Conceptualising sound making and sound loss in the urban heritage environment

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ABSTRACT

Human existence is complemented by environmental sounds as by-products of people’s activities as well as intentionally generated sounds that allow human society to function, including transport and traffic sounds and notification sounds. The resulting soundscapes surround and permeate people’s daily existence. Technological, as well as behavioural change causes some of these sounds to become extinct at the local or universal level. While expressions of human communication through spoken words (language) and song are deemed to be heritage and thus formally collected and documented, there is a general lack of consideration of the heritage potential of anthropogenic environmental sounds. Focussing on examples from the state of NSW (Australia), this paper discusses sound loss in the urban heritage environment and advances two variations of a conceptual framework to assist heritage practitioners in decision-making to assess heritage potential in order to safeguard some of these sounds for the future.

Introduction

As a fundamentally social species inhabiting municipalities of various size (villages, towns and cities), humans have developed soundscapes that surround and permeate their daily existence. Such soundscapes include sounds that may be ancillary, i.e. emanate from societal activities (e.g. sounds emerging from traffic), or intentional, i.e. emitted from sound making devices to signify events or dangers to the public (e.g. loudspeaker announcements at subway stations). Traffic and transport sounds may include noises of combustion engines, road, traffic and noises, and aircraft sounds, whilst notification signals may include the sounds of church bells, fog horns, train and car horns and emergency sirens. These resulting soundscapes are dynamic, with changes occurring alongside transformations of underlying human activity patterns, including technological and societal changes.

The concept of aural heritage, its conceptualisation and management, is a rapidly expanding area of research, covering aspects of both natural and human heritage. Previous work, for example, has attributed value towards sounds in natural heritage spaces, such as avian soundscapes (Farina et al. 2011) or sounds in specific, spatially defined areas (Bernat 2013), and there has been particular discussion in the literature pertaining to the semantic richness of sounds across many levels of the social sphere (Schafer 1994; LaBelle 2010). Soundscapes have been examined across a variety of environmental spaces, including indoor urban (Mattern 2007; Mackrill et al. 2013), outdoor urban (Huang and Kang 2015; Wood 2015), transportation systems (Maffei et al. 2012b; Yilmazer and Bora 2017) and the natural environment (Marley et al. 2016). More recent research has investigated the acoustic environment of religious spaces (Alonso et al. 2019; Álvarez-Morales et al. 2020) and across multiple world heritage sites such as caves, stone circles, monumental structures and cultural soundscapes (Sü Gül 2019; Till 2019; Zheng 2019), as well as the development of human-centred acoustical data collection strategies to accurately preserve aural heritage (Kolar et al. 2021).
As with all constructs of value, the perception and conceptualisation of soundscapes in natural spaces is anthropogenic (Schafer 1994), even though extraneous noises may not only collide with the human perception of ‘nature’ but also interfere with inter- and intra-species faunal communication (Larsen and Radford 2018).

Throughout the literature, the terms ‘aural, ‘sound’ and ‘auditory’ are used interchangeably, without any determination of the difference between each term. Despite both ‘aural’ and ‘auditory’ being associated with the receptor of the emitted physical energy of sound wavelengths as ‘related to the sense of hearing’ (Collins Dictionary 2018a, 2018b), the term ‘sound’ can also be described as related to the receptor as ‘something that you hear’ (Collins Dictionary 2018c). As such, this paper will echo the compatible use of such terminology and will also use these terms interchangeably with reference to heritage.

The human built environment is a rich source of sounds and soundscapes that warrant consideration as aspects of human cultural heritage. The discipline of cultural heritage management, which focusses on the preservation of traces of past human endeavour and behaviour, has developed an array of criteria and protocols for identification, documentation and management of humanity’s heritage (Australia Convention Concerning the Protection of the World Cultural and Natural Heritage 1972; U.S. Department of the Interior 2011; ICOMOS 2013). While the legal frameworks of heritage protection of most countries include the evaluation of an object or place’s aesthetic, historical, or scientific value for past, present or future generations to determine its cultural [heritage] significance (Ancient Monuments and Archaeological Areas Act 1979; ICOMOS, 1964; US Historic Preservation Act s. 1, 1966), they tend to focus on the protection of tangible entities and struggle to address intangible aspects.

Intangible heritage is defined as embracing all forms of traditional and popular or folk culture, such as ‘oral traditions and expressions, including language as a vehicle of the intangible cultural heritage; performing arts; social practices, rituals and festive events; knowledge and practices concerning nature and the universe; and traditional craftsmanship’ (Lennon et al. 2001, p. 14; UNESCO n.d., p. 1). Not surprisingly, a highly specific field of auditory heritage is associated with the identification and preservation of languages that have come under threat from marginalisation by dominant cultural groups. Much research has been carried out into Indigenous languages, both in terms of linguistic documentation (Curnow 1997; Epps et al. 2012) and in terms of preserving the use of the spoken word (Crawford 1995; Nicholls 2005), including associated Indigenous spoken arts as well as cultural traditions and practices (Eder 2007; Willox et al. 2013). Research has also been conducted into the need for, and technicalities of, the documentation of culturally significant sounds of the dominant cultural groups, such as music, oratory and commemorative events (Hill 2012; Bijsterveld 2013; Birdsal and Drozdzewski 2018).

In recent times, the concept of the importance of sound is emerging as a greater issue and is beginning to be discussed worldwide. In 2017, UNESCO passed a resolution recognising the importance of the sound environment in shaping human behaviour, both at the personal and collective level. Noting that an increase in urbanisation could lead to an increase in sound level and subsequent changed soundscapes, it raises awareness of the preservation of even the ‘least significant sounds’ (UNESCO 2017). Drawing on this raised awareness, the Assemblée Nationale (France) enacted national regulatory frameworks in 2021 to both define and protect elements of sensory heritage, leading to the protection of ‘sons et odeurs des campagnes françaises’ (sounds and smells of the French countryside) against possible community disturbance (Assemblée Nationale, 2021). Whilst awareness of the importance of sound and soundscape components is growing, there is a lack of research that adequately addresses the fact that the current urban heritage environment encompasses an array of sounds and soundscapes that are in themselves short-lived and ephemeral. Significantly, though, while such soundscapes may (re-)occur on a regular basis, they are not static, but undergo changes concurrent with changes in the patterns of the underlying human activity. In order to advance heritage management approaches towards this ephemeral auditory heritage, there is a need to conceptualise sound making and sound loss in the urban heritage environment.

