

Unfortunately, the outcome to this case is not recorded, however, local authorities throughout the world routinely consider the issues identified in this case when assessing modern day nuisance complaints.

While some of the Assizes of Nuisance cases relate to the 'environmental' nuisance issues of noise, dust, odour and vibration, complaints relating to noise are few in number. It is hardly surprising that stormwater management and sewerage issues are recorded as the most frequent cause of nuisance cases. 14th Century London was primarily constructed of timber buildings, and rotting (as well as fire) were major hazards and the sewerage system was rudimentary.

3. POST INDUSTRIALISATION

With the exception of the Assizes of Nuisance, there is limited published data relating to noise nuisance until after the Industrial Revolution. Concerns about the need for a co-ordinated approach to water supply and sanitation became prevalent in the mid 19th Century, however public debate in the latter part of the century also related to the unhealthy effects of noise exposure. Anti-noise campaigns were initiated, with commercial and industrial noise sources identified as a particular concern (Payer, 2007).

During this period, noise issues were increasingly documented in the press. Common noise complaints related to *"Clanging bells, cracking whips, clattering carriages, clamouring hawkers and cabmen, roaring crowds, barking dogs....itinerant musicians"* (Picker, 2003). Noise sources of this type resulted in numerous complaints in

Victorian London and city noise levels were commented on by noted personalities including Charles Darwin and Charles Dickens. John Leech, a close friend of Dicken's and illustrator of some of Dicken's works, was driven mad by street music in the last years of his life. He bitterly commented that rather *"than continue to be tormented in this way, I would prefer to go to the grave where there is no noise."* - which he did, a few days later (Picker, 2003).

The advent of the motorcar in the late 1800's resulted in a change in the focus of noise complaints. The noise of vehicle wheels on roads remained, however it was engine noise from automated trucks and the use of vehicle horns that caused the highest number of complaints. This is demonstrated by surveys completed by the City of New York Noise Abatement Commission (Noise Abatement Commission, 1930) (Figure 2).

The City of New York Noise Abatement Commission is an example of one of the first municipal noise control organisations. The Commission was well resourced, and had a team of noise abatement officers and a fully equipped noise mobile noise monitoring vehicle (refer to Figure 3). The commission completed extensive noise monitoring throughout the City of New York, and researched the noise levels generated by different activities, including types of motor horn and vehicle, to allow provision of noise abatement advice to the municipality.

Table 1 lists the key city noise sources identified by the Commission, and the number of noise complaints associated with these sources. The noise sources of concern are very similar to those encountered today, with the exception of doormen's whistles, phonographs and peddlers. Traffic and transport related sources result in >50 % of the recorded complaints. Unamplified noise sources, eg, domestic noise and barking dogs, result in just over 7 % of the total complaints.

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Table 1: Noise Complaints in New York, 1930

Source	Number	Percent
Traffic (Trucks, Automobile Horns, Cut-outs, Brakes, Buses, Traffic Whistles, Motorcycles)	4,016	36.28
Transportation (Elevated, Street Cars, Subway)	1,801	16.29
Radios (Home, Streets and Stores)	1,367	12.34
Collections and Deliveries (Ash, Garbage, Milk etc)	1,023	9.25
Whistles and Bells (Fire Dept, Locomotives, Tugs and Steam Ships)	916	8.28
Construction (Riveting, Pneumatic Drills)	819	7.4
Vocal, etc (Newsboys, Peddlers, Dogs, Cats, Noisy Parties)	805	7.27
Others	321	2.89
Total	11,068	100

