

Technical Services – Noise & Vibration
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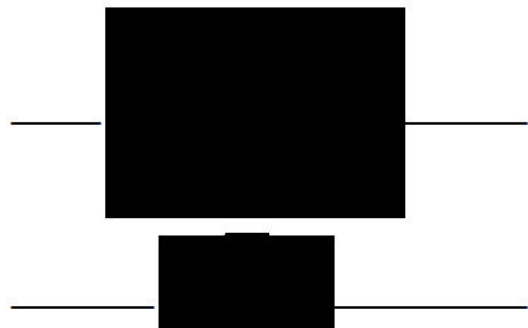
Technical Report

Reference: N&V – R2943

**NOISE & VIBRATION INVESTIGATION AT ■ EFFRA GARDENS, ■ HEARTWELL
AVENUE, LONDON, E16 ■**

Issue Date: 18th June 2021

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1. COMPLAINT DETAILS

Complaint ref.	15441744		
Property location	Between Canning Town and North Greenwich on the Jubilee line and between Canning Town, West Silvertown and Royal Victoria on the DLR (see Figure 1)	LCS Codes	<u>Jubilee</u> J006/JEBLO 1,373m J006/JWBLO 171m <u>DLR</u> T800/TNBMA 257m T800/TSBMA 214m T700/TNBMA 1,373m T700/TSBMA 103m T240/TEBMA 211m T240/TWBMA 678m