Drawing primarily on examples from the state of New South Wales (NSW), and to a lesser extent greater Australia and worldwide, this paper will first identify sounds and the equipment and conditions that make such sounds and then will discuss the various processes that lead to sound loss. Based on these, conceptual frameworks will be advanced which classifies...
sounds and provides suggested approaches for the management of these sounds in the cultural heritage management framework, which has the potential to be employed across varying levels of management globally.

What devices make these sounds?

There is much interplay in the literature between the terms of specific sounds heard in the environment and the actual devices that make these sounds. These terms are often used interchangeably, with examples being ‘tea kettle’ and ‘telephone’ (Marcell et al. 2000, p. 855), or ‘foghorn’ and ‘church bell’ (Ballas 1993, p. 252). In these cases, the actual devices are listed as ‘sound types’ of environmental sounds, possibly suggesting two things; that the world of sound in research does not differentiate between sound and device, and/or the sounds created by these devices are so inextricably linked with the tangible device that only one term is applied. From a management perspective, neither is ideal, as it should be possible to manage any sounds emanating from a device separately to the device itself.

Whilst there are some studies looking at sound making devices in the environment, the majority of these investigate these devices within the context of an environmental soundscape, and few look at the devices separately: for example, Buddhist temple bell ringing was examined within the soundscape and cultural background of the area (Ge et al. 2013); church bell ringing was examined within a historical context of renaissance Florence (Lee 2017); and car horns were examined as noise within a cityscape (Nagahata 2010). There are, however, numerous publications which examine sound making devices, with these predominantly looking at popular heritage items with a broader appeal, including reference books on steam trains (e.g. Semmens and Goldfinch 2004), motorcycles (e.g. Rafferty 1997) and foghorns (e.g. Renton 2001). Despite these, there is no literature in hand that researches sound making devices in a broader context and specifically none that further categorises these sounds.

To investigate these devices, we can explore what management is currently in play with regards to sound making devices. As an exploratory example focussing on the most populous state of Australia, a brief search of the NSW State Heritage Register was undertaken to note what sound making devices were mentioned, alongside the corresponding number of these devices in the Register. The Register is a requirement stipulated by the NSW Heritage Act 1977, and functions as an inventory of heritage items located in and deemed significant to the heritage of the state of New South Wales. At the time of the search, it contained 1,699 recorded items (NSW Heritage Office 2018). The entire list of entries listed under the NSW Heritage Act was manually screened in March 2018 for the presence of potential sound making devices, with objects being selected based on similarly known devices listed in the available literature. These included items such as locomotives, fire engines, churches and railway stations. Furthermore, individual search terms were applied to confirm that no sound making device entries were missed, with search terms again being informed by previous literature; terms included ‘bell’, ‘clock’, ‘water’, ‘music’ and ‘siren’. Any item found mentioning a device which could theoretically make a discernible ‘characteristic’ sound was noted, and further notes were made pertaining to the description of these devices. A sound was determined to be characteristic to a device if there was an expected recognisable association between the two, with decisions being ultimately based on sonic examples noted in the literature.

Only 147 of 1,699 records made specific reference to an item which had the potential to create an identifiable sound. Of these, 112 records specifically mentioned an object which may create a sound, with the most common sound-making devices referenced being church bells, organs/pianos, clock tower bells and engines/pumps (Table 1). Of these records, only 16 gave further information on the actual methods, frequency or pitches of sound produced, or the importance this sound-producing object has with reference to heritage.

However, it is acknowledged that this list is expected to be far from comprehensive based on three accounts. Firstly, it is recognised that both the title screening and keyword searches relied on terms limited to the available literature, with results therefore constrained by bias of both the researcher and the work of previous researchers. Secondly, the extent of textual description of the object/place, its cultural/historical context and significance varies widely between register entries. Finally, it is expected that the heritage registers are far from complete (Savage 2001), and
Table 1. Sound making devices referenced in NSW state heritage register (note: some entries make reference to more than one sound source). Analysed from NSW Heritage Office (2018).

| Device type          | Listed items with identifiable sound potential (n) | Items with detailed sound information (n) |
|----------------------|---------------------------------------------------|----------------------------------------|
| Church bell          | 40                                                | 7                                      |
| Clock tower bell     | 29                                                | 4                                      |
| Organ/piano          | 29                                                | 4                                      |
| Engine/pump          | 11                                                |                                        |
| Clock bell           | 6                                                 | 1                                      |
| Other bell           | 5                                                 | 1                                      |
| Film                 | 4                                                 |                                        |
| Projector            | 4                                                 |                                        |
| Fire bell/gong       | 3                                                 |                                        |
| Gun/cannon           | 3                                                 |                                        |
| Rail equipment       | 3                                                 |                                        |
| Servant bell         | 3                                                 |                                        |
| Old                  | 2                                                 |                                        |
| Carillon             | 1                                                 | 1                                      |
| Carousel             | 1                                                 | 1                                      |
| Chinese drum and gong| 1                                                 |                                        |
| Fog                  | 1                                                 |                                        |
| Fog siren            | 1                                                 | 1                                      |
| Fountain             | 1                                                 |                                        |
| Roller coaster       | 1                                                 |                                        |
| Steam train whistle  | 1                                                 |                                        |
| Zither               | 1                                                 |                                        |
| TOTAL                | 147                                               | 16                                     |

examples include a fog bell at Fort Denison (Figure 1) and a bell on a wooden structure at Tomago House and Chapel (Figure 2, top left). It is important to note that the Fort Denison fog bell has only recently been decommissioned (NPWS, pers. comm. 2017), and despite playing an important part in the history of Port Jackson (Sydney Harbour) no reference to it or its sound is made in the Heritage Register. The current NSW State Heritage Register therefore does shed light on current attitudes regarding sound heritage management in NSW, with the majority of listed sound making devices being limited to historic churches and town hall structures, or musical instruments.

The demise of sound in the built environment

As the world changes, it is foreseeable that many aesthetic elements of the built environment will change correspondingly, affecting associated aural/sound characteristics of these elements. Technological advancements may render active sound-making devices obsolete; society may change its general disposition towards social engagements, celebratory activities or religious events; and policy or legislation may enact future change of sound emanation from industry and private engagements.

