PAGERPOWER
Urban & Renewables

Terrestrial Television Baseline Survey Report

Salboy Central Ltd

Viadux Phase 2

December 2023







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ADMINISTRATION PAGE

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1	December 2023	Initial issue

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EXECUTIVE SUMMARY

Report Purpose

Pager Power has been commissioned to investigate the potential impact of a proposed building development (Plots 2A and 2B) located on Albion Street, Manchester city centre, upon terrestrial television reception in the surrounding area.

The development will introduce new tall structures into the area, which could interact with wireless terrestrial television signals and cause interference in the surrounding area. This report produces the results of a television baseline survey along with a prediction of the expected impact.

Findings

- The development is within the coverage area for the Winter Hill television transmitter. The baseline survey confirmed it was the main transmitter serving the area.
- Any interference would be due to shadowing effects i.e. the weakening of the transmitted signal due to the physical presence of the buildings.
- A site survey was undertaken on the 13th of December 2023 to confirm the relevant transmitter and record the signal quality.
- The average terrestrial signal strength is good in the development shadow zone for the main multiplexes and moderate on average for the local (lower power) multiplexes.
- Negative effects upon signal strength are typically limited to within 1km of the development and within its shadow zone based on Pager Power's industry experience.
- Predominately multistorey flats and/or commercial property are located from 150m to 1km of the development. The signal strength within this range was recorded as good for the main multiplexes. A reduction in signal strength is possible; however, effects are unlikely to be noticeable considering the baseline signal strength and the existence or height of any aerials within this range.
- At locations beyond 1km and within the shadow zone, the signal strength was on average 57.68dB for the main multiplexes. Effects at this range are likely to be relatively small based on previous experience.

Mitigation

No requirement for pre-emptive mitigation has been identified.

In the event that effects are reported, it is recommended that a reception measurement is undertaken (post-construction) to investigate the likely cause of the interference.

Mitigation measures should be installed if reported effects are found to be attributable to the development. Solutions are likely to be readily available if required, the most common options are presented in Section 6.

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ABOUT PAGER POWER

Pager Power is a dedicated consultancy company based in Suffolk, UK. The company has undertaken projects in 58 countries within Europe, Africa, America, Asia and Australasia.

The company comprises a team of experts to provide technical expertise and guidance on a range of planning issues for large and small developments.

Pager Power was established in 1997. Initially the company focus was on modelling the impact of wind turbines on radar systems. Over the years, the company has expanded into numerous fields including:

- Renewable energy projects.
- Building developments.
- Aviation and telecommunication systems.

Pager Power prides itself on providing comprehensive, understandable and accurate assessments of complex issues in line with national and international standards. This is underpinned by its custom software, longstanding relationships with stakeholders and active role in conferences and research efforts around the world.

Pager Power's assessments withstand legal scrutiny and the company can provide support for a project at any stage.

1 BACKGROUND

1.1 Introduction

Pager Power has been commissioned to investigate the potential impact of a proposed building development (Plots 2A and 2B) located on Albion Street, Manchester city centre, upon terrestrial television reception in the surrounding area.

The development will introduce new tall structures into the area, which could interact with wireless terrestrial television signals and cause interference in the surrounding area. This report produces the results of a television baseline survey along with a prediction of the expected impact.

1.2 Description of Development

The description of the development is as follows[1]:

The Site is located in Manchester city centre. It is bounded by the Manchester Central Conference Complex and Great Northern Warehouse to the north, Albion Street to the east, the Deansgate Castlefield Metrolink station and Deansgate Locks to the south, and the Beetham Tower to the west. It extends to 1.49 ha.
The Proposed Development will be delivered across two plots:

- *Viadux Plot 2A: 76-storey tower to comprise hotel and residential use with ground floor commercial space.*
- *Viadux Plot 2B: 23-storey affordable housing building.*

Plot 2a is located immediately east of the recently completed Phase 1 building, on land partially com prising the grade II listed Castlefield Viaduct. This plot will deliver a 76-storey mixed use tower comprising a hotel (Use Class C1) with associated bar and restaurant and residential units above comprising 1, 2 and 3 bed, and penthouse apartments (Use Class C3) with associated residential amenity spaces. Secure cycle spaces, serving this and the Phase 1 building, are provided at the ground floor level. At viaduct level, a redesigned service yard for the conference centre is enclosed by a new podium structure with residents' external amenity space above. A section of the Great Bridgewater Street bridge (deck) is removed to bring light into the street below.

