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Cadenza Building

Earlsfort Terrace, Dublin 2

MetroLink Environmental Impact Assessment Report (EIAR) Review

29 February 2024

› urban solutions
Property Development Managers

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Report: DC1763-R05

Report Control

Document Title:	MetroLink Environmental Impact Assessment Report (EIAR) Review
Project:	Cadenza Building
Client:	Urban Solutions
Job Number:	DC1763
File Origin:	Z:\Allegro Acoustics\Allegro Acoustics Live\Projects\DC1550 to DC1900\DC1763\Reports
Report Author:	Dirun Ergin BA MSc
Signed:	
Date:	29 February 2024

Issue	Date	Status	Checked By	Signed
1	25/02/2024	Final	Stephen Kearney BE MIEI MIOA	
2	29/02/2024	Final	Stephen Kearney BE MIEI MIOA	
3				

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Executive Summary

Allegro Acoustics has carried out a review of Chapter 13 (Airborne Noise and Vibration) and Chapter 14 (Ground-borne Noise and Vibration) of the Environmental Impact Assessment Report (EIAR) issued by Transport Infrastructure Ireland (TII) for the MetroLink project. The EIAR and the potential noise and vibration impacts that the MetroLink project may have on the Cadenza building have been assessed relative to the following:

- **Baseline noise and vibration levels**

  It is noted that there are no baseline noise or vibration monitoring locations included in the vicinity of the Cadenza building. We ask TII to provide an explanation regarding this absence and to clarify that they will carry out baseline noise and vibration monitoring in the Cadenza building area prior to the commencement of the Metro North project.

- **Construction phase**

  It is noted that there are no construction noise assessment locations included in the vicinity of the Cadenza building. We ask TII to clarify that they will carry out additional construction noise impact calculations to outline the predicted construction noise levels at the Cadenza building.

  The criteria defined for airborne construction noise as 75dB L_{Aeq} in the EIAR is considered to be high for the Cadenza building. Considering the airborne sound insulation performance of the façade of the Cadenza building, 75dB L_{Aeq} at the outside of the building is likely to result in an indoor noise level that may cause disruption to tenant concentration levels, conversations and meetings. Allegro Acoustics suggests 70dB $L_{Aeq\ (1hr)}$ and 80dB L_{Amax} should be the accepted as maximum permissible noise levels at the façade of the Cadenza building due to demolition and construction activities.

  Allegro Acoustics suggests that TII demonstrate, through additional calculations, that airborne noise resulting from construction activities will not exceed acceptable levels 70dB $L_{Aeq\ (1hr)}$ and 80dB L_{Amax} at the Cadenza building.

  The criteria defined for ground-borne noise level as 45dB $L_{Amax,s}$ due to TBM advancement and 40dB $L_{Amax,s}$ due to other construction activities are likely to cause disturbance on the tenants of Cadenza building. As such, a lower noise criteria that is below the typical background noise level in an office / meeting room (35dB L_{Aeq}) is recommended.

  The Figure 14.2 in the EIAR shows a ground borne noise level of 50dB $L_{Amax,s}$ at the Cadenza building during the operation of TBM. Allegro Acoustics considers this level to be unacceptable to the users of the Cadenza building. This level would be clearly audible and is likely to cause disruption to tenant concentration levels, conversations and meetings. EIAR states that no mitigation method can be applied to decrease the noise impact of the operation of TBM other than informing the occupants of noise sensitive buildings preceding the operation of TBM. Allegro Acoustics recommends that TII agree specific times and durations for the TBM operation to occur around the Cadenza building to ensure that construction related activities do not interfere with the tenant's use of the building.

- **Operational phase**

  Ventilation and air conditioning systems serving the underground stations, shafts and tunnels may have an air borne noise impact on Cadenza building. It is asked that TII confirm if there will be any sources of ventilation plant to be located close to the Cadenza building.

