TECHNICAL REPORT

ST. EDMUNDS RESIDENTIAL DEVELOPMENT
TRAFFIC NOISE IMPACT ASSESSMENT
LIFFEY VALLEY
DUBLIN

For:

Moykerr Limited
The Grange
Newcastle Road
Lucan
Co Dublin

Report prepared by:
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1.0 INTRODUCTION

Planning Permission is currently being sought for a new residential development to be located in the Liffey Valley area of Dublin that is proposed to be constructed on green / brown field lands immediately adjacent to arterial road access to the N4 national road. The development will be located in a moderately high noise level environment due to a long boundary adjacency with the arterial roads and busy roundabout. Appropriate consideration must therefore be given to its inward impact due to traffic noise emissions.

The development is an amendment to the development currently being undertaken on site, previously granted SHD proposal ABP 305857-19. It consists of the construction of 4 no apartment blocks ranging height from 2 - 9 storeys comprising 313 no. residential units, a creche and amenity space. This will provide an increase of 61 no. additional apartments. All the residential units will have associated private open space / balconies / terraces facing north / south / east / west.

The development will include 214 no. car parking spaces, 5 motorcycle parking spaces and 378 no. bike parking spaces. The site is accessed through the existing vehicular access to the west, off the unnamed road to the west. There will be a number of pedestrian entrances along St. Loman's Road, the Fonthill Road (R113) and the unnamed road to the west. The upgrading and re-landscaping of 4,400 sq.m of land to the east of the site in the ownership of South Dublin County Council.

In addition to all of the new facilities, all other site services and works to enable the development of the site will also be provided including site, bin stores, ESB substations, associated roadworks and services connections, a large quantity of public and communal open space, boundary treatment works and landscaping. A full development description is included in the statutory notices.

CLV Consulting Limited has been commissioned by Moykerr Limited to conduct an assessment of the likely inward traffic noise impact expected to be experienced by the development and to provide appropriate recommendations for reducing road traffic noise emissions to acceptable limits in both internal and external development locations.

The following document details the results of an ambient noise survey conducted on development lands, sets out appropriate criteria in respect of both internal and external noise level requirements, provides a detailed account of our assessment and lists the mitigation recommendations that were determined as being required in order to ensure the proposed development minimises potential significant noise impacts from the adjacent N4 arterial roadway systems.

2.0 RECEIVING ENVIRONMENT

An environmental noise survey was conducted in order to quantify the existing noise environment on development lands adjacent to the perimeter roadways. The survey was conducted in general accordance with *ISO 1996-2: 2017: Acoustics - Description, measurement and assessment of environmental no*ise.

Specific details are set out in the following sections.

2.1 Measurement Location

Given that the adjacent roadways are the only noise source of any significance identified in the vicinity of the development site, it was desired to conduct noise measurements as close to the development building area as possible with a direct line of sight to the road. Following an initial site survey of the full extent of the development / roadway boundary, it was clearly evident that the highest traffic noise levels occur in the vicinity of the roundabout, immediately adjacent to the southeast corner of the development.

The most appropriate measurement location was therefore determined to be at the top of the slope immediately overlooking the roundabout with direct line of sight with both the roundabout and all of its arterial roads. All noise measurements were conducted at this location. See Figure 1.

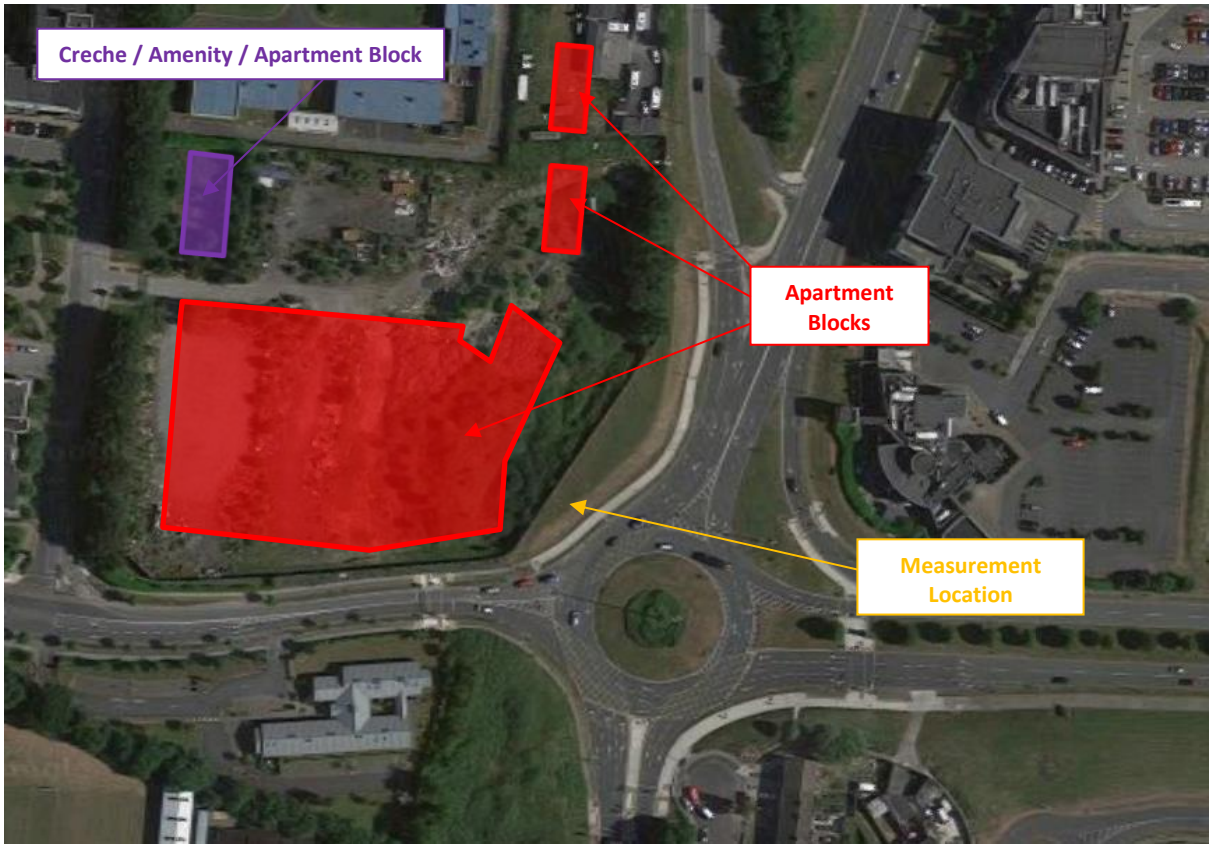

Figure 1 Site Layout Showing Approximate Position of Measurement Location

2.2 Survey Periods

Noise measurements were conducted over the course of three survey periods as follows:

- Morning Rush Hour 07:30 to 09:30hrs on 30 January 2019.
- Evening Rush Hour 16:30 to 18:30hrs on 29 January 2019.
- Night-time 23:00 to 00:00hrs on 29 January 2019.

