



Royston Station and Leete Place Noise Monitoring Report

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Glossary

Term or Acronym	Definition
Ambient Noise Level	The overall background sound pressure level in a given environment.
Amplifier	An electronic device for amplifying voltage, current, or power of a signal
Automatic Gain Control	A system that controls the increase in the amplitude of an electrical signal from the original input, to the amplified output, automatically.
A-Weighted	A-weighting is an adjustment of SPLs that takes into account how the human ear perceives it. Shown as (A)
Decibel (dB)	A logarithmic unit used for measuring sound levels.
Gain	The amount of amplification applied to a signal, often measured in dB.
Hertz (HZ)	A unit of frequency equal to one cycle per second.
LAeq	The equivalent continuous sound level over a period of time, A-weighted.
LAFmax	A-weighted, maximum sound level, measured with a fast time-constant.
Lden	The day–evening–night noise level over a whole day with a penalty of 10 dB(A) for night time noise.
PA	Public Address
SPL	Sound Pressure Level. The change in the local air pressure when a sound wave passes through.

Summary

Encompass Engineering has been commissioned by Govia Thameslink Railway (GTR) to conduct a comprehensive noise monitoring and analysis of the public address (PA) system, specifically focusing on the speakers at Royston station and their impact on the nearby residential street, Leete Place. This work was initiated in response to noise complaints from local residents regarding the PA system speakers on the extended area of Platform 2.

The monitoring exercise took place on the 28th of January 2025. Measurements and recordings were captured over a period of three hours and 43 minutes and a total of 13,258 data samples were collected during that time period. Thorough analysis and calculations have been conducted on the data to understand the potential risks and liabilities GTR may be subject to. Additionally to the monitoring performed on the 28th, Encompass Engineering also attended Leete place on the

Following the analysis, several key findings were identified from the data. Whilst the primary results are located in the body of the report, the key points are as follows.

1. The highest LAFmax reading captured arose from brake squeal from train unit 700107. The value was 95.6dB(A). This requires further investigation by the GTR engineering team.
2. Average total LAFmax readings during the entire monitoring period, across automated announcements, manual announcements and train noise, were 67.31dB(A) at Royston station, and 55.53dB(A) at Leete Place, which lie closely with the World Health Organisation's (WHO) guidance for recommended levels in residential areas.
3. Manual announcements pre-station office microphone gain adjustment were higher than automated announcements, during the same period, at Royston Station; 66.69 dB(A) for manual vs 64.40dB(A) for automated.
4. Post-station office microphone gain adjustment, manual announcements became quieter on average than automated announcement across the whole monitoring period; (58.98dB(A) for manual vs 63.87 dB(A) for automated at the platform, and 49.32dB(A) vs 53.84dB(A) at Leete Place).
5. Sound levels emitted from the passenger announcements do not contravene the maximum limit stipulated in the Network Rail standard NR/L2/TEL/30134.
6. There is a risk that the current audio levels for automated announcements are only just at the minimum required levels at Royston station, some even fall below this.

Following review of the data, the below recommendations have been put forward for review.

The recommendations and proposed mitigation measures which could be considered are as follows;

1. Conduct a more detailed review of the current speaker set up and assess whether levels are correctly set to ensure the required volumes are being emitted.
2. Produce station staff training and/or briefings on how the platform office microphone should be used to ensure consistent usage across all team members.
3. Utilise the automatic gain control system already installed to allow announcements to be automatically raised when trains are going past to ensure important messages are not missed.
4. Evaluate and test the adoption of the newly proposed speaker systems against the current ones.
5. Conduct further train monitoring and investigation, particularly on unit 700107 due to the excessive brake squeal.
6. Carry out a town hall meeting with local residents, providing all local residents a summary of findings.
7. Design and implement a more streamlined and accessible communication system between residents and GTR.

Introduction

Encompass Engineering were procured by GTR to support them with the investigation and monitoring of noise arising from passenger announcement speakers at Royston train station. This exercise was required owing to GTR receiving noise complaints associated with the passenger announcement speakers at the station.

Royston station is situated approximately 13 miles southwest of Cambridge, and is positioned on the Cambridge line, providing services to Cambridge from London Kings Cross as seen in Figure 1. The station is operated by GTR and is serviced by both Thameslink and Great Northern trains. The rail units servicing this line are the class 700 and class 387.

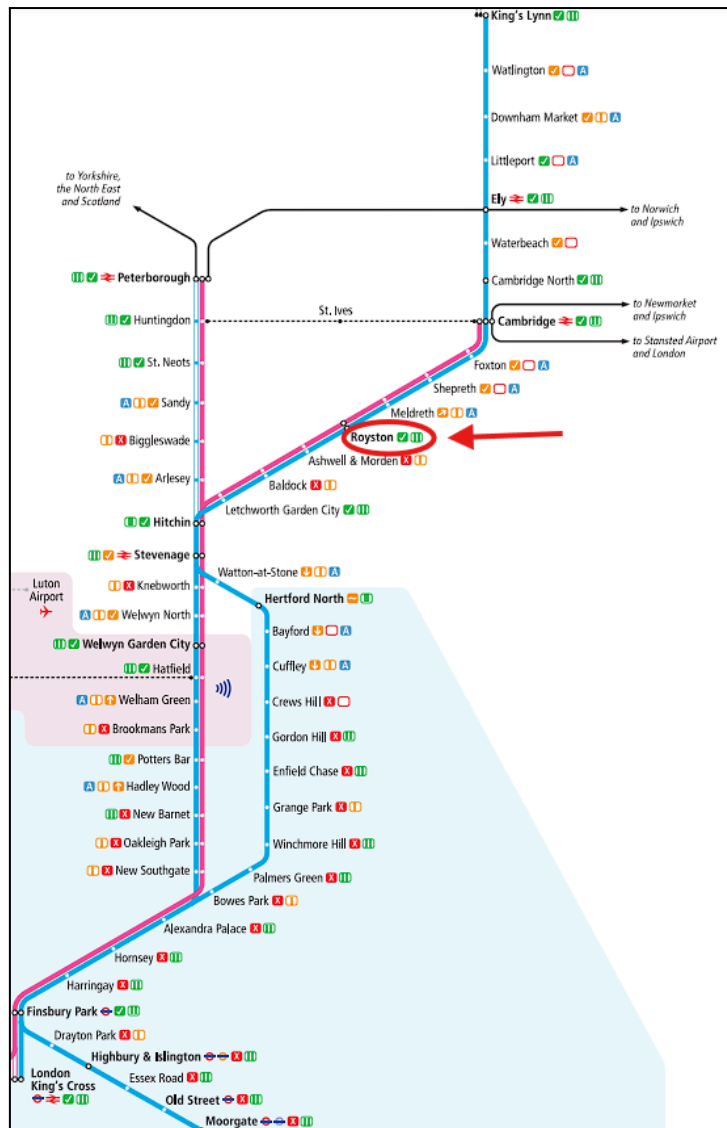


Figure 1 - Map of Cambridge Line including Royston station

Equipment Set-Up

Following the agreed submission of the method of works (EESL-GTRN-MET-001) with GTR to investigate the noise levels of PA speaker announcements at Royston station, the Encompass Engineering team attended the location on the 28th January 2025. Following a debrief, monitoring began at approximately 09:47 am, at both Royston station and Leete Place.

The monitoring setup was established to capture the impact of both automated and manual announcements on the surrounding environment, as well as the interaction between these announcements and the noise produced by train operations. Given the proximity of the speakers to residential areas, it was important to capture a range of sound levels throughout the day to better understand the temporal variations in noise exposure.

The first element of monitoring for Royston station was conducted between the second and last speakers of the platform 2 extension. This was later moved at 10:24 am to between the third and second to last speakers on platform 2 in order to capture output from a wider range of speakers. The approximate monitoring equipment placements are shown in figure 2 below.

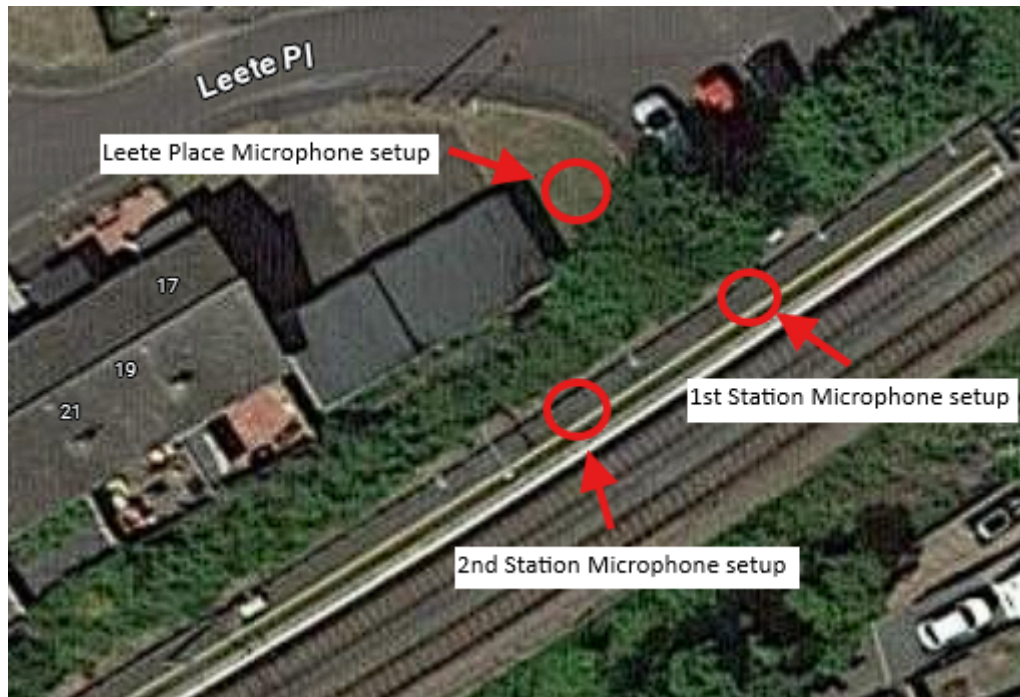


Figure 2 - Setup locations of both microphones for monitoring at Royston station and Leete Place.

