MACH ACOUSTICS

MONKTON PARK, CHIPPENHAM – SKATE PARK

Noise Impact Assessment

Wiltshire Council

27 June 2013

MONKTON PARK, CHIPPENHAM – SKATE PARK

Noise Impact Assessment

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1.0 INTRODUCTION

MACH Acoustics has been commissioned by Wiltshire Council to carry out a noise impact assessment at the proposed location for a skate park at Monkton Park, Chippenham.

As part of this noise impact assessment, a series of noise surveys and assessments for the proposed skate park has been undertaken. This document is seen to provide a summary of MACH Acoustics findings to date.

No conditions relating to planning and acoustics have been identified for noise from skate parks. Such to establish suitable noise levels, an assessment has been carried out to BS 4142: 1997 “Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas”. This standard is mainly used for plant noise assessments, but is often used to assess other type noise in the absence of other guidance. Guidelines from the World Health Organisation and Chartered Institute of Environmental Health have also been used to assess the noise impact.

This assessment has been benchmarked against an extensive level of noise monitoring undertaken at sensitive locations around the proposed skate park. CadnaA noise mapping software has been used to predict noise levels at all sensitive properties around the proposed skate park. Noise from the proposed skate park is based upon two sets of measurements taken at a skate park constructed using smooth concrete.

In summary, it is found the noise levels for the propose skate park will be below the existing background noise levels and below all advised guidance figures.

2.0 SITE LOCATION

Proposals are to locate a new skate park at Monkton Park, Chippenham. Monkton Park is located to the north of Chippenham town centre and is surrounded mainly by residential housing along the northeast site boundary. Chippenham town centre lies to the south of the park with mainly commercial/retail buildings along the southern boundary to the proposed location of the skate park. There is however some residential houses located on St Mary's Street which back onto the Monkton Park.

To the north of the site are office buildings overlooking Monkton Park. To the north east of the park are the rear gardens of residential housing on Sadlers Mead.

It is considered that the nearest residential properties to the proposed location of the skate park are houses on Sadlers Mead, Monkton Hill and St Marys Street. The nearest commercial building to the skate park is that along Monkton Park.

Figure 1 below provides a location map and aerial photo of Monkton Park and surrounding area.

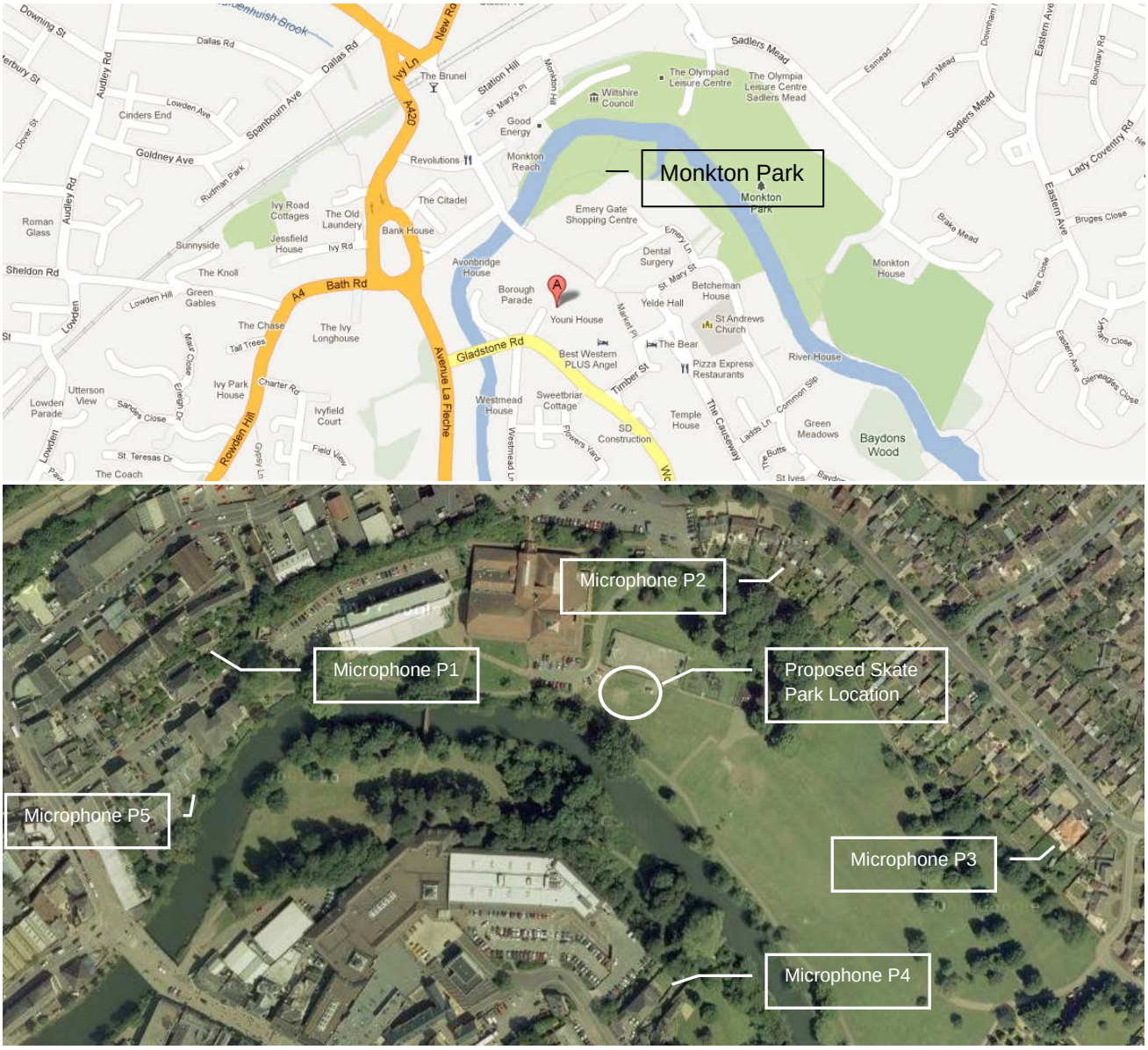


Figure 1: Site location map and aerial photo

3.0 NOISE SURVEYING

To assess noise levels at nearby residential dwellings and other noise sensitive locations, a number of environmental noise surveys were carried out.

3.1 Monkton Hill Residential and No.8 Sadlers Mead

To assess noise levels at the nearby residential dwellings at Monkton Hill and No.8 Sadlers Mead, two environmental noise surveys were carried out between the 10th and 11th May 2012. The surveys were conducted over a 24 hour period to determine the environmental noise levels on-site, however only the noise levels measured during the assumed operational hours of the skate park will be used in calculations.

The microphones were positioned at points considered to have an ambient background noise representative of the nearby residential dwellings on Monkton Hill and Sadlers Mead. The chosen measurement locations were on the top floor of the residential house at Monkton Hill (P1) and the rear of the residential house at No.8 Saddlers Mead (P2), both overlooking Monkton Park. These measurement positions are marked as P1 and P2 in Figure 1 above. It is considered that the main noise sources at the residential properties on Monkton Hill and Sadlers Mead are from passing road traffic and background noise from the town centre. The main noise source to the rear of properties on Sadlers Mead is background noise levels from the town centre.

3.2 No.40 Sadlers Mead Residential

To assess noise levels at No.40 Sadlers Mead, an environmental noise survey was carried out between 30th and 31st October 2012. The survey was conducted over a 24 hour period to determine the environmental noise levels on-site, however only the noise levels measured during the assumed operational hours of the skate park will be used in calculations.

A microphone was positioned at a point considered to have an ambient background noise representative of the residential dwelling. The chosen measurement location was to the rear of the residential house at No.40 Saddlers Mead overlooking Monkton Park. This position is marked as P3 in Figure 1 above.

3.3 St Marys Street Residential

To assess noise levels to the rear of residential properties on St Marys Street overlooking Monkton Park, an environmental noise survey was carried out between 13th and the 14th March 2013. The survey was conducted over a 24 hour period to determine the environmental noise levels on-site, however only the noise levels measured during the assumed operational hours of the skate park will be used in calculations.

The chosen measurement location was to the rear of the Dutch Tea Rooms overlooking Monkton Park and is the property which is adjacent to the residential dwelling under assessment. This position is marked as P4 in the Figure 1 above. The main noise sources to the rear of the residential property on St Marys Street, are from vehicles entering and leaving the adjacent car park and plant associated with the large retail unit.

3.4 Monkton Hill Offices

To assess noise levels to the rear of the office buildings on Monkton Hill overlooking the park, an attended environmental noise survey was carried out on 9thJuly 2012. The survey was conducted during the daytime period to determine the environmental noise levels to the rear of the office buildings.

The microphone was positioned at a point considered to have an ambient background noise representative of the levels at office windows. The measurement location is marked as P5 in Figure 1 above. The main

noise sources to the rear of the offices are from road traffic in and around the town centre and plant noise from the adjacent commercial unit.

3.5 Measurement Equipment

The following measurement equipment was used, which complies with BS EN 60942:2003 i.e. Class 1 device:

- Norsonic 140 Real Time Analyser
- Norsonic 1251 Calibrator (114 dB @ 1000Hz)
- Norsonic 1225 Microphone
- Svantek 949 SLM
- SV 22 Microphone
- 2 x Norsonic weather protection kit

The meters were calibrated before and after testing - no deviations were found. The meters were set to measure consecutive 'A' weighted 5-minute samples. This time period is in line with BS 4142 requirements.

3.6 Weather Conditions

The weather remained dry, with no wind throughout the duration of the surveys.

4.0 NOISE SURVEY RESULTS

Continuous noise levels were measured at the residential properties at No.8 and No.40 Sadlers Mead, Monkton Hill, St Marys Street and to the rear of offices on Monkton Hill adjacent to Monkton Park, Chippenham. The surveying was carried out to determine the existing noise levels in the area. The following graphs show the noise levels recorded at these locations.