The morning and evening rush hour measurements were conducted over typical daytime and evening rush hour periods during periods of high traffic volumes on the adjacent road networks in order to obtain worst case noise levels during the busiest traffic periods.

The night-time period measurement period was selected to provide an indication of the night time noise emissions from the adjacent road networks during the earliest hours of the night time period.

The meteorological conditions over the course of each survey period are detailed in Table 1.

Survey Period	Wind		Temperature - °C	Cloud Cover – %	Relative Humidity - %	Precipitation?
	Speed	Direction				
Morning Rush Hour	5 - 6 m/s	WNW	13	20	84	None.
Evening Rush Hour	4 - 5 m/s	SW	20	10	77	None.
Night Time	2 - 3 m/s	SSW	16	50	86	None.

Table 1 Meteorological Conditions During the Noise Surveys

2.3 Personnel & Instrumentation

Brian S. Johnson (CLV) conducted the noise level measurements during all survey periods. He is an internationally experienced acoustic consultant who has been working in the fields of architectural / building acoustics and noise control since 1994. He has been based in America, Europe, Asia and Australia and is a member of the Institute of Acoustics. Brian also has extensive knowledge in the field of environmental acoustics and holds a Certificate of Competence in Environmental Noise Measurements from the Institute of Acoustics.

The measurements were conducted using an NTI Audio Type XL2 Sound Level Meter (Serial #A2A-10989-EO). It was fitted with a 90mm windshield and was check calibrated both before and after the survey using a Casella Cel 120 Acoustic Calibrator (Serial #3921077). The microphone was positioned approximately 1.4m above the ground.

The calibration certificates for the sound level meter and calibrator are provided in Appendices A & B respectively of this document.

2.4 Procedure

Measurements were conducted continuously during all three measurement periods. Sample periods for all measurements were 10 minutes in duration. The results were saved to the instrument memory for later analysis. All primary noise sources contributing to noise build-up were also noted.

2.5 Measurement Parameters

The statistical noise survey results are presented in terms of the following five parameters:

- L_{Aeq} is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period.
- L_{Amax} is the instantaneous maximum sound level measured during the sample period.
- L_{Amin} is the instantaneous minimum sound level measured during the sample period.
- L_{A10} is the sound level that is exceeded for 10% of the sample period. It is typically used as a descriptor for traffic noise.

L_{A90} is the sound level that is exceeded for 90% of the sample period. It is typically used as a descriptor for background noise.

The "A" suffix denotes the fact that the sound levels have been "A-weighted" in order to account for the non-linear nature of human hearing.

All sound levels in this report are expressed in terms of decibels (dB) relative to $2x10^{-5}$ Pa.

2.6 Measurement Results

The survey results for all three measurement periods are summarised in Table 2 below.

Time		Measured Noise Levels (dB re. $2x10^{-5}$ Pa)				
		L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}
Morning Rush Hour	07:30 - 07:40hrs	70	82	60	71	67
	07:40 - 07:50hrs	70	76	59	71	67
	07:50 - 08:00hrs	70	77	65	72	67
	08:00 - 08:10hrs	70	82	62	72	67
	08:10 - 08:20hrs	70	79	60	72	67
	08:20 - 08:30hrs	70	82	61	72	67
	08:30 - 08:40hrs	69	79	61	71	66
	08:40 - 08:50hrs	70	80	63	71	67
	08:50 - 09:00hrs	69	82	60	71	66
	09:00 - 09:10hrs	69	78	62	71	66
	09:10 - 09:20hrs	69	78	61	71	67
	09:20 - 09:30hrs	69	74	63	71	66
Evening Rush Hour	16:30 - 16:40hrs	70	85	61	71	67
	16:40 - 16:50hrs	70	79	64	71	67
	16:50 - 17:00hrs	70	79	60	71	67
	17:00 - 17:10hrs	71	90	60	72	67
	17:10 - 17:20hrs	70	80	62	72	67
	17:20 - 17:30hrs	70	76	64	71	67
	17:30 - 17:40hrs	70	83	62	71	67
	17:40 - 17:50hrs	69	75	61	71	66
	17:50 - 18:00hrs	69	80	65	71	67
	18:00 - 18:10hrs	69	80	64	71	67
	18:10 - 18:20hrs	69	78	60	71	67
	18:20 - 18:30hrs	70	75	63	71	67
Night Time	23:00 - 23:10hrs	66	75	52	68	59
	23:10 - 23:20hrs	64	73	50	68	56
	23:20 - 23:30hrs	63	72	49	67	55
	23:30 - 23:40hrs	65	72	52	68	58
	23:40 - 23:50hrs	63	72	48	67	54
	23:50 - 00:00hrs	62	73	45	65	50

Table 2 Summary of Measured Noise Levels

During all measurement periods, the ambient noise levels in the vicinity of the development were completely dominated by local traffic noise travelling through the roundabout and along the adjacent road networks. The only other noise source of any significance that was identified during the surveys was occasional pedestrian pass by and aircraft flyover events. However, neither of these sources were of a magnitude to provide any significant contribution to the noise levels reported in Table 2.

The adjacent arterial road network noise emission measurement results can therefore be summarised as follows:

- Morning rush hour noise levels: 69 - 70dB L_{Aeq} and 66 - 67dB L_{A10}.
- Evening rush hour noise levels: 69 - 71dB L_{Aeq} and 66 - 67dB L_{A10}.
- Night time period noise levels: 62 - 66dB L_{Aeq} and 50 - 59dB L_{A10}.