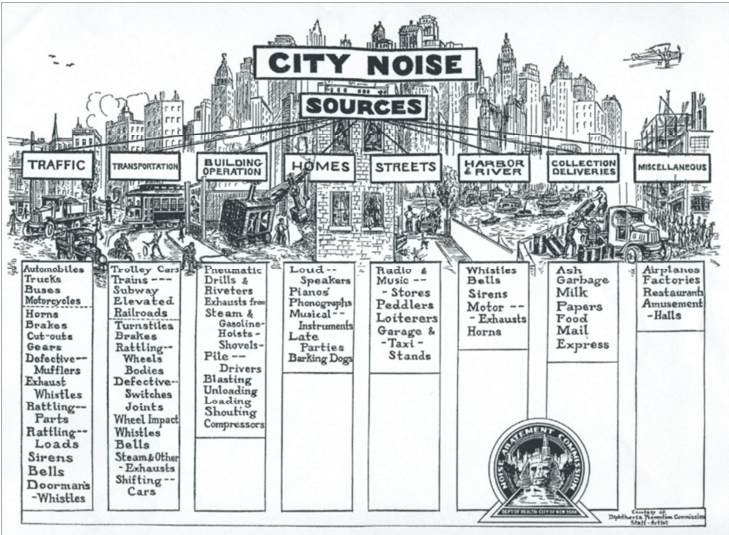


Figure 2: Summary of New York City Sources of Noise (circa 1930)

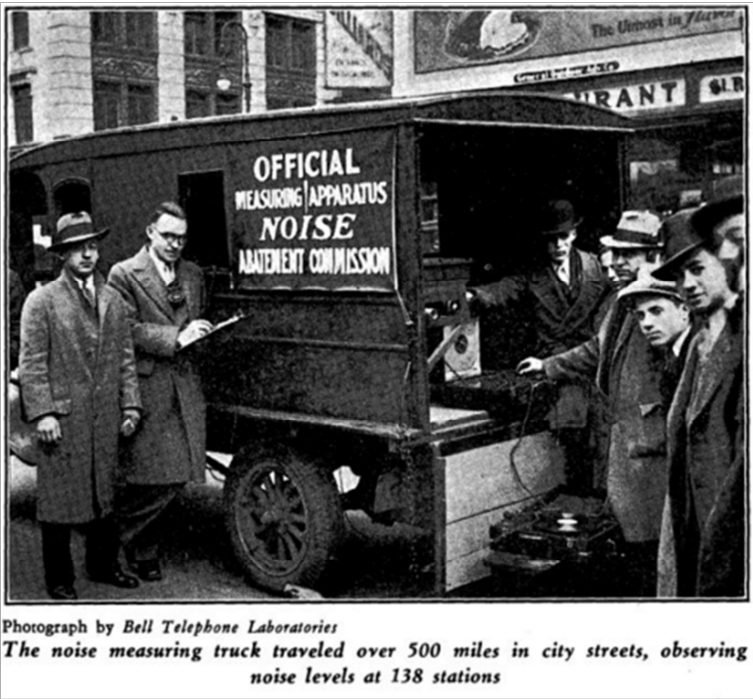


Figure 3: New York City Noise Abatement Mobile Noise Monitoring Unit

4. CURRENT NUISANCE DATA

4.1 United Kingdom

Review of nuisance data compiled in the last two decades allows analysis of the change in type of environmental complaint since the time of the Assizes of Nuisance (14th Century) and a comparison with the records from 1930's New York. In the United Kingdom (UK) detailed, national data relating to nuisance complaints and records exists. Table 2 presents a summary of the recent complaint data relating to statutory nuisances (Temple Consultants, prepared on behalf of DEFRA, 2011).

Table 2: Nuisance Complaints per Million Population – UK 2010

Nuisance Category	Number	Percent
Odour	389	4.5
Dust	77	0.9
Smoke	793	9.1
Insects	83	1.0
Fumes & Gases	169	1.9
Accumulations (ie, waste)	1,327	15.2
Animals	84	1.0
Premises	238	2.7
Noise	5,572	63.8
Any other matter	3	0.03
Total per Million Population	8,750	100

The UK data presented in Table 2 demonstrates that noise is overwhelmingly the most significant issue currently, at 63.8 % of all nuisance complaints. A detailed breakdown of UK noise nuisance complaints for 2010 is presented in Table 3. This confirms that 72.8 % of the complaints relate to domestic noise. Few complaints relate to industrial noise (3.9 %) and fewer still relate to traffic noise (0.8 %). The relative lack of transport noise complaints indicates that these are not typically reported as statutory nuisances, and are probably addressed through an alternative regulatory framework.