[1] Viadux Phase 2A, Phase 2B and Phase 2c EIA Briefing 4.12.23.

1.3 Development Details

The general arrangement plan for the proposed development is shown in Figure 1 below[2], this assessment pertains to Plots 2A and 2B buildings only.

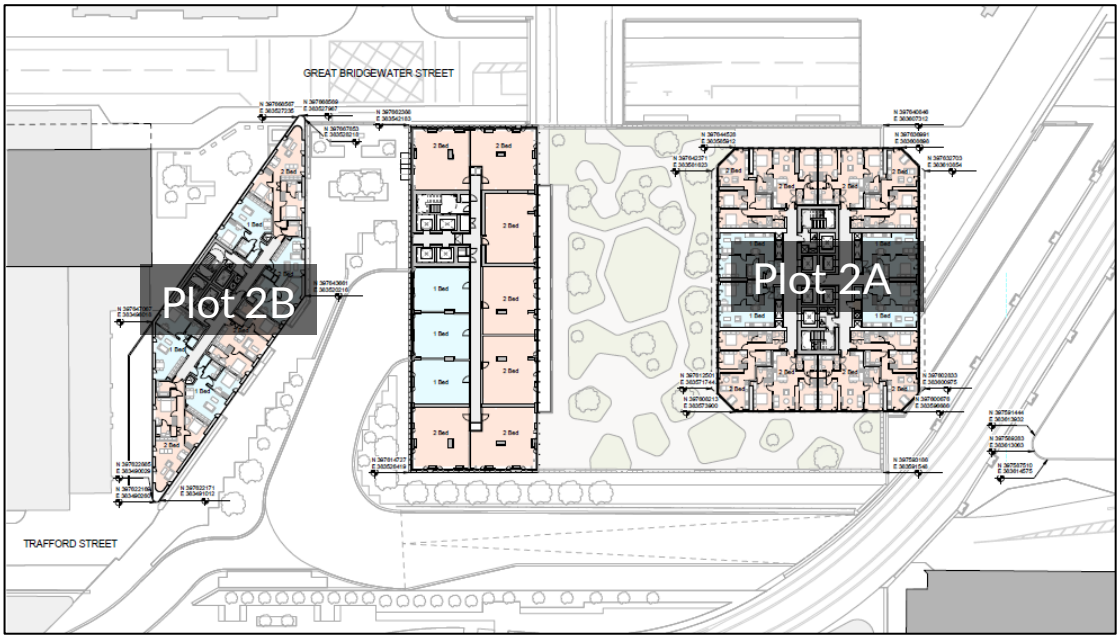


Figure 1 *Proposed development general arrangement plan*

[2] 10448-SHP-ZC-A-B5D9-G100-SK-05-001 [cropped]. The landscaping and floorplan shown are indicative only.

1.4 Development Site Layout – Aerial Image

The development site boundary for the proposed development overlaid onto aerial imagery is shown in Figure 2 below (white areas outlined in red).