3.0 DEVELOPMENT INTERNAL / EXTERNAL NOISE CRITERIA

3.1 External Noise Level Criteria

Guideline criteria for external noise levels in the development's public open space and apartment block central court yards can be found in both the *BS 8233 Guidance on Sound Insulation and Noise Reduction for Buildings* and *ProPG: Planning & Noise (Professional Guidance on Planning & Noise for New Residential Developments)* guidance documents. Both of these documents state that ambient noise levels in external residential areas should ideally not be above 50 - 55dB L_{Aeq}.

Although exceedances of this criteria is naturally not desirable, both the *BS 8233 Guidance On Sound Insulation And Noise Reduction For Buildings* and *ProPG: Planning & Noise (Professional Guidance on Planning & Noise For New Residential Developments)* recognize that their stated guideline values are not achievable in all instances and that external noise levels in excess of this criteria would not be prohibitive provided additional considerations are made in relation to the development.

From BS 8233:

> *It is recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.*
>
> *In high-noise areas, consideration should be given to protecting these areas by screening or building design to achieve the lowest practicable levels. Achieving levels of 55dB $L_{Aeq,T}$ or less might not be possible at the outer edge of these areas, but should be achievable in some areas of the space.*

From ProPG:

> *These guideline values may not be achievable in all circumstances where development might be desirable. In such a situation, development should be designed to achieve the lowest practicable noise levels in these external amenity spaces.*
>
> *Where, despite following a good acoustic design process, significant adverse noise impacts remain on any private external amenity space (e.g. garden or balcony) then that impact may be partially off-set if the residents are provided, through the design of the development or the planning process, with access to:*
>
> - *A relatively quiet facade (containing openable windows to habitable rooms) or a relatively quiet externally ventilated space (i.e. an enclosed balcony) as part of their dwelling; and/or*
> - *A relatively quiet alternative or additional external amenity space for sole use by a household, (e.g. a garden, roof garden or large open balcony in a different, protected, location); and/or*
> - *A relatively quiet, protected, nearby, external amenity space for sole use by a limited group of residents as part of the amenity of their dwellings; and/or*
> - *A relatively quiet, protected, publicly accessible, external amenity space (e.g. a public park or a local green space designated because of its tranquillity) that is nearby (e.g. within a 5 minutes walking distance).*

Given the above guidance, the following general approach was developed as the development's external noise level strategy in order to provide an acceptable external ambient noise environment:

- ✓ The 50 - 55dB L_{Aeq} external criteria will be designed for in all instances where it is practically possible to be achieved.
- ✓ Where this external criteria range is not achievable, external noise levels will be attenuated as far as practicable.
- ✓ Relatively quiet external amenity spaces will be incorporated into the development.
- ✓ The façade design of all residential spaces will incorporate superior sound insulation glazing / façade elements to achieve a quiet internal acoustic environment that will comply with criteria applicable to low level residential bedroom environments (see Section 5).

3.2 Internal Noise Level Criteria

Appropriate guidance for internal noise levels within residential spaces is contained within *BS8233 (2014): Guidance on Sound Insulation and Noise Reduction for Buildings*. This British Standard sets out recommended noise limits for indoor ambient noise levels in residential dwellings / apartments as detailed in Table 3. In order to design for worst case conditions, we have also assumed the below criteria would apply to the creche / residential amenity building (as it contains apartments as well).

Activity	Room Type	Design Criterion $L_{Aeq,T}$ (dB)	
		Daytime (07:00 - 23:00hrs)	Night Time (23:00 - 07:00hrs)
Resting / Sleeping Conditions	Living Rooms	35dB $L_{Aeq,16hr}$	-
	Bedrooms	35dB $L_{Aeq,16hr}$	30dB $L_{Aeq,8hr}$

Table 3 Recommended Indoor Ambient Noise Levels from *BS8233 (2014)*

In summary, the following internal noise level criteria would therefore apply to the proposed development:

- Daytime Periods (07:00 to 23:00 hours) 35dB $L_{Aeq,16hr}$
- Night Time Periods (23:00 to 07:00 hours) 30dB $L_{Aeq,8hr}$

4.0 EXTERNAL NOISE LEVEL ASSESSMENT

4.1 Public Amenity Areas

There are a total of four blocks that are proposed to be included in the scheme. They have been numbered as Blocks 1 - 4 with Block 1 being a tower block complex with various cores, lock 2 being a single five storey apartment block, Block 3 being terraced housing and Block 4 being a creche / resident amenity / apartment building. See Figure 2 below.

Figure 2 Apartment Tower Blocks

Apartment Block 1 Central Courtyard Areas –Apartment Block 1 will consist of six cores that are up to eight stories in height and will locate along the southern boundary of the site. Given its location immediately adjacent to the L1042 roadway and roundabout, the external perimeter apartments in this block on the south and east facades will be exposed to the highest noise levels of any in the development. However, the architectural design strategy is for the cores to be constructed in parallel orientations with two storey high duplex apartment units connecting each block to each other along their ends. This arrangement effectively forms two central courtyard areas that will serve as an acoustically sheltered green amenity area for the occupants of this tower block.

See Figure 3 below.