These locations were selected owing to the location of the noise complainant. The potential problematic speakers are highlighted in figure 3 below and photographed in figure 4.

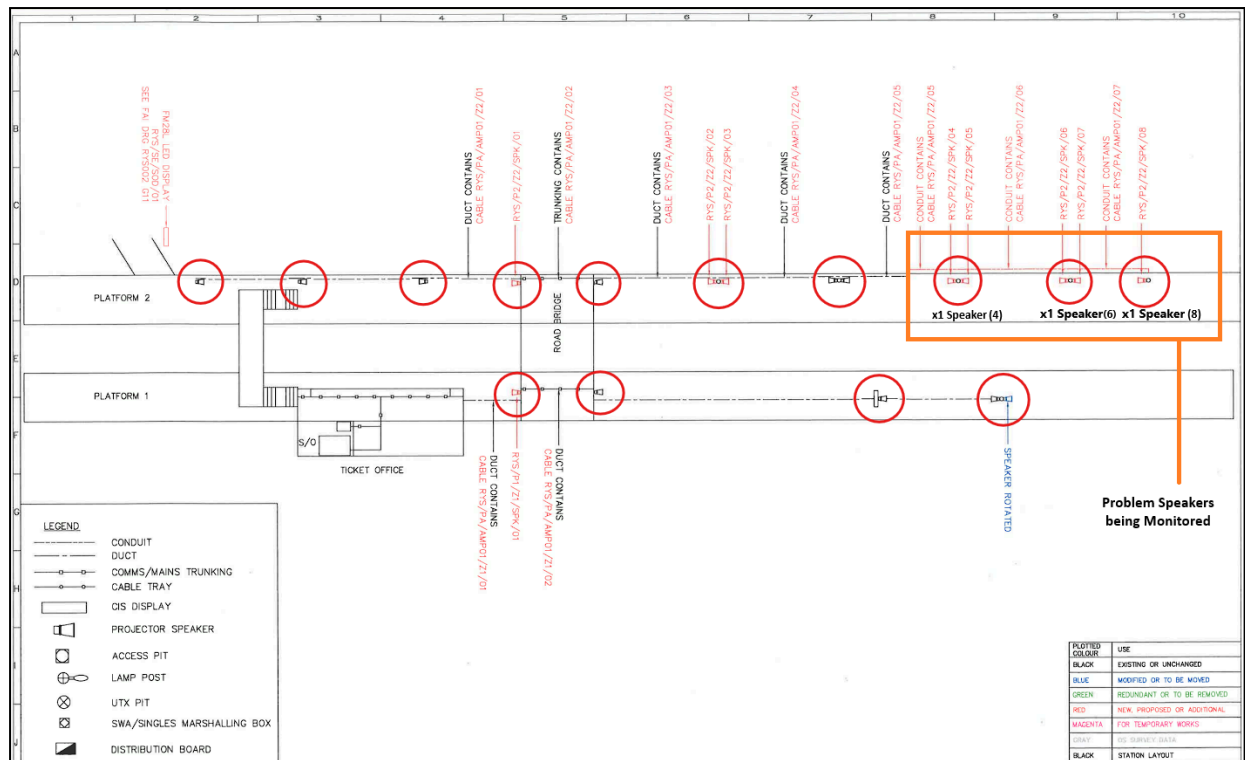


Figure 3 - Station schematic of Royston station with all speakers identified.



Figure 4 - Final speaker at the end of Platform 2 extension, Royston station.

The microphone set ups are demonstrated below in figure 5. The left image shows the platform set up. This was placed at an approximate distance of six meters from both

speakers. Meanwhile, the microphone at Leete Place (right photo) was placed approximately 11 meters from the final speaker at the end of the platform 2 extension.



Figure 5 - Microphone set up location at Platform 2 after 10:43am **(Left)**. Microphone set up location at Leete Place **(Right)**.

Decibel levels were recorded for manual and automated announcements, capturing the content of each announcement and any additional relevant information. Furthermore, train arrival and departure timings and noise levels were also logged, to facilitate analysis of three noise sources.

It should be noted that at approximately 11:20 am, the station office microphone, which was the identified problematic manual announcement microphone, had its sound level reduced following discussion between GTR and Encompass Engineering personnel.

The noise levels at Royston station's extended platform 2 were captured over a period of 3 hours and 43 minutes. Supplementary monitoring has also been completed at Leete place.

To further support the data captured on the 28th January 2025, some additional minor monitoring was also completed at Leete place on the 10th February 2025, to further validate the original data captured. The equipment was set up the same conditions to the image in figure 5 on the right.

Speaker Isolation Exercise

In order to assess the sound levels of the three new speakers on the platform, an exercise was completed where the new speakers present on the platform 2 extension were

isolated, and manual announcements were played through them in order to evaluate noise levels from them at different configurations. These speakers were 4, 6 and 8 (as per figure 3). Note- The schematic also shows speakers 5 and 7. These speakers have been removed and are no longer fitted.

The configurations tested were as follows; all speakers fully disconnected, last speaker operational only (speaker 8), third and second-to-last speakers only (4 and 6) and finally all connected. The results of this test can be seen in Table 2.

It is important to note, however, that the microphone was located nearest to speaker 8, likely explaining the higher values for the speaker 8 isolation test.

The full process carried out for this exercise is outlined below.

1. Baseline Noise Measurement
 - a. Disconnect all new platform extension speakers (Speakers 4, 6, and 8).
 - b. Record noise levels of manual announcement volumes without the new speakers.
2. Isolation of Final Platform Speaker (Speaker 8)
 - a. Reconnect only Speaker 8 (final platform speaker).
 - b. Disconnect Speakers 4 and 6.
 - c. Conduct manual announcements and record noise levels.
3. Isolation of Mid-Platform Speakers (Speakers 4 and 6)
 - a. Disconnect Speaker 8.
 - b. Reconnect Speakers 4 and 6 (second and third to last speakers).
 - c. Conduct manual announcements and record noise levels.
4. Full System Reconnection
 - a. Reconnect all platform extension speakers (Speakers 4, 6, and 8).
 - b. Maintain constant monitoring of noise levels and system performance for the remainder of the observation period..

Continuous Monitoring

Following the speaker isolation exercise at Royston station, all speakers were reconnected, and monitoring of noise levels continued for the continuation of the day for both Royston station and Leete Place. At the end of the monitoring, speakers 4 and 6 were disconnected, leaving only speaker number 8 active so that the operational configuration returned to its previous state pre-monitoring. At approximately 10:24 a.m., the microphone was moved to between speakers 4 and 6, closer to the resident's gardens, in order to get a better representation of noise levels of the station speakers.

Results and Analysis

Full result breakdown is shown in the below tables. Full analysis can be found in the analysis section.

Results utilising all data sets captured

The following tables demonstrate the key measurements utilising all available captured data.

Total Readings captured

Type	Qty
Total data samples collected	13,258

Table 1- Total number of data samples collected- Royston Station

A total of 13,258 data samples were collected across the monitoring period. Each reading constitutes 1 second of real time. As such, finite levels have been extrapolated and analysed. Additional samples in addition to the ones collected at Royston Station were collected at Leete Place, however due to a number of factors, these have not been included in the full analysis. The Leete Place data included in the results are based on commonly used calculations in acoustics, based on the Royston Station data set. These were then validated by further noise monitoring conducted and completed on the 10th of February 2025, at Leete Place.

True location Ambient noise levels

True Location Ambience (excluding rail-based noise and PA announcements)			
Type	Royston station	Leete Place 28th Jan	Leete Place 10th Feb
Average dB	48.9	49.0	50.9

Table 2 - Location Ambient Noise levels

Analysis was carried out on the captured data and the values of all station-based noise (such as passenger announcements and train traffic) have been removed to provide a true ambient noise level. As is seen in Table 2, the ambient noise levels at Leete place are around 49 dB(A). Whilst the ambient levels were relatively similar, the slight increases

and decreases across both locations is likely attributed to the varying levels of footfall, station users and vehicular traffic on any given day.

Following the initial monitoring and analysis, additional monitoring was completed at Leete Place. From the data captured on the 10th, the data demonstrates a slight increase in ambient noise levels, an increase of 1dB(A). This monitoring was completed over a shorter duration and the use of road vehicles in the area was detected on some of the data. With a larger sample size and without the road vehicle noise, it could be speculated that the readings would be closer to levels detected at Royston Station. However both sets of data give a good range of the levels to be expected at the location.