  The EIAR states that airborne noise impact due to ventilation systems will be assessed at the further design development stage and does not include criteria, calculations or mitigation measures for the noise of ventilation systems. Should any potentially noisy vents or ventilation equipment be located close to the Cadenza building, it is recommended that the external noise criteria outlined by Allegro Acoustics, 55dB $L_{Ar,30min}$, be applied.

It is essential for the Cadenza building that passing trains do not create ground-borne noise and vibration which will be perceived by the office occupants during working hours.

The EIAR states that 40dB $L_{Amax,s}$ is an acceptable threshold level for ground-borne noise occurred due to railway operation. We ask TII to provide a reference for the threshold mentioned above. Allegro Acoustics note that the proposed 40dB $L_{Amax,s}$ criteria is above a typical office / meeting room background noise level of 35dB L_{Aeq} and as such is likely to be audible inside the Cadenza building.

The Figure 14.6 in the EIAR shows a ground borne noise level of 37dB $L_{Amax,s}$ at the Cadenza building during the operation. Allegro Acoustics considers this level to be unacceptable to the users of the Cadenza building. This level would be audible and is likely to cause disruption to tenant concentration levels and / or annoyance to users of the space.

Regarding to predicted vibration impact, the Table 14.45 in the EIAR presents VDV (Vibration Dose Values) in units of $mm.s^{-1.75}$. Allegro Acoustics asks TII to confirm that this is the correct unit of measurement for this table as VDV is often represented in the units $m.s^{-1.75}$.

Report Author

This assessment and report have been compiled by Dirun Ergin. Dirun has been working as an acoustician for eleven years and as a Principal Acoustic Consultant at Allegro Acoustics for two years. Dirun holds an MSc degree in Building Physics concentrated on Architectural Acoustics from Yıldız Teknik University in İstanbul and a BA Degree in Interior Architecture and Environmental Design from Bilkent University in Ankara. Dirun has experience in acoustic design and consultancy for projects of several sizes for a range of functions including office, hospitality, residential, educational, performance and studio from concept stage to detailed acoustic solutions as well as acoustic measurements and site inspections. It is proposed that Dirun has the experience and qualifications necessary to demonstrate that she is a well qualified acoustician for complying this report.

1 Introduction

Allegro Acoustics has carried out a review of Chapter 13 (Airborne Noise and Vibration) and Chapter 14 (Ground-borne Noise and Vibration) of the *Environmental Impact Assessment Report (EIAR)* issued by Transport Infrastructure Ireland (TII) for the MetroLink project. The purpose of the review is to assess and comment on the potential noise and vibration impacts that the MetroLink project may have on the Cadenza building (20 Earlsfort Terrace and 65A Adelaide Road) during the Construction and Operational Phases of the project.

2 Airborne Noise and Vibration

2.1 Baseline Noise and Vibration Monitoring Locations

Figure 1 below outlines the noise and vibration monitoring locations included in the EAIR report between the St. Stephen's Green Station and the Charlemont Station. It is noted that despite the proposed tunnel passing very close to the Cadenza building, there are no baseline noise or vibration monitoring locations included in the vicinity of the Cadenza building. Baseline noise and vibration measurements are of critical importance as they provide a reference point for which to compare against should noise or vibration issues arise at the Cadenza building post the commencement of the MetroLink project.