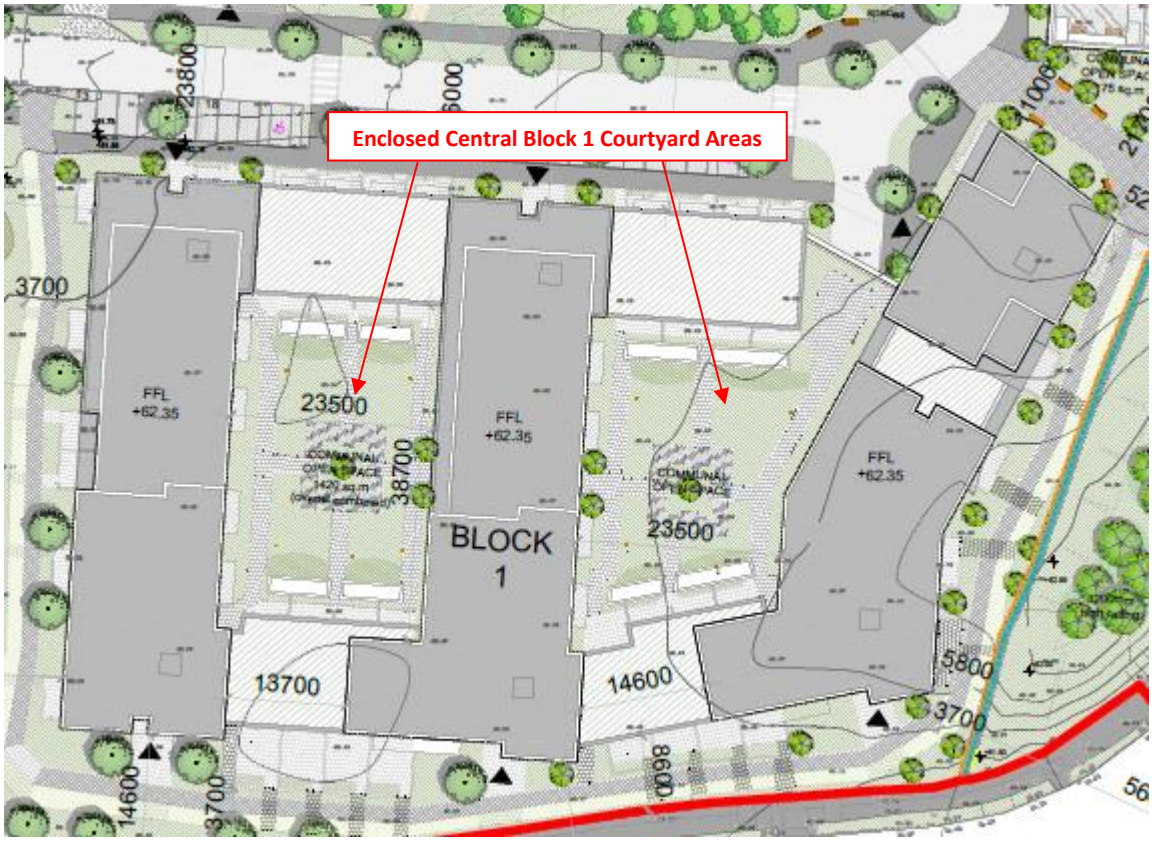

Figure 3 Tower Apartment Block 1 Layout

Although these central courtyard areas will only be located approximately 35m from the adjacent roadway, the architectural design of the perimeter duplex units effectively creates a substantial (and wide) two storey high barrier wall that will shield these areas from traffic noise.

Noise prediction calculations conducted based on the worst case measured noise levels confirms that ambient noise levels in these central courtyard areas will be of the order of 43 - 45dB L_{Aeq} during peak rush hour periods. Noise levels of this order would be well below the 50 - 55dB L_{Aeq} external design criteria and sufficient for a courtyard amenity area space.

No further mitigation measures would therefore be required in reducing traffic noise emissions for the Apartment Block 1 central courtyard amenity areas.

Public Open Space – the development public open space will be located in the central portion of the development, north of Block 1, west of Block 2 and east of Block 4. Given this central location within the development, the public open space will be shielded from direct line-of-sight with all of the adjacent roads.

See Figure 4 below.

Figure 4 Development Public Open Space Location

Noise prediction calculations conducted based on the worst case measured noise levels indicates that ambient noise levels in this common green area will be of the order of 52 - 53dB L_{Aeq} during peak rush hour periods. Noise levels of this order would be within the 50 - 55dB L_{Aeq} external design criteria and therefore sufficient for a common green amenity area.

No further mitigation measures would therefore be required in reducing traffic noise emissions for the public open space.

4.2 External Balconies

Apartment balconies will be provided for most apartments in all blocks. Balconies are a little different in nature to private gardens and amenity areas in that high noise levels are generally more tolerated (i.e. inner city balconies are typically left open and can overlook busy road routes whilst most gardens are located at the rear of properties and are fenced in).

In this instance, we would recommend making the balcony balustrades for outward facing balconies along southern and eastern facades of Block 1 and eastern facades of Blocks 2 & 3 imperforate so that a measure of acoustic shielding will be provided for occupants in seated positions. Acoustic calculation predictions for a seated occupant with a head height of approximately 1m on external balconies with solid, imperforate balcony balustrades provided confirmed that noise levels experienced for balcony occupants will be ≤ 55dB(A) during most periods. Predicted noise levels on Block 4 balconies are predicted to be ≤ 55dB(A) regardless.

In addition to this architectural recommendation, the following considerations should also be noted:

- Given the lack of significant reflective building surfaces across both adjacent roadways to the development, traffic noise emissions on balcony areas will not experience any reflections or reverberant noise build-up and will therefore be less than those on many other suburban apartment balconies that directly overlook roads.
- An abundance of landscaping features (e.g. trees, hedges, etc) will be provided along the development perimeter boundary with the adjacent roadways. These landscaping measures will provide a minimal degree of extra sound absorption / scattering / diffusion, but will also provide a significant psychological benefit / reduction in the subjective perception of traffic noise for balcony occupants (see Section 4.4).
- Design considerations in accordance with the *ProPG: Planning & Noise* guidance document, which states the following:

  > '*Where, despite following a good acoustic design process, significant adverse noise impacts remain on any private external amenity space (e.g. garden or balcony) then that impact may be partially off-set if the residents are provided, through the design of the development or the planning process, with access to a relatively quiet, protected, nearby, external amenity space for sole use by a limited group of residents as part of the amenity of their dwellings*'.

  In accordance with this recommendation, quiet central courtyard amenity spaces have been provided as part of the development to ensure that residents of each of the apartment blocks have such a quiet external space available.

In summary, although external noise levels on balconies along southern and eastern facades of Block 1 and balconies of eastern facades of Blocks 2 & 3 with direct line of sight to the adjacent roadways will be slightly higher than ideal ranges during rush hour periods, given the provision of imperforate balustrades, the lack of reverberant noise reflections from adjacent building facades and provision of perimeter landscaping features, traffic noise emissions will be both reduced as far as practical and will be less than experienced on most other similar urban and suburban tower block balconies.

4.3 Development Boundary Landscaping

In addition to the traffic noise mitigation recommendations discussed in the previous sections, it is also recommended to provide an abundance of landscaping features (e.g. trees, hedges, etc) along the development perimeter boundary with the adjacent roadways. Although these landscaping measures will only provide a very minimal degree of extra sound absorption / scattering / diffusion, it has been experimentally proven that shielding of roadways with landscaping features provide a significant psychological benefit and reduction in the subjective perception of traffic noise emissions. It will also help to minimise traffic noise impact on Apartment Block 1 balcony areas (as discussed in Section 4.2).

Landscaping measures should therefore be provided as densely as possible along the southern boundary areas.

