A Case Study of Wellington City District Plan Change 23: Noise Insulation Rules

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Author's Note: *A plan change is an evolving process. Changes or amendments may have been made to the rule since this report went to print.*

Introduction

This abbreviated paper describes the context and background to a planning proposal to achieve minimum indoor acoustic exposure levels in new dwellings in the Central Area of Wellington City. The proposed method to be adopted is to specify acoustic insulation based on a minimum acoustic performance of the building envelope. This report sets out to assess and qualitatively comment on the proposed measures in both acoustic terms and in terms of "process" under the Resource Management Act 1991.

Council has the primary role in managing noise in the city. The management of inner city noise in Wellington has been an historic issue for the Wellington City Council (WCC) particularly in relation to acoustic insulation of inner city residences. Insulation of inner city apartments was first investigated by the Council in 1999 following the investigation of living "issues" in the Te Aro area. This lead to the instigation of the Inner City Noise Forum in June of 1999. Since that time, Council has continued to investigate issues related to inner city living and inner city noise. Results from these investigations have clearly indicated that there is a need to 'better' manage inner city noise to achieve the objectives and goals set out in the Wellington City District Plan.

The District Plan change requires "habitable spaces" within all new and altered buildings be acoustically insulated from external noise, including noise from traffic, within the Central Area of Wellington City. The method of specifying acoustic insulation has revolved around specifying minimum acoustic performance of the building envelope (as opposed to setting indoor sound levels).

The overall finding is that the justification for such measures appears to exist with the technical specification of acoustic isolation consistent with best international practice. Overall the Wellington City Council plan change appears to be a well thought out proposal that has good potential for addressing a current problem and ensuring a more sustainable future for living environments within the Central Area of Wellington City.

The Central Area

The Central Area contains Wellington's main commercial heart, and is bisected by a number of busy streets and main roads. As a centre for commercial and entertainment activity, the Central Area is an inherently noisy place. Current and future central city residents therefore need protection against the effects of noise, especially loud noise at night. Historic Wellington City Council measurement data illustrates that noise levels are generally higher

during the day, but different noise sources become important at night when entertainment activities flourish (especially on Fridays and Saturdays). While noise is often associated with a busy and vibrant city, noise levels in the heart of Wellington City needs to be controlled to some extent and the current noise rules for the Central Area attempt to achieve that, albeit at a 24 hour noise limit that is higher than anywhere else in the city.

The "physical" Central Area extends from the Thorndon Railway yards to the Basin Reserve and is bounded generally by the line of the existing motorway to the west, Webb and Buckle Streets to the south and Kent Terrace to the east. The city has grown since 1840, when early colonists moved from Petone (Pito-one) to the deeper and more sheltered waters of Lambton Harbour.

Key Architectural Influences of the Central Area

Wellington City's architectural style is built on the traditions of the British Empire, with a great deal of Victorian and Edwardian architecture. The 1920's and 30's was a major building period for Wellington, while building in the 1940's and 50's was less prolific due to World War II. Following World War II Wellington City started to expand very quickly with growth generated by a buoyant economy, increasing population and an increase in building (state housing in particular). Due to this, urban planning had become a key issue.

According to conservation architect Chris Cochran "it was the earthquakes that struck Wellington in 1848 that firmly established timber as the pre-eminent building material". Due to the susceptibility of timber to fire, and the fire concerns about timber structures, Wellington's first comprehensive by-laws were produced in 1892 dividing the city into 3 districts. The Central Area became known as the "brick area", as all construction within this area was to be brick, stone or concrete. In 1908 the by-laws were changed to take account of structural steel framing and reinforced concrete[1].

The architectural history of the area has dictated what building materials exist today, particularly the outer building fabric. This is of relevance to the proposed noise insulation rule which is based on setting a minimum standard of acoustic insulation for the façade of the building envelope.