Highest and Average LAFmax Measurements - All data (60s)

Combined readings throughout monitoring (60s) (trains & announcements)		
Type	Royston station	Leete Place
Max dB (LAFmax)	95.6	90.22
Average dB (LAFmax)	70.09	61.74

Table 3 - Max and average readings utilising all collected data samples

When conducting analysis on the entire data sets for the highest LAFmax values at both the station and Leete Place, the main observations with the highest recorded value stemmed from rail traffic arriving at Royston Station. Unit 700107 exhibited excessive levels of brake squeal whilst coming to a stop. Whilst brake squeal isn't uncommon in rolling stock, the excessiveness of this example, seen in Table 3 (95.6dB(A)), is unusual and as such, should be investigated further by the GTR Engineering and Maintenance teams.

It is worth noting that the max reading was significantly higher than the ambient noise levels at both the station and Leete Place, and if this was to continue, this could raise further complaints. The 60-second timeframe means that, at any moment within a one-minute period, the highest noise level that is likely to occur at Royston Station, considering all noise sources, is around 70.09 dB(A) on average. For Leete Place, this is about 61.74 dB(A).

Generally, however, the average LAFmax noise levels across the entire data set were 21.19dB(A) & 12.75dB(A) higher than the ambient noise levels for both Royston Station and Leete Place, respectively. Most of this difference in decibel levels is attributed to the large difference between noise generated by trains, and the ambient noise without

trains. However, when evaluating this same average of the combined readings against the ambient noise levels on the 10th of February at Leete place, the difference between readings is 10.84dB(A), a 1.91dB(A) reduction from the 28th of January data. This indicates that there will be days where noise will come across as higher or lower due to differences in general ambient noise and varying noise sources.

Combined LAeq measurements – All Data

Combined LAeq readings throughout monitoring (60s) (trains & announcements)		
Type	Royston station	Leete Place
Averages of all LAeq values	58.83	48.98

Table 4 - LAeq - averages All LAeq data

The averages of all individually measured LAeq values gathered throughout the course of the monitoring, and across all sources, is listed above in Table 4. Table 4 demonstrates the values over an 8-hour period. When compared against the health and safety at work act, whose threshold limit is 80dB(A) without hearing protection, the readings are well within the accepted limits for workplace noise regarding station staff. The 60 second timeframe denotes that at any given period of one-minute, the average noise level experienced at Royston Station, with all noise sources included, is likely to be 58.83dB(A). Meanwhile, this would be 48.98dB(A) for Leete Place.

When reviewing other guidelines, however, the World Health Organisation (WHO) sets out in their guidance document; "Guidelines for Community Noise 1999", that LAeq levels should not exceed 55dB(A) in order to minimise annoyance to residents and other affected individuals within the community. However, this is only a guideline, and the document further states that any noise level up to the aforementioned threshold should generally not constitute an annoyance to most people. The average noise level of all data from all noise sources at Leete Place falls below this 55dB(A) recommendation, as seen in Table 4 above. The levels specifically for the speaker announcements are broken down further below in the report.

It is also worth noting that a 2018 revision of the WHO guideline exists, setting out recommendations and guidelines for noise levels for the European region. However, this document does not differentiate noise thresholds by environment-specific noise exposure levels, such as communities, and instead focuses on exposure levels from noise sources directly, such as rail. This document states that railway traffic should produce less than 54dB Lden (average day, evening and night values), similar to the previous 1999 publication, but does not specify the environment or location-specific exposure levels.

Results utilising data captured from individual observations

The following tables break down the findings from all key observations such as manual and automated announcements, horn usage, general train operation noise and other miscellaneous observations such as wildlife and the movement of equipment.

Breakdown of Individual observations

Key readings collected	
Type	Qty
Total Key Readings	89
Manual announcements	15
Automated announcements	46
Train Horn	5
Train General	23

Table 5 - Breakdown of individual observations

As demonstrated in Table 5 above, there were a total of 86 individual observations captured throughout the monitoring. These were primarily public announcements whose timings and noise levels were logged specifically, as this was the primary remit of the monitoring. However, other focus areas included train horn usage, traction noise and brake squeal.

Noise level readings based on Individual observations

Type	Highest LAFmax dB(A) recorded		Average LAFmax dB(A)	
	Royston station	Leete Place	Royston station	Leete Place
Manual announcements	68.5	59.96	64.70	54.00
Automated announcements	64.01	52.83	60.7	48.12
Train Horn	86	82.62	65.97	55.84
Train General	95.6	83.00	66.00	55.78

Table 6 - Max and Average dB(A) Readings across all announcements and train-based noise.

Starting with the LAFmax for the announcements, overall, no readings from both announcement types at platform 2 were found to exceed the Network Rail standard NR/L2/TEL/30134 maximum threshold of 90dB(A).

It is seen in Table 6, however, that the manual announcements were louder than those of the automated ones. This supports the complainants' concerns that the manual announcements are more of an issue than the automated ones. Particularly, the 68.5dB(A) value is attributed to the station staff having blown air into the microphone whilst conducting a manual announcement test.

At 11:20 however, the office microphone had its setting adjusted which resulted in a lowered volume being emitted from the speakers. Table 7 below demonstrates this change in sound pressure levels detected before and after adjustment. This table presents a clear improvement on the previous levels detected, and demonstrates the measures being taken to improve the conditions at Royston.

Type	Highest LAFmax dB(A) readings		Average LAFmax dB(A) readings	
	Before	After	Before	After
Manual announcements at Royston Station	68.50	63.80	66.69	58.98

Table 7 - Manual Max and Average dB(A) Readings before and after microphone adjustment.

Referring back to Table 6 and comparing the data against the Network Rail standard NR/L2/TEL/30134, the average maximum sound levels measured at the station for manual announcements are below the stipulated 65dB minimum requirement. This is also applicable for automated announcements, as the average maximum noise level reading detected failed to meet the network rail requirement. This could potentially be a health and safety risk to passengers at the station of the announcements, this is further expanded in the GTR risks and liabilities section below.

To further elaborate on this point, since the average of all maximum noise levels (LAFmax) collected from both announcement types fall below this Network Rail standard minimum, then it is likely that a majority of the individual announcements also failed to meet this minimum, further confirming the presence of risk and liability for GTR.

Remaining with the data in Table 6, as previously stated in the report, another area for concern is the noise arising from the trains themselves as they are emitting a much greater sound pressure level. Of particular concern is the brake squeal detected on unit 700107; if situations such as this continue to occur, there would be further grounds for residential and staff complaints. Further detail on this is provided in the additional observation section.

Average values for both LAFmax and LAeq readings based on all 86 individual observations

	Royston Station				
	Average LAFmax during 60s dB(A)	Average LAeq during 60s dB(A)	Average LAFmax during Observation dB(A)	Average duration of Observation (s)	Average LAeq during Observation dB(A)
Manual announcements	72.55	61.20	64.70	10.72	57.04
Automated announcements	69.55	58.52	64.01	18.48	57.04
Train Horn	70.04	58.76	65.97	28.10	58.60
Train General	70.06	58.77	66	28.83	58.65

Table 8 - Averages of all LAFmax and LAeq values over a 60 second period, and over the duration of the announcement or train passing, for all 89 individual observations.

As previously stated in section; 'Combined LAeq measurements – All Data', the WHO guidance for noise levels in local residential areas suggests an upper limit of 55dB(A) in order to minimise annoyance and health impacts. Throughout the individual 86 measurements taken, the overall average maximum decibels for any given 60 second interval at Leete Place was 48.98dB(A), which falls well below this guideline level. This value would likely be much lower if instances such as the brake squeal and horn usage were monitored and mitigated. Furthermore, as previously mentioned, this limit is only a guidance, and not a binding requirement to follow.

Isolation Exercise Results at Royston station

Table 9 below details the results of the Speaker isolation tests as detailed in the equipment set up section.

Test	Manual Announcement Speaker Configurations	LAFmax dB(A)	Announcement Duration (s)	LAeq dB(A)
1	speakers 4,6 &8 disconnected	0	9	0
2	Speaker 8 connected Only	61.9	9	53.8
3	speakers 4 and 6 connected only	0	9	0
4	All speakers connected	62.2	9	51.3

Table 9 - Results of speaker isolation tests at Royston station.

Test 1, measured speaker output with speakers 4,6 & 8 disconnected. With these speakers all disconnected no announcements were detected by the sound pressure meter. This was validated when listening back to the captured audio. The approximate duration of the announcement was 9 seconds.

Test 2 measured the speaker outputs as per the current mitigated conditions at Royston station (just speaker 8 switched on and operational). Again the test announcement was carried out for 9 seconds, with a max sound pressure level detected of 61.9 dB(A) and an average output over the duration of 53.8dB(A).

Test 3 measured speaker output with speakers 4 & 6 being switched on but speaker 8 switched off. Again the duration lasted for 9 seconds. However no announcements were detected by the sound pressure meter. This was validated when listening back to the captured audio.