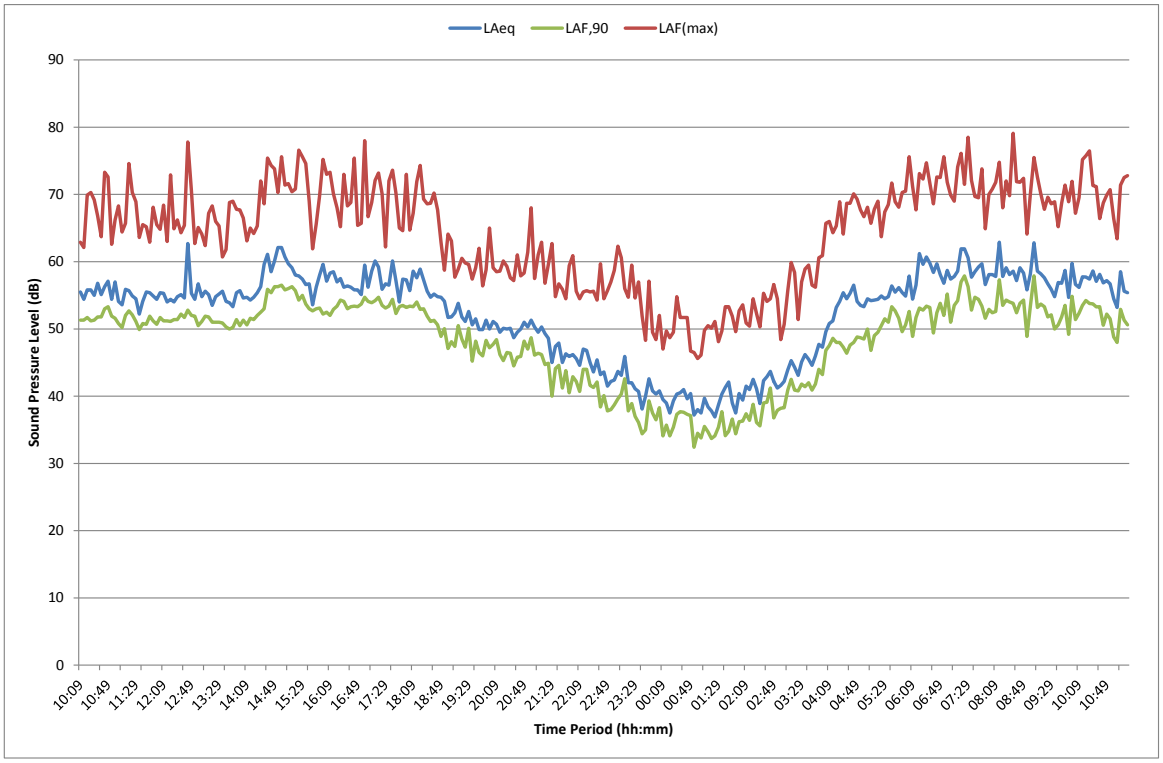


Figure 2: Measured Noise Levels at Monkton Hill

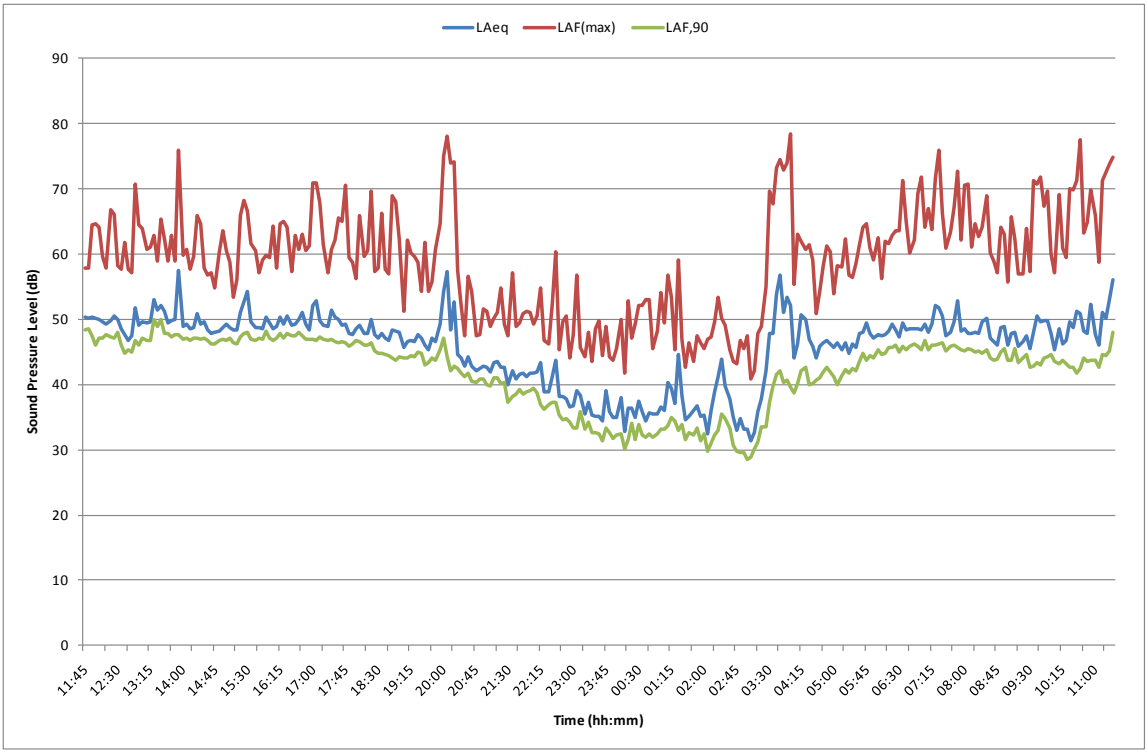


Figure 3: Measured Noise Levels at No.8 Sadlers Mead

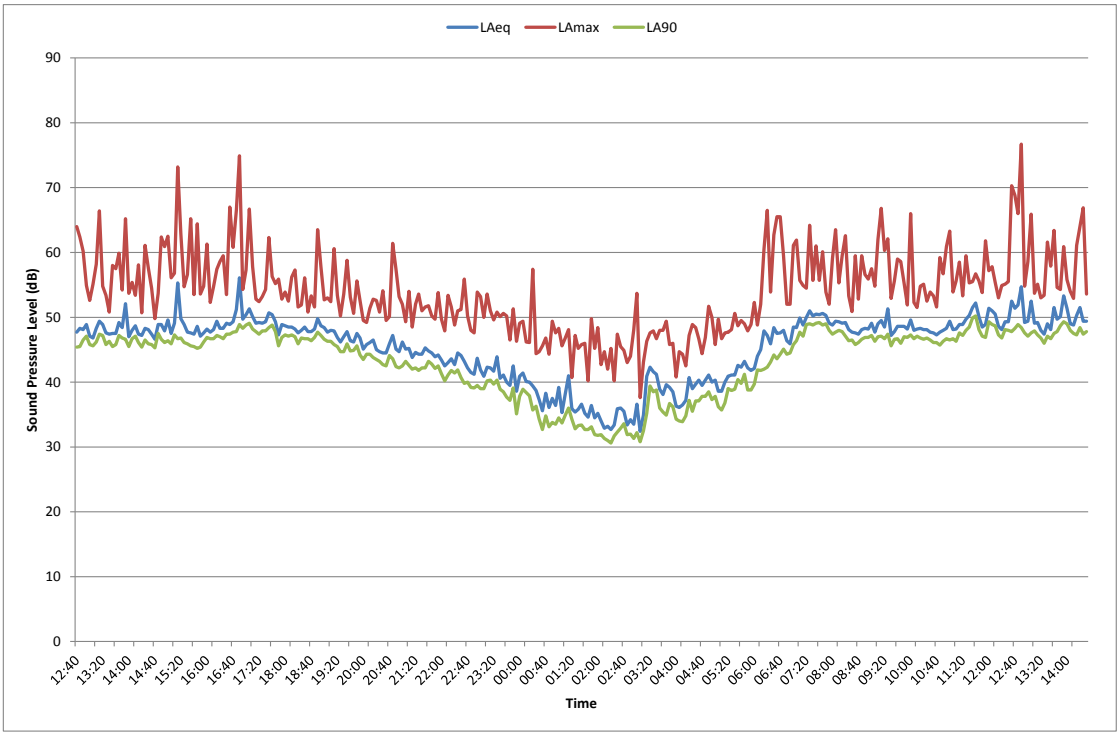


Figure 4: Measured Noise Levels at No.40 Sadlers Mead

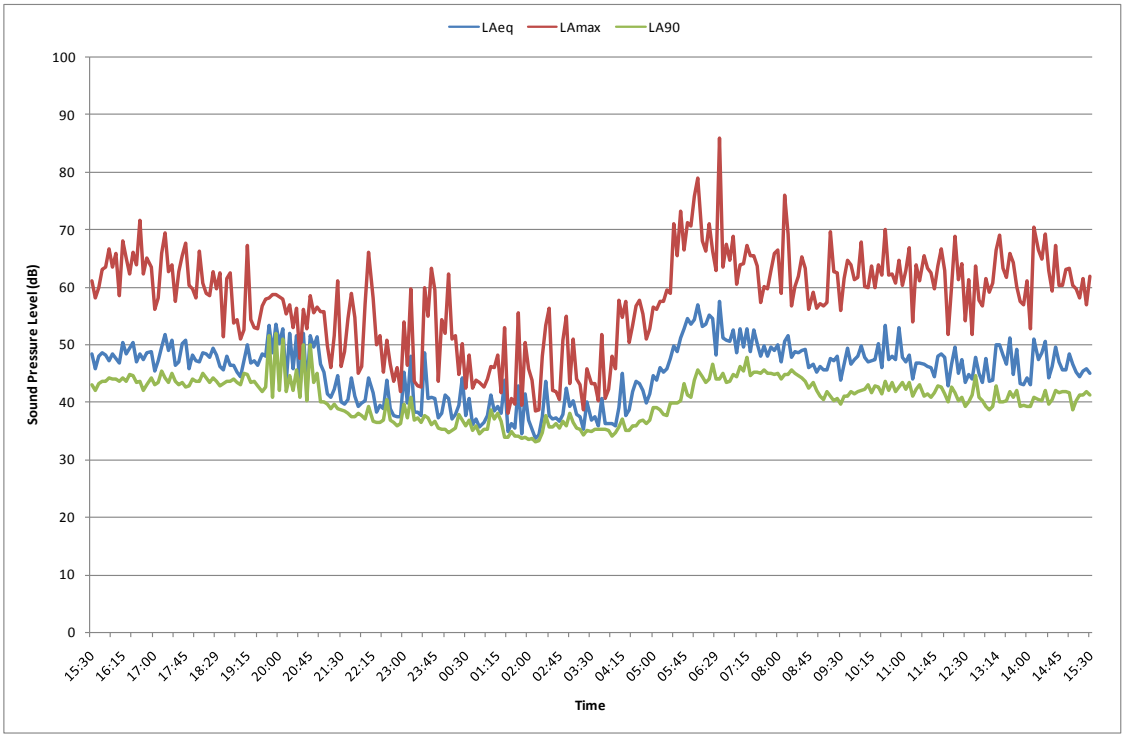


Figure 5: Measured Noise Levels at rear of St Marys Street

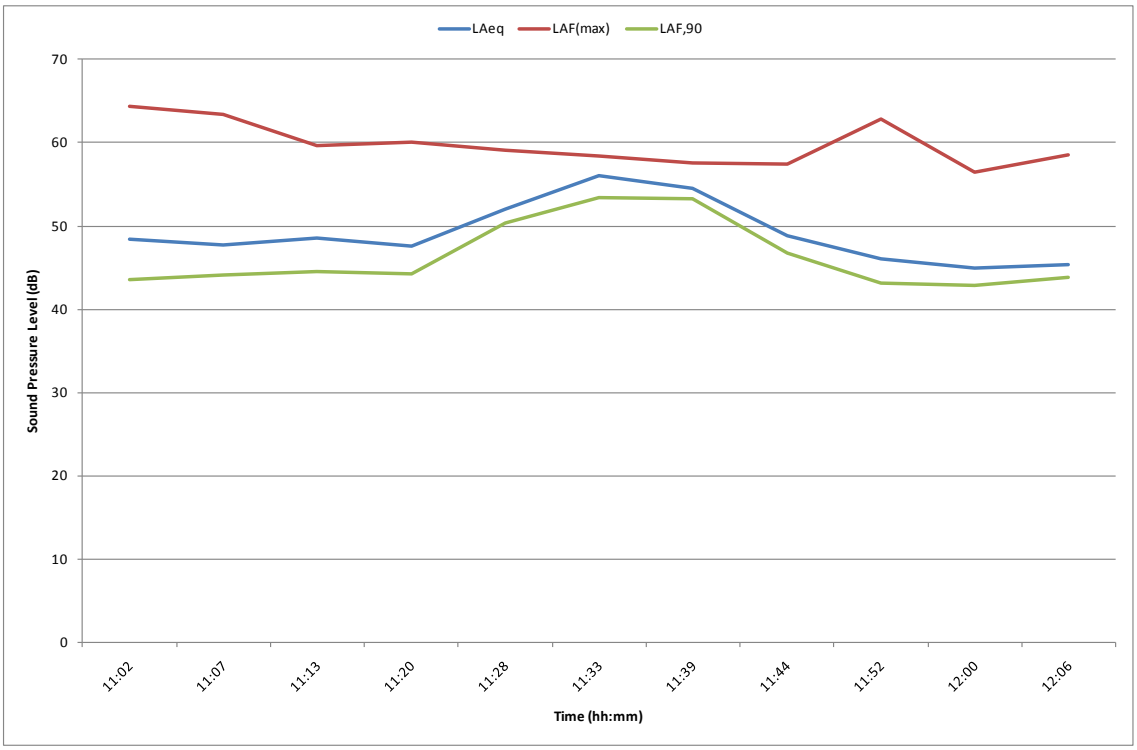


Figure 6: Measured Noise Levels at Monkton Hill Offices

It is understood that the skate park will not be flood lit, therefore will only be used during daylight hours up to 10pm during summer time. MACH Acoustics has used the minimum background noise levels during the assumed operational hours of the skate park (08:00 hours to 22:00 hours) as a target figure for noise levels.