Today the central business district between Parliament and the Civic Centre is characterised by intensive high-rise office and commercial development. As the Central Area has become increasingly populated, many older buildings are converted for residential use and many new apartments are established in the Central Area. However as new fit outs occur, often the original building fabric will remain or an existing fabric altered. It may even be the case that a new building is constructed and hence the building fabric represents current technology and materials. Overall the result seen today is a mixture of old and new building envelopes, creating buildings with varying degrees of acoustics insulation.

Growth in The Central Area

More people are now living within the Central Area than when the Wellington City District Plan was first drafted in 1994 and although it is true that people moving into the Central Area need to be aware of increased noise, current and future Central Area residents need some protection against the worst effects of noise.

Statistics show that the total cumulative number of "flats/units/townhouses/apartments joined together in a one, two or three or more storey building or joined to or as part of a shop" in the Wellington Region has grown from 33,500 in the year 1991 to 35,200 in the year 2001. Along with the growth in construction, Wellington City's current population of 237,000 is projected to grow by a further 5% by the year 2021[2].

Housing has been a topic of "interest" in New Zealand for most of the twentieth century. Factors influencing the housing market have included increasing home ownership, the provision of low-cost rental housing and changing accommodation-subsidisation policies. The increased number and significance of cultures that make up Wellington, together with other social and economic trends, have had an impact on the current state of the housing sector in Wellington and New Zealand as a whole.

Accelerated social, economic and technological change is prompting changes in the form and function of the Central Area and Council's intention is to encourage positive growth, which promotes the City's comparative advantages. The District Plan is one of Councils "tools" to achieve these goals. Growth within Wellington City and the Central Area itself is inevitable. The District Plan recognises the importance in maintaining amenity values, while at the same time encourages a mixture of compatible non-residential activities in order to promote the sustainable management of the city[3]. The difficulty that arises is maintaining a balance between the amenity values people expect in a residentially zoned area versus that for inhabitants within the Central Area.

Amenity is defined under the Resource Management Act 1991 *"those natural or physical qualities and characteristic of any area that contribute*

1. Kernohan, D. 1994. Wellingtons Old Buildings. Victoria University Press.
2. 2. Source: Statistics New Zealand. "stats.govt.nz" web site.
3. 3. Refer to Pages 1/14 (s4) of WCC District Plan, "Specific Issues" Maintaining the Quality of Living Environments.

to people's appreciation of its pleasantness, aesthetic coherence and cultural and recreational attributes".

In a discussion paper by the Building Industry Authority (BIA) entitled "Suggested Amendments to the Building Code (the First Schedule of the Building Regulations 1992: Isolating buildings from environmental sound" under the section titled Reverse Sensitivity, the report states "Requiring future building work to use noise isolation to ensure an acceptable acoustical environment does not address already high noise levels. However, this is not unusual, Environmental Court decisions have reflected this trend by ruling that residents who move into an area in full knowledge of adverse noise effects can not be afforded the same level of protection as those who have adverse noise imposed on them."