Test 4 measured conditions with all speakers switched on. Whilst the max output was higher (62.2 dB) than that of speaker 8, the average (51.3) across the duration was actually lower than when just speaker 8 was switched on.

Whilst observing the results in table 9, the average noise levels detected for the second test(speaker 8 only) are higher than those of test 4(all speakers on). Whilst the general hypothesis would be that with all speakers on, the result should be higher, the results contradict this theory. This is explained due to several influencing factors. The first is owing to the noise meter positioning which was closer to speaker 8 than to speakers 4 and 6, however, this influence is considered minor. Another factor arising from the exercise on the day of monitoring, was that owing to the design and directionality of speakers, when speaker 8 was isolated, it was incredibly difficult to hear speakers 4 and 6, this is observed in the findings for test 3 where the detected values were 0. This would likely indicate that the results for test 4 are likely just readings from speaker 8, despite 4 and 6 being switched on. The final factor to consider was that, owing to time constraints, each isolation exercise was only completed once per configuration which only gave a small data set for analysis. The smaller data set meant there was more ability for slight alterations to adjust the average readings, such as blowing into the speaker before speech, wind noise or other noise inputs influencing the data. Completing this exercise with multiple samples would give a greater sample size and provide a much greater level of detail into the configurations. This exercise however, does give positive indications that the directionality of the current speakers is working.

Additional Observations

Train Noise

The analysis of train noise levels collected from both Leete Place and Royston station confirmed a significant difference between train and speaker noise, with train arrivals

and departures producing consistently higher max and average dB(A) levels than both automated and manual announcements. This finding indicates that train noise and announcements are distinct in their impact, and that train operations are the dominant noise source at both Royston station and Leete Place.

The recorded brake squeal of Unit 700107, with LAFmax 95.6dB(A) has the potential of causing discomfort and hearing damage with long enough exposure, as well as creating further noise complaints at different locations. A spectrogram depicting the spike in frequencies can be seen in 'Figure 6'. Further investigation into this issue is highly recommended.

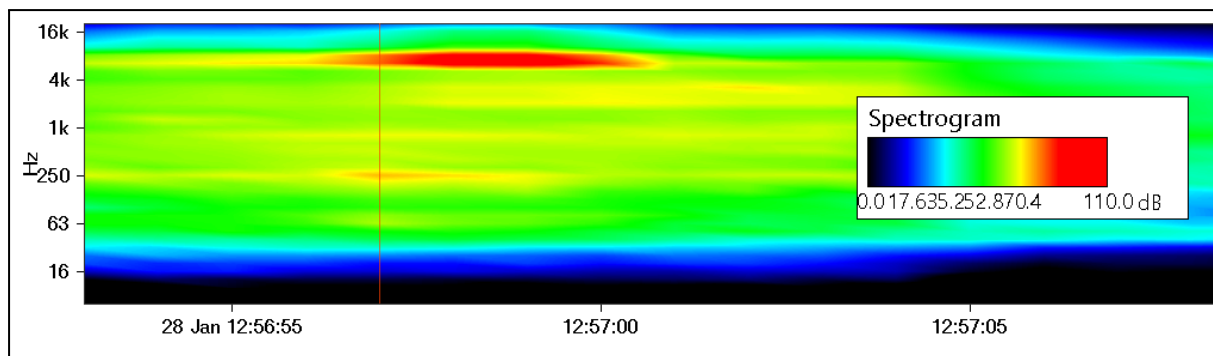


Figure 6 - A-weighted spectrogram of frequency (Hz) and peak decibels generated by unit 700107

This spectrogram visualises the noise levels recorded of unit 700107 in comparison to the relevant frequencies in hertz (Hz). The decibel peak occurred between 8kHz and 10kHz, a high enough frequency range to cause damage to hearing with prolonged exposure. Notably, a portion of the noise occurred at lower frequency ranges - between 200Hz and 315Hz. The lower part of this frequency range can be problematic because their longer wavelengths are less affected by atmospheric absorption and obstacles, allowing them to penetrate buildings and cause greater noise disturbance at lower decibel levels.

Additionally, the average noise levels of train arrivals and departures where horns were sounded were nearly identical at both locations (around 79.8dB(A)), suggesting that train noise is relatively uniform regardless of where it is measured and if horns are used. This is likely due to the consistent noise output from train engines, braking systems, and mechanical operations, which dominate overall sound levels, potentially obscuring the extent of horn noise.

Community Feedback

During the course of the monitoring of noise levels at Leete Place, one resident approached the Encompass Engineering team to provide some additional information and their perspective on the situation.

Principally, the resident pointed out that manual announcements were the issue, as they were louder than the automated announcements. They also stated that particular members of the GTR staff at Royston Station spoke into the microphone louder on average during manual announcements. Furthermore, the resident also mentioned that manual announcements were significantly more commonplace and louder during weekends and over the summer months, when they were outside in their garden.

Finally, the resident stated that there was no easy, clear and direct way of communicating concerns and complaints with GTR, short of going to the station platform themselves and requesting the volume be lowered (which the resident says has been done on multiple occasions). They also mentioned that GTR failed to keep residents informed about this situation and that GTR responses are limited.

GTR Liabilities and Risks

The current findings do not indicate that there is risk of the PA system noise levels exceeding standards. The data collected confirms that no announcement exceeds the 90dB(A) threshold or the 80dB(A) average over an 8-hour period, set out in Network Rail standard NR/L2/TEL/30134 and HSE Noise at Work guidelines. This is demonstrated in both figures 7 and 8 below.

For the minimum threshold sound levels being reached for passenger announcement levels as stipulated in the Network Rail standard, It was found that all automated and manual readings fell short of the required 65dB(A) output. As demonstrated in figures 7 and 8 below. This poses a significant safety risk to GTR. However, the network rail standard does specify the following;

"The system shall provide a minimum SPL of 10dBA above normal ambient noise levels at all times within the range of 65dBA up to the maximum SPL level unless environmental noise pollution issues prevent this figure being achieved."

If environmental noise pollution is a factor there could be grounds to adjust the noise outputs following discussion and agreement with Network Rail.