Table 3: Breakdown of Noise Complaints – UK 2010

Nuisance Category	Number	Percent
Industrial	227	3.9
Commercial/Leisure	780	13.5
Domestic	4,203	72.8
Construction/Demolition Sites	191	3.3
Vehicles & Plant in Streets	133	2.3
Traffic	51	0.9
Miscellaneous	185	3.2
Total per Million Population	5770	100

A national noise survey completed in 2008 in the UK provides a further breakdown of neighbourhood and domestic noise nuisance issues (Environmental Protection, United Kingdom, 2008). The most frequent neighbourhood noise related issues were as follows:

- Cars/motorbikes – 18 %
- Alarms – 12 %
- Fireworks – 12 %
- Children – 12 %
- Shouting/Arguments – 9 %

- Aircraft – 8 %
- Pets – 8 %
- Helicopters – 7 %
- Loud music – 7 %
- Doors banging – 4 %
- Parties – 3 %
- Commercial noise – 3 %
- Pubs/Clubs/Entertainment venues – 3 %

It is interesting that noise issues related to amplified music are relatively infrequent compared to the unamplified human voice as evidenced by the higher ranking of 'shouting/arguments' and 'children' in this survey. In terms of broader community attitudes toward noise sources, the UK National Noise Survey (UK DEFRA, 2014) provides data relating to perceived annoyance, as opposed to noise issues that are significant enough to have resulted in a nuisance complaint. This survey considers noise sources regulated at both local level (ie, nuisance) and regional and national level (ie, transportation). The results of the survey demonstrate that similar numbers of people are annoyed by road traffic noise (55 %) and noise from neighbours (54 %) in 2012. More people are highly annoyed (11 %) by neighbours than road traffic (8 %), aircraft (4 %) and construction related noise (3 %), and this indicates that people are likely to complain about domestic noise than transport noise, despite similar numbers of people being annoyed by these noise sources.

4.2 Australia

In Australia a national database relating to environmental nuisance is not maintained, therefore reference is made to records maintained at State level. For New South Wales, Environmental Incident reports (complaints) data are compiled and data for the period 2008/2009 (DECCW NSW, 2010) is presented in Table 4.

Table 4: Environmental Line Incident Calls NSW – 2008/9

Type	2008/9
Odour	32
Noise	21
Water	17.6
Chemicals	8.7
Air	8
Native Vegetation	7
Pesticides	4
Other	1.7

The NSW data presented in Table 4 indicates that odour is the most significant cause of complaint at 32 %, with noise second most frequent at 21 % of complaints. Further detail relating to both of these nuisance categories is provided by some individual Councils in NSW. As an example, Table 5 presents a breakdown of noise complaint data for Blacktown Council (Blacktown City Council, 2010).

The data in Table 5 confirms that noise from barking dogs was the cause of 68 % of the noise complaints in 2009 – 2010. Music was the second highest cause of noise complaints at 20 %. Industrial and commercial noise issues are relatively minor cause of complaint at 6 % of all noise complaints. Transport noise sources are not represented in the data, as these are not under the jurisdiction of the Blacktown Council Environment Department

Table 5: Noise Complaints Received by Blacktown Council

Nuisance Source	2005-6	2006-7	2007-8	2008-9	2009-10
Barking Dogs	786	827	870	841	793
Industrial/commercial	61	61	83	99	74
Air Conditioners	46	51	47	52	28
Alarms	30	36	42	31	21
Music	229	240	264	264	238
Pool Filters	16	9	5	10	5
Total	1,168	1,224	1,311	1,297	1,159

Western Australia (WA) completed a local government noise survey in 2005/06 (DEC, 2006). A total of 5,900 complaints per million population was determined, which is similar to the rate observed in the UK of 5,572 noise complaints per million population. The Western Australian data is provided in Table 6. The categories adopted in the WA survey have been combined to reflect the categories adopted in the UK survey. This allows a direct comparison of the two datasets. For the domestic complaints, barking dogs are the primary cause at 6,727 complaints.