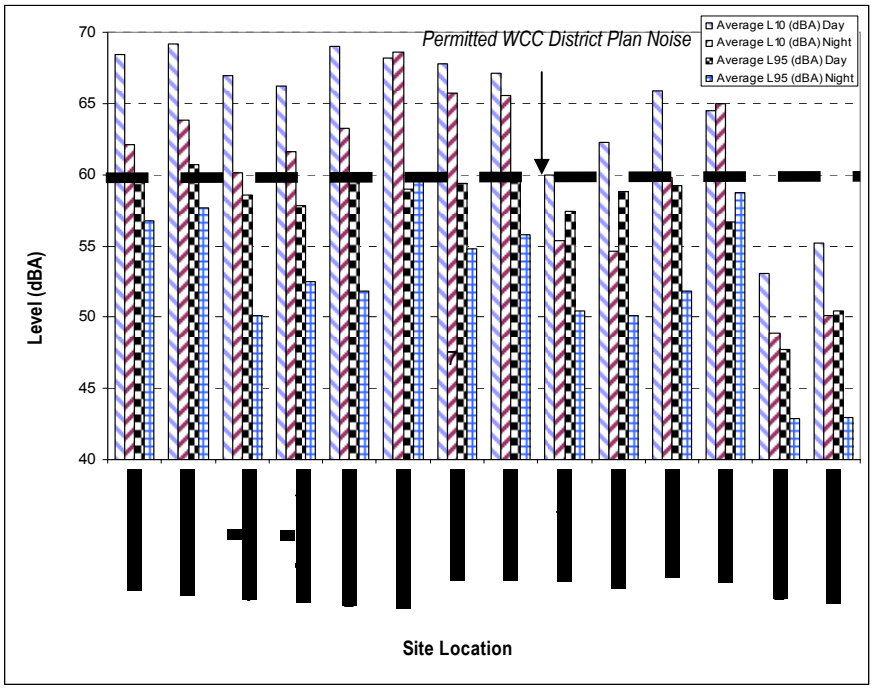

Figure 1: Monitoring results for the most recent [published] 2000-2001 Inner City Noise Monitoring Survey.

This statement illustrates the fact that it may not always be reasonable for residents of the Central Area to assume the same level of acoustic protection as provided in a "pure" residential setting. However a minimum level of protection must still be provided to protect health and amenity.

Central Area Activities

The Central Area is a diverse area as it not only contains commercial premises but also residential sites. One primary factor, which is changing the area, is the fact that it continues to grow and attract more and more residential apartments and dwellings. The simple fact is that the Central Area has evolved to an area where commercial and residential activity co-exists. People that live in the Central Area chose to enjoy an "inner city" lifestyle, which is close to business, retail and entertainment sectors. However with this choice of lifestyle comes the disadvantage of enhanced noise levels due to living in the busiest area of the city.

Noise is an inevitable by-product of a wide variety of activities in Wellington's Central Area. Most of these activities are related to commercial undertakings and entertainment activities such as shops, bars, clubs and accommodation. Noise also arises from other activities providing essential services to the central commercial area such as rubbish collection, glass recycling, street cleaning, construction activities, and goods pick-up and deliveries.

Noise in a residential setting can affect quality of life and have implications for health and well-being. A reasonable sound climate within living spaces free from annoying sounds or sounds that regularly wake people from sleep (or prevent people from getting to sleep) is considered a basic requirement for healthy living in any environment, and is an essential component of sustainable inner city living. There is however, wide variation in sensitivity to noise in the general population. Some people don't seem to mind, others may be relatively sensitive.

Due to the growth and development of the Central Area the District Plan noise rules and objectives have needed to be revisited to ensure the continued protection of health and amenity to its occupiers.

Ambient Noise Surveys

In order to monitor the effectiveness of the District Plan noise rules and objectives the WCC have been undertaking ongoing noise surveys[4] for the inner city area of Wellington. The objective of the surveys is to assess the noise levels at selected sites in the inner city area and provide new data to extend Wellington City Council's database of information on the state of the local environment.

Monitoring the state of the environment involves integrating new and existing data to provide for a more comprehensive overview of the environment.

Figure 1 illustrates the monitoring results for the most recent [published] 2000-2001 Inner City

4. Section 35 of the RMA requires Council to gather, monitor, and keep records.

Noise Monitoring Survey. Note the significant levels of noise above the permitted District Plan noise level.

Current Legislation

Council has the primary role in managing noise in the city. Specific limits on emissions of noise are set in place by way of rules contained in the District Plan, mandated by the Resource Management Act 1991 (RMA). However it is important to understand that not all noise emissions are governed by the Wellington District Plan. The purpose of the RMA is to promote the 'sustainable' management of natural and physical resources.