Such changes may allow some sounds to become lost at some locations or altogether, with ‘sound loss’ being analogous to the extirpation or extinction of a species within the natural environment – the sound is no longer heard or experienced in its original setting at a specific location (extirpation) or universally (extinction). This may present an issue if such aural elements are considered to have heritage value with

Figure 1. The now obsolete fog bell at Fort Denison, NSW (Spennemann and Parker 2020).
respect to the community, and management of these devices may therefore need to be enacted. Let us then consider potential causes of demise of sound (sound loss) in the built environment, across standard causal auditory categories. A taxonomy of the acoustic environment for soundscape studies has been developed within the ISO/TS 12913–2 (Acoustics – Soundscape Part 2), which breaks down the acoustic environment of human activity into the categories social/communal, electro-mechanical, transportation, and human movement/voice – instrument/other human sounds (ISO 2018). Whilst recognising this breakdown is appropriate for the actual classification of human activity sounds in the acoustic environment, the umbrella term ‘social/communal’ is too nebulous when looking at sound loss as a potential heritage issue. Also, in recognising that this paper is not focussing on human movement or instrumental/singing components, we will therefore group these sounds into the more commonly identifiable terms ‘signals’ and ‘human activity’. To assist in conceptually understanding probable future continuance of sounds.

Figure 2. Examples of church bells. clockwise from top left: campanile bell at tomago house and chapel, tomago, NSW; Single tower bell at St Mary and pope kyrillos Coptic orthodox church, cundletown, NSW; Bell tower housing diatonically tuned set of bells at Christ Church St Laurence Anglican church, Sydney; multiple tower bells at St Nicholas Greek Orthodox Church, Marrickville, NSW (all photos M Parker).
within the built environment, an investigation of some past and probable future causes of demise or loss of these sounds is presented below. A number of examples is presented to demonstrate the breadth and complexity of the issue at hand. The grouping of the examples discussed is based on the classification provided by the ISO/TS 12913–2 and augmented by Shafer’s (Schafer 1994) work. Based on these examples, we will then propose a classification and heritage action framework for anthropogenic sounds of the built environment.

**Signals**

As defined by Schafer, signal sounds are those designed to be actively listened to by society as they constitute acoustic warning devices or notices (Schafer 1994). Signal sounds can be activated for social, industrial or commercial purposes, and can include the ringing of church and school bells, fog signal calls, factory sirens, and clock chiming. As these sounds are intentionally generated and may have great relevance to societal function, signal sounds have significant heritage potential, and obsolescence could render a real issue in heritage management.

**Church bells**

The ringing of church bells is linked with many churches of the Christian faith. Comprising of a metal bell being struck with either a hammer or a clapper, church bells have been rung at regular services and celebratory events since mediaeval times, individually or in sets tuned diatonically (Johnston 2006). Bells can be internal or external, singular or in assemblages, and can be situated in bell towers, belfry/apex structures, or on separate structures, such as campanile, adjacent to the church (Parker and Spennemann 2021b) (Figure 2). However, in recent times there have been numerous examples where these sound-making devices have become silenced, primarily due to the sale, deconsecration or re-appropriation of a church; or where the sound emanated from the bells has been controlled in such a way that it is now heavily muted, often as a result of social changes in a community.

The sale or deconsecration of a church building will effectively mute any church bell ringing through religious practice, potentially silencing the ringing of all bells on the premises. There are known occurrences of churches being sold off publicly in New South Wales to fund abuse compensation claims (Vinalaes 2017), due to public infrastructure initiatives, reallocation of church resources (Collins 2004, May 28; Bertola 2015; Bastians 2017) and because of a general decline in church parishioner numbers (Clarke 2015; Davis 2016; Mexon 2017). At least three decommissioned churches in the greater Sydney region were observed to have a church bell on site (Bertola 2015; Clarke 2015; Craze 2017, December 7), although specific ringing practices of these churches were not investigated.

A 2012 future growth strategy of the Anglican Diocese of Newcastle stated that nine of its fifteen churches in the Newcastle and Newcastle West area could be made redundant due to ‘falling congregation numbers, maintenance problems, lack of financial contributions, no on-site parking, fire risk issues and disconnect with community’, despite four of these churches being heritage listed (Page 2012, para. 3). Further afield across Australia, a further 50 churches in Tasmania were planned to be sold by The Anglican Diocese of Tasmania, to assist in funding an $8 million redress payout to survivors of church child sex abuse (Gooch 2018). It is unknown what bell ringing practices are in place in these churches, but it is expected that more churches that contain bells will be deconsecrated in the future.

While there are a number of adaptive reuses for defunct church buildings (Velthuis and Spennemann 2007), the use of the bells is generally discontinued, unless the physical bells themselves find reuse in other localities and settings (Parker and Spennemann 2021b).

The sound of church bells may be at risk even in churches with stable parishioner numbers, due to lack of community support or noise complaints by neighbours. Examples include St Catherine’s Greek Orthodox Church in Mascot, NSW – which has been subject to three petitions calling for soundproofing of the church bell towers, following the alleged breaking of its bell-ringing curfew of ‘every Sunday, Christmas Day, Easter Sunday and Good Friday, plus five other days per year’ (Suckling 2013, paras. 3–4), and St Nicholas Greek Orthodox Church in Marrickville, NSW. The latter has totally silenced all bell ringing due to the rising number of complaints by church neighbours, as a result of gentrification and general societal change of the local area (De Sousa, personal communication, September 2018).

Another example is Naremburn’s St Leonard’s Church, NSW, which had their bell tolling volume restricted to 60 decibels and was directed to limit its
tolling to ‘no more than twice a day and no more than five times per week to be shared between Sunday services, weddings, funerals and special religious ceremonies’ with additional sound mitigation methods in use during practice sessions due to complaints by neighbours about the sound disturbing their sleep (Gladstone 2015; Murada 2014; para. 5).