As can be seen from Figures 2, 3, 4, 5 and 6 above, the background noise levels (L_{A90}) have only a slight variation throughout the day time period with the L_{A90} typically between 40 and 45 dB. However the background noise level L_{A90} does drop off in the evening. The lowest measured background noise levels between 08:00 hours and 22:00 hours are therefore considered somewhat onerous since it is likely that skating will not take place much later than 19:00 hours, hence using noise levels up until 22:00 hours is seen to be an onerous and robust approach.

Table 1 provides a summary of the lowest measured background noise levels (L_{A90}) and average ambient noise levels (L_{Aeq}) for the operational hours of the skate park (08:00 to 22:00 hours) at the residential houses at No.8 and No.40 Sadlers Mead, Monkton Hill and the rear of St Mary's Street.

Measurement Location	Time Period	Lowest Measured Background Noise Level L_{A90}	Average Ambient Noise Level L_{Aeq}
Monkton Hill	08:00 – 22:00 hours	40 dB	57 dB
No. 8 Sadlers Mead	08:00 – 22:00 hours	37 dB	49 dB
No. 40 Sadlers Mead	08:00 – 22:00 hours	41 dB	49 dB
St Marys Street	08:00 – 22:00 hours	38 dB	48 dB

Table 1: Measured Noise Levels at Residential

The measured noise levels at the nearby office building have been included within Table 2 below.

Measurement Location	Time Period	Lowest Measured Background Noise Level L_{A90}	Average Ambient Noise Level L_{Aeq}
Monkton Hill Offices	Daytime	43 dB	51 dB

Table 2: Measured Noise Levels at Office

Table 3 below presents a summary of L_{Amax} noise levels recorded at each of the measurement locations.

Measurement Location	Time Period	Maximum Noise Level Range L_{Amax}	Highest Measured Noise Level L_{Amax}
Monkton Hill	08:00 – 22:00 hours	55 - 79 dB	79 dB
No. 8 Sadlers Mead	08:00 – 22:00 hours	47 - 78 dB	78 dB
No. 40 Sadlers Mead	08:00 – 22:00 hours	49 - 77dB	77 dB
St Marys Street	08:00 – 22:00 hours	45 – 76 dB	76 dB

Table 3: Summary of measured L_{Amax} noise levels

5.0 GUIDANCE DOCUMENTATION

There are no relevant guidance documents available with respect to assessing noise from outdoor skate parks. There is however a number of documents and assessment methods that can be used to determine the noise impact on local residents. The purpose of this section is to provide a summary of guidance documentation relating to the noise impact on residential dwellings.

5.1 British Standard 4142

British Standard 4142:1997 'Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas',(BS 4142) describes a method of determining the level of noise of an industrial nature, together with the procedures for assessing whether the noise in question is likely to give rise to complaints from persons living in the vicinity. As such, an assessment to BS 4142 is typically called for within planning conditions.

The likelihood of complaints in response to a noise depends on various factors. BS 4142 assesses the likelihood of complaints by considering the margin by which the noise in question exceeds the existing background noise level. This standard also allows for an appropriate correction for the acoustic features present in the noise.

BS 4142 states that:

- A difference of around +10 dB or more indicates that complaints are likely.
- A difference of around + 5 dB is of marginal significance.
- If the rating level is more than 10 dB below the measured background noise level, then this is a positive indication that complaints are unlikely.

A 5 dB correction should be added if one or more of the following features (see the list below), are present within the noise sources in question.

- The noise contains a distinguishable, discreet, continuous note (whine, hiss, screech, hum);
- The noise contains distinct impulses (bangs, clicks, clatters, or thumps);
- The noise is irregular enough to attract attention.

It can be argued that this 5 dB correction is out of place as the skate park is likely to have days of no use and minimal hours of operation compared to plant noise. Possible levels of annoyance caused by the noise will decrease significantly because of this. It should also be noted that the skate park will be used mostly in finer weather when outdoor activities such as gardening or other social activities such as park games or BBQ's are taking place. Despite this, it has been asked to include a 5dB penalty due to the sound content of a skate park.

5.1.1 BS4142 Summary

In MACH Acoustics experience, planning documentation typically interprets BS 4142 by stating that the source noise level should not exceed the existing ambient background noise levels, L_{A90},by 0 dB during the day time period (0700 to 2300 hours) and either -5 dB or -10 dB during the night time period. In some rare cases, more stringent targets are given for daytime noise levels than 0 dB above background noise. These are typically applied to inner city locations where noise levels are high and planners are attempting to reduce or prevent noise creep from plant noise. In the case of this development, noise levels are not of the same nature, therefore noise creep is not seen to be an issue. It is therefore considered that a target level equal to or below the existing background noise level at the nearest residential dwelling is appropriate.

5.2 World Health Organisation: Guidelines on Community Noise

The World Health Organisation (WHO) document 'Guidelines for Community Noise', sets out guidance as to noise levels at which there will be an unacceptable impact on the local community. This guidance considers many different types of noise sources. In paragraph 4.3.1, the impact of noise on dwellings is considered.

WHO guidelines states:

To protect the majority of people from being seriously annoyed during the daytime, the sound pressure level on balconies, terraces and outdoor living areas should not exceed 55 dB L_{Aeq} for a steady, continuous noise. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound pressure level should not exceed 50 dB $L_{Aeq.}$

The guidelines also state that at night, sound pressure levels at the outside façades of the living spaces should not exceed 45 dB L_{Aeq} and 60 dB L_{Amax}, so that people may sleep with bedroom windows open.

The daytime period is typically taken to be from 0700 – 2300 hours and night time period as 2300 – 0700 hours. Although not defined within the WHO guidelines the evening period is typically taken to be from 1800 – 2300 hours.

5.2.1 WHO Summary

These guidelines are typically adopted and applied to various noise sources with the criteria that noise levels at nearby noise sensitive receivers during the daytime (0700 – 1800 hours) should not exceed 50dBA, and during the evening period (1800 – 2300 hours) should not exceed 45dBA.

5.3 Chartered Institute of Environmental Health: Clay Target Shooting

The Chartered Institute of Environmental Health (CIEH) guidance document 'Clay Target Shooting: Guidance on the Control of Noise' describes how noise from clay pigeon target shooting can occur and provides advice on methods to minimise or prevent annoyance and intrusion. The guidance includes details of a recommended method for the measurement and subsequent assessment of clay target shooting noise produced by the Building Research Establishment (BRE) and derived from research.

The BRE research suggests that there is no fixed shooting noise level at which annoyance starts to occur. Annoyance is less likely to occur at a mean shooting noise level (mean SNL) below 55 dBA, and highly likely to occur at a mean shooting noise level (mean SNL) above 65 dBA. The likelihood of annoyance at levels within this range will depend upon local circumstances and other factors.

In accordance with CIEH guidance, the SNL is defined as the logarithmic average of the 25 highest shot levels over a 30 minute measurement period. The shot levels will have been obtained from recorded levels corrected where necessary for residual noise. For the purposes of this assessment the mean SNL has been derived from the logarithmic average of the maximum noise levels recorded for each 1 minute measurement period at existing skate parks.

5.3.1 CIEH Summary

The CIEH guidelines can be adopted and applied to the impulsive noise or maximum noise levels measured as L_{Amax}, created by landing skate boarding jumps and tricks. Based on CIEH guidelines, impulsive noise levels from stake boarding activities should not generally exceed 55 dB $L_{AF,max}$ when measured at the nearest noise sensitive location.

6.0 SKATE PARK ASSESSMENT

It is understood that the proposed skate park is to be formed from mass concrete with various curvatures, ramps and rails for performing jumps, tricks and grinds. Figure 7 below shows some of the typical features found within a skate park.

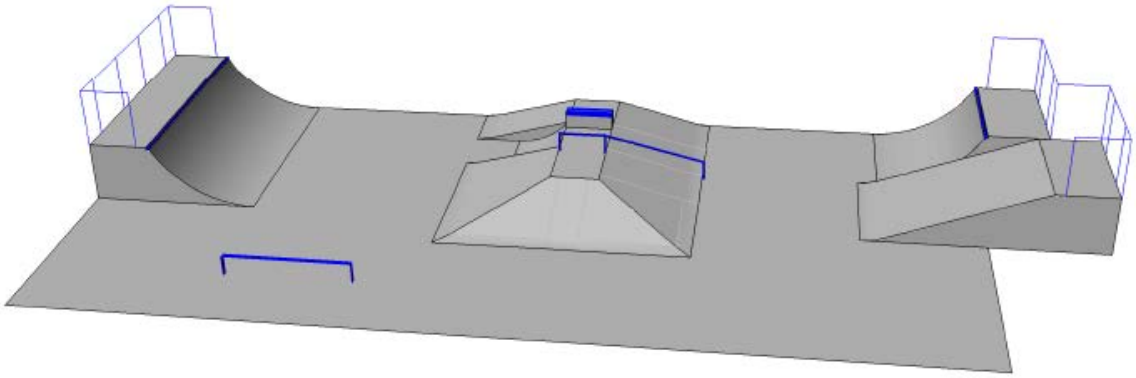


Figure 7: Typical features of a Skate Park

To determine noise levels from the proposed skate park, MACH Acoustics carried out surveys at existing skate parks of a similar concrete construction to the proposed development. It has been concluded that several noise sources exist at a skate park which are discussed further.

6.1 Subjective Noise Levels

The use of a BMX (Bicycles) is one of the quietest pieces of apparatus used due to the large rubber wheels. The air inside the tyre cushions any impact when the BMX lands a trick. Therefore BMX riding is not seen as an issue.

The next type of noise is vocal which comes from youths using the park. On the whole, noise was observed to be at normal conversational levels, however there were few occasions of cheering, these usually emanated from areas where socialising took place. A crucial observation is that youths at the skate parks tended to gather at locations where they don't get in the way of other individuals. Careful planning could encourage onlookers to congregate away from the nearest noise sensitive location.

Figure 8 below shows pictures of Horfield skate park, Bristol and demonstrates that socialising took place in particular areas. Figure 9 shows that the area has little obstacles with raised boxes that have been designed to be used for skating are actually used as seating and the placement of a refuse bin on this side of the park may have also contributed to socialising taking place in these areas.

Figure 10 shows a much larger and open planned skate park located in St George, Bristol. Picture a) shows a group of BMX users waiting their turn on a particular run they have picked out to use. This area can then be thought of as an area not used for riding, at this particular point in time and is therefore an area where shouting could occur. Picture b) shows that the railings are used as seats which has encouraged socialising in this area.

The loudest noise in a typical skate park is caused by the use of skateboards. There are essentially two types of noise created from skateboards, the first which is the lower of the two, is generated by the interaction of the wheels on the ground commonly known as rolling. It is seen that providing the skate park is made with a smooth concrete finish, this noise is not seen as an issue. The second noise is impact noise which occurs when a board is launched into the air for a trick and landed. This creates a short impulsive noise that is transient in nature.

Operational hours are to be when visibility is good. In most cases, this is most likely to be during daylight hours, though as can been seen in Figure 8 below, the use of lights can extend the duration for which the park could be used.

a) area of little socialisation

b) area of most socialisation

Figure 8: Horfield Skate Park, Bristol

a)

b)

Figure 9: Horfield Skate Park highlighting areas of congregation

a)

b)

Figure 10: St Georges Skate Park with areas of socialising circled.

6.2 Measured Noise Levels

To determine the noise impact of the proposed skate park at the nearest noise sensitive locations, MACH Acoustics have undertaken a series of measurements at existing skate parks. The following figures show noise levels measured at 1 metre from the perimeter of two concrete based skate parks. The sound level meter was set to measure 1 minute consecutive time samples.