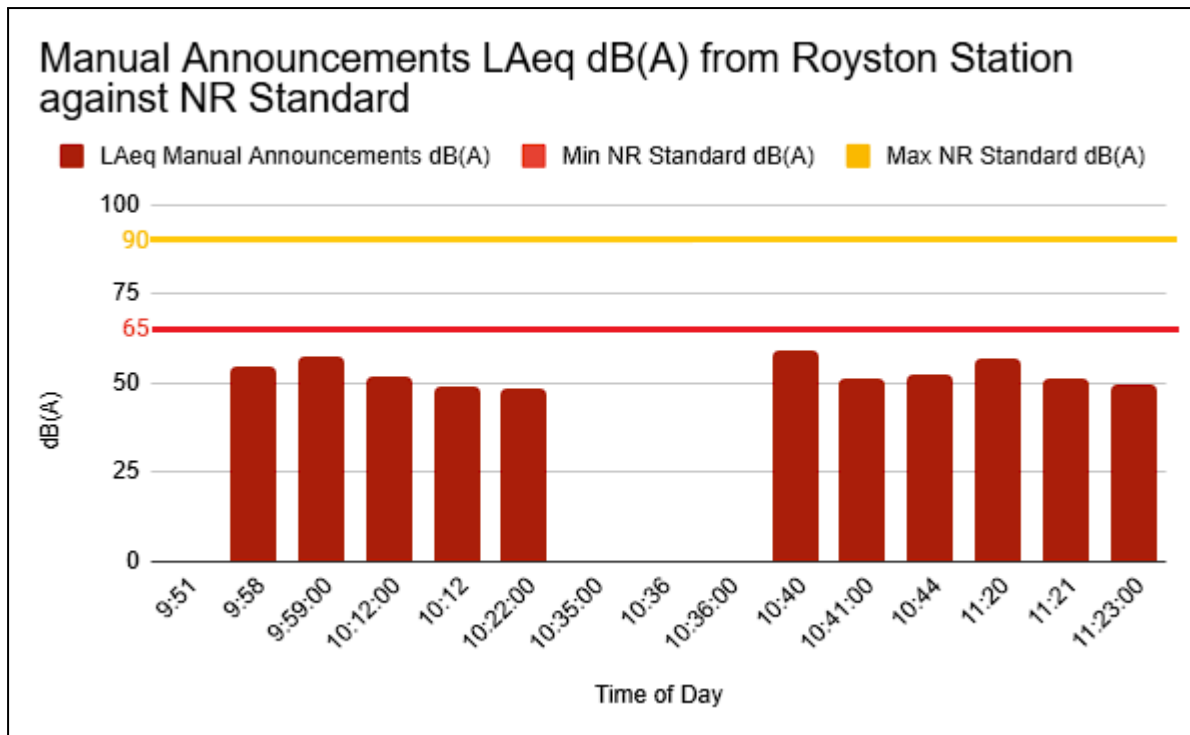


Figure 7 - LAeq dB(A) of Manual Announcements recorded at Royston Station

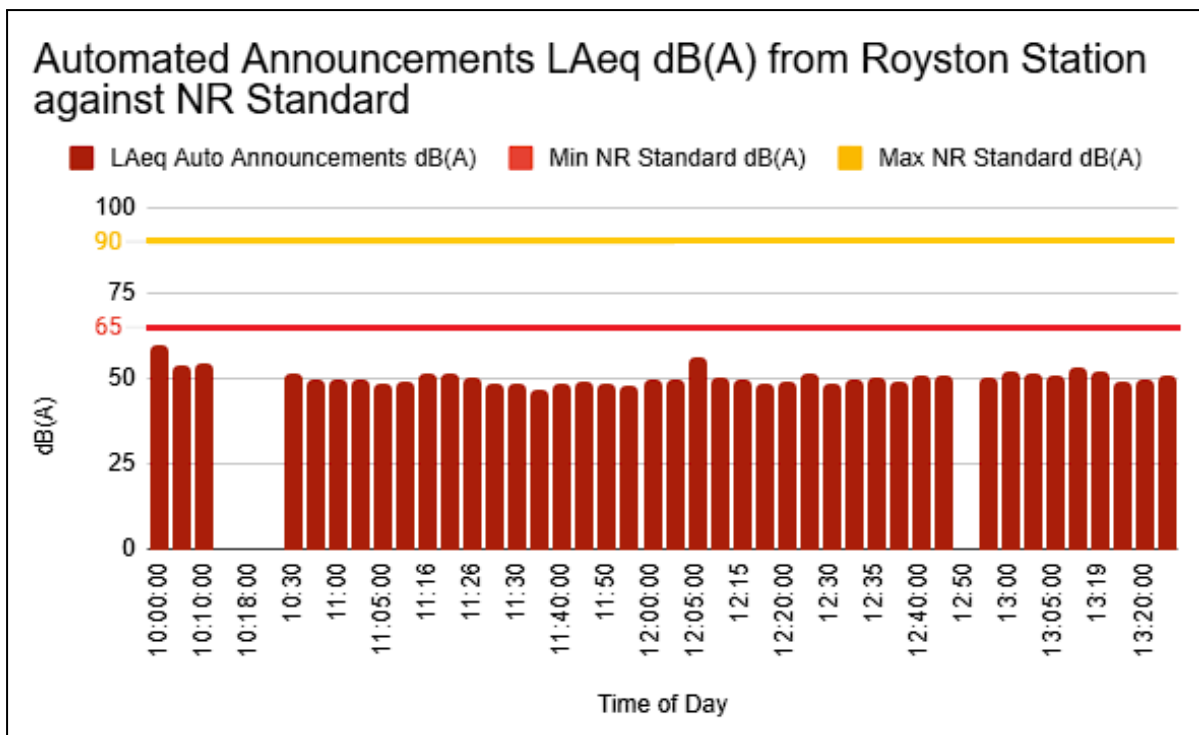


Figure 8 - LAeq dB(A) of Automated Announcements recorded at Royston Station

It is important to note that Figures 7 and 8 above contain some zero-values. This is because certain observations for individual announcements were obscured by

significantly louder train noise. As a result, the exact dB(A) levels of the announcements could not be extracted, as only the train noise was discernible.

As the current speaker noise levels are failing to meet the minimal threshold set out by the NR standard (65dB), it is essential to conduct a review on either increasing the speaker volumes or reviewing a different type of speaker. Another aspect to ensure the safe levels would be achieved is setting a minimum/ maximum range for the speaker volume. If this was set at a constant minimum level of 65dB, using common acoustics calculations, this would result at an approximate sound level of circa 50.19 dB at Leete Place. If the latter option was selected, it would be advisable to carry out trials monitoring the noise levels at Leete place as the adjustments were made.

It is recommended a re-test is completed if changes are made to ensure compliance with the minimum SPL requirement.

Recommendations

Announcement and Amplifier Adjustments

Our analysis of the data revealed that while not in excess of the 90dB(A) and 80dB(A) 8-hour average threshold set out in Network Rail standard NR/L2/TEL/30134, the noise levels for both announcement types failed to meet the minimum 10dB(A) above ambient or 65dB(A) (whichever is higher) requirement. As 65dB(A) is higher than the ambient recorded, then the amplifier gain levels should be increased to ensure that all announcements are consistently above this minimum threshold of 65dB(A), in order to minimise health and safety risks. At this minimum threshold, Leete Place readings would register at a minimum of 50.2dB(A), still within the WHO guidelines. The data shows that the speakers do not consistently meet and exceed this minimum threshold set out by the standard.

GTR should also utilise the 'automatic gain control' system, which is already installed at the station, to automatically raise and lower announcement volume when ambient noise levels rise (e.g. when a train passes through), in order to minimise the health and safety risk of safety announcements not being heard over the significantly louder train noise. A starting value of 55dB should be used to ensure that, once the background noise goes above this, the speaker levels will increase inline with the Network Rail standard. As the ambient noise levels at Royston station are below 55dB(A), there should be no increase unless a train is coming through which will ensure local residents are not disturbed from the use of this equipment.

Finally, a briefing should be given to station staff, setting out a consistent standard or guideline for station office microphone usage for manual announcements. This will ensure that manual announcements made from this microphone, regardless of user, are made at consistent volumes, limiting the variation in noise levels. Following this, a re-test is recommended to be conducted to verify that the noise levels are above the minimum requirements in order to minimise risk of non-compliance for GTR.

Potential Future Speakers

The new proposed 'SHUFFLE' speaker systems offer improved sound quality with a wider frequency range (90Hz–19kHz vs. 120Hz–18kHz old) for better clarity from lower frequencies, and higher power handling (25W–50W) for louder, more effective emergency and safety announcements. Their enhanced durability makes them ideal for poor weather conditions, with a broader temperature tolerance, impact resistance and IP66 rating ensuring greater weather and vandalism resistance.

However, potential concerns include the need to upgrade existing amplifiers to support higher power ratings if they do not already, and the requirement for a robust network

infrastructure to handle any different communication protocols, resulting in a higher upfront cost. Evaluations and testing should be conducted after installation and setup, including acoustic testing for speech intelligibility, environmental stress testing for durability, and network reliability checks. A cost-benefit analysis should also be completed to compare installation and long-term savings from reduced maintenance, with user trials conducted to assess performance.

Further Train Monitoring

A significant reading noted from the monitoring period was the presence of excessive brake squeal from one particular train. Unit 700107 departed from platform 2 at approximately 12:57 p.m., exhibiting brake squeal and peaking at 95.6dB(A). It is highly recommended that a follow up investigation and monitoring be conducted on this particular unit and its braking system. If left unchecked and unresolved, unit 700107 will likely cause further noise disturbances at other locations outside of Royston station and Leete Place.

Stakeholder Engagement

Whilst It is recommended that GTR carry out a town hall meeting with local residents, providing all local residents a summary of findings. Furthermore, GTR creates a simpler and more transparent communication channel between them and local communities that fosters clear, multi-sided communication. This will allow GTR to reinforce their reputation and relationship with the local community, demonstrating transparency and a commitment to addressing noise concerns.

Additionally, it is recommended that GTR follow up on the resident's feedback given in section 'Community Feedback', by creating a streamlined and transparent communication system or channel to engage with residents. In this manner, residents can be better informed and can be part of the resolution process, allowing GTR to improve their relationship with local residents and communities near their infrastructure. It has also been seen among other TOCs that often an explanation as to why noise levels are where they are can satisfy neighbour concerns and reduce complaints made.

Staff Training

A further recommendation for GTR is to write and publish training or briefings for the use of the station office microphone to ensure that this is consistent across all users and therefore limits the possible differences in how each staff member would use it. This should be done in conjunction with testing the speaker levels so that the 65dB(A) measurement is taken inline with the proposed briefing specification.

Conclusion

Overall, the noise monitoring and analysis conducted at Royston station and Leete Place has provided a comprehensive understanding of the impact of the PA system on the local residential area. The findings indicate that while the PA system noise levels were under the maximum threshold of 90dB(A) set out by Network Rail standard NR/L2/TEL/30134, they are at risk of non-compliance with the standard as they do not meet the minimum 10dB(A) above ambient noise levels or 65dB(A) (whichever is higher) for any announcement type.

Train noise, particularly from unit 700107, was the primary source of disruption, with excessive brake squeal identified as a key issue. Investigating this unit is highly recommended to prevent similar issues at other locations it serves.

Based on the results, the proposed mitigation measures are minimal but are vital to ensure compliance. This mainly includes increases to automated and manual announcement volume levels to mitigate GTR's risk of non-compliance and liability. Following this adjustment, a re-test should be carried out to validate that these minimums are being met. Further testing and evaluation of new speaker systems for the station platform and a focused investigation into Unit 700107, specifically addressing the brake squeal issue, is also highly recommended.

Whilst the noise evidence collected does not cause immediate concern that the sound levels currently being generated are out of the ordinary and provide cause for noise complaints, it is worth noting that noise disturbances can and are subjective. Therefore, the recommendation to engage with the local community to either present the report findings and the positive steps GTR is taking to help reduce noise pollution will help maintain transparency and foster ongoing dialogue and relationships between GTR and residents.

The overall outcome of this report highlights the potential risk GTR faces is in actual fact as a result of the PA speakers being too high but actually too low, which could result in a non-compliance with the relevant Network Rail standard, as the PA system speakers do not meet the minimum sound pressure level requirements above ambient noise.