Legislation of sound can affect the ringing of church bells, and varies from country to country. In Post-War Yugoslavia, an official socialist 1953 regulation limited bell ringing to regular services and banned any church bell ringing connected to other Christian activities including funerals, the traditional Angelus rung three times a day, or ringing in the evening or at dawn; and upon Slovenia’s independence, a 1995 decree again declared bell ringing as an official source of noise (Kovačič 2017). This is juxtaposed by legislation in the United Kingdom, where the Church of England Synod has requested government consultation with a view to ‘protecting the ringing of church bells throughout the country from unreasonable restriction and, if appropriate in the light of the outcome of such consultation, to bring forward legislation to that end’ (Pocklington 2018, para. 6). Legislation with reference to any sound emanating from religious structures can clearly have considerable influence on sound demise or protection.

It is also expected that a number of churches may have progressed from traditional physical bell ringing to the broadcast of bell recordings (analogue or digital) using speakers on-site, changing the nature of the sound event (Figure 3). While it is unknown how many churches undertook this change and over what period these changes occurred, the advent of advanced technologies and the prevalence of records from the 1930s–40s (Osborne 2016, pg. 68) suggests this period might have been a turning point for some churches to start using recorded church bell sounds, potentially causing the extinction of some live sounds with all the operator-error induced variability that this entails.

The sound of active churches may change as a result of catastrophic events, such as the broad reduction (and occasional increase) of church bell ringing due to the COVID-19 pandemic restrictions across 2020–21 (Parker and Spennemann 2020a), and specific interruptions of sound due to the devastation of St Paul’s Catholic Church, Clarence Valley NSW, as a consequence of fire (Jones 2018); the collapse of Sacred Heart Church, Beagle Bay WA after years of tropical storms and cyclones (Collins 2018, May 12). Due to the unexpected nature of events worldwide, it becomes clear that not all sound demise is predictable, and contingency management might need to be employed.

Despite local and state-wide community protests over the sale of churches (Vinales 2017; Gooch 2018), it is unknown to what extent potential church bell ringing sound loss will have on either the church or local community. Whilst previous research has identified a high level of attributed value of church bell ringing with respect to heritage of practitioners in Catholic, Orthodox, Presbyterian, Uniting Church and Anglican faiths in NSW (Parker and Spennemann 2020b), further research is warranted into this area to investigate the extent of this value and the importance of church bell ringing in the community in terms of aural heritage.

**Fog signals**

A fog signal is a functional sound produced specifically in inclement weather in ports or coastal regions, designed to reduce the danger to sea borne navigation during poor visibility by marking out an ‘audible’ lighthouse. The sounding instruments include gongs, bells (Figure 1), rockets and explosives, reeds, sirens and diaphones amongst others (Figure 4), with each
device being at risk of obsolescence through technological change since their first implementation (Renton 2001).

In Australia, the first records of operating fog signals were in New South Wales. Two two-foot diameter Chinese gongs were sounded at Fort Denison, and on the lightship Bramble within Port Jackson as early as 1866, being manually operated at five minute intervals in adverse weather, or in reply to a ship’s bell or whistle (Anonymous 1866, 1908).

Due to increased shipping in Port Jackson, three ‘improved’ fog signals (fog bells) were then cast and installed around Sydney harbour at Bradley’s Head, Fort Denison (Figure 1) and Dawes Point to replace these gongs, and were operated via electric motors at specified intervals apiece (Austin 1905; Anonymous 1905a, 1905c) until complaints about their efficiency necessitated the bells to operate continuously during fog (Anonymous 1905b; Norrie 1906, September 26). It was later decided to add ‘technologically advanced’ fog sirens at Sow and Pigs Reef in 1923 and at Bennelong Point in 1926 to complement these three bells (Anonymous 1923, 1926). Over time, both the Dawes Point and Bennelong Point fog bells were replaced by fog sirens, the Sow and Pigs Reef siren was removed, whilst the Fort Denison bell and Bradley’s Head siren remained (Robinson 2011). These were then decommissioned in 2014 and there are no current fog signals operating in Sydney Harbour (NPWS, pers. comm., March 2017).

Around Australia, other early fog signals used included detonating fog signals/rockets at Cape Otway, Cliffy Island, Gabo Island, Fremantle and Rottnest Island (Anonymous 1886b, 1892, 1893, 1906b, 1906c), automatic signals buoys (Anonymous 1877), a hand-rung fog bell in Newcastle Harbour (Anonymous 1925) and chemical odour floating receptacles (Anonymous 1906a). Over time, more effective inventions replaced these earlier devices, including fog sirens at Point Lonsdale, Cape Otway, Gabo Island, Cliffy Island and Nobbys Head (Anonymous 1886a, 1938a), light controlled shore based fog signals (Anonymous 1929a), powerful diaphones at Low Head, Cliffy Island and Point Lonsdale (Figure 4) (Anonymous 1929c, 1934, 2004) and radio beacons at Cape Otway and Cape Schanck (Anonymous 1938b, 1941).

Continued obsolescence of fog signals is most evident at Gellibrand Point (Victoria), where the early lightship foghorn signals sounded in parallel with a gong (later replaced by tonite rockets) (Anonymous 1878, 1887), later replaced by a submarine bell, then finally by a powerful fog horn housed on the Gellibrand Pile Light before it was destroyed in 1976 after being clipped by the Melbourne Trader in foggy weather (Anonymous 1913, 1939; Macdonald 2005).

In 1929, there were 13 operating fog signals around Australia’s coast, including the aforementioned four signals in Sydney Harbour (Anonymous 1929b). Today, there are only four known fog signals remaining in operation on the coast of Australia (Robinson 2011).

This loss of fog signal sound through obsolescence and technological change is echoed worldwide. In 2011, the Commissioner of Irish Lights
officially decommissioned the final nine remaining fog horns from the country’s coast, following a gradual disablement of fog signals over the previous twenty years (Siggins 2011). The central reason cited was that ‘rapid advances in marine technology have rendered fog signals obsolete and they are not an aid to navigation’ (Siggins, para. 5), and the functionality of the sound was no longer required. Similarly, the final Scottish foghorn was decommissioned in 2005 at Skerryvore lighthouse (Shute 2013), the US Coast Guard replaced 17 foghorns with radio-activated sound signals along the Maine coast in 2016 and a further seven in 2017 (Anonymous 2017a). Trinity House reported only 24 fog horns that were still operational around the entire coast of England and Wales (Shute 2013, April 7 2018), and the Port of Auckland has removed five of the nine fog horns in Auckland Harbour to remove ‘unnecessary night noises’ (Anonymous 1998, para.1).