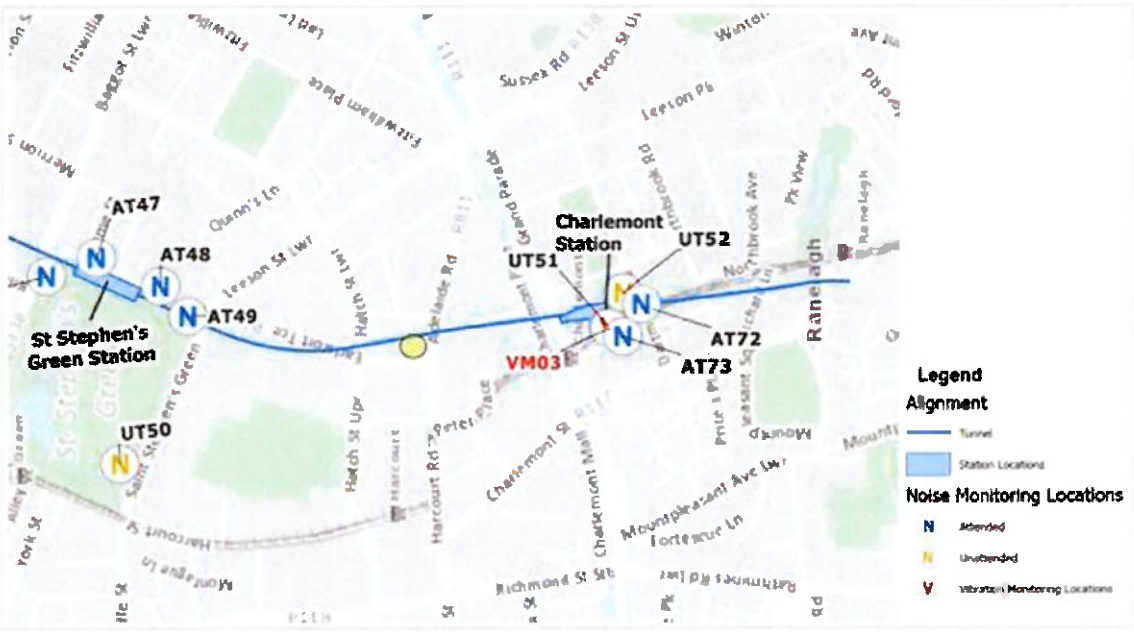

Figure 1: Extract from *EIAR* Figure 13.1 Noise and Vibration Monitoring Locations Sheet 7.

Comment 1: We ask TII to provide an explanation as to why no noise or vibration monitoring receptors have been included at the Cadenza building and to clarify that they will carry out baseline noise and vibration monitoring prior to the commencement of the MetroLink project.

2.2 Construction Phase Noise Impacts

2.2.1 Noise Sources

Allegro Acoustics understands that the underground tunnel and stations at St Stephen's Green and Charlemont and the Intervention Tunnel at Charlemont Station will be the main areas for construction related noise and vibration in the vicinity of the Cadenza building.

Comment 2: It is asked that TII confirm if there will be any construction works other than tunnel boring directly at the Cadenza building area and specify the direct distances from closest construction sites to Cadenza building.

Comment 3: It is asked that TII confirm if there will be additional support plant causing disturbing level of noise (like generators, pumps, ventilation fans etc) situated close to the Cadenza building.

2.2.2 Criteria

Tables 13.12 and 13.13 in the EIAR report note that construction noise limits will be defined using the ABC Method as defined in British Standard *BS 5228 – 1: 2009+A1:2014* [3]. According to this methodology, a daytime construction noise criteria of up to 75dB L_{Aeq} could be applied to the Cadenza building. The Cadenza building has designed to a façade specification of 28dB $R_w + C_{tr}$. As such, based on the proposed criteria and the façade design of the building, construction noise levels of up to 53dB L_{Aeq} could be present inside the Cadenza offices if construction activities are ongoing outside the building. These levels are likely to cause disruption to tenant concentration levels, conversations and meetings.

Comment 4: Allegro Acoustics suggests the criteria outlined in Table 1 below be applied to the metro link construction, at the Cadenza building. This criteria is based on the recommendations for construction noise outlined by the National Roads Authority in the document *Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes* [4].

Proposed Construction Noise Criteria		
Day & Times	dB $L_{Aeq\ (1hr)}$	dB L_{Amax}
Monday – Friday (07:00 to 19:00)	≤70	≤80

Table 1: NRA Guidelines [4] on maximum permissible noise levels at the façade of the noise sensitive buildings due to demolition and construction activity.

2.2.3 Noise Assessment

Figure 2 below depicts the locations included in the Metrolink construction noise assessment. It is noted that despite the fact that Cadenza building is a noise sensitive office building, there are no construction noise assessment locations included in the vicinity of the Cadenza building.