5.0 INTERNAL NOISE LEVEL ASSESSMENT

5.1 Apartment Blocks

Apartment Block 1 - It was determined as part of our external noise level modelling prediction exercise that worst case noise levels along the perimeter facing facades of these apartment blocks overlooking the adjacent roadways will be of the order of 68dB L_{Aeq} during daytime periods and as high as 61dB L_{Aeq} during the earliest portion of night time periods. Noise levels (perpendicularly incident) on most of these facades are predicted to be relatively similar given their common parallel aspect with the roadways. Noise levels are also predicted to be relatively similar to these on the tower block facades above the duplex units along the south and east perimeters of the buildings with a direct view to the roads.

Noise levels incident on all remaining apartment block facades are predicted to be ≤ 50dB L_{Aeq} during all periods due to their perpendicular aspect with the road and/or full or partial acoustic shielding from the development buildings themselves.

Although the external wall constructions are not known at this stage, assuming a construction with a minimum performance specification of 50dB R_w is provided (such as a minimum 200mm thick solid masonry or brick wall or a 2 x 100mm concrete block cavity masonry wall with battened composite boards as the internal finish), they should be sufficient to reduce external noise levels of this order to well below the internal design criteria.

Detailed consideration, however, will need to be given to the external glazing configurations, external door (balcony) constructions and ventilation openings.

Given the different ranges of external noise levels on the various facades of the dwellings, it is prudent to provide a different range of noise reductions specifications for the glazing elements on each façade. Based on the various noise level ranges, two recommended minimum glazing specifications were determined and are summarised in Table 4.

Glazing Spec Type	Octave Band Centre Frequency (Hz)						Typical Glazing Configuration
	125	250	500	1k	2k	4k	
A	22	24	30	38	35	30	6mm glass - 12mm air space - 8mm glass
B	25	28	36	41	42	40	10mm glass - 12mm air space - 6mm laminate glass

Table 4 Dwelling Glazing Sound Insulation Performance Requirements, SRI (dB)

Figure 5, on the following page, details the locations where the various glazing specifications should be applied for all apartment block floors.

: Glazing Specification A

: Glazing Specification B

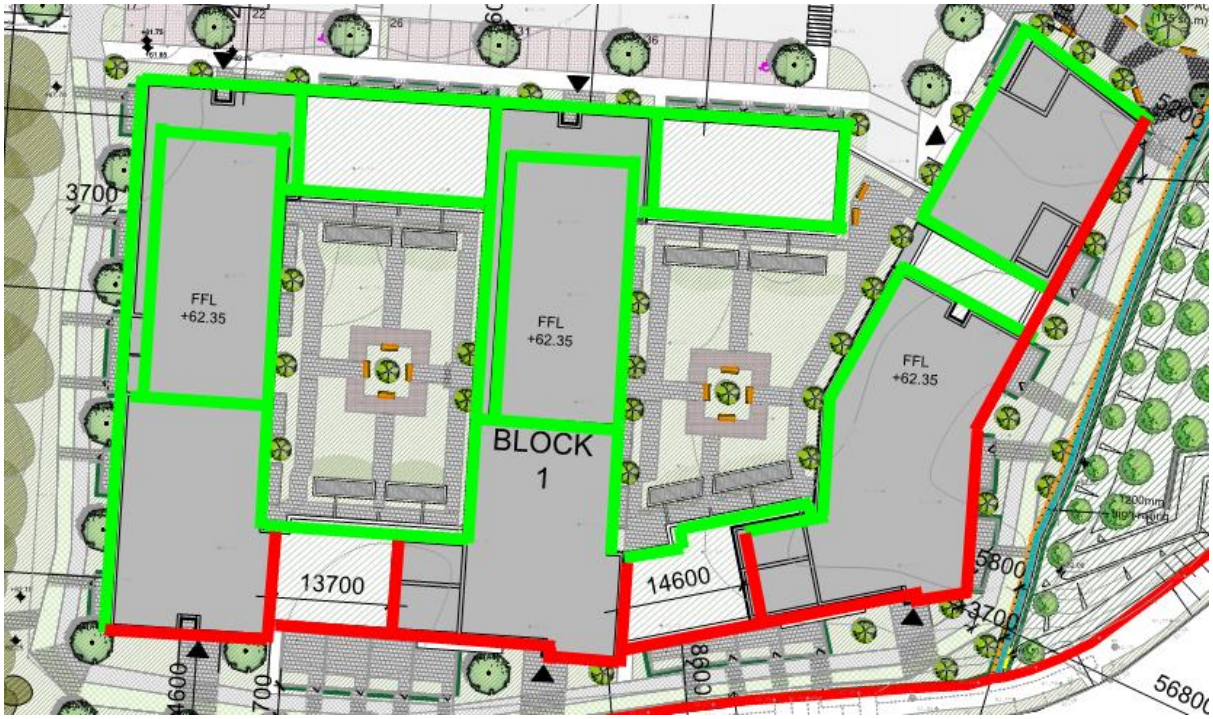

Figure 5 Apartment Block 1 Glazing Sound Insulation Minimum Performance Requirements (All Levels)

It should be noted that the performance values detailed in Table 4 are the basis of the assessment and that the glazing configurations detailed are merely typical examples which can be expected to afford these performance values. Alternative products with an equivalent or better performance would also provide sufficient sound insulation.
For operable windows, the proposed framing design will need to be acoustically reviewed during the design stage and acoustic treatment may be required. At a minimum, operable windows would need to incorporate compressible gasket seals to the full perimeter of the frame and any sliding windows will need to be installed in a rebated frame and sealed so that no gaps exist around the perimeter when closed.

The other design element consideration is in relation to external doors located on external façades in balcony areas. These entry doors should be selected with the minimum performance specifications listed in Table 5 below.

Glazing Specification	Minimum External Door Sound Insulation Performance (dB R_w)
A	30
B	35

Table 5 External Door Minimum Sound Insulation Performance Specifications

Acoustic test data should be obtained from the façade supplier to confirm that all primary window and external door constructions to be supplied performs to the required acoustic specification as given above. If acoustical performance data is not available for any of the specific systems, then it must be provided in accordance with the following details:

- The performance requirements shall be obtained from laboratory measurements obtained in accordance with *ISO 140-3: 1995 "Measurement of sound insulation in*

buildings and of building elements" and weighted in accordance with *ISO 717-1: 1997 "Acoustics - Rating of sound insulation in buildings and of building elements - Part 1: Airborne sound insulation"*.