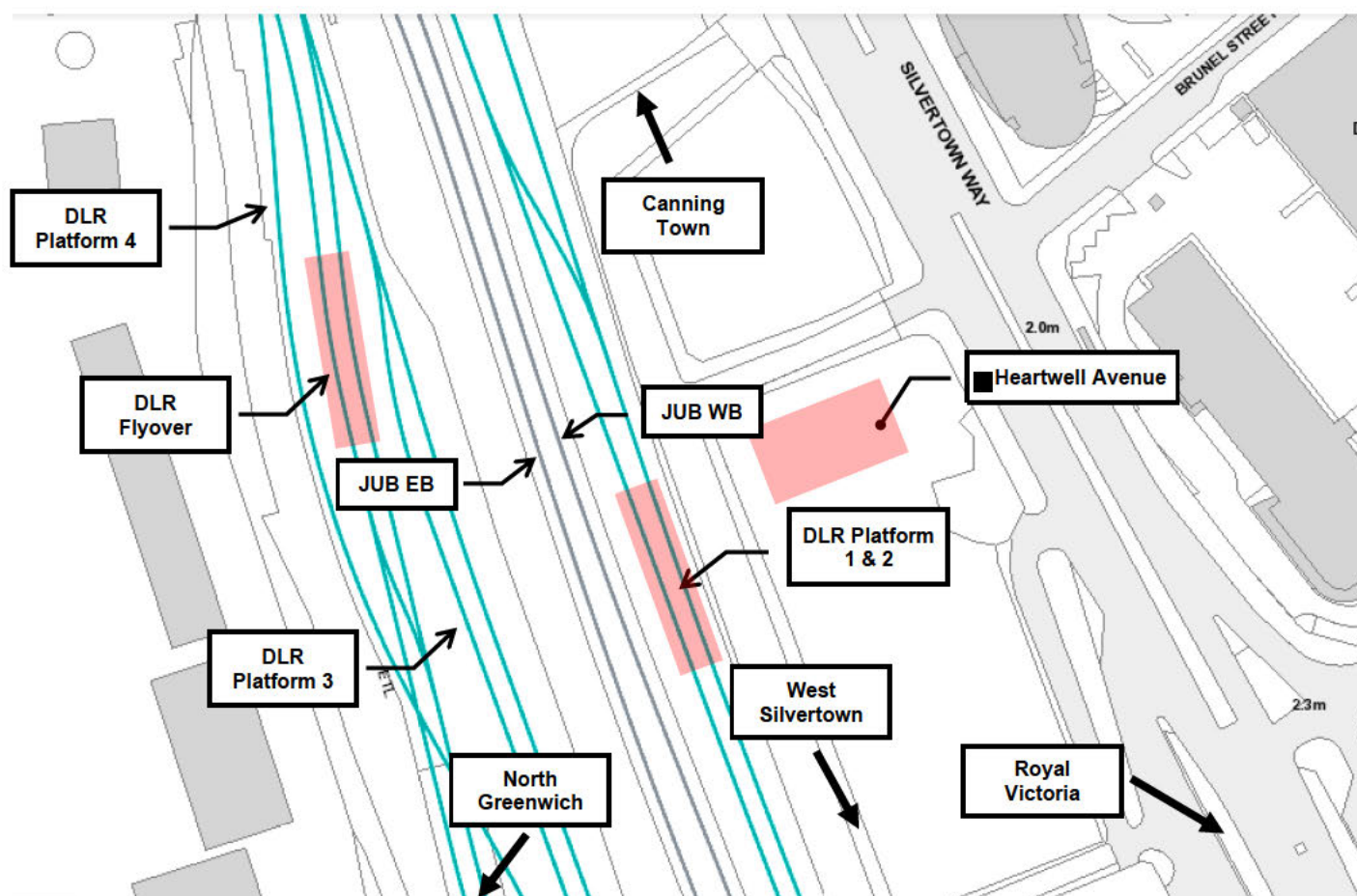


Figure 1 – Map showing the Jubilee line and Dockland Light Railway (DLR) in relation to the property

The resident has raised a noise complaint with Transport for London in response to noise emanating from the Jubilee line and the Docklands Light Railway (DLR). The resident first noticed the noise on 28th November 2020 when they first moved into the property. Measurements were conducted both before and after a scheduled grind of the Jubilee line.

2. MEASUREMENT DETAILS

Date of measurements	20/04/2021 & 18/05/2021
Measurement location	Living area
Microphone position	Centre of sitting area – opposite balcony door
Equipment used	Svantek SVAN 958A Class 1 sound & vibration analyser S/N 69835



Table 1 – Survey details

The property is a brand-new ■■■ apartment, part of an ongoing development, and is designed in a modern style with many hard surfaces. The external façade of the property is approximately 50% glazed and there was no evidence of mechanical ventilation. The property possesses a balcony which is also composed of hard surfaces and overlooks the Jubilee line and DLR, though the view of the nearest DLR lines and part of the Jubilee line are obscured by concrete walls.

There is still extensive construction work taking place in the area around the property which increased the ambient noise level.

3. RESULTS OF NOISE MEASUREMENTS

On the 20th April measurements were conducted between 10:15 and 10:40 with the balcony door open and between 10:43 and 11:05 with the balcony door closed. On the 18th May measurements were conducted between 09:56 and 10:20 with the balcony door open and between 10:20 and 10:42 with the balcony door closed.

The background noise level (L_{90}) was derived using the entire measurement period. Some train events were excluded from the results because the events were contaminated by extraneous noises emanating from sources either inside or outside the property.

Train movements were identified, and the direction of travel determined using TrackerNet.

Date	Jubilee line (balcony door open)								Background (L ₉₀ dB(A))
	Eastbound				Westbound				
	No. of Trains	Min.	Max.	Mean	No. of Trains	Min.	Max.	Mean	
20/04/2021	8	71	74	72	8	82	85	83	46
18/05/2021	8	75	79	77	7	73	75	74	52
Date	Jubilee line (balcony door closed)								Background (L ₉₀ dB(A))
	Eastbound				Westbound				
	No. of Trains	Min.	Max.	Mean	No. of Trains	Min.	Max.	Mean	
20/04/2021	7	43	46	44	8	52	57	55	30
18/05/2021	8	45	47	46	6	42	45	44	31
Date	DLR (All services)								Background (L ₉₀ dB(A))
	Balcony door open				Balcony door closed				
	No. of Trains	Min.	Max.	Mean	No. of Trains	Min.	Max.	Mean	
20/04/2021	11	56	69	64	5	35	36	36	See above
18/05/2021	11	60	71	67	6	35	42	40	See above

Table 2 – Measurement results ($L_{max, Fast}$ (dB(A)))

4. OBSERVATIONS

On 20th April, eastbound services presented initially with noise emanating from the tunnel portal and after exiting the tunnel, presented with a tonal roaring noise. Westbound services presented initially with a rough rumbling accompanied by traction noise as they accelerate out of Canning Town which gave way to a tonal roar; noise was also apparent from the tunnel portal once the train had entered the tunnel.