In summary, the Central Area noise rules allow L_{10} 60 dBA and 85 dBA L_{max} at adjoining boundaries 24 hours per day. The Central Area noise rules are the primary method for controlling noise and are defined as higher than "normal" for permitted activities due to the zoning of the area i.e. mixture of residential and commercial activities. It can be seen from the WCC ambient noise survey that the actual measured noise levels are generally higher than the allowable permitted noise level as outlined in the District Plan noise criteria – this illustrates a conflict between permitted levels and actual measured levels.

Current Situation

The Central Area has evolved from an area that once only contained residential dwellings to the commercial heart of the city. The ever-changing environment has, over the last few decades, rapidly changed from predominately commercial property, to an area which now contains numerous dwellings, apartments and habitable spaces. In today's climate both commercial and residential dwellings sit side by side and should therefore be able to co-exist.

While the policies and objectives of the District Plan address noise effects, there is a distinct lack of methods to achieve a useful outcome. The responsibility is left with "... the designer, developer or user to ensure that buildings are appropriately insulated against unreasonable noise...(WCC District Plan rule 13.1.1.1)".

Under current legislation such as the Building Act or District Plan, designers and developers have no incentive to provide new apartments or dwellings within the Central Area with acoustic insulation. As insulation will increase costs, there is a disincentive to provide this protection measure unless the purchasers are aware of the need for insulation and select this attribute when making their purchase decision.

The reference in the Plan for "users" to provide acoustic insulation can be misleading. Incorporating acoustic insulation into an apartment after it has been constructed is more difficult and costly. If acoustic

	1999/2000	2000/2001
Central Area	17%	27%
All Other Areas	83%	73%

Figure 2: Noise Complaints (%) for Central Area versus remainder of Wellington City District — 1999 to 2001.

insulation is not incorporated within the dwelling when constructed, it is unlikely to be added later owing to cost implications.

The "short falls" for the protection against noise are becoming increasingly apparent as the Central Area develops. There are a range of noise sources identified as the cause of noise complaints registered with WCC through the after hours call out service. The issue of music noise from inner city bars/clubs and noise issues between adjoining apartments (stereos etc) are the most common source of complaints. Other sources such as night time construction noise, and late night/early morning glass collection are also mentioned, and to a lesser extent, music noise from busking.

Figures 2 and 3 summarise noise complaint information collected for the Central Area. This data was used as part of the Council's plan change analysis for deciding appropriate ways to better meet the District Plan objectives.

Summary noise complaint information from February 1998 to April 1999 indicated complaints from the Central Area averaged 17% of all noise complaints received. The most recent analysis of complaints up to May 2001 indicates noise complaints from the Central Area now comprise 27% of all noise complaints. In other words the proportion of noise complaints from the Central Area has nearly doubled in recent times. This is shown in Figure 2.

The number of complaints is highest in locations within Central Areas, the area to which Plan Change 23 is being adopted.

How do District Plan Noise Rules Compare?

NZS6802:1991

What constitutes a "reasonable level" of noise is not prescribed by the Resource Management Act. As a guide, noise limits prescribed in District Plans or in New Zealand

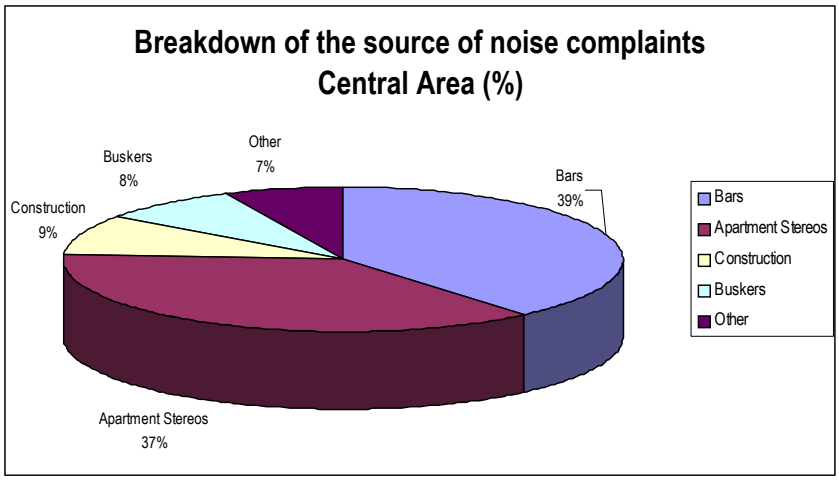

Figure 3: Break down of noise Complaints for Central Area

Standard NZS6802:1991 *"Assessment of Environmental Sound"* may be used to determine limits of acceptability.