Figure 11: Horfield Skate Park, Bristol

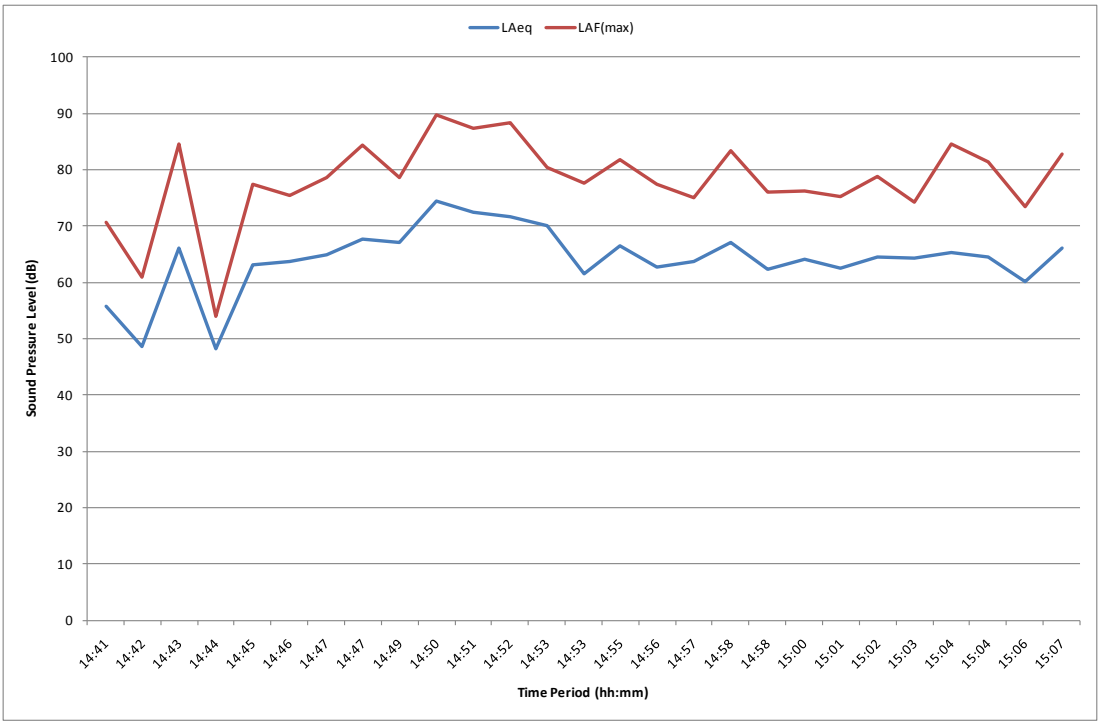


Figure 12: St Georges Skate Park, Bristol

Figures 11 and 12 above show that the average noise levels measured at each skate park remain relatively constant when there is activity at the skate parks. Based on the location of the microphone during each skate park survey, calculations have been carried out to determine the noise levels at the centre of each skate park which was estimated to be approximately 5 metres distance from the microphone location. This calculated level can be defined as the reference source noise level. Table 4 below summarises the calculated noise levels at the centre of each skate park.

Skate Park	Average Ambient Noise Level L_{Aeq}	Maximum Noise Level Range $L_{AF,max}$
Horfield Bristol	82 dB	91 - 103 dB
St George Bristol	81 dB	88 - 104 dB

Table 4: Predicted Noise Levels from Skate Parks

Based on measured noise levels, Table 4 above shows that the typical average noise levels from a concrete based skate park is in the region of 81 - 82 dB L_{Aeq} and the maximum noise level is 103 - 104 dB $L_{AF,max}$. Maximum noise levels $L_{AF,max,}$ typically range from 88 to 104 dB.

7.0 NOISE IMPACT ASSESSMENT

To assess the spread of noise from the proposed skate park, a noise mapping assessment was undertaken using CadnaA software. Noise mapping works by placing a grid over the proposed site and then calculating the noise levels at the each of the nodes making up the grid. The method used by CadnaA to produce the noise maps below, is the calculation method defined in ISO 9613-2:1996 'Acoustics-Attenuation of sound during propagation outdoors'. The key advantage of using this type of modelling is its accuracy. This type of modelling takes into account the effects of screening from buildings, reflection from nearby buildings, the effects of ground absorption, all calculations are assessed as downwind for all directions the effects of light winds blowing from source to receiver as well as a wide range of other factors.

To build the model accurately and to the right scale, an aerial photo of the site along with contoured maps has been used. The detail of these contoured maps was enhanced further by including measurements from an onsite topographical survey across the site, this has been included within Appendix B for reference. The noise model was calibrated using measured data from the existing skate parks as described in Section 6 above.

Figure 13 below show the results of modelling the skate park based on a point source with no mitigation methods. This is considered representative since the skate park will act as a point source at the distances under consideration. The figure provides the calculated values for the L_{Aeq} and L_{Amax}, based on 82 dB L_{Aeq} and 104 dB L_{Amax} as per the noise levels in Table 4 above. The coloured map only represents the L_{Aeq} noise levels, Appendix D includes all calculated maps.

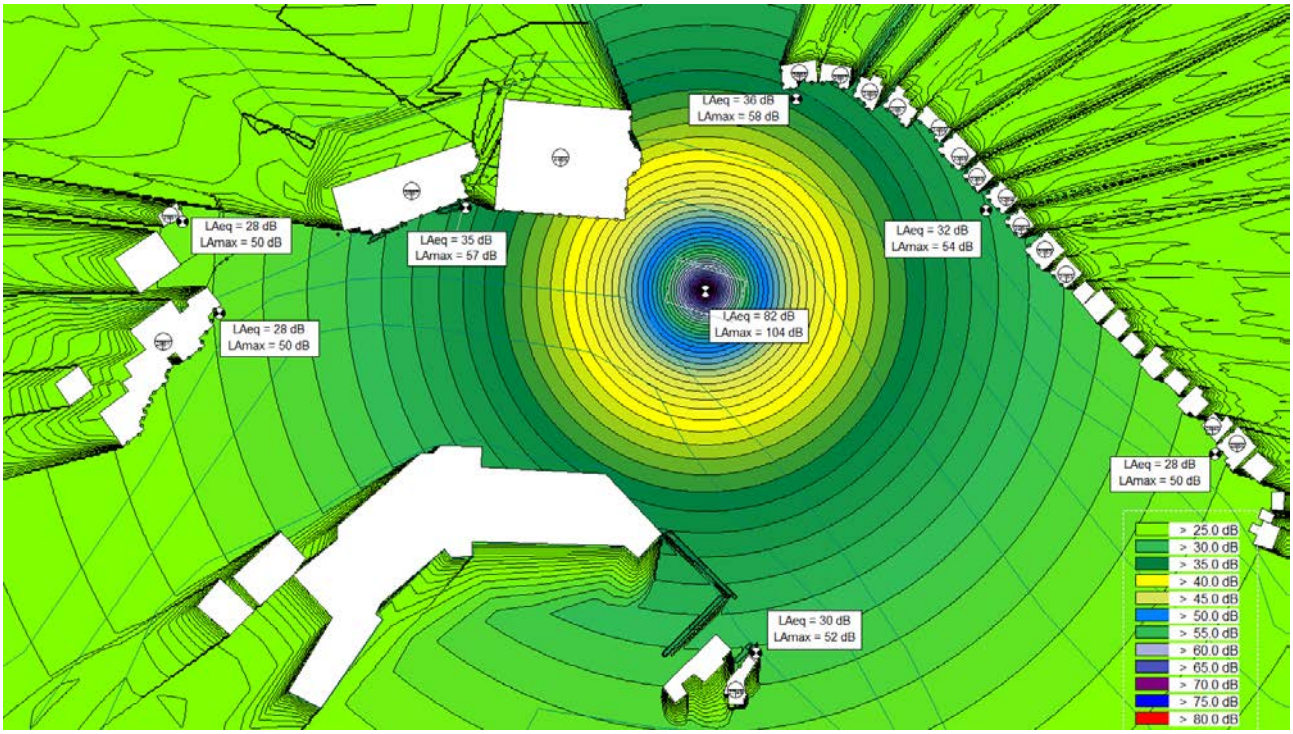


Figure 13: Park with no mitigation

Four scenarios have been calculated in order to investigate the use of acoustic screening and sinking the skate park below current ground level. These scenarios are:

- No Mitigation – Skate park in proposed location, next to the MUGA, with no acoustic screening
- 4.4 metre high screen on the north perimeter and half way across the east perimeter
- 1.9 metre high screen in same position as above and skate park level lowered 1.5 metres
- 1.4 metre high screen in same position and skate park lowered 2 metres

Figure 14 shows one of these scenarios as an example, where the skate park is lowered by 1.5 metres and a barrier 1.9 metre included.

The calculations produced by the noise mapping, for each of the 4 scenarios, are included in Appendix C.

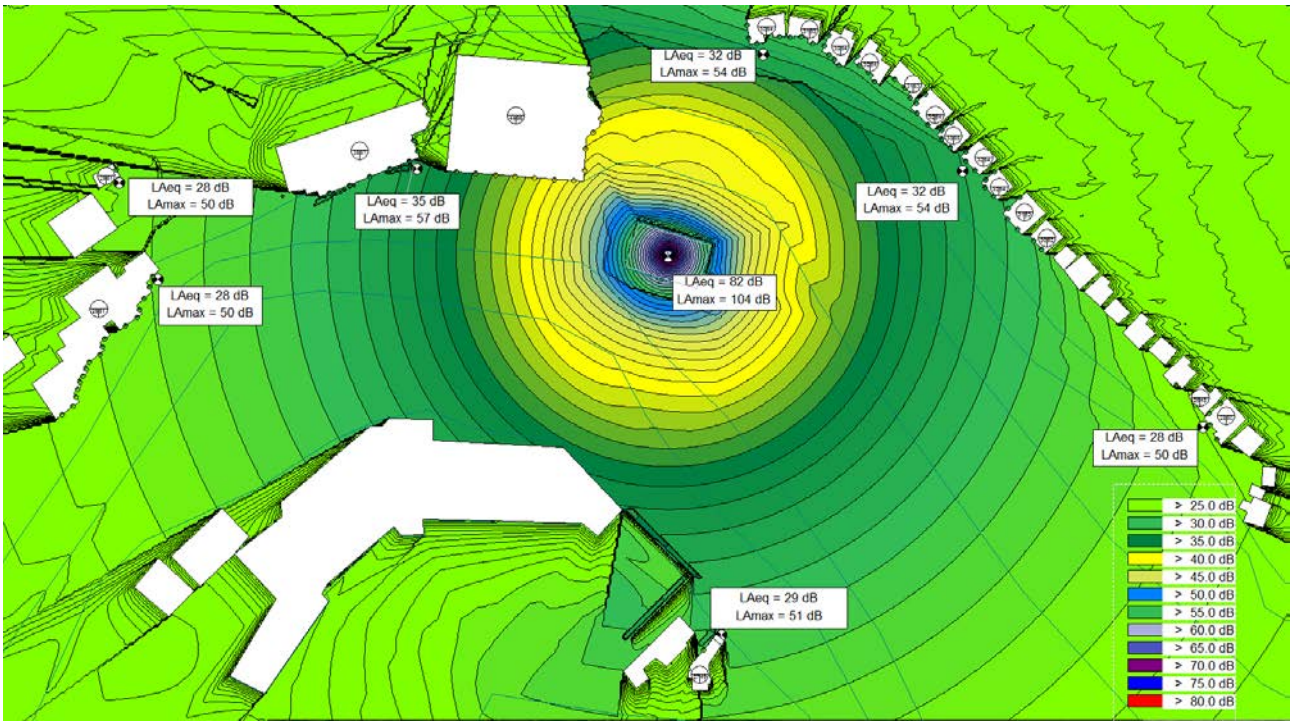


Figure 14: Park lowered 1.5m + 1.9m barrier

The above model can be used to assess the noise levels at a range of locations by means of using the coloured contours. Noise levels at the nearest/most sensitive receptors have been established by means of adding receiver positions to the above maps. The table below provides the calculated L_{Aeq} levels and L_{Amax} levels at these positions with no mitigation.