Comparison of the two datasets indicates that the domestic noise categories are overwhelmingly the most significant. Commercial noise complaints are the next most significant in the UK, and have a similar percentage occurrence in the WA dataset. Construction noise has a slightly higher percentage of noise complaints in WA, and this may be attributable to the construction boom noted to be taking place at the time of the survey.

Environmental complaint data is also published by the South Australian EPA (SA EPA, 2015). Based on a summary of "Stage 1" (initial) complaints for the period from 2011 – 2014, these records indicate that noise is overwhelmingly the most significant cause of environmental complaints. This is consistent with the data from Western Australia and the UK. When the specific causes of noise complaints are identified, construction noise was the most significant source of noise in South Australia, followed by 'general noise' – which will include domestic noise and barking dogs.

Table 6: WA Environmental Complaints (2005 – 2006)

Category	Number	%
Industrial	173	1.5
Commercial/Leisure	728	6.3
Domestic	9,189	79.9
Construction/Demolition/Blasting	844	7.3
Vehicles, Equipment in Streets	69	0.6
Traffic	166	1.4
Miscellaneous	141	1.3
Total	11,501	100

4.3 Asia

An example of complaint data records for Asia is those maintained by Bangkok, a well-developed and relatively modern city. Table 7 shows that the nuisance complaint categories are fairly consistent with those in the UK and Australia, with noise causing the most complaints, followed by odour (Bangkok Department of Environment, 2001). Waste and wastewater related nuisance issues are relatively minor.

Table 7: Nuisance Complaints Data – Bangkok (2001)

Nuisance Category	1997	1998	1999	2000
Noise	33.7	31.6	35.3	39.7
Odour	31.6	30.9	30.3	29.9
Animal	3.8	3.4	5.0	8.4
Particulate	12.1	9.7	6.3	5.9
Wastewater	9.3	8.6	6.1	4.8
Latrine	1.3	1.2	1.7	1.8
Solid waste	2.3	2.1	2.0	1.4
Breeding	2.1	4.9	2.1	0.7
Vibration	0.3	0.2	0.8	0.7
Miscellaneous	7.1	7.2	9.9	6.3

4.4 Commentary on Nuisance Datasets

The reliability of complaint data depends on the ability of the complainant to identify the appropriate agency to respond to the problem, and the ability of the agency to record and investigate the issue, and in particular to identify vexatious complaints. This notwithstanding, assuming that the complaint data provides a reasonable indication of current environmental nuisance concerns, the modern datasets confirm that noise nuisance is generally the most frequent cause of nuisance. When the sources of noise nuisance are examined, it is the non-mechanised and unamplified sources – barking dogs in particular – that are the major cause of complaint. The nuisance datasets generally do not consider transport noise sources, however data from the UK confirms that transport noise concerns a similar proportion of the population as the non-amplified domestic noise sources such as barking dogs.

5. HAVE WE FAILED TO EFFECTIVELY MANAGE ENVIRONMENTAL NOISE NUISANCE?

5.1 Medieval Nuisance as a Modern Paradigm

Clearly, environmental nuisance complaints remain a significant issue in the modern world. In terms of the types of nuisance that occur, there is a marked difference between the modern day nuisance datasets and the historic data. In Medieval London, the nuisance issues focussed on property rights and protection, and the majority of 'environmental nuisance' issues related to concerns about cesspits, sewerage and stormwater. Since the 14th Century, the primary importance of implementing water and wastewater supply, management and treatment systems has been clearly understood. Modern municipalities deal with these issues in a co-ordinated way, with consequent improvements in public health as well as reduced nuisance impacts. Whilst odour complaints related to wastewater treatment plant do occur today, the datasets reviewed indicate that odour issues are generally less significant than noise as a modern day environmental nuisance. The medieval industrial nuisance example sounds remarkably familiar, but few noise related cases are documented in the Assizes of Nuisance.