Appendices

Appendix 1: All Royston Station Automated Announcements Individual Observations

Observation Number	Time	Type	Content	LAFmax (60s)	LAeq (60s)	Observation Duration LAFmax	Observation Duration LAeq	Observation duration (S)	Unit	Was the Observation the Loudest Y/N	Notes
7	10:00:00	Automated	Engineering	72.7	58.8	72.7	59	23	N/A	Yes	Spike in LAFmax during announcement due to staff talking and phone ringing.
8	10:05:00	Automated	Security	59.3	51.77	59.3	53.2	14	N/A	Yes	
9	10:10:00	Automated	Engineering	60.4	54.38	59.8	53.7	23	N/A	No	
13	10:15	Automated	Engineering	65	54	N/A	N/A	23	N/A	No	Couldn't be heard
14	10:18:00	Automated	Security	83.7	71.3	N/A	N/A	14	N/A	No	Couldn't be heard
16	10:20	Automated	Engineering	59.5	49.5	N/A	N/A	23	N/A	No	Couldn't be heard
21	10:30	Automated	Engineering	59.2	51.39	59.2	50.8	23	N/A	Yes	
30	10:50	Automated	Engineering	72.7	57.9	54.5	49.4	23	N/A	No	Spike in LAFmax value due to bird noises recorded at 70.8dB(A)
32	11:00	Automated	Engineering	60	49.5	58	49.4	23	N/A	No	
33	11:02:00	Automated	Train arrival info	75.4	63.2	56	49	30	N/A	No	
34	11:05:00	Automated	Security	61.2	48.6	51.3	47.7	14	N/A	No	
36	11:10	Automated	Engineering	52.2	47.5	52.2	48.4	23	N/A	Yes	
37	11:16	Automated	Non-stop train	83.9	71.7	55.8	50.8	7	N/A	No	
40	11:20:00	Automated	Engineering	63.8	52.3	60.7	51.1	23	N/A	No	No '.co.uk' part could be heard
43	11:26	Automated	Train arrival info	69	54.3	59.8	49.7	32	N/A	No	Sound cut off from train
45	11:30:00	Automated	Engineering	58.4	48	51.6	47.8	23	N/A	No	
46	11:30	Automated	Train arrival info	58.4	48	51.6	47.9	41	N/A	No	
48	11:35	Automated	Security	59.1	46.9	48.3	46.3	14	N/A	No	
49	11:40:00	Automated	Engineering	55	47	52.6	47.9	23	N/A	No	
50	11:40	Automated	No smoking	55	47.79	55	48.7	6	N/A	Yes	
51	11:50	Automated	Engineering	55.7	47.7	52.8	48.1	23	N/A	No	

Observation Number	Time	Type	Content	LAFmax (60s)	LAeq (60s)	Observation Duration LAFmax	Observation Duration LAeq	Observation duration (S)	Unit	Was the Observation the Loudest Y/N	Notes
52	11:51:00	Automated	Non-stop train	54.7	47.5	49.4	47.6	7	N/A	No	
54	12:00:00	Automated	Engineering	59.3	48.7	52.6	49	23	N/A	No	
55	12:00	Automated	No smoking	59.3	48.7	56	48.9	7	N/A	No	
57	12:05:00	Automated	Security	63.3	52	63.3	55.8	14	N/A	Yes	Lots of rain noise spiking the LAFmax value.
59	12:10:00	Automated	Engineering	58.8	48.9	58.8	49.6	23	N/A	Yes	
60	12:15	Automated	Non-stop train	54.6	48.9	51.3	49.3	7	N/A	No	
61	12:20:00	Automated	Engineering	60	48.1	52.8	48.2	23	N/A	No	
62	12:20:00	Automated	No smoking	60	48.1	55.9	48.5	7	N/A	No	
63	12:24	Automated	Train arrival info	78.9	66.2	55.1	50.7	30	N/A	No	Partially obscured by train, may be spiking LAFmax value.
66	12:30	Automated	Engineering	53.8	48.4	52.6	47.7	23	N/A	No	
67	12:32:00	Automated	Train arrival info	53.8	50	53.7	49.4	23	N/A	No	Difficult to hear
69	12:35	Automated	Security	80	63.8	53	49.6	14	N/A	No	
71	12:40:00	Automated	Engineering	56	49	54.8	48.7	23	N/A	No	
72	12:40:00	Automated	No smoking	56	49	56	50.5	14	N/A	Yes	
74	12:46	Automated	Non-stop train	56.5	50.1	52.9	50.3	7	N/A	No	
76	12:50	Automated	No smoking	59.7	49.5	N/A	N/A	N/A	N/A	No	Could not be heard.
77	12:50:00	Automated	Engineering	59.7	49.5	57.3	49.6	23	N/A	No	
79	13:00	Automated	Engineering	61.1	50.4	61.1	51.7	23	N/A	Yes	Spike in LAFmax value due to a flock of birds passing overhead.
80	13:00	Automated	No smoking	61.1	50.4	55.7	50.7	7	N/A	No	
81	13:05:00	Automated	Security	59.6	48.9	59.6	50.3	14	N/A	Yes	
83	13:10:00	Automated	Engineering	57.9	52.1	57.9	52.6	23	N/A	Yes	
86	13:19	Automated	Non-stop train	84.8	71.9	56.7	51.3	7	N/A	No	Very difficult to hear.
87	13:20	Automated	Engineering	55.6	48.9	51.6	48.8	23	N/A	No	Difficult to hear
88	13:20:00	Automated	No smoking	55.6	48.9	55.1	49.3	7	N/A	No	
89	13:27	Automated	Train arrival info	73.8	58.8	58.2	50.4	12	N/A	No	Obscured by incoming train. Could not hear the second half

Observation Number	Time	Type	Content	LAFmax (60s)	LAeq (60s)	Observation Duration LAFmax	Observation Duration LAeq	Observation duration (S)	Unit	Was the Observation the Loudest Y/N	Notes
											of the announcement.

Appendix 2: All Royston Station Manual Announcements Individual Observations

Observation Number	Time	Type	Content	LAFmax (60s)	LAeq (60s)	Observation Duration LAFmax	Observation Duration LAeq	Observation duration (S)	Unit	Was the Observation the Loudest Y/N	Notes
3	9:51	Manual	N/A	59	52.45	N/A	N/A	N/A	N/A	No	All platform extension speakers disconnected. Couldn't hear announcement.
5	9:58	Manual	Test Announcement	77.9	62.66	61.9	53.8	9	N/A	No	
6	9:59:00	Manual	Train arrival info	82.9	59.9	64.4	56.8	10	N/A	No	Spike in LAFmax (60s) due to staff dropping object.
10	10:12:00	Manual	Test Announcement	81.2	70.2	62.2	51.3	9	N/A	No	
11	10:12	Manual	Train arrival info	81.2	70.2	58.2	48.6	8	N/A	No	
18	10:22:00	Manual	Test Announcement	57.3	48.8	54.1	47.7	9	N/A	No	
22	10:35:00	Manual	N/A	78.4	61.4	N/A	N/A	N/A	N/A	No	Could not be heard. Resident approach Encompass staff to speak.
25	10:36	Manual	N/A	82.1	73.4	N/A	N/A	N/A	N/A	No	Could not be heard
26	10:36:00	Manual	N/A	82.1	73.4	N/A	N/A	N/A	N/A	No	Could not be heard
27	10:40	Manual	Test Announcement	72	55.3	68.5	58.4	7	N/A	No	
28	10:41:00	Manual	Test Announcement	61.3	49.1	61.3	50.9	3	N/A	Yes	Air blown into the microphone
29	10:44	Manual	Train arrival info	64.6	49.7	64.6	51.6	18	N/A	Yes	
39	11:20	Manual	Train arrival info	63.8	52.3	63.8	56.1	14	N/A	Yes	
41	11:21	Manual	Train arrival info	59.2	49.7	53.9	50.7	25	N/A	No	
42	11:23:00	Manual	Test Announcement	59.3	49.6	57.5	49.2	6	N/A	No	

Appendix 3: All Royston Station Train Horn Individual Observations

Observation Number	Time	Type	Content	LAFmax (60s)	LAeq (60s)	Observation Duration LAFmax	Observation Duration LAeq	Observation duration (S)	Unit	Was the Observation the Loudest Y/N	Notes
1	9:34	Train Horn	N/A	82.4	68.1	N/A	N/A	N/A	N/A	No	
2	9:49:00	Train Horn	N/A	82.4	68.1	82.4	70.5	34	700002	Yes	
20	10:28:00	Train Horn	N/A	85.6	73.4	85.6	73.5	83.4	N/A	Yes	
47	11:32	Train Horn	N/A	76.8	67.9	76.8	70.3	34	N/A	Yes	
84	13:19:00	Train Horn	N/A	65.6	50.9	84.8	74.1	36	N/A	Yes	Train sounds horn at a further distance from the platform than others (65.6dBA)