Noise Level	Monkton Hill	No.8 Sadlers Mead	No. 22 Sadlers Mead	No.40 Sadlers Mead	St Mary's St	Council Offices
Calculated L_{Aeq} Ref 82 dB	28 dB	36 dB	32 dB	28 dB	30 dB	35 dB
Calculated L_{Amax} Ref 104 dB	50 dB	58 dB	54 dB	50 dB	52 dB	57 dB

Table 5: Calculated noise levels at noise sensitive locations with no mitigation

It can be seen from the table above that calculated average noise levels from the skate park at the nearby residential properties are in the region of 28 to 36 dB. The average noise level at the council offices is 35 dBA.

8.0 MITIGATION METHODS

As mentioned in the previous section, three mitigation options have been explored, the results of each are assessed in the following sections. All three options utilise a screen in the same location but at different heights, where two options include the addition of lowering the skate park into the ground, sections and plans are shown in Figures 15 and 16. A list of the scenarios modelled is provided below;

- No Mitigation – Skate park in proposed location, next to the MUGA, with no acoustic screening
- 4.4 metre high screen on the north perimeter and half way across the east perimeter
- 1.9 metre high screen in same position as above and skate park level lowered 1.5 metres
- 1.4 metre high screen in same position and skate park lowered 2 metres

The screen is to be located along the whole northern perimeter of the skate park and half of the east perimeter, as shown by the red line in Figure 15.

The acoustic screen can be made from any material but must achieve a surface mass of at least 10kg/m^2. The barrier must be complete to all edges with no gaps.

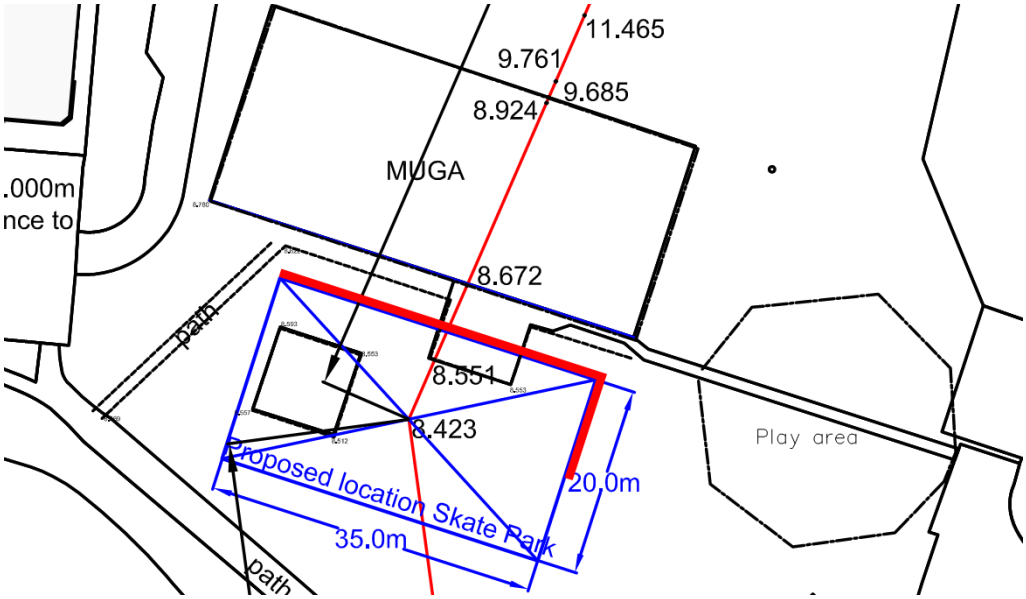


Figure 15: Location of Acoustic Screen (red line)

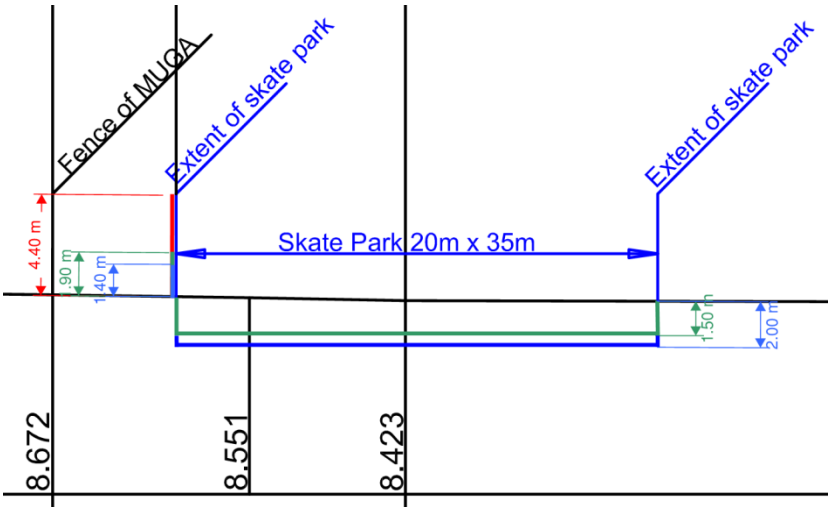


Figure 16: Section of Skate Park with screening options

9.0 NOISE NUISANCE ASSESSMENT

As per Section 5 above, a noise nuisance from a given noise source is conventionally assessed as a ratio of the noise from the proposed source to the background noise levels at a given sensitive location. This report thus far provides the results of noise monitoring establishing the background noise levels at a range of key locations. Such to assess the impact of noise levels from the proposed skate park, data is presented relating to measurements taken at similar skate parks to that proposed at Monkton Park. This information has then been used to calibrate an acoustics model assessing the spread of noise from the skate park across the local area. Receiver locations have then been added to the noise model such to assess the noise levels at critical locations in the vicinity of the skate park.

Tables 6 and 7 provide a summary of the information presented within this report for all the considered noise sensitive locations and scenarios.

Noise Level	Monkton Hill	No.8 Sadlers Mead	No.22 Sadlers Mead	No.40 Sadlers Mead	St Mary's St
Existing background noise level L_{A90}	40	37	37	41	38
BS4142 Criteria, 5dB penalty	35	32	32	36	33
No Mitigation					
Calculated L_{Aeq}	28	36	32	28	30
BS4142 Criteria	-7	**+4**	0	-8	-3
4.4m Barrier					
Calculated L_{Aeq}	28	32	32	28	32
BS4142 Criteria	-7	0	0	-8	-1
-1.5m Skate Park 1.9m Barrier					
Calculated L_{Aeq}	28	32	32	28	29
BS4142 Criteria	-7	0	0	-8	-4
-2m Skate Park 1.4m Barrier					
Calculated L_{Aeq}	28	32	32	28	28
BS4142 Criteria	-7	0	0	-8	-5

Table 6: Average noise level, L_{Aeq} comparison to L_{A90}

Based on the lowest measured background noise level during the survey periods and the suggested design target including any tolerance or correction factors, it can be seen from the table above that the average noise level from the skate park exceeds the Noise level criteria by 4dB at 8 Saddlers mead. All other locations are within limits based upon the BS4142 method.

All three mitigation options, do not exceed the existing background noise levels at the nearby residential building.

It should be noted that BS4142 is a method of rating noise from an industrial source affecting residential areas, therefore this assessment does not apply to the office buildings. However the following table provides a comparison between the existing ambient noise levels L_{Aeq} and predicted background noise levels from the proposed skate park, considering the council offices and some of the residential buildings.

Noise Level	Monkton Hill	No.8 Sadlers Mead	No.40 Sadlers Mead	St Mary's St	Council Offices
Existing ambient noise level L_{Aeq}	57	49	49	48	51
No Mitigation					
Calculated L_{Aeq}	28	36	28	30	35
L_{Aeq} Level Difference	-29	-13	-21	-18	-16
4.4m Barrier					
Calculated L_{Aeq}	28	32	28	32	35
L_{Aeq} Level Difference	-29	-17	-21	-16	-16
-1.5m Skate Park 1.9m Barrier					
Calculated L_{Aeq}	28	32	28	29	35
L_{Aeq} Level Difference	-29	-17	-21	-19	-16
-2m Skate Park 1.4m Barrier					
Calculated L_{Aeq}	28	32	28	28	35
L_{Aeq} Level Difference	-29	-17	-21	-20	-16

Table 7: Comparison of ambient L_{Aeq} noise levels

It can be seen from Table 7 above that the average noise level from the skate park is significantly below the existing ambient noise levels at the nearby residential properties for all scenarios, including that with no mitigation measures.

Based on the WHO Guidelines on Community Noise it is seen that the average noise level from the skate park does not exceed the 45 dBA guidance criteria at the nearby residential buildings, therefore the impact on the local community is seen to be low.

Additionally, the average noise level at the Council Office building is approximately -16 dB below the existing ambient noise level, which is a positive indication that complaints will be unlikely.

Table 8 below provides a summary of the comparison between the existing maximum noise levels at noise sensitive locations and calculated maximum noise levels from the skate park.

Ref	Noise Level	Monkton Hill	No.8 Sadlers Mead	No.40 Sadlers Mead	St Mary's St	Monkton Hill Offices
L1	Existing L_{Amax} noise levels (dB)	55 - 79	47 - 78	49 - 77	45 - 73	57 - 64
L2	Calculated L_{Amax} Ref 88 - 104 dB	34 - 50	42 - 58	34 - 50	36 - 52	41 - 57
L3	L_{Amax} Difference Min/Max (dB)	-21 / -29	-5 / -20	-15 / -27	-9 / -21	-16 / -7

Table 8: Comparison of maximum L_{Amax} noise levels

Attenuation losses provided by the terrain and other features described in the noise modelling within Section 7 above, have been calculated.

As can be seen in Table 8 above, the calculated impulsive noise levels, L_{Amax} from the skate park (L2) based on typical maximum noise levels of 88 to 104 dB at the nearby residential properties is below the existing measured noise levels at the residential properties.

Calculations show that typical maximum noise levels from the skate park are more than -5 dB, the existing maximum noise levels at the residential properties (L3). This is a positive indication that impulsive noise from activity at the skate park will not be audible over the existing maximum noise level climate at the residential properties.

However with consideration of CIEH guidelines, impulsive noise levels from stake boarding could be said to not exceed 55 dB L_{AFmax} when measured at the nearest noise sensitive location. It can be seen from calculated noise levels in Table 8 above, this criteria is exceeded at the location of 8 Sadlers Mead, when there is no mitigation. However, Table 9 provides the calculated results L_{Amax} for all residential locations, for the 4 different options. It is shown that the 55dB limit is complied with for each of the options with mitigation methods.

Scenario	Monkton Hill	No.8 Sadlers Mead	No. 22 Sadlers Mead	No.40 Sadlers Mead	St Mary's St
No Mitigation	50	**58**	54	50	52
4.4m Barrier	50	54	54	49	54
-1.5m Skate Park 1.9m Barrier	50	54	54	49	51
-2m Skate Park 1.4m Barrier	50	54	54	49	50

Table 9: Calculated L_{Amax}

10.0 CONCLUSION

MACH Acoustics carried out an extensive environmental noise assessment at the nearby residential properties to the proposed locations of a skate park at Monkton Park, Chippenham.

Results of the assessment determined that the existing noise levels to the rear of residential properties on Monkton Hill, Sadlers Mead and St Mary's Street are relatively low. Additional measurements were carried out at nearby offices to the proposed location of the skate park to determine existing noise levels.

The proposed location of the skate park is close to the commercial area of Chippenham, where existing background noise levels are considerably higher than noise levels at the nearest residence. Based on this location, calculations show that typical noise levels from the skate park are -10 dB below the existing ambient noise levels L_{Aeq} at the nearby residential locations, which is considered a positive indication that complaints are seen as unlikely.