In the modern world, noise nuisance is the primary cause of environmental complaints. To consider the possible reasons for the current predominance of noise nuisance complaints relative to all environmental complaints, the following questions are explored:

- Has the population density increased in major cities, thus increasing exposure to noise sources?
- Have community noise levels increased over time?
- Are noise management measures ineffective?
- Have community perceptions as to the acceptability of noise changed?

5.2 Population Density

A possible cause for the increase in domestic noise nuisance complaints is increasing population density resulting in lesser distances between households, thus enhancing the risk of complaints from about neighbourhood noise. Information relating to population densities in major cities is of relevance in assessing this.

At the time of the Assize of Nuisance, the City of London comprised a relative small area of land between the Tower of London and St Pauls Cathedral. In 1300 the population of London was approximately 100,000 in an area of around 1 square mile. In recent times the population of inner London has less than half of this density (Greater London Authority, 2010) and data for the Manhattan area of New York in 1930 (City of New York & Boroughs: Population & Population Density from 1790, 2001) confirms that the population density was also lower than Mediaeval London.

This demonstrates that the Assizes of Nuisance relate to a population density similar to those in modern cities, and denser than the current inner London suburbs and New York in the 1930s. The types of nuisance recorded in The Assizes of Nuisance reflect, in part, the issues associated with overcrowding (appropriate boundaries, overlooking, trespassing, rainwater runoff affecting neighbours), poor sanitation (cesspit location) and the high cost of buildings (ownership and construction disputes). Building standards have improved too, and continue to improve particularly in the area of noise control between multi-tenanted buildings. Therefore, it is not simply that increasing population density is to blame for the current levels of community noise complaint.

Given the relatively high population density required to support community services and infrastructure, it is likely that population densities could increase in the future. The increasing focus in town planning schemes in Australia on energy efficient building designs that maximise natural ventilation and light may only serve to heighten the potential for nuisance conflicts. Air pathways also provide an entry point for noise, hence the provision of natural light and ventilation can directly conflict with noise abatement policies that result in the need to enclose and acoustically treat buildings. For these reasons, increasing population density may become a factor in exacerbating neighbourhood and domestic noise nuisance in the future.

5.3 Changes in Community Noise Levels

5.3.1 Introduction

Based on the modern noise complaint data, transport noise, domestic noise and barking dogs are currently the primary sources of noise complaints. Noise is mentioned in a relatively small number of cases in the Assizes of Nuisance, and there is no mention of transport noise and barking dogs. In 1930's New York transport noise was a significant concern, but domestic noise and barking dogs were a lesser concern than in modern times. Hence it is worth exploring the possible reasons for the change in significance of these noise nuisance issues over time.

5.3.2 Have Transport Noise Levels Increased?

In the modern world, transport noise remains a key source of noise complaint. Despite the noise emission controls that are imposed on new road vehicles, aircraft and locomotives the World Health Organisation has concluded that in excess of 1 million healthy life years are lost each year from transport related noise sources in Western Europe (WHO, 2011).

The absence of transport noise cases in the Assizes of Nuisance is somewhat unexpected. Traditional road construction methods included a range of materials, earth, gravel and cobblestones. Cobblestones gave the greatest strength and were commonly used, but resulted in high noise levels as the metal shod horses' hooves and metal bound cartwheels contacted the uneven stone surface. There is anecdotal evidence throughout history about the annoyance caused by carts and carriageways driving on cobbles streets, to the extent that straw would be lain on the surface to dampen the noise in some circumstances – including on medical advice when the occupant of a neighbouring house was sick (Nightingale, 1860).