Maximum recommended noise levels for residential sites are specified in New Zealand Standard NZS6802:1991. The relevant limits are contained in clause 4.2.2 of the standard which states that:

"...the desirable upper limit of sound exposure at or within the boundary of any residential land use is as follows:

- *Daytime* *55 dBA L_{10}*
- *Night-time* *45 dBA L_{10} and an L_{max} of 75 dBA or the background sound level plus 30, whichever is the lower"*

According to this standard, these upper limits of noise are necessary to protect health and amenity. The permitted Central Area noise limit (60 dBA) is 15 dBA above the night time limit recommended by NZS6802:1991, although this limit is effectively reduced to 55 dBA as a result of the special audible characteristic penalty imposed on music noise by the Standard.

World Health Organization?

WHO guidelines recommend an internal noise level of 35 dBA (L_{eq}) as being satisfactory for avoidance of sleep disturbance. This generally equates to 55 dBA outside the dwelling, assuming a 20 dBA loss through closed windows. Open windows will generally only provide a 10 dBA reduction, thus night times during summer can lead to noise problems when there are high outdoor noise levels. The Wellington City District Plan noise rules permit 45 dBA inside a dwelling.

New Zealand Building Act

Currently the New Zealand Building Act does not consider sound insulation for the external envelope/ façade of any building.

RMA Section 32

A Section 32 analysis of the Resource Management Act 1991, is

concerned with the process of delivering plan change provisions. It provides a methodology which helps the authority in its decision making process – it is not a section dealing with the activities themselves. A Council **must** undertake a section 32 analysis for substantive, not procedural, reasons. It is a duty not an option of the Council to undertake a Section 32 Analysis whenever reviewing a plan change.

In carrying out their Section 32 analysis, the Wellington City Council needed to know whether the current District Plan, rules, and objectives achieved the goals of the Resource Management Act, and secondly, what the benefits and costs of introducing a rule to require sound insulation are?

As part of that analysis, a detailed report submitted by the Planning Department to the WCC "Built and Natural Environment Committee" entitled "Progress Report – Port Noise & Inner City Noise", and a later paper entitled "Proposed Plan Change For Inner City Noise – Background Information", outlined options available for the Central Area plan change.

The second paper concluded that a new noise rule was necessary:

"It has been concluded that the introduction of a rule into the District Plan is now considered necessary to ensure that buildings accommodating new noise sensitive activities are insulated to protect against external noise. Results from investigations clearly indicate that there is a need to better manage inner city noise if we are to achieve the objectives and goals set out in the District Plan. Non-Council initiatives, such as the Civic Trust Seminar Inner Space to Living Space, have also provided a useful discussion forum in which to gauge how noise can affect peoples living experiences in the inner city".

Proposed Plan Change

The proposed method to be adopted in Wellington for specifying acoustic insulation centres on specifying minimum acoustic performance of the building envelope (as opposed to setting indoor sound levels) and is based on international best practice. The focus on sustainability requires a long-term consideration of possible Central Area activities (at permitted noise emission levels) in the future, coupled with possible noise impact from non-District Plan controlled noise sources e.g. traffic noise. These "drivers" have indicated that the cumulative outdoor noise environment is significant, but also that the levels can be highly variable. It became evident that specifying a maximum indoor sound level would not provide a proper acoustic design target unless the external noise levels were known with certainty, or set out within the rule specification. As future outdoor noise levels are not known and are highly variable, a rule based around the performance of the building envelope was preferred.