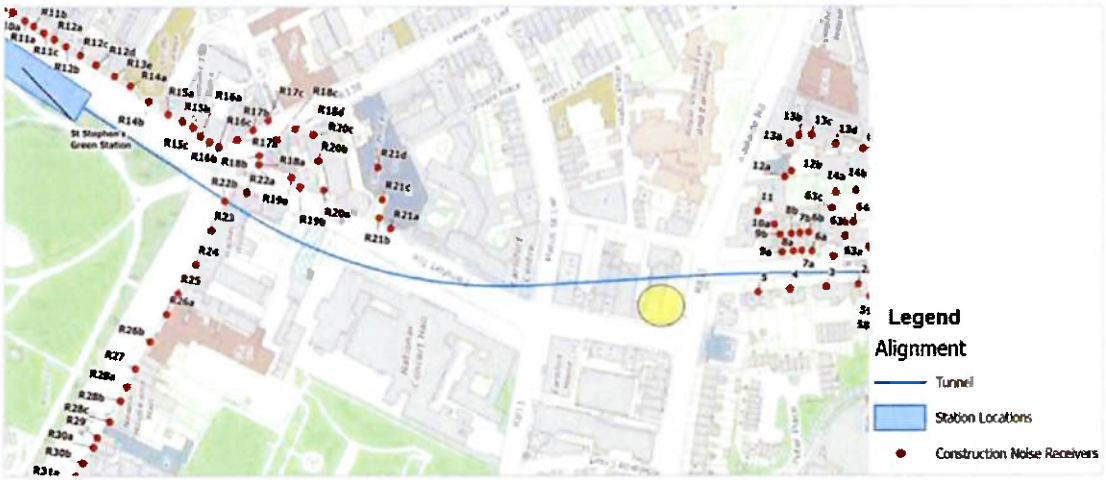

Figure 2: Extract from Figure 13.2 Construction Noise Assessment Locations Sheet 29.

Comment 5: We ask TII to provide an explanation as to why no construction noise assessment locations have been included at the Cadenza building and to clarify that they will carry out additional construction noise impact calculations to outline the predicted construction noise levels at the Cadenza building should construction activities take place at this location.

2.3 Operational Phase Noise Impacts

2.3.1 Noise Sources

Allegro Acoustics understands that ventilation and air conditioning systems serving the underground stations, shafts and tunnels will be the main MetroLink project elements which have the potential to cause airborne noise during operation.

Comment 6: It is asked that TII confirm if there will be any sources of ventilation plant to be located close to the Cadenza building area. The impact of any breakout noise from ventilation shafts and grilles at surface level close to Cadenza building will be required to be assessed considering their effects on external noise levels at the building area.

2.3.2 Criteria

Allegro Acoustics suggests the criteria outlined in Table 2 below to be taken into consideration for operational noise assessment to ensure an acceptable environmental noise level for Cadenza building.

External Noise Criteria		
Day & Times	dB $L_{Ar,30\,min}$	Reference Document
Monday – Friday (07:00 to 19:00)	55	Good Practice / NG4 [5]

Table 2: External noise criteria for Cadenza building.

Comment 7: It is stated in the EIAR that airborne noise impact due to ventilation systems will be assessed at the further design development stage. The EIAR does not include criteria, calculations or mitigation measures for the noise of ventilation systems. Should any potentially noisy vents or ventilation equipment be located close to the Cadenza building, it is recommended that the external noise criteria outlined in Table 2 above be applied.

3 Ground-borne Noise and Vibration

3.1 Construction Phase Vibration Impacts

3.1.1 Criteria

Figure 3 below depicts the indoor noise level criteria included in the EIAR for construction stage ground-borne noise.

Table 14.3: Groundborne Noise from Underground Sources - Threshold of Significant Effects on Non-Residential Buildings

Building	Level/ Measure (Activity except TBM)	Level/ Measure (TBM advancement)	Commentary
Offices	40 dB $L_{Amax,S}$	45 dB $L_{Amax,S}$	***Human Response:*** Noticeable to all and disturbing to some.