Whilst noise monitoring data to demonstrate noise levels of iron clad wheels on cobble stones is not available, data is available to show the clear significance of noise emissions from the cobbled surface relative to modern road surfaces (E. Freitas, 2012). The data presented in Table 8 confirms that noise levels from cobblestone surfaces result in source noise levels increasing by up to 8 dB(A) for a modern vehicle relative to a modern road

surface. The noise of the iron clad wheels, a cart or carriage axle and metal shod horses' hooves would further increase these noise levels, relative to the modern car used in the testing of road surfaces. Therefore, it is likely that noise levels of pre-modern vehicles on traditional roads would have been at least 10 dB higher than modern vehicles, probably significantly more. Although the number of vehicles would have been significantly lower, the duration of noise caused by a passing equipage would have been significantly longer than a modern vehicle. This is due to the lower speeds of a horse drawn vehicle compared to an automobile.

Table 8: L_{Amax} dB(A) of Various Road Surfaces (Ordinary/Hybrid Test Vehicle) (E. Freitas, 2012)

Type of Surface	30 (km/h)	40 (km/h)	50 (km/h)	60 (km/h)	70 (km/h)
Cobblestones	68.4/65.3	72.6/70.0	75.8/73.7	78.5/76.7	80.7/79.3
Dense Asphalt	63.9/59.6	67.5/63.9	70.2/67.2	72.5/69.8	74.4/72.1
Open Asphalt Rubber	63.2/60.5	66.7/64.2	69.5/67.1	71.8/69.4	73.7/71

In New York in 1930, it was the blasting of vehicle horns that was the greatest source of complaints in the early years of automobiles, followed by vehicle noise. In many – but not all – modern societies the use of vehicle horns is restricted to emergency warnings, hence this key source of noise complaint in 1930's New York is no longer a major concern. Levels of noise in 1930's New York were measured, as shown in Figure 4, and indicate that street noise levels were equivalent to, and possibly higher, than we experience today.

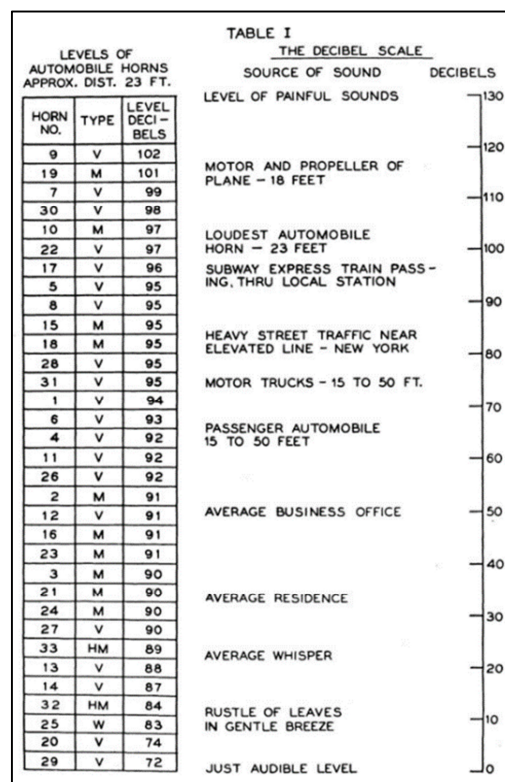


Figure 4: Noise Levels in New York City Compared to Vehicle Horn Noise (circa 1930)

Fortunately, with the uptake of electric vehicles projected to increase substantially over the next 10 years, road transport noise levels are likely to reduce, although there is some debate about the reduction likely to be achieved (Jan Jabben, 2012). In Japan in 2013 20 % of new vehicle sales were electric hybrid vehicles (Argonne National Laboratory, 2014). The CityHush project in Europe has published comparisons of noise levels from electric vehicles and standard vehicles (City Hush, 2010). The data shows that at speeds of 50 kph, electric vehicles produce noise levels 5 – 10 dB lower than combustion engines. At low speeds, 30 kph and less, tyre/road noise is negligible

and the noise from the vehicle is so low that a draft directive has been published by the European Community that proposes that electric vehicles to incorporate a low noise alert (Economic Commission for Europe Inland Transport Committee, 2016). This draft proposal defines minimum sound level requirements measured at 2 m of 50 dB(A) at 10 kph, 56 dB(A) at 20 kph and 47 dB(A) when reversing. For quiet vehicles, such as electric cars, an acoustic vehicle alert system (AVAS) is proposed to be required to generate the specific noise level required in the standard.