Noise levels at most residences will be 0dB or below the existing background noise level, L_{A90}. Only 8 Sadlers Mead and the 6 adjacent dwellings to the east do not achieve a 0dB criteria against the background L_{A90}. Mitigation will be required if this is to be met. It should be highlighted that the background noise level used within this assessment is typically around 10pm. The background noise level throughout the day, up until approximately 7pm, in all receiver locations, is generally 5dB to 10dB higher than that used. It is therefore considered that complying to this guidance is a very robust approach.

The calculations have shown to achieve this level of attenuation a 4.4 metre high screen is required, or any of the other alternative mitigation options as given in Section 8.

No mitigation methods are seen to be required on the south side of the skate park, since distances are much greater than at 8 Sadlers Mead. Although, it is considered that if the option of sinking the Skate Park by 2 metres is considered, this would provide additional benefits as opposed to no mitigation.

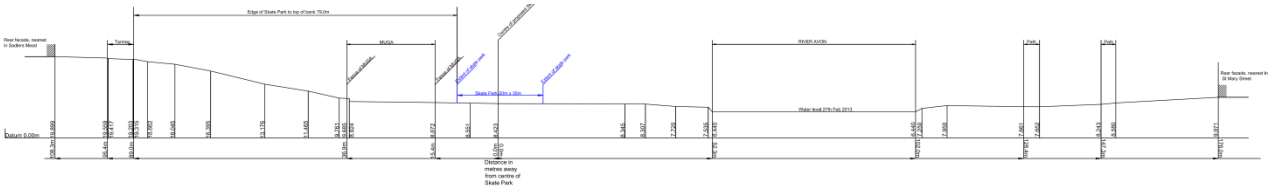
Additionally, several guidance documents were assessed. Taking the most stringent requirement (of CIEH), it was determined that impulsive noise levels from the skate park should not exceed 55 dB $L_{AF,max}$ at the nearby residential locations, in order to reduce the likelihood of annoyance. Calculations show that this criterion fails by 3dB at 8 Sadlers Mead and the 4 adjacent dwellings to the east. In order to achieve this criterion, mitigation methods will be required, their specification has been provided in Section 8.

APPENDIX A– GLOSSARY OF TERMS

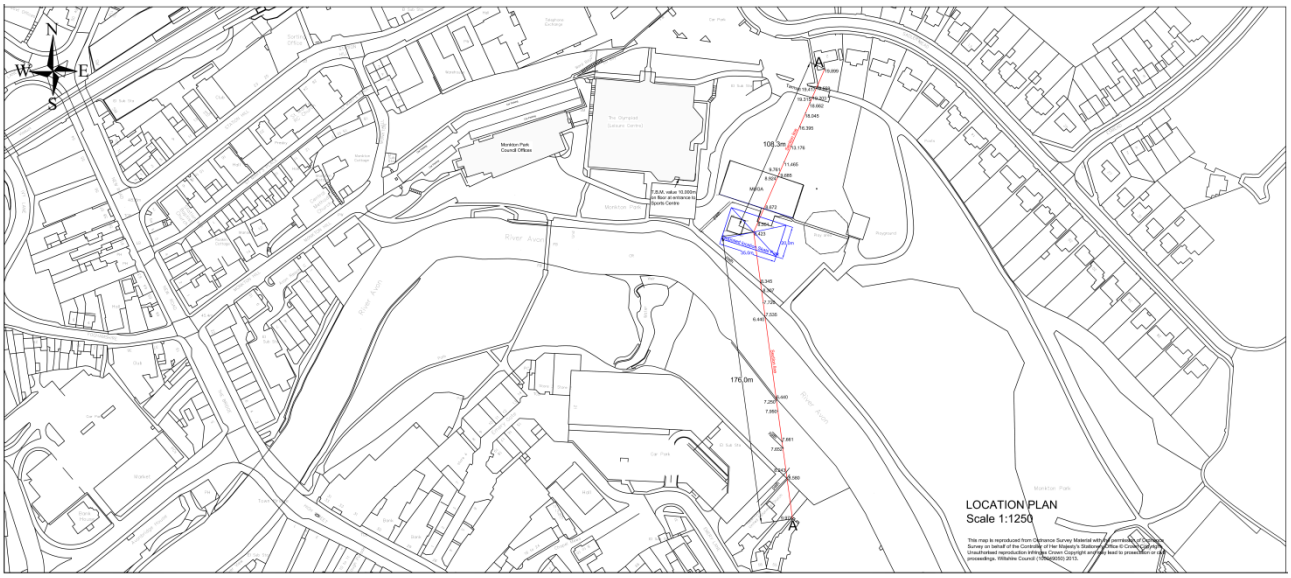
Ambient	The ambient noise level is the noise level measured in the absence of the intrusive noise or the noise requiring control. Ambient noise levels are frequently measured to determine the situation prior to the addition of a new noise source.
C_{tr}	Ctr is a sound insulation adjustment, commonly used with Rw and DnT,w. Ctr adjusts for low frequency noise, like noise from trucks and subwoofers. Ctr values typically range from about -4 to about -12.
dB	Decibel. The unit of sound levels.
dBA	A-weighted decibel. The A-weighting approximates the response of the human ear.
$D_{nT,w}$	Weighted standardised level difference. A single number rating of the sound level difference between two rooms. DnT,w is typically used to measure the on-site sound insulation performance of a building element such as a wall, floor or ceiling.
Flanking	Transmission of sound energy through paths adjacent to the building element being considered. For example, sound may be transmitted around a wall by travelling up into the ceiling space and then down into the adjacent room.
Frequency	Sound can occur over a range of frequencies extending from the very low, such as the rumble of thunder, up to the very high such as the crash of cymbals. Sound is generally described over the frequency range from 63Hz to 4000Hz (4kHz). This is roughly equal to the range of frequencies on a piano.
Impact sound	Sound produced by an object impacting directly on a building structure, such as footfall noise or chairs scrapping on a floor.
L_{Aeq}	The equivalent continuous sound level. This is commonly referred to as the average noise level and is measured in dBA.
L_{A10}	The noise level exceeded for 10% of the measurement period, measured in dBA. This is commonly referred to as the average maximum noise level.
L_{A90}	The noise level exceeded for 90% of the measurement period, measured in dBA. This is commonly referred to as the background noise level.
L_{AFmax}	The highest measured A weighted sound pressure level of the measurement period.
NR	Noise Rating. A single number rating which is based on the sound level in the octave bands 31.5Hz – 8kHz inclusive, generally used to assess noise from mechanical services in buildings.
Octave band	Sound, which can occur over a range of frequencies, may be divided into octave bands for analysis. The audible frequency range is generally divided into 7 octave bands. The octave band frequencies are 63Hz, 125Hz, 250Hz, 1kHz, 2kHz and 4kHz.
Reverberation time (T60)	Reverberation time is used for assessing the acoustic qualities of a space. T60 is measured in seconds (s) and describes how quickly sound decays within a space.

R_w	Weighted sound reduction index. A single number rating of the sound insulation performance of a specific building element. Rw is measured in a laboratory. Rw is commonly used by manufacturers to describe the sound insulation performance of building elements such as plasterboard and concrete.
Sound absorption	When sound hits a surface, some of the sound energy is absorbed by the surface material. 'Sound absorption' refers to ability of a material to absorb sound.
Sound insulation	When sound hits a surface, some of the sound energy travels through the material. 'Sound insulation' refers to ability of a material to stop sound travelling through it.
Structure-borne transmission	Transmission of sound energy as vibrations inside the structure of a building.

Appendix B – Topography of site



LONGITUDINAL SECTION A-A



APPENDIX C – CALCULATION TABLES

	No Barrier, dB					
	8 Sadlers Mead	22 Sadlers Mead	40 Sadlers Mead	St Marys Street	Monkton Hill	Office Monkton Hill
Sound Power Level, LWeq	94	94	94	94	94	94
Sound Power Level, LW,max	116	116	116	116	116	116
Attenuation: geometric divergence	51	54	59	56	59	59
Attenuation: atmospheric absorption	0	0	1	0	1	1
Attenuation: ground effect	7	8	6	8	6	7
Attenuation: Foliage	0	0	0	0	0	0
Attenuation: Barrier	0	0	0	0	0	0
Meteorological Correction	0	0	0	0	0	0
Equivalent Sound Pressure Level, LAeq	36	32	28	30	28	28
Maximum Sound Pressure Level, LAmax	58	54	50	52	50	50

Table C1: No Barrier

	Flat, Screen 4.4m, dB						
	8 Sadlers Mead	22 Sadlers Mead	40 Sadlers Mead	St Marys Street			Monkton Hill
				Direct	Reflected	Summed Total	
Sound Power Level, LWeq	94	94	94	94	94		94
Sound Power Level, LW,max	116	116	116	116	116		116
Attenuation: geometric divergence	51	54	59	56	57		59
Attenuation: atmospheric absorption	0	0	1	0	0		1
Attenuation: ground effect	7	8	6	8	8		6
Attenuation: Foliage	0	0	0	0	0		0
Attenuation: Barrier	4	0	0	0	0		0
Meteorological Correction	0	0	0	0	0		0
Equivalent Sound Pressure Level, LAeq	32	32	28	30	27	32	28
Maximum Sound Pressure Level, LAmax	54	54	50	52	49	54	50

Table C2: Screen 4.4m High

	Sunk -1.5m, Screen 1.9m, dB					
	8 Sadlers Mead	22 Sadlers Mead	40 Sadlers Mead	St Marys Street	Monkton Hill	Office Monkton Hill
Sound Power Level, LWeq	94	94	94	94	94	94
Sound Power Level, LW,max	116	116	116	116	116	116
Attenuation: geometric divergence	51	54	59	56	59	59
Attenuation: atmospheric absorption	0	0	1	0	1	1
Attenuation: ground effect	7	8	6	8	6	7
Attenuation: Foliage	0	0	0	0	0	0
Attenuation: Barrier	4	0	0	1	0	0
Meteorological Correction	0	0	0	0	0	0
Equivalent Sound Pressure Level, LAeq	32	32	28	29	28	28
Maximum Sound Pressure Level, LAmax	54	54	50	51	50	50

Table C3: Skate Park Sunk by 1.5m, Screen 1.9m High

	Sunk -2m, Screen 1.4m, dB					
	8 Sadlers Mead	22 Sadlers Mead	40 Sadlers Mead	St Marys Street	Monkton Hill	Office Monkton Hill
Sound Power Level, LWeq	94	94	94	94	94	94
Sound Power Level, LW,max	116	116	116	116	116	116
Attenuation: geometric divergence	51	54	59	56	59	59
Attenuation: atmospheric absorption	0	0	1	0	1	1
Attenuation: ground effect	7	8	6	8	6	7
Attenuation: Foliage	0	0	0	0	0	0
Attenuation: Barrier	4	0	0	2	0	0
Meteorological Correction	0	0	0	0	0	0
Equivalent Sound Pressure Level, LAeq	32	32	28	28	28	28
Maximum Sound Pressure Level, LAmax	54	54	50	50	50	50