Figure 3: Extract from *EIAR* Chapter 14 - Section 14.2.1 - Table 14.3.

Figure 4 below depicts the vibration criteria included in the EIAR to evaluate the impact of ground-borne noise and vibration of construction activities.

Table 14.18: Assessment Locations and Thresholds for AZ4 Northwood to Charlemont

Building / Location Description	Locations	Groundborne noise level, $L_{Amax,S}$ dB			Vibration					Air overpressure (blasting)
					Blasting mm/s PPV	Construction/ TBM $ms^{-1.75}$		Operation $ms^{-1.75}$		
		TBM Passage	Mechanical Excavation	Operation		VDV_{day}	VDV_{night}	VDV_{day}	VDV_{night}	
Office	Dublin Bus Office; General Post Office; The Irish Times; Dublin Fire Brigade HQ; Leinster House; Office of Public Works; new Charlemont oversite development	45	40	40	8	1.6	n/a	0.8	n/a	125

Figure 4: Extract from *EIAR* Chapter 14 - Section 14.3.1.4 - Table 14.18.

Comment 8: The reference for the ground borne noise criteria shown in Figure 3 above could not clearly found in the EIAR. We ask TII to provide a reference for this proposed noise criteria. Allegro Acoustics notes that the criteria shown above (45dB $L_{Amax,s}$) is likely to cause disruption to tenant concentration levels, conversations and meetings. As such, a lower noise criteria that is below the typical background noise level in an office / meeting room (35dB L_{Aeq}) is recommended.

Comment 9: Table 14.18 of *EIAR* shows that Cadenza building was not specifically specified as a noise sensitive assessment location. We ask TII to confirm that the limits outlined in this table apply to the Cadenza building.

Comment 10: The 125dB threshold level for air over pressure due to blasting is considered excessive. Should this level of noise be unavoidable during blasting, it is proposed that fixed times and durations for blasting be agreed between TII and the Cadenza building when blasting is occurring close to the Cadenza building.

Comment 11: Allegro Acoustic understands that the threshold of vibration due to blasting shown in Figure 4 above, is defined depending on the effects of vibration on buildings and structures instead of on human response. Allegro Acoustics suggests that the assessment of vibration calculations for the Cadenza building should be done without ignoring human responses.

Table B.1 Guidance on effects of vibration levels

Vibration level	Effect
0.14 mm·s^{-1}	Vibration might be just perceptible in the most sensitive situations for most vibration frequences associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 mm·s^{-1}	Vibration might be just perceptible in residential environments.
1.0 mm·s^{-1}	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10 mm·s^{-1}	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

Figure 5: Extract from BS5228-2 that provides guidance on the human response to vibration.

3.1.2 Predicted Impacts

Figure 6 below (EIAR Figure 14.2) shows the predicted level of ground-borne noise due to construction activities at the Cadenza building.