So while the overall size of the population exposed to road transport noise has increased, the absolute noise level and exposure period per vehicle has decreased, and is likely to continue to do so. The use of warning devices such as horns and hooters, with noise levels intended to protrude above the ambient background, has also decreased in many western cities. Ultimately there is a lower threshold to this reduction which will be defined by tyre-road noise, or low noise warning alerts. Despite this, the overall significance of road transport noise in defining community background noise levels could decrease in the coming decades.

5.3.3 Why are Barking Dogs Such a Problem?

Barking dogs feature as the primary cause of noise complaints for the majority of Local Authority datasets in Australia, and for 8 % of complaints in the UK. Whilst dogs would have been present in Mediaeval London - including working dogs, companion dogs and strays - there is no mention of noise from barking dogs in the Assizes of Nuisance cases. In 1930's New York, 'vocal' noises - which included barking dogs - accounted for 7 % of all noise complaints. This is significantly lower than the percentage complaints recorded in modern day Australia.

The size of the dog population in 14th Century London is not documented, however published data is available for the early part of the 19th Century, and in 1819 it was estimated that there was one dog for every 16 inhabitants in Paris (Barles, 2016). In the modern era, data recently published for the UK confirms that 30 % of households owned one or more dogs, giving an estimated UK dog population in 2011 of 11,599,824 dogs (JK Murray, 2015). In Australia, 39 % of households own a dog, equivalent to 4.2 million dogs or 19 dogs per 100 people (Pet Ownership Statistics, 2013). This suggests that, for both the UK and Australia, the dog population may be significantly higher than in 19th Century Paris.

Pet ownership data indicates that there has been a significant increase in pet ownership in the last 50 years. This is associated with the increasing affluence of western societies and levels of disposable incomes - owning a pet is a luxury rather than a necessity. Since 1967 in the United States ownership of pet dogs has increased from 22 million to 70 million - more than a threefold increase (Serpell, 2013).

The reason why the noise from barking dogs is so annoying is related to noise character. Like vehicle horns, the acoustic characteristics of barking dogs - the rapid rise time and the intrusion above the ambient background noise levels - enhances the likelihood of complaints. These characteristics are not likely to change, as the noise source is difficult to manage. The current significance of barking dog noise complaints could also be related to societal changes, such as a lower tolerance of external noise sources impinging on personal space, particularly in a domestic setting and perhaps a trend toward companion dogs as opposed to working dogs. It is beyond the scope of this paper to further investigate this issue. However, given the increasing levels of dog ownership in many western societies, there is clearly a potential for noise from barking dogs to remain a major noise issue for the foreseeable future.

5.4 Noise Management Methods

In terms of management of environmental noise nuisance, the methods adopted in medieval London remain current today:

- minimum buffer separation distances for incompatible landuses;
- defining acceptable hours of operation;
- specification of building location to minimise impacts;
- consideration of acoustic mitigation through building design, orientation and construction materials.

The methods we adopt today for management of noise nuisance continue to rely on these primary tools. Modern society also has additional tools to assist in setting acceptable limits for environmental nuisance, and these are commonly adopted in determining compliance. We are now able to measure noise with a high degree of accuracy. Mathematical modelling can also be completed to determine where impacts from these emissions may occur. Where nuisance complaints arise, we no longer simply measure buffer separation distances, but are often able to quantify the impacts to allow a comparison with numeric standards and goals.

Given the continued prevalence of noise complaints, clearly the ability to quantify nuisance issues does not necessarily resolve all environmental nuisance conflicts. Planning tools and environmental legislation in Australia and overseas acknowledge that it is not possible to completely 'sanitise' the environment to the extent that noise is inaudible. However, communities and complainants often seek 'nil' impact as an end point for environmental compliance. As a result, determining the degree of acceptability of noise to enshrine in legislation remains problematic. Determining the degree of compliance with statutory nuisance legislation can also be challenging and as a result some nuisance cases continue to be determined through legal proceedings and a trial by the judiciary.