Appendix 4: All Royston Station Train General Individual Observations

Observation Number	Time	Type	Content	LAFmax (60s)	LAeq (60s)	Observation Duration LAFmax	Observation Duration LAeq	Observation duration (S)	Unit	Was the Observation the Loudest Y/N	Notes
4	9:57:00	Train General	N/A	81.1	67.46	81.1	69.9	73.8	700131	Yes	
12	10:12:00	Train General	N/A	81.2	70.2	81.2	73.5	46	700152	Yes	
15	10:18	Train General	N/A	83.7	71.3	83.7	77.6	14	387103	Yes	
17	10:21	Train General	N/A	81.7	70.5	81.7	74.9	22	387107	Yes	
19	10:27	Train General	N/A	83.7	71.2	85.6	71.7	138.6	N/A	Yes	
23	10:36	Train General	N/A	82.1	73.4	82.1	73.6	68.4	700131	Yes	
24	10:36:00	Train General	N/A	82.1	73.4	82.1	73.6	68.4	700131	Yes	
31	10:54	Train General	N/A	81.6	70.3	81.6	75.5	18	N/A	Yes	Non-stop train passing through
35	11:06	Train General	N/A	84.1	75.2	84.1	76.3	46	N/A	Yes	Freight Train passing through
38	11:16:00	Train	N/A	83.9	71.7	83.9	75.4	25	N/A	Yes	Non-stop train

Observation Number	Time	Type	Content	LAFmax (60s)	LAeq (60s)	Observation Duration LAFmax	Observation Duration LAeq	Observation duration (S)	Unit	Was the Observation the Loudest Y/N	Notes
		General									
44	11:27:00	Train General	N/A	78.7	70.6	78.7	70.4	75.6	N/A	Yes	
53	11:56	Train General	N/A	84	57.86	84	76.9	24	387117	Yes	
56	12:01:00	Train General	N/A	79.1	69	79.1	70.9	76.8	700118	Yes	
58	12:06:00	Train General	N/A	81.1	63.18	81.1	75.4	32	700139	Yes	Arrives to Platform 1.
64	12:24:00	Train General	N/A	78.9	56.03	78.9	69.6	N/A	700135	Yes	Train arrives into platform 2, door operation beeping noise.
65	12:26	Train General	N/A	84.1	74.5	84.1	72.3	126.6	700135	Yes	Same train as above departs from platform 2, door operation beeping noise.
68	12:33:00	Train General	N/A	83.8	73.4	83.8	73.7	21	387106	Yes	
70	12:36:00	Train General	N/A	81.9	62.23	81.9	75.4	39	700118	Yes	Arrives to Platform 1
73	12:44	Train General	N/A	81.2	71.6	81.2	75	28	N/A	Yes	
75	12:47	Train General	N/A	83.6	71.8	83.6	77.2	17	N/A	Yes	Non-stop train
78	12:56:00	Train General	N/A	95.6	78.5	95.6	77.3	73.2	700107	Yes	Loudest instance. Caused by severe brake squeal. Unit needs investigating.
82	13:06:00	Train General	N/A	87.6	76.1	87.6	77.6	42	700135	Yes	
85	13:19	Train General	N/A	84.8	71.9	84.8	74.1	36	N/A	Yes	Same train as above, non-stop train.

Appendix 5: All Calculated Leete Place Automated Individual Observations

Formula Used: $X - 20 \cdot \log_{10}(11/2)$

X = Royston station dB(A) value.

The formula is a commonly used calculation in acoustics to determine sound level reduction over distance using the inverse square law.

Observation Number	Time	Type	Content	LAFmax (60s)	LAeq (60s)	Observation Duration LAFmax	Observation duration LAeq	Observation duration (S)	Unit	Was the Observation the Loudest Y/N	Notes
7	10:00:00	Automated	Engineering	64.65	49.13	N/A	N/A	23	N/A	No	Spike in LAFmax during announcement due to staff talking and phone ringing.
8	10:05:00	Automated	Security	49.69	41.28	N/A	N/A	14	N/A	No	
9	10:10:00	Automated	Engineering	50.91	44.19	N/A	N/A	23	N/A	No	
13	10:15	Automated	Engineering	56.05	43.77	N/A	N/A	23	N/A	No	Couldn't be heard
14	10:18:00	Automated	Security	76.93	63.09	N/A	N/A	14	N/A	No	Couldn't be heard
16	10:20	Automated	Engineering	49.91	38.74	N/A	N/A	23	N/A	No	Couldn't be heard
21	10:30	Automated	Engineering	49.57	40.85	49.57	40.19	23	N/A	Yes	
30	10:50	Automated	Engineering	64.65	48.12	44.32	38.63	23	N/A	No	Spike in LAFmax value due to bird noises recorded at 70.8dB(A)
32	11:00	Automated	Engineering	50.47	38.74	48.23	38.63	23	N/A	No	
33	11:02:00	Automated	Train arrival info	67.66	54.04	46.00	38.18	30	N/A	No	
34	11:05:00	Automated	Security	51.81	37.74	40.75	36.73	14	N/A	No	
36	11:10	Automated	Engineering	41.76	36.51	41.76	37.51	23	N/A	Yes	
37	11:16	Automated	Non-stop train	77.16	63.53	45.78	40.19	7	N/A	No	
40	11:20:00	Automated	Engineering	54.71	41.87	51.25	40.53	23	N/A	No	No '.co.uk' part could be heard
43	11:26	Automated	Train arrival info	60.52	44.10	50.24	38.96	32	N/A	No	Sound cut off from train
45	11:30:00	Automated	Engineering	48.68	37.07	41.09	36.84	23	N/A	No	
46	11:30	Automated	Train arrival info	48.68	37.07	41.09	36.95	41	N/A	No	
48	11:35	Automated	Security	49.46	35.84	37.40	35.17	14	N/A	No	
49	11:40:00	Automated	Engineering	44.88	35.95	42.20	36.95	23	N/A	No	
50	11:40	Automated	No smoking	44.88	36.83	44.88	37.85	6	N/A	Yes	
51	11:50	Automated	Engineering	45.66	36.73	42.43	37.18	23	N/A	No	

Observation Number	Time	Type	Content	LAFmax (60s)	LAeq (60s)	Observation Duration LAFmax	Observation duration LAeq	Observation duration (s)	Unit	Was the Observation the Loudest Y/N	Notes
52	11:51:00	Automated	Non-stop train	44.55	36.51	38.63	36.62	7	N/A	No	
54	12:00:00	Automated	Engineering	49.69	37.85	42.20	38.18	23	N/A	No	
55	12:00	Automated	No smoking	49.69	37.85	46.00	38.07	7	N/A	No	
57	12:05:00	Automated	Security	54.15	41.53	54.15	45.78	14	N/A	Yes	Lots of rain noise spiking the LAFmax value.
59	12:10:00	Automated	Engineering	49.13	38.07	49.13	38.85	23	N/A	Yes	
60	12:15	Automated	Non-stop train	44.44	38.07	40.75	38.52	7	N/A	No	
61	12:20:00	Automated	Engineering	50.47	37.18	42.43	37.29	23	N/A	No	
62	12:20:00	Automated	No smoking	50.47	37.18	45.89	37.62	7	N/A	No	
63	12:24	Automated	Train arrival info	71.57	57.39	44.99	40.08	30	N/A	No	Partially obscured by train, may be spiking LAFmax value.
66	12:30	Automated	Engineering	43.54	37.51	42.20	36.73	23	N/A	No	
67	12:32:00	Automated	Train arrival info	43.54	39.30	43.43	38.63	23	N/A	No	Difficult to hear
69	12:35	Automated	Security	72.80	54.71	42.65	38.85	14	N/A	No	
71	12:40:00	Automated	Engineering	46.00	38.18	44.66	37.85	23	N/A	No	
72	12:40:00	Automated	No smoking	46.00	38.18	46.00	39.86	14	N/A	Yes	
74	12:46	Automated	Non-stop train	46.56	39.41	42.54	39.63	7	N/A	No	
76	12:50	Automated	No smoking	50.13	38.74	N/A	N/A	N/A	N/A	No	Could not be heard.
77	12:50:00	Automated	Engineering	50.13	38.74	47.45	38.85	23	N/A	No	
79	13:00	Automated	Engineering	51.70	39.75	51.70	41.20	23	N/A	Yes	Spike in LAFmax value due to a flock of birds passing overhead.
80	13:00	Automated	No smoking	51.70	39.75	45.66	40.08	7	N/A	No	
81	13:05:00	Automated	Security	50.02	38.07	50.02	39.63	14	N/A	Yes	
83	13:10:00	Automated	Engineering	48.12	41.64	48.12	42.20	23	N/A	Yes	
86	13:19	Automated	Non-stop train	78.16	63.76	46.78	40.75	7	N/A	No	Very difficult to hear.
87	13:20	Automated	Engineering	45.55	38.07	41.09	37.96	23	N/A	No	Difficult to hear
88	13:20:00	Automated	No smoking	45.55	38.07	44.99	38.52	7	N/A	No	
89	13:27	Automated	Train arrival info	65.88	49.13	48.46	39.75	12	N/A	No	Obscured by incoming train. Could not hear the second half of the announcement.

Appendix 6: All Calculated Leete Place Manual Individual Observations

Formula Used: $X - 20 \cdot \log_{10}(11/2)$

X = Royston station dB(A) value.

The formula is a commonly used calculation in acoustics to determine sound level reduction over distance using the inverse square law.