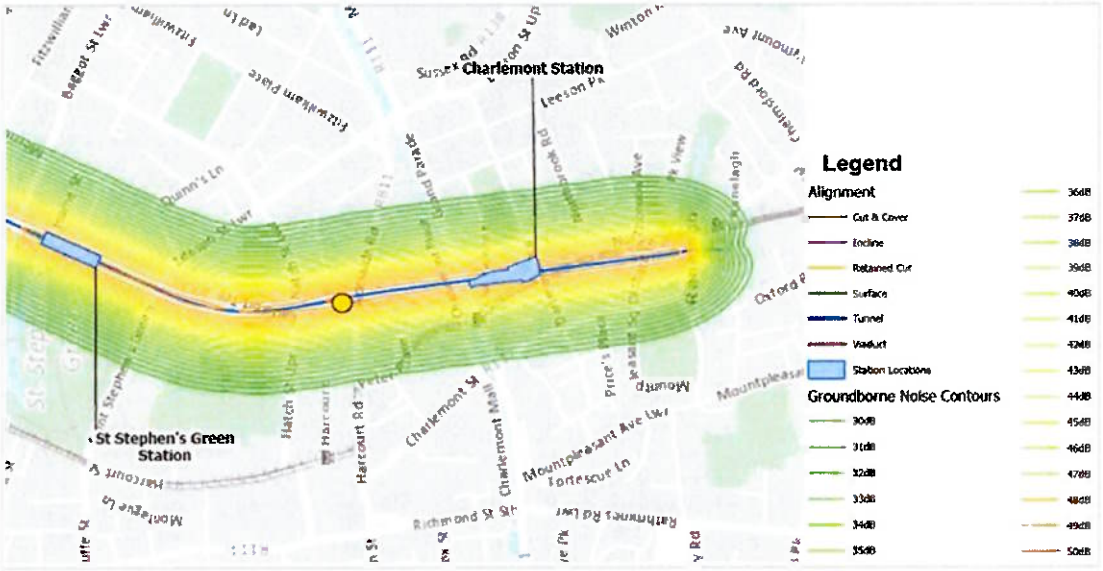

Figure 6: Extract from *EIAR* Figure 14.2 Groundborne Noise from Tunnel Boring Machine Sheet 7.

Comment 12: The extract from EIAR Figure 14.2 shown above shows a ground borne noise level of 50dB $L_{Amax,s}$ at the Cadenza building during construction. Allegro Acoustics considers this level to be unacceptable to the users of the Cadenza building. This level would be clearly audible and is likely to cause disruption to tenant concentration levels, conversations and meetings.

3.1.3 Mitigation Measures

Allegro Acoustics understands that good practice ground-borne noise and vibration mitigation measures in compliance with BS 5228 are presented in the EIAR. However, it is stated in the EIAR that "no effective methods are available to reduce ground-borne noise or vibration from TBMs at source" other than informing the occupants of noise sensitive buildings preceding the operation of TBM.

Comment 13: Allegro Acoustics recommends that TII agree specific times and durations for the TBM operation to occur around the Cadenza building to ensure that construction related activities do not interfere with the tenant's use of the building.

3.2 Operational Phase Vibration Impacts

3.2.1 Noise Sources

Allegro Acoustics understands that the trains to be operated within the tunnels will be the main source for operation related ground-borne noise and vibration in the vicinity of the Cadenza building. Considering the function of the Cadenza building, it is essential that passing trains do not create ground-borne noise and vibration which will be perceived by the office occupants during working hours.

3.2.2 Criteria

The EIAR states that 40dB $L_{Amax,s}$ is an acceptable threshold level for ground-borne noise occurred due to railway operation.

Comment 14: We ask TII to provide a reference for the threshold mentioned above. Allegro Acoustics note that the proposed 40dB $L_{Amax,s}$ criteria is above a typical office / meeting room background noise level of 35dB L_{Aeq} and as such is likely to be audible inside the Cadenza building. The proposed 40dB $L_{Amax,s}$ criteria is therefore likely to cause disruption to tenant concentration levels and / or annoyance to users of the space. It is recommended that the operational phase ground-borne noise criteria is reduced to significantly below the background noise level in an office.

3.2.3 Predicted Impacts

Figure 7 below (EIAR Figure 14.6) shows the predicted level of ground-borne noise due to railway operation at the Cadenza building.