In considering the success of the various planning and legal tools adopted today, relative to those adopted in medieval times, the major advances in public health and sanitation have resolved a significant portion of the nuisance complaints that arose historically. However, noise nuisance is now one of the most prevalent causes of nuisance complaint despite the sophisticated tools we have available for managing these issues. Could it be that we are simply unable to tolerate the intrusion of others or the actions of others into our own personal space?

5.5 Changing Attitudes to Noise

In the mid 19th and early 20th Century, concerns that the world was simply becoming too noisy were prevalent. Similar concerns continue to be articulated (The Independent, UK, 2016). Despite this, attitudes to noise may be changing. Whilst in Australia 'quiet carriages' on suburban trains have had some success, in the UK they were introduced on trains only to be phased out due to lack of demand. The Commercial Director of CrossCountry trains commented that 'For the vast majority, train travelling is a social experience' (The Independent, UK, 2016). Research completed in New Zealand has concluded that for public spaces to thrive, a certain amount of noise and embodied disorder must be tolerated (Bonnie-May Shantz, 2008). This supports the view that different environments should be characterised by a 'Soundscape' (Brown, 2007), and that acoustic qualities and characteristics are an important feature of our social heritage.

The relevance and significance of environmental noise may, however, be addressed through a different mechanism in future. Social norms around behaviour in public have changed markedly in the last decade, especially regarding noise. Portable electronic and audio devices allow people wearing headphones to increasingly move around the community in a 'portable personal space', in which they listen to their individually tailored acoustic environment through a set of headphones. These individuals are isolated from the acoustic environment around them, and there is no longer a clear demarcation between personal and private space. As a result, external noise sources no longer have a significant impact.

Perhaps these mobile private spaces will result in less noise nuisance complaints in the future as environmental noise no longer intrudes on the listener. The availability of 'sleep phones' to allow the wearer to listen to music in bed may also address, to a degree, the issue of noise induced sleep disturbance. Looking further into the future, as new technologies proliferate, it is not beyond the realms of possibility that the ear could be bypassed entirely, with music and entertainment provided via a neuro-prosthetic device directly to the auditory nerve.

6. CONCLUSIONS

Noise and acoustics have been important issues throughout human history. 700 years ago, environmental nuisance concerns focussed on issues other than noise; whilst noise nuisance complaints did occur, they were limited in number compared to those arising from sanitation and stormwater impacts. Following the industrial revolution, noise nuisance issues became more significant. This was related to the improvement in public sanitation health control which reduced nuisance complaints relating to water and sewerage, as well as increasing mechanisation and technologies resulting in new noise sources.

In the early 20th Century, transport noise was a primary concern and the first noise abatement commissions were formed. In modern times, despite significant improvements in our ability to quantify and manage noise, nuisance complaints are dominated by noise issues. Whilst transport noise remains a concern for a significant number of people, domestic related noise – particularly barking dogs – dominate noise nuisance complaints.

The evidence indicates that the cause of the current dominance of domestic noise complaints is not directly related to population densities in towns and cities. Individual noise levels from road transport vehicles have decreased in level and the prevalence of road transport noise as the dominant feature of the sound environment for many communities may reduce significantly in the coming decades. An increase in the number of dogs as pets,

and the characteristics of barking, are likely to be the primary cause of the current level of domestic noise nuisance complaints. Domestic related noise nuisance could further increase in the future as background noise levels due to road transport reduce, population densities increase and modern building designs adopt passive ventilation and maximise natural light.

Looking further ahead, the current trends in behaviour indicate that sensitivity to external sources of noise could in fact reduce, and result in fewer noise complaints. It is probably unlikely that the ear will become completely redundant in the future, but currently available technologies could entirely change the complexion of noise nuisance in the future as we tune out unwanted noise, and tune in to our preferred auditory environment.

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