While fog signal sound has changed over time due to improvements and developments in sound creating devices, modern technological advances are clearly contributing to a total loss of this sound. Despite there being no local protests about the decommissioning of these devices (and the corresponding loss of sound), there is evidence to suggest that these sounds are highly valued by the community. In commemoration of the sound loss from the Souter Lighthouse, United Kingdom, an hour-long musical project ‘Foghorn Requiem’ was composed to be performed by 55 nautical vessels’ foghorns and a 75 piece brass band, accompanied by the booming bass of the lighthouse foghorn (Shute 2013, April 7 2018). Other community involvement in commemorations of lost sounds include tours and sounding of the obsolete foghorn of Point Lonsdale, Victoria (Payne 2015), and a commemorative digital sound documentary titled Eulogy for a Sound, created during the decommissioning of the final foghorn in Ireland (Murphy 2011).

In each of these cases, members of the community discuss the importance of how these functional sounds have affected their lives in the past, and that the sound gave them a sense of assurance and nostalgia. These commemorative works and comments make it clear that these intentionally generated sounds have a high degree of value attributed to them by the community, and that sound loss through device obsolescence has negative social ramifications.

**Sounds from public buildings**

Most intentional emission of sound from public buildings relates to a communal broadcasting of time signals. Some, such as cannons associated with timeballs (Duncombe and Haupert 1970), have been made obsolete with the increasing ubiquity of personal timekeeping devices. If public buildings harbour any sound-emanating objects such as tower clock bells or chimes, it is expected that any sale or reappropriation of these buildings may then fundamentally change the nature of any sound associated with these objects. Examples from NSW include: the closure of Mullengandra Public School due to dwindling student numbers, which stopped the school bell being rung even though the school was the ‘heart of a rural community for nearly 150 years’ (Gerathy 2017, para. 1); and the public lease of heritage listed Lands and Department of Education buildings of Sydney announced by NSW State Government in 2015 (Philipson 2015). Despite the clock tower atop the Lands Department Building having no chiming mechanism (Watson, pers. comm. 19 February 2018), it is anticipated that some public buildings with chiming clocks may be affected by future leases/sales of public buildings nationally.

Other sounds emanating from public buildings may be lost due to societal change, such as the suspension of loudspeaker propaganda broadcasts alongside the dismantlement of broadcast devices in May 2018, as a result of a more agreeable relationship between North and South Korea (ABC News 2018, April 29).

**Human activity**

With reference to human activity sounds, loss or demise of these sounds may result from social changes affecting the place in which the sound is created, or how the sounds are utilised in the social setting. Often, human activity sounds are censored or limited by policy or legislation methods, with Australian and global examples including: the decrease of town criers/market criers in Melbourne, Victoria, through closure of market halls as a result of changes in council regimes (Doggett 2015); the decrease of amusement park sounds through closure or restriction of ‘noisy’ rides in Sydney, NSW (Hasham 2015); and changes to the social activity soundscape of Rio di Janeiro, Brazil, as a result of social or government imposed changes (Medrado and Souza 2017).
A particularly poignant example of the loss or limitation of a human activity sound is the religious sound of the Islamic call to prayer (Azan), with this sound often being the target of confrontation by neighbours complaining about the sound disrupting their sleep patterns. On an international scale, the sound is particularly at risk in Israel. In March 2017, the Israeli parliament gave preliminary approval for ‘sound pollution’ measures, eliminating the use of loudspeakers at any time and limiting loudspeakers in urban areas between 11:00 pm and 7:00 am (Anonymous 2017b). These measures will potentially impose restrictions on all pre-dawn calls to prayer, could limit broadcast of the Azan through any large broadcast means, and recent amendments could consent to the confiscation of loudspeakers belonging to religious institutions that break the law, alongside significant fines to violators (Harkov 2018).

Noise mitigation methods are being incorporated in other parts of the globe. Both Indonesia and China limit (or eliminate) loudspeaker volume to reduce contention regarding mosque broadcasts within suburban areas (Anonymous 2015; Williams 2017), and the United Arab Emirates has contrasting measures in place to not only limit the decibel level of the call to prayer, but also to ensure it is of sufficient volume to be heard appropriately for functional use (Moukhallati 2017).

In Australia, mosques have been subjected to noise complaints in both Sydney and Melbourne. Since some objections have been raised before the construction of the actual structure, it appears that there is a deeper social intolerance at play here rather than simply a ‘noise’ issue (Hedjes 2013; O’Brien 2016, January 9), a discriminatory sentiment echoed in other countries such as Malaysia, United Kingdom, Germany, Denmark, Italy and Sweden (Elvery 2018). Any social change towards religious hostility therefore has the potential to cause sound loss of human activity based religious sounds (and signal sounds alongside), having management implications if these sounds have heritage value imparted onto them.

**Transportation sounds**

Transportation sounds include the traffic sounds of cars, trucks, motorcycles and buses, as well as their associated accelerating and braking sounds, alongside sounds generated by railway, aircraft and shipping (Guastavino 2007; Zannin et al. 2013; Borelli et al. 2016). Sound change and associated demise of any transportation sound is predominantly linked to both progressive technological change and initiatives to counteract or minimise ‘noise’ concerns, and these are discussed in greater detail below. Despite many of these sounds being by-product or unintentional sounds, they have heritage potential if the devices emanating these sounds could become obsolete, and/or if there is value attributed to these sounds by a community or by society at large.

**Technological change**

Throughout history, new technology has rendered older transportation methods to become practically obsolete. Diesel/petrol fuelled vehicles replaced horse and cart transportation, and diesel/electric engines of trains replaced steam trains, diesel engines and turbines replaced paddle steamers and steam ships, which originally replaced sailing ships (Anonymous 1936; Cooper et al. 1973; Harlaftis et al. 2012). At each point of technological change, new transportation sounds have emerged and older sounds have dwindled in the soundscape.

Improvements in rail track technology, in particular the continuously welded tracks, have rendered the traditional gaps in jointed rails obsolete, leading to the demise of the traditional ‘clickety-clack’ sounds of passing trains (Van Ruiten 1988; Choi et al. 2020). Sounds have also diminished due to automation of some transportation systems, such as manually operated railway signal boxes (Webb 2015; Carey 2017, March 12).