Table C4: Skate Park Sunk by 2m, Screen 1.4m High

Appendix D – Noise Maps

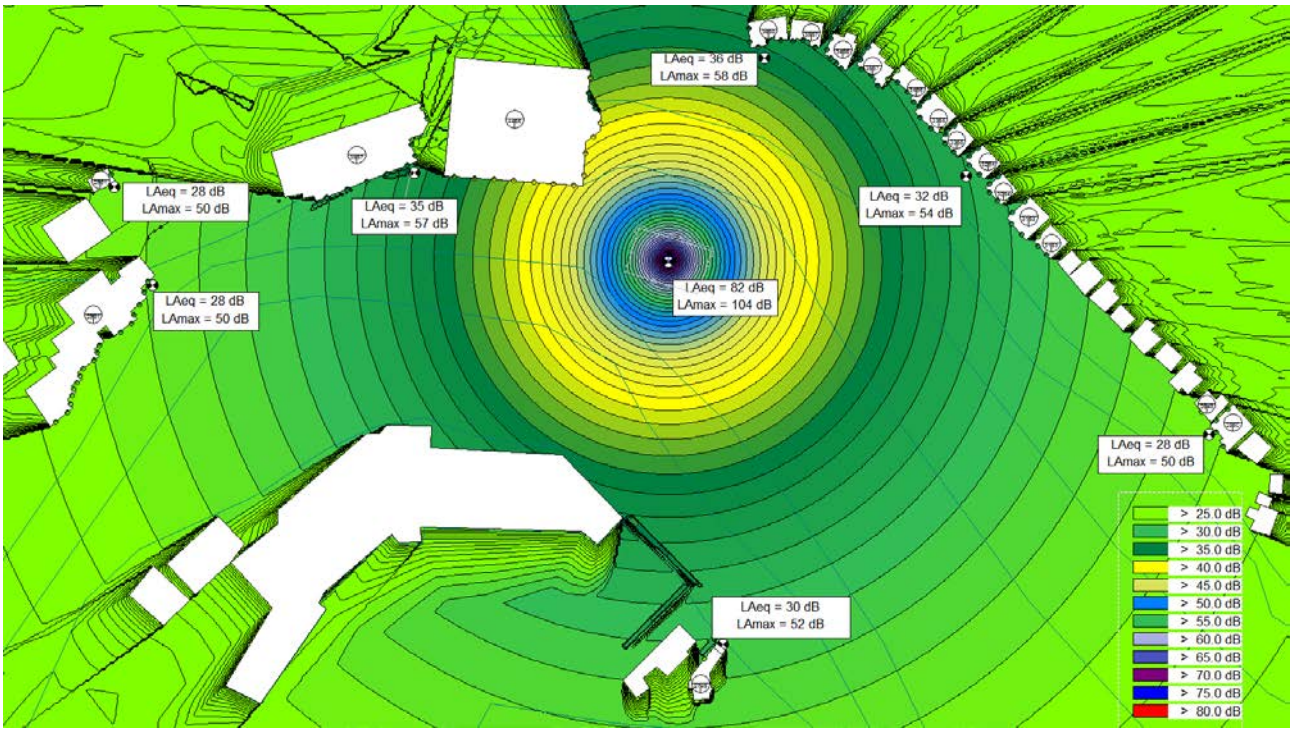


Figure D1: No Mitigation - L_{Aeq}

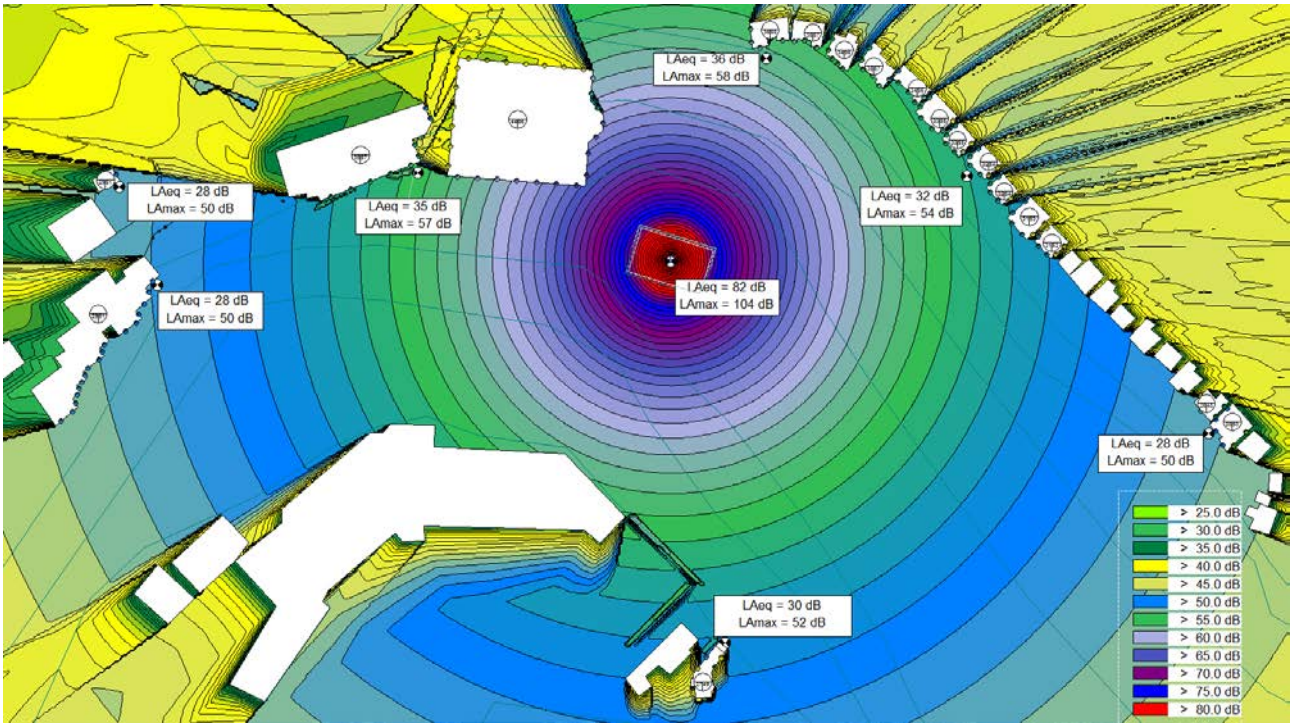


Figure D2: No Mitigation - $L_{A,max}$

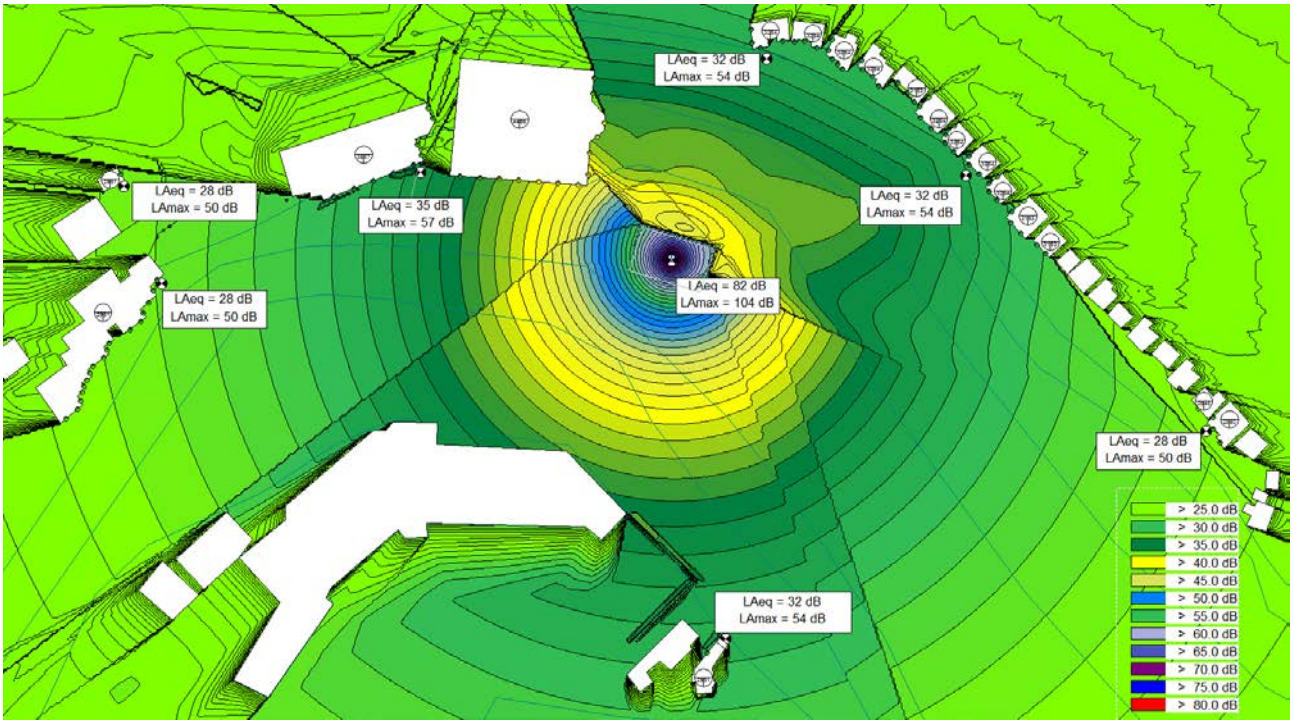


Figure D3: 4.4 metre Barrier - L_{Aeq}

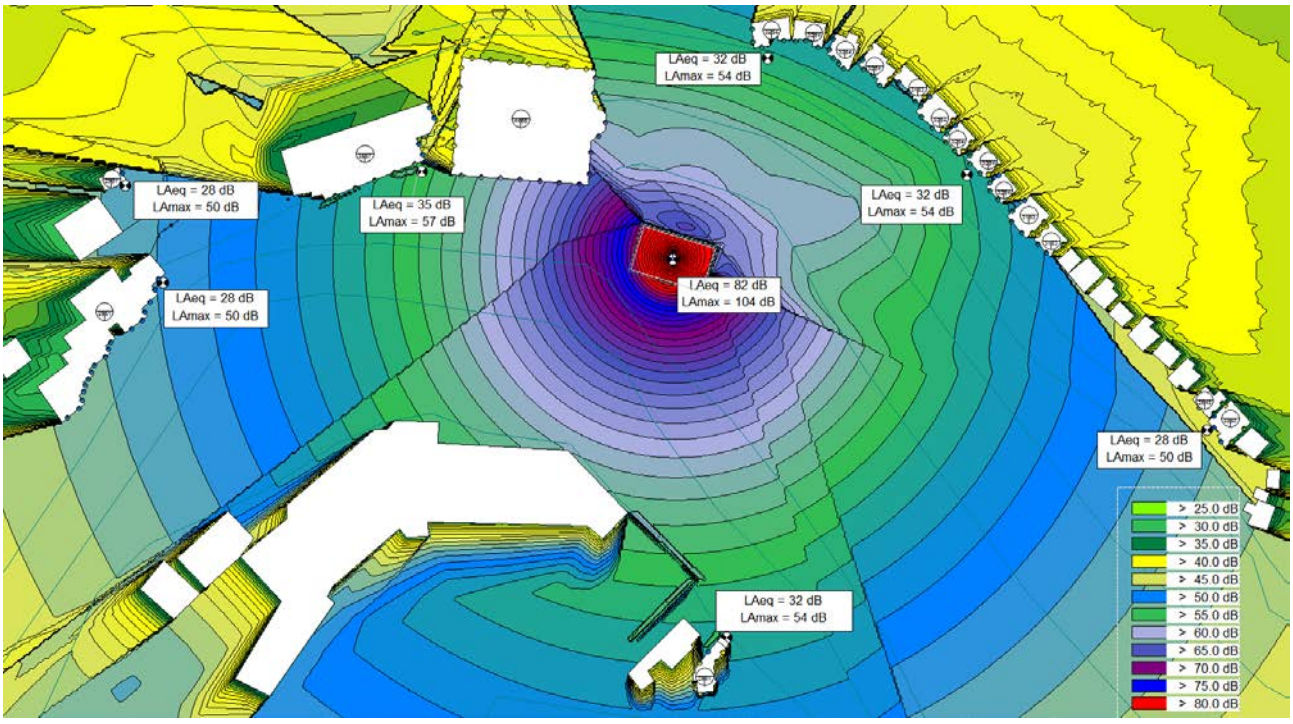


Figure D4: 4.4 metre Barrier - $L_{A,max}$