- Laboratory measurements shall be obtained from an independent acoustic test laboratory accredited by a recognized approving body and shall be a fully representative part of the system including associated framing or support system and seals.
- Ratings and measurements obtained in accordance with other equivalent standards may also be permitted and should be submitted to the client representative for approval.
- The Trade Contractor shall provide Tender test certificates demonstrating compliance with the specified acoustic performance for the products offered. Failing this, the Trade Contractor shall allow in the Tender for the expense of such necessary testing as demonstrating compliance with the specification. The tests shall be carried out at an independent acoustic test laboratory approved by a recognized acoustic institution.

It is also important that the sound insulation performance of trickle vents do not significantly compromise the integrity of the window performance. Provision should be made for provision of acoustic trickle vents in apartment block façades that achieve the minimum sound reduction values listed in Table 6 below.

Glazing Specification	Minimum External Door Sound Insulation Performance (dB $D_{n,e,w}$)
A	35
B	42

Table 6 Trickle Vent Minimum Sound Reduction Performance Specifications

Apartment Blocks 2 & 3 - these apartment blocks are set further back from the road and will be slightly shielded from part of the adjoining roadway by the embankment at ground level. However, upper floor levels will have a direct view of the road and will have a direct acoustic line of sight with the N4 slip road.

It was determined from our prediction exercise that worst case noise levels at the east facades of Blocks 2 & 3 and the south facade of Block 2 with direct line of sight to the road will be of the order of 61 - 65dB L_{Aeq} during daytime periods and as high as 55 - 59dB L_{Aeq} during the earliest portion of night time periods. Noise levels incident on all remaining facades are predicted to be ≤ 50dB L_{Aeq} during all periods due to either a perpendicular aspect with the adjoining N4 slip road (north facade) or that it faces away from it entirely (west façade).

External façade constructions with a minimum performance specifications of 50dB R_w should be provided (similar to those discussed for Apartment Block 1) in order to ensure external noise levels are reduced to well below the internal design criteria. Roof constructions will also need to be a minimum of 40dB R_w which can be easily achieved with a concrete tile roof and plasterboard ceiling construction.

Detailed consideration, however, will need to be given to the external glazing configurations, external door (balcony) constructions and ventilation openings.

Given the two different ranges of external noise levels on the various facades of Apartment Blocks 2 & 3, a similar two level strategy was adopted for the glazing elements on each of the apartment block façades.

The recommended minimum glazing specifications summarised in Table 4 were therefore applied to this building as shown in Figure 6 below.

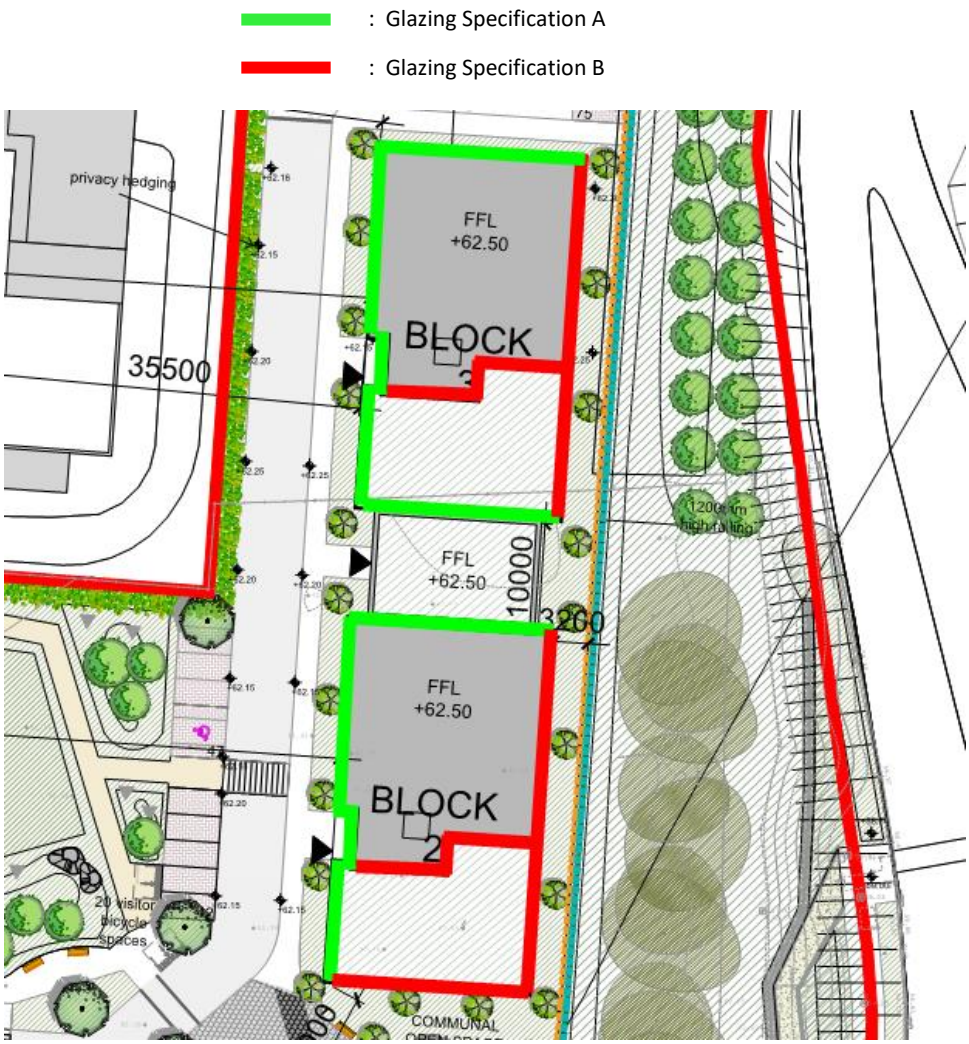

Figure 6 Apartment Blocks 2 & 3 Glazing Sound Insulation Minimum Performance Requirements - All Floors

Acoustic test data should be obtained for all window constructions being considered as discussed previously in this section.

The other design element consideration is in relation to external doors located in external balcony areas and for all trickle vents which should be selected with the minimum performance specifications listed in Tables 5 & 6 respectively.