In urban spaces, the sharp, accented clack-clack of shod horse hooves on cobble stone pavements that characterised nineteenth-century city streets (Boutin 2015) gave way to the thrum of combustion engines in urban stop-start traffic. The sounds of that type of traffic are also changing with the increasing abandonment of V6 and V8 engines by automobile manufacturers in favour of V4 engines (Vincent et al. 2019). In the near future, the sound pattern generated by combustion engines in urban areas will diminish dramatically concomitantly with the shift to electric engines as many cities are embracing electric cars. With the rise of electric transportation and the anticipated arrival of electric trucks and electric planes, the traditional combustion engine may soon be left behind (Vaughan 2018; Forbes 2018, October 27). While uptake of electric vehicles is slow in some countries, national policy settings are about to change this (Danielis et al. 2020; Foley et al. 2020; Broadbent et al. 2021).
As well as transformation of engine types over time, the evolution of sounds generated by moving vehicles is linked to differing types of road surfaces, tyre size and tread patterns, as well as the rubber composition of these tyres. Road noise is directly affected by the road surface; unsealed roads create considerable noise through type impaction on the uneven surface, whereas the use of more modern porous road pavement surfaces reduce and attenuate contact sound, with road noise reductions relating in part due to the thickness of the porous layer, the surface porosity and the coarseness of the aggregate mix used (Crocker et al. 2005; Pierce et al. 2009). With continued evolution of road surfaces and the recent addition of poroelastic compositions (increased rubber content), it is plausible that traffic noise could fundamentally change due to higher noise-dampening response (Biligiri et al. 2013). Furthermore, with different tyre size and tread patterns (Sandberg 2004), and evolution of tyre compound type (Kole et al. 2017) it is expected that further changes in traffic sounds may occur in the future. Additionally, climate change-induced temperature increases could also affect traffic sounds, with a lower demand for studded tyres, which generate a significantly greater tyre–road noise (Vaiškūnaitė et al. 2009). This would affect Alpine towns in Europe and other snow bound areas, such as some urban agglomerates in Alaska and Canada (Anfosso-Lédée and Pichaud 2007). Due to increased automation and the emergence of new technologies in the future, transportation sounds will continue to transform, rendering some sounds practically obsolete. If any of these potentially lost sounds have value placed on them by society, sound loss could therefore have management ramifications and responsibility should be taken to address this problem before the loss of sound takes effect. Of course, it useful to consider whether such variations in road noise are something that could or should be preserved or documented. We must take into account any heritage value judgements regarding these sounds when considering what is worth preserving. To the authors’ knowledge, no research has taken such needs into account with reference to road noise to date.

**Noise legislation**

Sound change can also be linked to legislative initiatives addressing noise concerns within the environment, with the first known reference being a noise ordinance decreed by Julius Caesar in 44 BCE, referring to the unwanted clanking of waggon noise on cobble stone streets (Richardson 2016). Excessive noise also effectively scuttled advanced technologies, such as that of the Concorde airliner, where complaints about its sonic boom restricted its use of supersonic speed to open water spaces (Schechter 1978; Rogers and Magliieri 2015). Recent studies have examined options to minimise/exclude sound emissions from train horns (Bunn and Zannin 2016), noise perception of these horns (Zannin and Bunn 2014), general railway noise (Bunn and Zannin 2016), and negative impact of aircraft noise on natural and urban settings (Vogiatzis and Remy 2014; Iglesias-Merchan et al. 2015). Past research has investigated change in urban soundscapes associated with the implementation of measures limiting car horn use and city traffic restrictions (Nagahata 2010; Maffei et al. 2012a).

In-place methods currently used to minimise transportation sound emissions include projects to reduce shipping noise footprints, cavitation and port noise issues (Borelli et al. 2016; Schenone et al. 2016); projects to implement low noise technologies in aircraft (lemma 2016) and noise abatement measures at airports (Ganic et al. 2016), road network surfaces and noise walls at highways (Attenborough et al. 2016; Petrovici et al. 2016; Van Renterghem et al. 2017), and across railway networks (QUIET-TRACK 2016). Regulations limiting the movement and activities of people may also have an indirect consequence on human produced sounds in the human, with local and national restrictions employed to limit the spread of COVID-19 being a particularly poignant and topical global example. Research has shown a significant decline in transport and pedestrian activity in both Melbourne and Sydney (Australia) (Spennemann and Parker 2020), in London (UK) (Aletta et al. 2020), and Madrid (Spain) (Asensio et al. 2020).

Worldwide projects to directly reduce/eliminate diesel powered vehicles, as well as the introduction of citywide car-free zones and greater development of bicycle friendly cities will further change transportation methods (Garfield 2017). It is expected that these and future projects will intensify further demise of transportation sounds. While noise abatement measures may be appreciated by the wider society, if the recognised value placed on currently obsolete sounds such as foghorns is anything to go by, there may be a subset of the community who could hear these lost contemporary sounds with a sense of nostalgia in the
future. Such future heritage may warrant management and documentation before any sound loss occurs.

Manufacturing sounds

Manufacturing plants are a ubiquitous source of sounds, both perceived as noise and as keynote sounds. Originally this a distributed system of small, artisanal factories with their individual sound patterns such as those of the hammering of a smithy or the clickety-clack of a water- or wind-powered mill. The industrial revolution both concentrated manufacture by replacing the artisanal operations and increased the emitted sound volume due to the employ of steam- and later combustion engines (Beard 2006; Bijsterveld 2008). While the underlying technological change eventually evoked a desire to abate the resulting noise (Bijsterveld 2001) it initially also spawned both positive and negative literary responses that influenced public perception (Norquest 2016).

Mechanical/other sound loss

With reference to mechanical or other anthropogenic sounds of the built environment, it is practically conceivable that all currently employed technologies may similarly be made redundant due to subsequent improvements, and sounds associated with these products/devices will be lost in the process. Examples include the transformation of communication devices (Kwon and Laku 2000), film projection apparatuses (Wollen 1980), manual type-writers (Chang 2012), cash registers (Rech 2017) and other product payment methods (Humphrey 2004). These advancements have rendered older technological sounds effectively obsolete, such as early telephone ring/dial sounds, early film projection operating sounds and cash register sounds, respectively. It is expected that impending technologies could render several other existing sounds to become lost or obsolete. Again, despite these sounds mainly being by-product sounds, they here may have heritage potential if the sound-making device becomes obsolete, and/or if there is value attributed to them by society.