Minimum Building Envelope Acoustic Performance

Having settled on the general approach, it was necessary to consider the specification of the rule to ensure adequate indoor levels were actually achieved. The initial approach was to consider the type of rule used in the NZBC (based around STC type specification for the building envelope). However, contact with the Building Industry Authority (BIA) revealed the latest international trend was towards "normalised level difference" with a phasing out of the STC type approach. The STC method only specifies acoustic protection down to 125 Hz, which does not extend into the low frequency region to be adequate for protecting against many typical sounds.

Despite its shortcomings, the STC is used as the primary rating in the proposed rules because of its widespread use by non-acoustical designers.

Specifying Isolation

The amount of sound isolation required was extremely important in terms of meeting the District Plans objectives in terms of health and amenity. Obviously the more protection the better, but costs could become excessive and certain high levels of acoustic treatment may become impractical and unwarranted. There is a point where the "more protection" is not practical and returns may become diminishing.

A recommendation was made with respect to ensuring a worst case approach was used and inner city noise levels should be assumed to be as high as 65 to 70 dBA in places, with the sound to be assumed to contain a significant low frequency component. It was concluded that by setting the limit at $D_nT_w + C_{tr} > 30$ would result in a reasonably good indoor sound climate (35 to 40 dBA) while not requiring excessive investment in noise control

An independent study[5] was carried out to review and evaluate technical aspects of the proposal to specify the acoustic insulation of new dwellings within the Central Area. The review was undertaken in a collaborative manner, with the acoustic calculations being conducted by Marshall Day Acoustics under the direction of Malcolm Hunt Associates.

The key assessment criteria investigated by the report was to answer the following questions:

- Given measured Central Area noise levels, does the proposed minimum level of acoustic insulation provide a suitable indoor sound climate, commensurate with the World

5. Marshall Day Acoustics, "WCC Central Area Acoustic Insulation Study Verification report using two virtual apartments". Report No. 02W104RA

Health Organization upper indoor noise limit for night- time of 35 dBA?

- Can this guideline for indoor noise levels be met by minimal modifications to current apartment construction methods and materials, i.e. without users incurring excessive cost or other difficulties for users?
- Is the actual method of calculation (prediction) of indoor sound levels difficult or time-consuming (raising possible questions about the costs of providing acoustic reports as part of the method of implementing the insulation proposals)?

The independent acoustic study illustrated the main World Health Organization upper indoor noise limit for night time of 35 dBA would be achieved within the noisiest parts of the Central Area using typical (solid) building materials and acoustically treated windows and that typical lightweight walls would require a small amount of increased mass to achieve the desired standard, and similarly typical lightweight windows would be insufficient and would require upgrading to laminated glazing.

The independent report concluded that a level of $D_nT_w + C_{tr} > 30$ dB was an acceptable minimum level in meeting the night time indoor sound level limit as set out by the World Health Organization. As a result of the work the critical level for the proposed plan change was set.

Conclusion

Proposed Plan Change 23 was publicly notified on Wednesday 1st October 2003. The proposed rules aim to protect new and converted buildings within noise sensitive areas against external noise. Investigations have clearly shown that there is a need to better manage inner city noise, if the goals and objectives of the district plan are to be achieved.

Half of all Central Area noise complaints relate to external noise sources. Noise complaints are rising and these complaints are likely to keep on increasing due to a move towards popular inner city living.

Buildings accommodating noise sensitive activities in the inner city have often not been acoustically insulated for a variety of reasons such as cost. Although the new insulation rules may equate to slightly higher costs for developers, the overriding benefit of introducing a performance standard to manage adverse noise effects from external noise outweighs this with positive effects relating to health and amenity values.

The new noise insulation rules will be another positive tool to achieve the overriding goals and objectives of the district plan, and aid in better managing inner city noise. ❑