Provided all of the recommended design measures detailed in this section are properly provided, noise levels inside this apartment block would comply with the established internal noise level design criteria and therefore provide a suitable internal acoustic environment throughout.

5.2 Creche / Resident Amenity / Apartment Building (Block 4)

The creche / resident amenity / apartment building (Block 4) is the most acoustically sheltered Block in the development as it locates in the northwest corner of the site and does not have an effective line of sight view with any of the main development perimeter roadways.

It was determined from our calculation prediction exercise that worst case noise levels at the facades of this block will be of the order of 51 - 52dB L_{Aeq} during daytime periods.

External constructions with a minimum performance specifications of 40dB R_w should be provided (similar to those discussed for the apartment blocks) in order to ensure external noise levels are reduced to well below the internal design criteria. Roof constructions will also need to be a minimum of 30dB R_w which can be easily achieved with a concrete tile roof and plasterboard ceiling construction. Detailed consideration, however, will need to be given to the external glazing configurations, external doors and ventilation openings.

A similar two level strategy similar to that employed for the apartment blocks was adopted for the glazing elements on each façade. The recommended minimum glazing specifications summarised in Table 4 were therefore applied to these two buildings as shown in Figure 7 below.

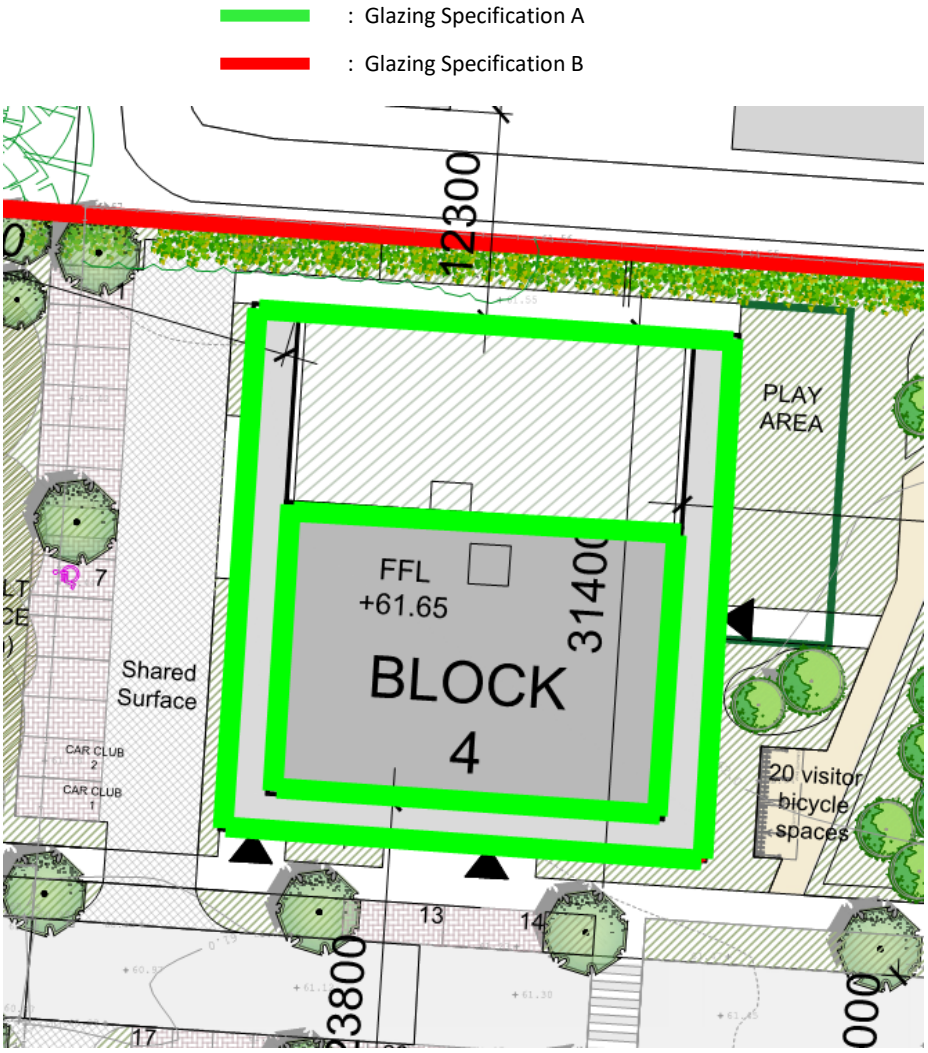

Figure 7 Block 4 Sound Insulation Minimum Performance Requirements - All Floors

Acoustic test data should be obtained for all window constructions being considered as discussed in the previous sections.

The other design element consideration is in relation to external doors and for all trickle vents which should be selected with the minimum performance specifications listed in Tables 5 & 6 respectively.

Provided all of the recommended design measures detailed in this section are properly provided, noise levels inside the development terraced housing units would comply with the established internal noise level design criteria and therefore provide a suitable internal acoustic environment throughout.

6.0 COMMENT ON COMPARISON BETWEEN PROPOSED / PERMITTED SITUATIONS

In regard to the comment made in the Inspector's Report, please note that there is not much difference from an inward noise impact assessment standpoint between the proposed and previously permitted situations. The mitigation recommendations made in this report are similar to those recommended previously and will all still be incorporated into the architectural design of the development accordingly.

7.0 SUMMARY OF NOISE IMPACT

7.1 External Noise Level Impact Summary

Given the moderately high ambient noise environment in the vicinity of the proposed development due to the adjacent roadways, a noise impact consideration approach consistent with the *BS 8233* and *ProPG* guidance documents was adopted in order to ensure an acceptable external ambient noise environment will be provided.

This approach is summarised as follows:

- ✓ The 50 - 55dB L_{Aeq} external criteria will be designed for in all instances where it is practically possible to be achieved.
- ✓ Where this external criteria is not achievable, external noise levels will be attenuated as far as practicable.
- ✓ Relatively quiet external amenity spaces will be incorporated into the development.
- ✓ The façade design of all residential spaces will incorporate superior sound insulation glazing / façade elements to achieve a quiet internal acoustic environment that will comply with criteria applicable to low level residential bedroom environments (considered as part of the Internal Noise Level Assessment).