What is potential heritage and what’s worth keeping?

Although the above discussion of sounds and associated devices is nowhere near exhaustive, this investigation does allow a more meaningful conception of some past and probable future causes of demise or loss of sounds within the built environment. This is an important issue, particularly if the sounds in question have any heritage significance to the community, as methods would then need to be employed to conserve or protect these sounds from potential extinction. Let us now consider what may be considered heritage and what may therefore be worth keeping. That said, this is not the place to discuss the processes of heritage management and the determination of cultural heritage significance (Howard 2003; Spennemann 2006b; Smith and Waterton 2012). Suffice to reiterate that the existing legal frameworks of heritage protection of most countries include the evaluation of an object or place’s aesthetic, historical, scientific value for past, present or future generations to determine its cultural [heritage] significance (Ancient Monuments and Archaeological Areas Act 1979; ICOMOS, 1964; US Historic Preservation Act s. 1, 1966) and tend to focus on the protection of tangible entities. They struggle to address intangible aspects as well as aspects of aesthetic value which are essentially a human response to a site or object in its environment. An assessment of the latter is highly subjective, especially so when considering auditory elements of heritage, such as the sounds of church bells or fog signals, which are ephemeral and entirely intangible manifestations of heritage, often of very short duration (unless they produce a continual sound).

As the previous discussion has shown, not all sounds are equal in their role and significance in the human environment, and therefore need to be ascribed different levels of cultural heritage significance. The most relevant classification of sound with reference to heritage is Shafer’s discussion of three main features of any soundscape: keynote sounds, signals and soundmarks (Parker and Spennemann 2021a). Keynote sounds are the ubiquitous sounds of a particular place, relating to a place’s geography, climate or the everyday behaviour of the society; signal sounds are functional sounds designed to be listened to as they constitute acoustic warning devices or notices; and soundmarks are the distinctive ‘landmarks of sound’ for a particular place – once a soundmark is identified, ‘it deserves to be protected, for soundmarks make the acoustic life of the community unique’ (Schafer 1994, p. 10).
Classification and heritage action frameworks

Research has shown that value attributed to sound, and therefore potential heritage importance, is linked to associated meaning. This has been demonstrated in religious settings in such examples whereby there is a positive correlation between factors of religious belief and degree of acoustic harmony in Buddhist temples (Zhang et al. 2016) and between ascribed importance placed on bell ringing with symbolism and religious embodiment (Zheng 2019; Parker and Spennemann 2020b). Importance attributed to soundscapes can also be influenced by elements of meaning through historical recognition and understanding (Jordan 2019). By nature of their communicative function, and being inextricably connected to meaning, it could be proposed that intentionally generated sounds, like signals or many human activity sounds, may have a greater heritage function than by-product sounds. Conversely, by-product sounds may have a greater relationship with the negatively associated term ‘noise’. Based on sound categories as recommended by ISO/TS 12913–2 Acoustics – Soundscape Part 2 (ISO 2018), and taking into account the relative importance of soundmarks, signals and keynotes as suggested by Schafer, alongside the potential for specific sounds to become obsolete, we present two versions of a classification and heritage action framework for anthropogenic sounds of the built environment. One framework designed for sounds that are still in use (Figure 5), and a variation on that framework for sounds that have become technologically obsolete or have been restricted/prohibited, and are therefore at risk of extirpation or extinction (Figure 7).

For the evaluation of their potential heritage value and subsequent management actions, we propose a step-by-step decision-making sequency that first considers the sound type, which, when filtered by its intent, results in a sound feature that forms the foundation for a value assessment. By manner of their association with meaning, intentional/functional signal sounds could have the highest heritage potential,

![Figure 5. Proposed classification and heritage action framework for anthropogenic sounds of the built environment that are still in use. *) Other may include natural sounds occurring in the built environment as a direct consequence of design and planning actions, e.g. water features, bird song.](image-url)
in particular if they rise to the level of soundmarks – by definition soundmarks deserve to be protected as they provide distinctively unique aural landmarks of a place. The literature shows that there is also potential that other intentional or by-product sounds arising from other categories could have attributed heritage significance if the sound is valued by the community, and even on some occasions, by-product sounds having the potential to be assigned the status of a soundmark (Minoura 2013). Some sounds that are by-products to human endeavour and have no value imparted onto them may be perceived entirely negatively, as ‘noise’, in which case they are imbued with a negative heritage value and can be abandoned where required. Other keynotes may well be part of the aural heritage of a place and thus be valued by sections of the community for whom they hold social value (for the concept of social value see Australia ICOMOS 2013; Canning and Spennemann 2001; S. Jones 2017).

It must be stressed that these classification frameworks are developmental in nature and aim to provide guidance for heritage management decisions, but should not initially or solely be relied upon to fully address the concerns of determining the heritage value of individual sounds. For example, it could be envisaged that some intentionally generated sounds may actually have no heritage value or negative heritage value to some sections of the community. For example, after the Royal Commission into child abuse in certain Australian religious institutions (Royal Commission into institutional Responses to Child Sexual Abuse n.d.) it is probable that some members of society may associate church bell ringing with
negative connotations and therefore low (or zero) heritage value. We therefore submit these proposed frameworks as preliminary management supports, recognising that actual heritage value of individual sounds (and soundscapes) must take into account standard heritage criteria alongside verified attributed values imparted by the community (Parker and Spennemann 2021a).

Successful management of heritage sounds

As the administrative processes of heritage management vary between jurisdictions, this paper is not the place to discuss the minutiæ of determination of cultural heritage significance as derived from attributed values. On a general level, decisions are based on a formal review of recommendations advanced by heritage professionals, guided by principles enshrined in overarching charters (e.g. Burra Charter, Australia ICOMOS 2013) and bound by state-specific regulatory guidelines (e.g. NSW Heritage Office 2006). Combined with formal classification of sound (Parker and Spennemann 2021a), the concepts advanced in this paper extend the standard approaches (e.g. NSW Heritage Office 2001) and provide practitioners with a conceptual framework and step-by-step decision-making tree to adequately document, assess and evaluate anthropogenic sound in the built environment and to recommend actions at a site-specific scale.