Observation Number	Time	Type	Content	LAFmax (60s)	LAeq (60s)	Observation Duration LAFmax	Observation duration LAeq	Observation duration (s)	Unit	Was the Observation the Loudest Y/N	Notes
3	9:51	Manual	N/A	49.35	42.04	N/A	N/A	N/A	N/A	No	All platform extension speakers disconnected. Couldn't hear announcement.
5	9:58	Manual	Test Announcement	70.46	53.44	52.59	43.54	9	N/A	No	
6	9:59:00	Manual	Train arrival info	76.04	50.36	55.38	46.89	10	N/A	No	Spike in LAFmax (60s) due to staff dropping object.
10	10:12:00	Manual	Test Announcement	74.14	61.86	52.92	40.75	9	N/A	No	
11	10:12	Manual	Train arrival info	74.14	61.86	48.46	37.74	8	N/A	No	
18	10:22:00	Manual	Test Announcement	47.45	37.96	43.88	36.73	9	N/A	No	
22	10:35:00	Manual	N/A	71.01	52.03	N/A	N/A	N/A	N/A	No	Could not be heard. Resident approach Encompass staff to speak.
25	10:36	Manual	N/A	75.15	65.43	N/A	N/A	N/A	N/A	No	Could not be heard
26	10:36:00	Manual	N/A	75.15	65.43	N/A	N/A	N/A	N/A	No	Could not be heard
27	10:40	Manual	Test Announcement	63.87	45.22	59.96	48.68	7	N/A	No	
28	10:41:00	Manual	Test Announcement	51.92	38.29	51.92	40.30	3	N/A	Yes	Air blown into the microphone
29	10:44	Manual	Train arrival info	55.60	38.96	55.60	41.09	18	N/A	Yes	
39	11:20	Manual	Train arrival info	54.71	41.87	54.71	46.11	14	N/A	Yes	
41	11:21	Manual	Train arrival info	49.57	38.96	43.65	40.08	25	N/A	No	
42	11:23:00	Manual	Test Announcement	49.69	38.85	47.67	38.41	6	N/A	No	

Appendix 7: All Calculated Leete Place Train Horn Individual Observations

Formula Used: $X - 20 \cdot \log_{10}(11/2)$

X = Royston station dB(A) value.

The formula is a commonly used calculation in acoustics to determine sound level reduction over distance using the inverse square law.

Observation Number	Time	Type	Content	LAFmax (60s)	LAeq (60s)	Observation Duration LAFmax	Observation duration LAeq	Observation duration (S)	Unit	Was the Observation the Loudest Y/N	Notes
1	9:34	Train Horn	N/A	75.48	59.51	N/A	N/A	N/A	N/A	No	
2	9:49:00	Train Horn	N/A	75.48	59.51	78.88	64.99	34	700002	Yes	
20	10:28:00	Train Horn	N/A	79.05	65.43	82.62	68.49	83.4	N/A	Yes	
47	11:32	Train Horn	N/A	69.23	59.29	72.35	64.76	34	N/A	Yes	
84	13:19:00	Train Horn	N/A	56.72	40.30	81.68	69.19	36	N/A	Yes	Train sounds horn at a further distance from the platform than others (65.6dBA)

Appendix 8: All Calculated Leete Place Train General Individual Observations

Formula Used: $X - 20 \cdot \log_{10}(11/2)$

X = Royston station dB(A) value.

The formula is a commonly used calculation in acoustics to determine sound level reduction over distance using the inverse square law.

Observation Number	Time	Type	Content	LAFmax (60s)	LAeq (60s)	Observation Duration LAFmax	Observation Duration LAeq	Observation duration (S)	Unit	Was the Observation the Loudest Y/N	Notes
78	12:56:00	Train General	N/A	90.22	71.13	83.00	72.93	73.2	700107	No	Loudest instance. Caused by severe brake squeal. Unit needs investigating.
82	13:06:00	Train General	N/A	81.29	68.45	79.88	73.28	42	700135	No	
85	13:19	Train General	N/A	78.16	63.76	74.40	69.19	36	N/A	No	Same train as above, non-stop train.
35	11:06	Train General	N/A	77.38	67.44	78.70	71.76	46	N/A	Yes	Freight Train passing through
65	12:26	Train General	N/A	77.38	66.66	77.79	67.09	126.6	700135	Yes	Same train as above departs from platform 2, door operation beeping noise.
53	11:56	Train General	N/A	77.27	48.08	56.11	72.46	24	387117	No	
38	11:16:00	Train General	N/A	77.16	63.53	74.14	70.71	25	N/A	No	Non-stop train
68	12:33:00	Train General	N/A	77.04	65.43	76.36	68.73	21	387106	No	
15	10:18	Train General	N/A	76.93	46.59	54.37	73.28	14	387103	No	Unit 387103
19	10:27	Train General	N/A	76.93	62.97	73.49	66.39	138.6	N/A	No	
75	12:47	Train General	N/A	76.82	63.64	74.27	72.81	17	N/A	No	Non-stop train
23	10:36	Train General	N/A	75.15	65.43	76.36	68.61	68.4	N/A	Yes	
24	10:36:00	Train General	N/A	75.15	65.43	76.36	68.61	68.4	700131	Yes	
70	12:36:00	Train General	N/A	74.92	52.96	61.80	70.71	39	700118	No	Arrives to Platform 1
17	10:21	Train General	N/A	74.70	62.30	72.71	70.13	22	387107	No	
31	10:54	Train General	N/A	74.59	61.97	72.32	70.83	18	N/A	No	Non-stop train passing through
12	10:12:00	Train General	N/A	74.14	61.86	72.19	68.49	46	700152	No	
73	12:44	Train General	N/A	74.14	63.42	74.01	70.24	28	N/A	No	
4	9:57:00	Train General	N/A	74.03	58.80	68.62	64.29	73.8	700131	No	
58	12:06:00	Train General	N/A	74.03	54.02	63.04	70.71	32	700139	No	Arrives to Platform 1.
56	12:01:00	Train General	N/A	71.80	60.52	70.62	65.46	76.8	700118	No	
64	12:24:00	Train	N/A	71.57	46.03	53.72	63.94	N/A	700135	No	Train arrives into

Observation Number	Time	Type	Content	LAFmax (60s)	LAeq (60s)	Observation Duration LAFmax	Observation Duration LAeq	Observation duration (S)	Unit	Was the Observation the Loudest Y/N	Notes
		General									platform 2, door operation noise. beeping
44	11:27:00	Train General	N/A	71.35	62.30	72.71	64.88	75.6	N/A	Yes	

Appendix 9: All Validated Leete Place Automated Individual Observations

Observation Number	Time	Type	Content	Validated LAFmax	Validated LAeq (60s)	Unit	Notes
1	10:33:30	Automated	Train arrival info	48.4	50.1	N/A	
3	10:35:20	Automated	N/A	N/A	48.1	N/A	Could not be heard
5	10:40:14	Automated	Passenger reminder	50.2	48.6	N/A	Content was unclear. Difficult to hear.
8	10:55:40	Automated	Train arrival info	48.7	47.6	N/A	
12	11:00:00	Automated	No smoking	51.3	49.6	N/A	
14	11:01:40	Automated	Non-stop train	48.1	49.4	N/A	
15	11:05:20	Automated	Security	48.7	49.1	N/A	
19	11:28:35	Automated	Train arrival info	49.2	48.3	N/A	
23	11:35:06	Automated	Non-stop train	48.8	51.1	N/A	
25	11:40:03	Automated	Non-stop train	52.3	51.1	N/A	
29	12:00:07	Automated	Passenger reminder	52.1	49.5	N/A	Content was unclear. Difficult to hear.

Appendix 10: All Validated Leete Place Train General Individual Observations

Observation Number	Time	Type	Content	Validated LAFmax	Validated LAeq (60s)	Unit	Notes
2	10:35:00	Train General	N/A	76.1	481	N/A	
4	10:37:02	Train General	N/A	71.9	52.9	N/A	
6	10:45:56	Train General	N/A	72.8	55	N/A	
7	10:46:40	Train General	N/A	72.1	49.5	N/A	
9	10:56:34	Train General	N/A	72.9	50.3	N/A	
10	10:56:51	Train General	N/A	70.3	50.3	N/A	
11	10:57:30	Train General	N/A	68.5	51.1	N/A	
13	11:01:30	Train General	N/A	85.2	49.4	N/A	
16	11:06:30	Train General	N/A	71.9	50	N/A	
17	11:19:54	Train General	N/A	70.7	50.4	N/A	
18	11:27:13	Train General	N/A	75.8	65.5	N/A	
20	11:29:23	Train General	N/A	76.5	63.3	N/A	
21	11:30:11	Train General	N/A	72.4	60.1	N/A	
22	11:33:39	Train General	N/A	69.1	61.1	N/A	
24	11:35:37	Train General	N/A	73.3	65.6	N/A	
26	11:46:58	Train General	N/A	74.8	62.5	N/A	
27	11:52:11	Train General	N/A	73.7	63.6	N/A	
28	11:56:58	Train General	N/A	77.7	64.3	N/A	
30	12:01:24	Train General	N/A	75	62.5	N/A	
31	12:02:08	Train General	N/A	69.4	59.6	N/A	