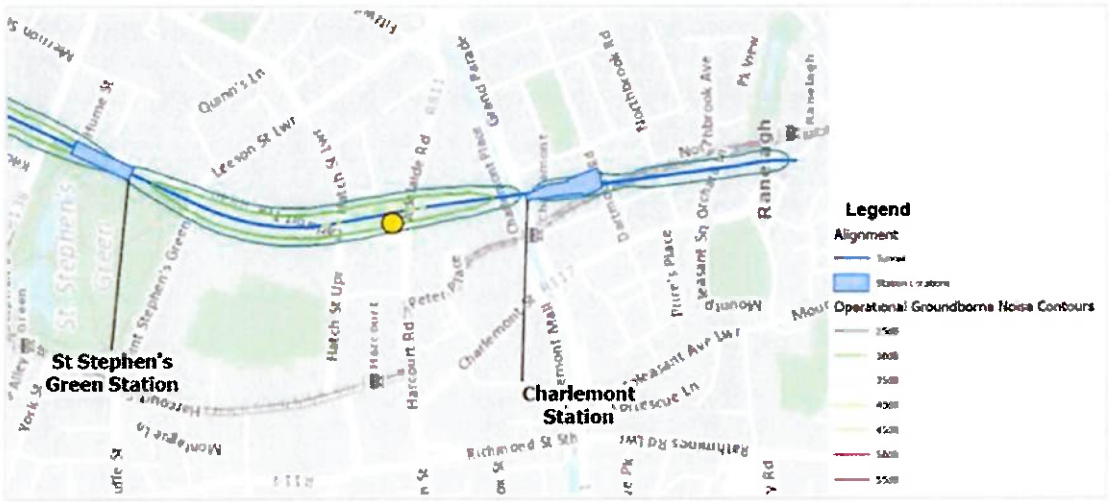

Figure 7: Extract from *EIAR* Figure 14.6 Groundborne Noise from Operation Sheet 7.

Comment 15: The extract from EIAR Figure 14.6 shown above shows a ground borne noise level of 37dB $L_{Amax,s}$ at the Cadenza building during operation. Allegro Acoustics considers this level to be unacceptable to the users of the Cadenza building. This level would be audible and is likely to cause disruption to tenant concentration levels and / or annoyance to users of the space.

Comment 16: EIAR Table 14.45 presents VDV (Vibration Dose Values) in units of $mm.s^{-1.75}$. Allegro Acoustics asks TII to confirm that this is the correct unit of measurement for this table as VDV is often represented in the units $m.s^{-1.75}$.

The vibration dose values likely to result in adverse comment as per BS 6742 are presented in Table 8 below.

Table 1 **Vibration dose value ranges which might result in various probabilities of adverse comment within residential buildings**

Place and time	Low probability of adverse comment $m{\cdot}s^{-1.75}$ 1)	Adverse comment possible $m{\cdot}s^{-1.75}$	Adverse comment probable $m{\cdot}s^{-1.75}$ 2)
Residential buildings 16 h day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 h night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

NOTE For offices and workshops, multiplying factors of 2 and 4 respectively should be applied to the above vibration dose value ranges for a 16 h day.

Figure 8: Extract from BS 6742.

Comment 17: The reported operational vibration value for in Table 14.45 of the EIAR for the receptor *20 Earlsfort Terrace* is a VDV of $0.11mm.s^{-1.75}$. Based on this level, the threshold values outlined in BS 6742 (Figure 8 above) suggest that adverse comment is not expected inside the Cadenza building.

4 References

[1] MetroLink Environmental Impact Assessment Report Volume 3 – Book 1: Population and Human Health, Traffic, Noise and Vibration and EMI/EMC - Chapter 13: Airborne Noise and Vibration
JACOBS & IDOM

[2] MetroLink Environmental Impact Assessment Report Volume 3 – Book 1: Population and Human Health, Traffic, Noise and Vibration and EMI/EMC - Chapter 14: Ground-borne Noise and Vibration
JACOBS & IDOM

[3] BS 5228-1:2009+A1: Code of practice for noise and vibration control on construction and open sites. Noise
BRITISH STANDARDS INSTITUTE (2014)

[4] Guidelines for the Treatment of Noise and Vibration in National Road Schemes
NATIONAL ROADS AUTHORITY (2004)

[5] Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) (2016)
EPA OFFICE OF ENVIRONMENTAL ENFORCEMENT (OEE)

[6] BS 5228-2:2009+A1: Code of practice for noise and vibration control on construction and open sites. Vibration
BRITISH STANDARDS INSTITUTE (2014)

[7] BS 6472-1:2008: Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting
BRITISH STANDARDS INSTITUTE (2008)