The management actions derived from this value assessment are for sounds and sound generating objects that are deemed to be of very high to medium heritage value, are to remain in situ and in their assigned function thereby preserving their heritage value. In addition, sounds and sound generating places and objects need to be documented in their current use, with additional selective documentation of sounds and sound generating places/objects of low heritage value. Given that heritage value is a mutable quality (Spennemann 2006a; Fredheim and Khalaf 2016), it is incumbent to also, albeit selectively, document some sounds that have been perceived entirely negatively, i.e. as ‘noise’.

The management of sounds that are at risk of extinction needs to follow different pathways. Once sound loss occurs, due to technological obsolescence, societal disinterest or legal restrictions, these sounds face extinction, unless active heritage management intervention occurs. It is therefore worth breaking down the heritage of sound into its components and to address the management of these components separately.

A sound, which is an ephemeral entity, is generated by a sound emitting piece of equipment, either stand-alone or housed in a structure, with the application of energy (Figure 6). Setting aside the energy source (electricity, compressed air, force, etc.), the devices themselves and the structures they are housed in (or mounted onto) are tangible and thus fall under standard heritage evaluation (historic and scientific value) and management strategies. Structures can be maintained and, as objects, the sound making devices can be curated in a museum or in situ. If the sound emitting device is well maintained and the energy source continues to be available, then the sound can be recreated at a future point in time, assuming that inter-generational continuation of operator skills is maintained.

The sound event itself, as an ephemeral entity, can be recorded and thus documented for posterity, assuming play-back devices are maintained or ‘loss-less’ audio-visual archiving occurs in the case of a migration to new storage media (Edmondson 2004). Such examples include the web-based soundscape recordings and crowd-sourced mapping sound project of the British Library. Whilst comprising of a healthy collection of fog warning signals (24 at the time of writing), church bell ringing and preserved industry and transport sounds, this project has also collected nature sounds and locational-specific soundscapes worldwide until 2011 (The British Library Board n.d.). A similar project is that of the London Sound Survey which operated on the longer longitudinal timeframe of 2008–2020. With the recordings permanently kept by the London Metropolitan Archives, sub-projects include sound maps of London waterways, and of stereo recordings made at evenly spaced points across the city, grid referenced at regular points on the map (The London Sound Survey 2020). Another example is the more personalised sound diary of Felicity Ford, designed as essentially a ‘time capsule’ of sounds in a typical day in the UK in 2011, with recorded files including public announcements, lorry automatic beeping systems, and the cry of market traders (Ford and Whitty n.d.). Especially poignant are Ford’s recordings of technological and human activity sounds in an expectation that such sounds would be lost or changed in the future, with such examples here
including the sounds of a car filling up with petrol, a water-inefficient washing machine, incandescent lightbulbs, and a traditional working water mill.

Learning from these examples, a particularly effective approach for the documentation of sound events would be the expanded use of community documentation for locational specific sounds on web-based sound maps, augmented with the availability to plant supplementary material such as photographs and videos of sound generating devices themselves. Whilst this process automatically gives a chance for (some of) the community to bestow heritage value to these sounds/objects, the limitations pertaining to expense/data requirements would effectively restrict this solution temporally or locationally.

As with sounds that are still actively used and maintained, documentation of these sounds is a key activity (Figure 7). A very different question is how to manage and preserve the sound in its setting as part of an urban soundscape. This may entail the maintenance of the sound generation despite its obsolescence on a continual or temporal (e.g. specific occasion) basis, which in turn requires the technical maintenance of the sound making devices, as well as the inter-generational continuation of operator skill sets. Examples for the latter, include the weekly sounding demonstration by volunteer teams of the decommissioned fog horn at Low Head (Tasmania) (pers. obs. 2013), and albeit not specifically focusing on sounds, steam engine preservation societies which have similar demonstration days (Breydon 2008; Fontana 2012). Such notion of functional heritage has been noted in the literature, in that cultural heritage sometimes cannot be identified without an understanding of its ‘meaning for societal processes’ (Loulanski 2006, p. 215), and the idea of actively working sites or objects having greater heritage value than those set up for restoration or re-enactment is implied in the Burra Charter (ICOMOS 2013).

Figure 7. Proposed classification and heritage action framework for anthropogenic sounds of the built environment that have or are likely to become technologically obsolete or become legislatively restricted or prohibited. *) Other may include natural sounds occurring in the built environment as a direct consequence of design and planning actions, e.g. water features, bird song.
Conclusion

Technological obsolescence, societal disinterest and legal restrictions have, and will continue to drive sound loss in the urban heritage environment. Unless the aesthetic value of environmental sound, from keynotes to soundmarks, is formally considered in heritage assessments and community heritage studies, many sounds will become extinct without adequate documentation and without any consideration to what extent that could, or should be preserved in the acoustic environment either permanently or temporally. We therefore present two versions of a classification and heritage action framework, one for those still in use, and one for those that have become technologically obsolete or have been restricted/prohibited, and are therefore at risk of extirpation or extinction. These frameworks not only assist in the conceptualisation of sound and sound loss in the environment, but provide clear management actions for those sounds and sound making devices which are considered to have acoustic heritage value. Whilst we recognise that these classification and heritage action frameworks have some limitations, we hope that this discussion may generate more debate around sound heritage alongside changes in societal behaviour and technological obsolescence.

It needs to be stressed again that heritage value is a mutable quality. In the context of sounds that are extirpated or extinct in their natural cultural setting, the social value attached to these sounds will diminish as time passes and the number of people who hold these values decreases, primarily through biological attrition. Thus we need to appreciate that the heritage values as ascribed in the flow chart (Figure 7) represent the status quo at the time of extinction, and that a trend of decreasing value over time is to be expected.

This holds particularly true for sounds. Heritage is all about personal identity in a communal setting and an attachment to place. Sounds, by their very nature are ephemeral and thus transient entities in human consciousness. Once no longer maintained (i.e. practiced), they cease to have a presence, unlike physical sites, such as buildings, monuments and landmarks, which even if not well maintained, have a visual presence that anchors or at least reinforces a personal feeling of ‘belonging’ and ‘home.’

As such, the notion of preserving functional heritage sounds and sounds in situ may be the key to successful aural heritage management, augmented by the more standard audio-visual archiving of these sounds and sound-emitting devices.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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