In accordance with this strategy, several mitigation measures were developed. These measures are summarised as follows:

Apartment Block 1 Central Courtyard Areas

- Apartment Block 1 central courtyard amenity areas were confirmed as being of the order of 43 - 45dB L_{Aeq} during peak rush hour periods and therefore compliant with the 50 - 55dB L_{Aeq} criteria.

Development Public Open Space

- The public green area located to the west of Block 2 was confirmed as being of the order of 52 - 53dB L_{Aeq} during peak rush hour periods and therefore compliant with the 50 - 55dB L_{Aeq} criteria.

Apartment Block Balconies

- Apartment Blocks 1 & 2 external balconies on southern and eastern facing facades and Block 3 external balconies on eastern facing facades were all recommended to be provided with solid, imperforate balustrades to reduce traffic noise emissions for seated balcony occupants. With provision of these balustrades and the lack of reverberant noise reflections from adjacent building facades, traffic noise emissions will be both reduced as far as practical and will be less than experienced on most other similar urban and suburban tower block balconies.

  Note that no additional consideration is required in respect of the Block 4 external balconies.

Miscellaneous

- In addition to the architectural measures listed above, landscaping measures (e.g. trees, hedges, etc) are also being provided as densely as possible along the development perimeter boundary areas with the adjacent roadways.

Assuming all of the above developed mitigation measures are incorporated into the development design, the magnitude of the inward noise impact from traffic on the adjacent roadways would be considered both minimal and minimised as far as practicable.

7.2 Internal Noise Level Impact Summary

Appropriate guidance for internal noise levels within residential spaces was taken from *BS 8233 (2014): Guidance on Sound Insulation and Noise Reduction for Buildings* as follows:

- Daytime (07:00 to 23:00 hours) 35dB $L_{Aeq,16hr}$
- Night-time (23:00 to 07:00 hours) 30dB $L_{Aeq,8hr}$
- Peak Noise Level (23:00 to 07:00 hours) 45dB $L_{Amax,F}$

Given the following requirements together with the existing external noise levels, the following mitigation measures were developed for both apartment block and terraced housing buildings in the development:

- Provision of minimum 50dB R_w external walls for Apartment Blocks 1, 2 & 3.
- Provision of minimum 40dB R_w external walls for Apartment Block 4.
- Provision of minimum 40dB R_w roof constructions for Apartment Blocks 1, 2 & 3.

- Provision of minimum 30dB R_w roof constructions for Apartment Block 4.
- Provision of high performing glazing specifications (as detailed in the specific sections).
- Provision of acoustic external entry doors.
- Provision of acoustic trickle vents.

Assuming the above developed mitigation measures are properly incorporated into the development design, the BS 8233 internal noise level criteria should be comfortably achieved and the magnitude of the inward noise impact would therefore be considered negligible.

APPENDIX A

SOUND LEVEL METER CALIBRATION CERTIFICATE

NSAI
National Metrology Laboratory

Certificate of Calibration

Issued to	CLV Consulting The NSC Campus Mahon Co. Cork
Attention of	Niall Vaughan

Certificate Number	180331
Item Calibrated	NTi Audio XL2-TA Sound Level Meter with NTi Audio MC230 Microphone
Serial Number	A2A-10989-E0 (SLM) and 9189 (Microphone)
Client ID Number	None
Order Number	PO12012018N3
Date Received	26 Jan 2018
NML Procedure Number	AP-NM-09
Method	The above sound level meter was allowed to stabilise for a suitable period in laboratory conditions. It was then calibrated by carrying out the verification tests detailed in IEC 61672-3 (2006), *Periodic tests, specification for the verification of sound level meters*. This standard specifies a procedure for the periodic verification of conformance of a sound level meter or integrating-averaging meter to IEC 61672-1 (2003).
Calibration Standards	Norsonic 1504A Calibration System incorporating: SR DS360 Signal Generator, No. 0735 [Cal Due Date: 21 Dec 2018] Agilent 34401A Digital Multimeter, No. 0736 [Cal Due Date: 17 Nov 2018] B&K 4134 Measuring Microphone, No. 0743 [Cal Due Date: 28 Apr 2019] B&K 4228 Pistonphone, No. 0740 [Cal Due Date: 21 Mar 2019] B&K 4226 Acoustical Calibrator, No. 0150 [Cal Due Date: 15 May 2018]

Calibrated by	David Fleming	Approved by	Paul Hetherington
Date of Calibration	09 Feb 2018	Date of Issue	09 Feb 2018

CIPM MRA

This certificate is consistent with Calibration and Measurement Capabilities (CMC's) that are included in Appendix C of the Mutual Recognition Arrangement (MRA) drawn up by the International Committee for Weights and Measures. Under the MRA, all participating institutes recognize the validity of each other's calibration certificates and measurement reports for quantities, ranges and measurement uncertainties specified in Appendix C (for details see www.bipm.org)

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APPENDIX B

ACOUSTIC CALIBRATOR CALIBRATION CERTIFICATE

NSAI
National Metrology Laboratory

Certificate of Calibration

Issued to	CLV Consulting The NSC Campus Mahon Co. Cork
Attention of	Niall Vaughan

Certificate Number	180332
Item Calibrated	Casella CEL-120/1 Acoustic Calibrator
Serial Number	3921077
Client ID Number	None
Order Number	PO12012018N3
Date Received	26 Jan 2018
NML Procedure Number	AP-NM-13
Method	The above calibrator was allowed to stabilize for a suitable period in laboratory conditions. It was then calibrated by measuring the sound pressure level generated in its measuring cavity (half-inch configuration). The calibrator's operating frequency was also measured.
Calibration Standards	Norsonic 1504A Calibration System incorporating: Agilent 34401A Multimeter, No. 0736 [Cal due date: 17 Nov 2018] B & K 4134 Measuring Microphone, No. 0743 [Cal due date: 28 Apr 2019] B & K 4228 Pistonphone, No. 0740 [Cal due date: 21 Mar 2019]

Calibrated by	David Fleming	Approved by	Paul Hetherington
Date of Calibration	07 Feb 2018	Date of Issue	07 Feb 2018

CIPM MRA

This certificate is consistent with Calibration and Measurement Capabilities (CMC's) that are included in Appendix C of the Mutual Recognition Arrangement (MRA) drawn up by the International Committee for Weights and Measures. Under the MRA, all participating institutes recognize the validity of each other's calibration certificates and measurement reports for quantities, ranges and measurement uncertainties specified in Appendix C (for details see www.bipm.org).

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