On 18th May, eastbound services presented with a tonal roar followed by a heavy, uneven rumbling which included a distinct impulsive noise. Westbound services presented with a heavy, uneven rumbling which gave way to a tonal roar. The two different noise characters in both eastbound and westbound events overlapped and cross-faded from one to the other as the trains moved along the section, from one track form to another. The level of noise emanating from the tunnel portal for trains travelling in both directions was greatly decreased.

Between the two sets of measurements the noise level for eastbound Jubilee line services increased by 2-6dB(A) while for westbound Jubilee line services it decreased by 9dB(A).

All DLR services present with impulsive noise as a result of points and crossings. The impulsive noise from services traversing between Canning Town platforms 1 and 2 and either Royal Victoria or West Silvertown is very crisp and clearly audible in the property, with windows both open and closed. Services traversing between platforms 3 and 4 and West Silvertown are quieter and less distinct with many services either being below the ambient noise or inaudible with the property's windows closed. Services traversing between platforms 3 and 4 and Royal Victoria, making use of the flyover, present with an impulsive noise from the points and crossing north of the bridge but also a second deep impulsive noise emanating from the points and crossing on the flyover directly opposite the property. DLR services present with minimal traction noise. The variation in average level between the two measurement dates is likely a result of grouping all DLR services into a single set of values.

The attenuation of the noise from having the balcony door and windows open to having the same closed varied between 27 and 30 dB(A), for different services on the different days.

The developer's consultant has recommended a daytime limit of 35dB L_{Aeq}, the L_{Aeq} value for the whole measurement period with the windows closed on 18th May was 37.4dB L_{Aeq}. Additionally, the developer's consultant has recommended a night-time limit of 45dB L_{AFmax}, in the bedrooms, and the developer has specified the glazing accordingly. As of 18th May, the noise generated by the westbound road of the Jubilee line and all DLR roads are below the bedroom L_{AFmax} threshold in the living room of this property, while eastbound service are in the region of the threshold. As the bedrooms of this property do not overlook the railway in the same way as the living room it is possible that the L_{AFmax} criterion has been met in these spaces.

The Jubilee line track, adjacent to the property, was scheduled to be ground on, or about, 3rd May and a track inspection was conducted on 27th May.

It was found that the track form for both roads in this section is flat-bottom rail on concrete sleepers throughout, with the sleepers nearest to Canning Town sitting on ballast while those nearer to, and inside, the tunnel have been sunk into a concrete slab and fitted with resilient track fixings. The ballasted track is located at J006/JEBLO 1,406m and beyond on the eastbound road and before J006/JWBLO 140m on the westbound road. The floodgates for the tunnels are located at J006/JEBLO 1,274m on the eastbound road and J006/JWBLO 268m on the westbound road. Expansion switches were found on both rails at J006/JEBLO 1,415m on the eastbound road and J006/JWBLO 131m on the westbound road. The expansion switches on the eastbound road are the most likely source of the impulsive noise observed from the eastbound road. Friction modifier nozzles were found of both rails of the westbound road at J006/JWBLO 265m.

It was observed that, on both rails of both roads, the head of the rail was extremely smooth in the section over the concrete slab, with no evidence of corrugation or roughness. It is from this section that the tonal roar was observed to emanate. The ballasted section of, both rails of both roads, shows sporadic roughness which is in-keeping with noise observed from this section of track.



Figure 2 – Resilient track fixing on the eastbound Jubilee line, right-hand rail

The resident has stated that they are not disturbed by the noise from DLR services. The principal disturbing element of Jubilee line noise events is the tonal roar emanating from the concrete slab section of track.

The concrete slab and resilient fixings are present to mitigate vibration transmission into the ground and affecting surrounding properties. The frequency of the tone heard in property is independent of vehicle speed and there isn't any corrugation which could produce the tonal roar. As such, it can be surmised that the tonal roar is the result of a P2 resonance and that the energy which would normally be absorbed by the ground is instead transmitting into the air. Investigation of the vibration transfer dynamics would be required to determine which component of the support system is reflecting the energy back into the rail.

A 12th octave analysis of Jubilee line train events found that, both east and westbound roads present with a fundamental frequency of 364Hz. Eastbound services also present with 1.5th(550Hz), 2nd(730Hz) and 3rd(1090Hz) harmonics while



westbound services present with 2nd, 3rd and 4th(1460Hz) harmonics as well as broadband high frequency content.

Investigation of the vibration transfer dynamics would be required to determine which component of the support system is reflecting the energy back into the rail.