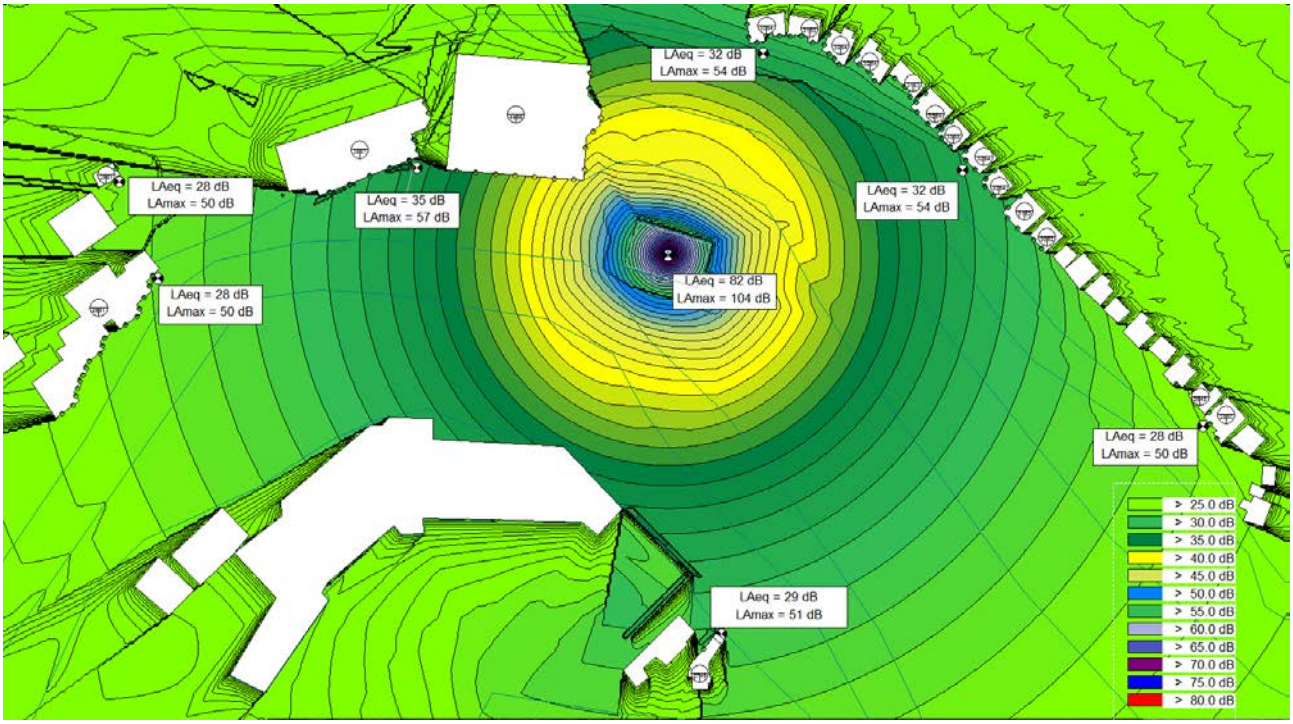


Figure D5: Sunk 1.5 metres, 1.9 metre Barrier - L_{Aeq}

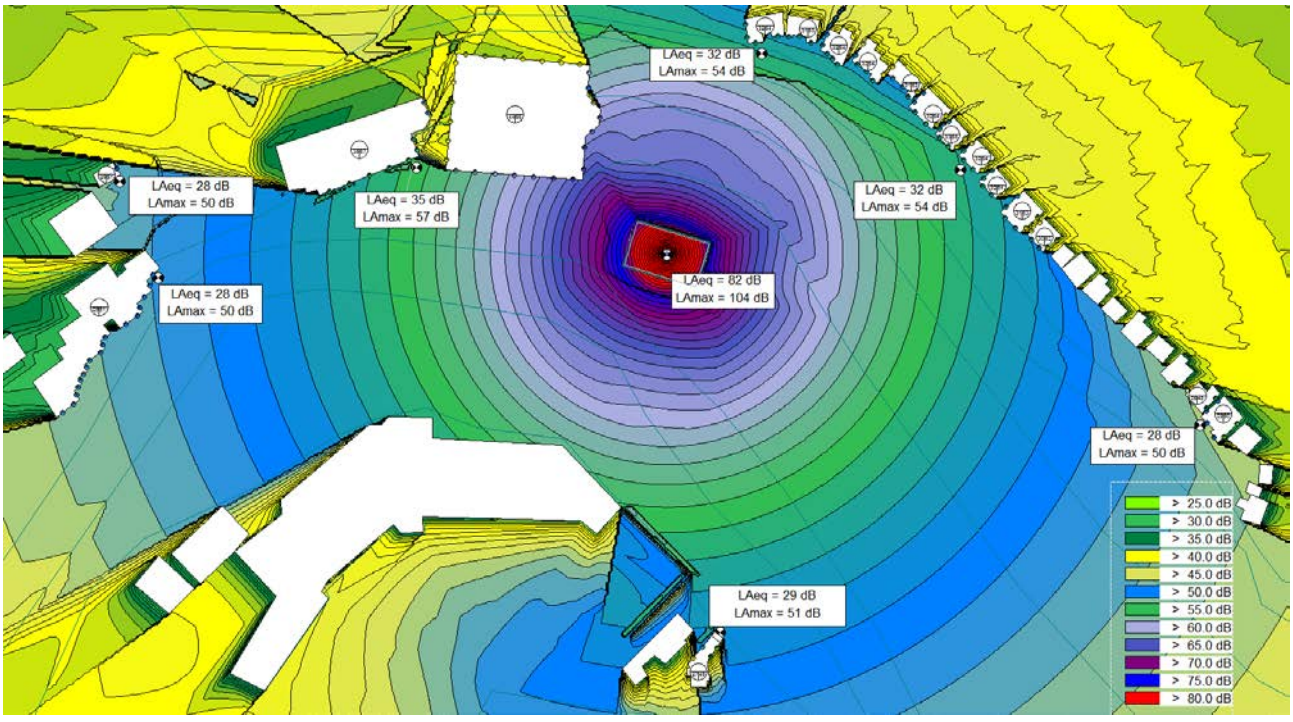


Figure D6: Sunk 1.5 metres, 1.9 metre Barrier - L_{Aeq}

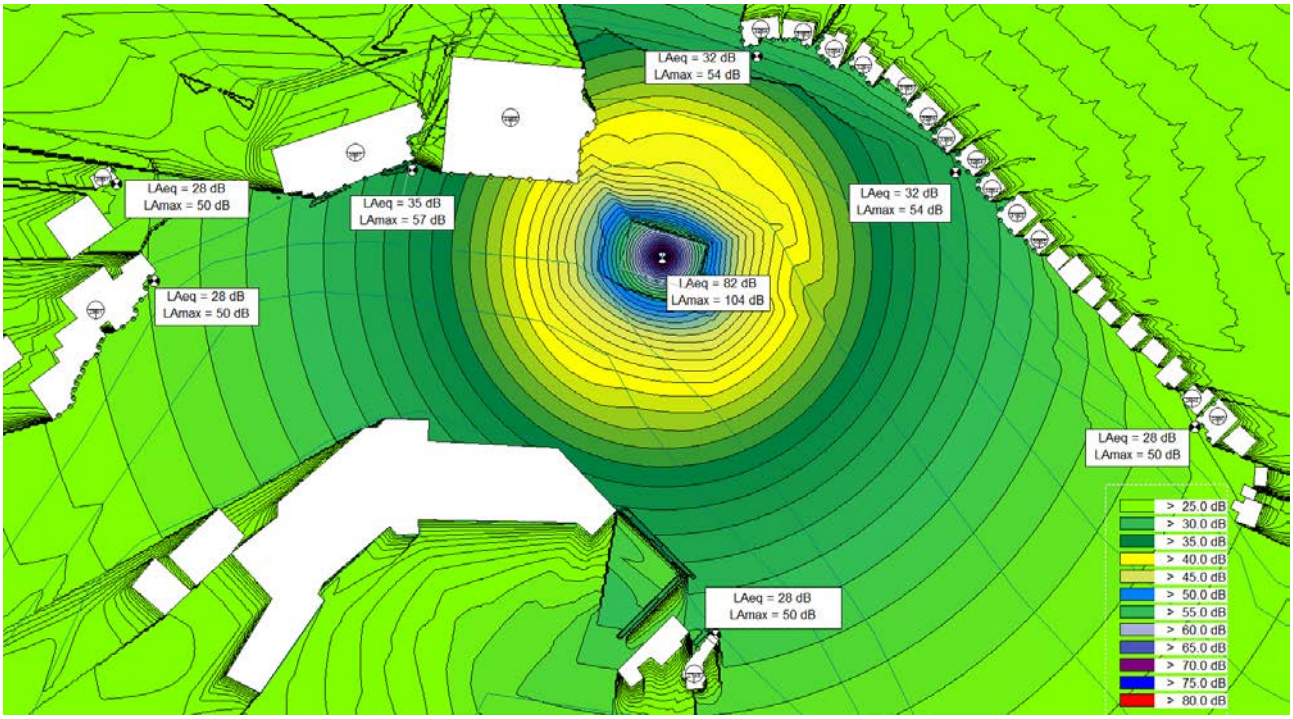


Figure D7: Sunk 2 metres, 1.4 metre Barrier - L_{Aeq}

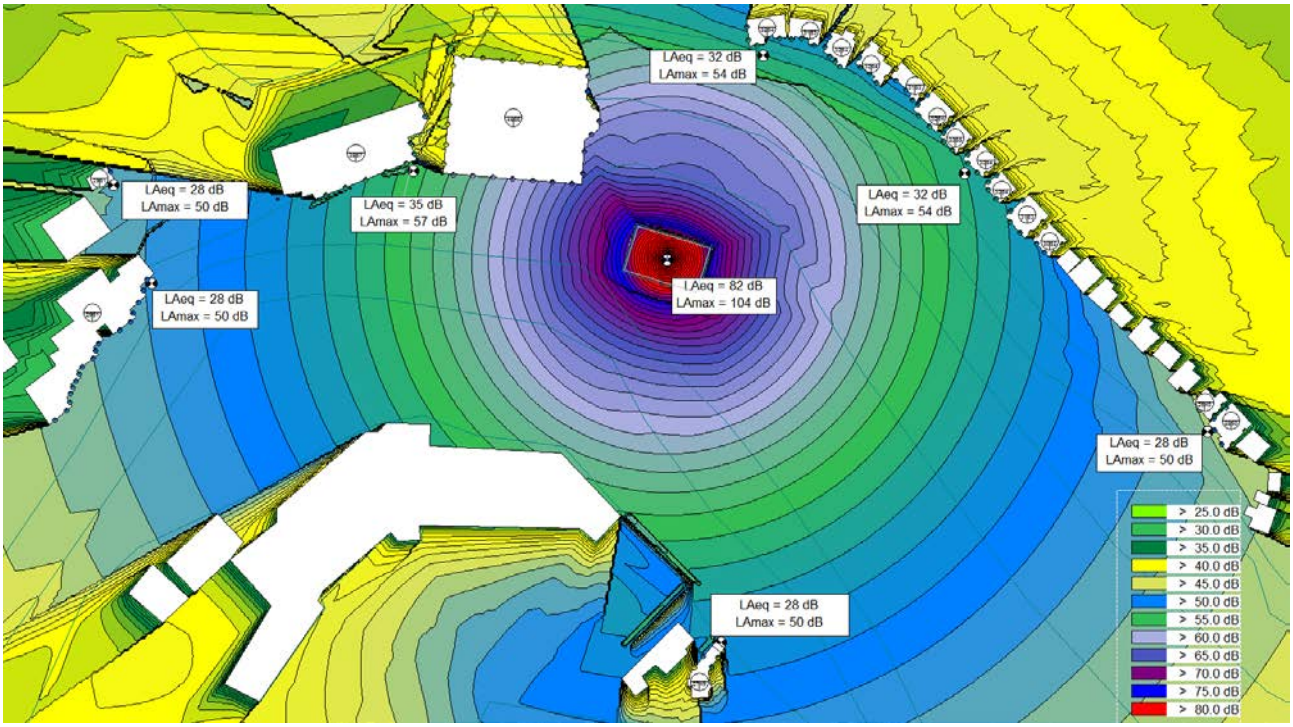


Figure D7: Sunk 2 metres, 1.4 metre Barrier - $L_{A,max}$