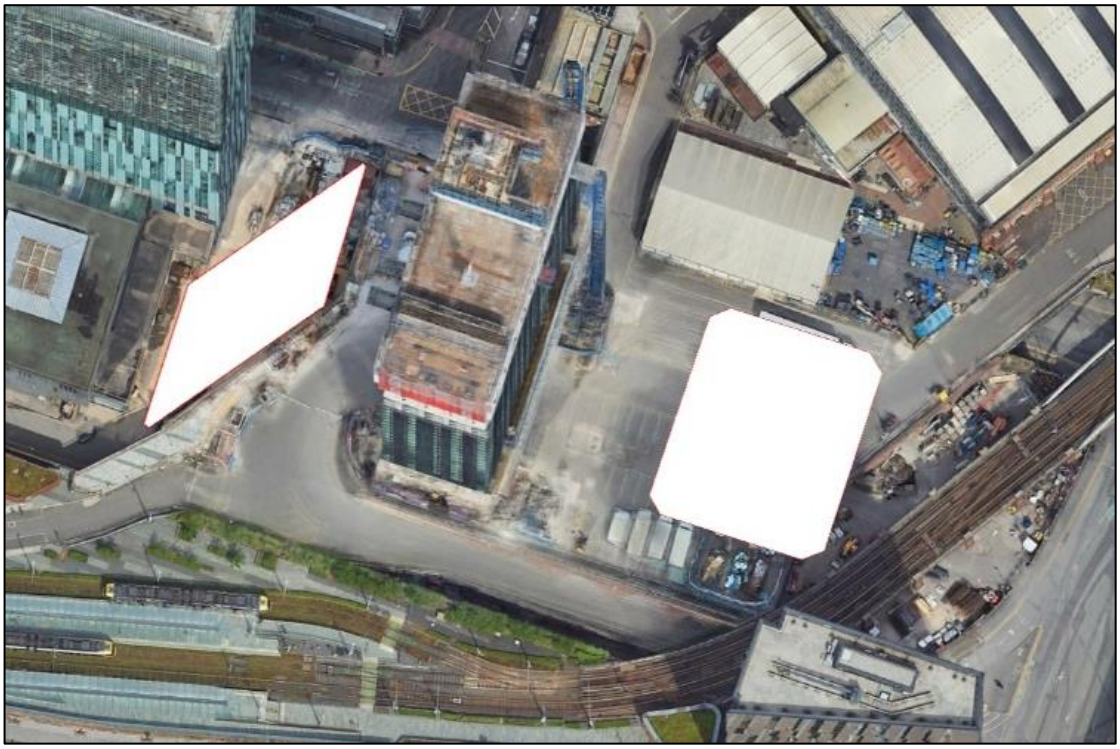


Figure 2 *Proposed development boundary overlaid on aerial imagery*

Plot 2B of the proposed development is in keeping with other existing low-rise buildings in the area and are therefore not predicted to have a significant impact upon terrestrial television signal reception. Plot 2B has not been mentioned further within this report.

2 TELEVISION TRANSMITTER DETAILS

2.1 Relevant Transmitter

Winter Hill is one of the UK's main television transmitters located approximately 24.6km northwest of the development. The Winter Hill transmitter serves the area around the development.

Digital television services are broadcast via Ultra High Frequency (UHF) signals; no analogue television signals are broadcast. The transmitter information is presented below[3].

2.2 Winter Hill Main Transmitter

The main Winter Hill transmissions are shown in Table 1 below.

	Public (PSB)			Commercial (COM)		
Service	BBC A	Digital 3&4	BBC B	SDN	Arqiva A	Arqiva B
Channel	32	34	35	29	31	37
Power	100 kilo-Watts (kW)					

Table 1 *Winter Hill main transmissions*

Additional Winter Hill transmissions are shown in Table 2 below.

	Local Multiplexes	
Service	LTVmux	Glmux
Channel	24	27
Power	2 kW	1 kW

Table 2 *Winter Hill additional transmissions*

[3] Source: Ofcom

3 BUILDINGS AND TELEVISION INTERFERENCE

3.1 Technical Overview

Terrestrial television services are provided by means of UHF radio waves which propagate from transmitters to receiving aerials which then relay the signal to a television set.

The quality of the image and sound on a television set is dependent on both the strength of the signal received directly from the transmitter (carrier signal) and the strength of any interference signals from other sources.

To achieve good quality reception an aerial must receive a strong carrier signal but weak interference signals.

3.2 Interference mechanisms

There are two ways that buildings can cause interference to television reception, these are described below.

3.2.1 Obstruction of the Signal

This is caused by the building physically blocking the transmitted television signal, reducing the strength of the carrier signal in the shadow of the building. In the case of Winter Hill transmissions, this would affect residences to the southeast of the development. Specifically:

- The highest losses (greatest interference) will be located immediately behind the building.
- Losses near the edge of the shadow zone will be less significant due to diffraction effects (bending of the signal).

The Ofcom document states that:

"In general, there will be three 'zones' behind the structure:

Zone A - close behind the structure (typically a few tens of metres) there may be a large reduction in signal level with a possible complete loss of reception

Zone B - further away (typically a few hundred metres) the signal reduction is less severe and the shadow will be smaller as diffraction effects partially fill in the shadow. Depending on the size of the structure, some locations could still lose reception completely

Zone C - some distance away (1-5km) the shadow will effectively have disappeared."

The zones mentioned are illustrated in Figure 3 on the following page[4], taken from Section 3.2 of an Ofcom paper[5] regarding the impact of buildings on broadcast signals.

[4] Source: Ofcom (2009): Tall Structures and their impact on broadcast and other wireless services.
[5] Reference as above.

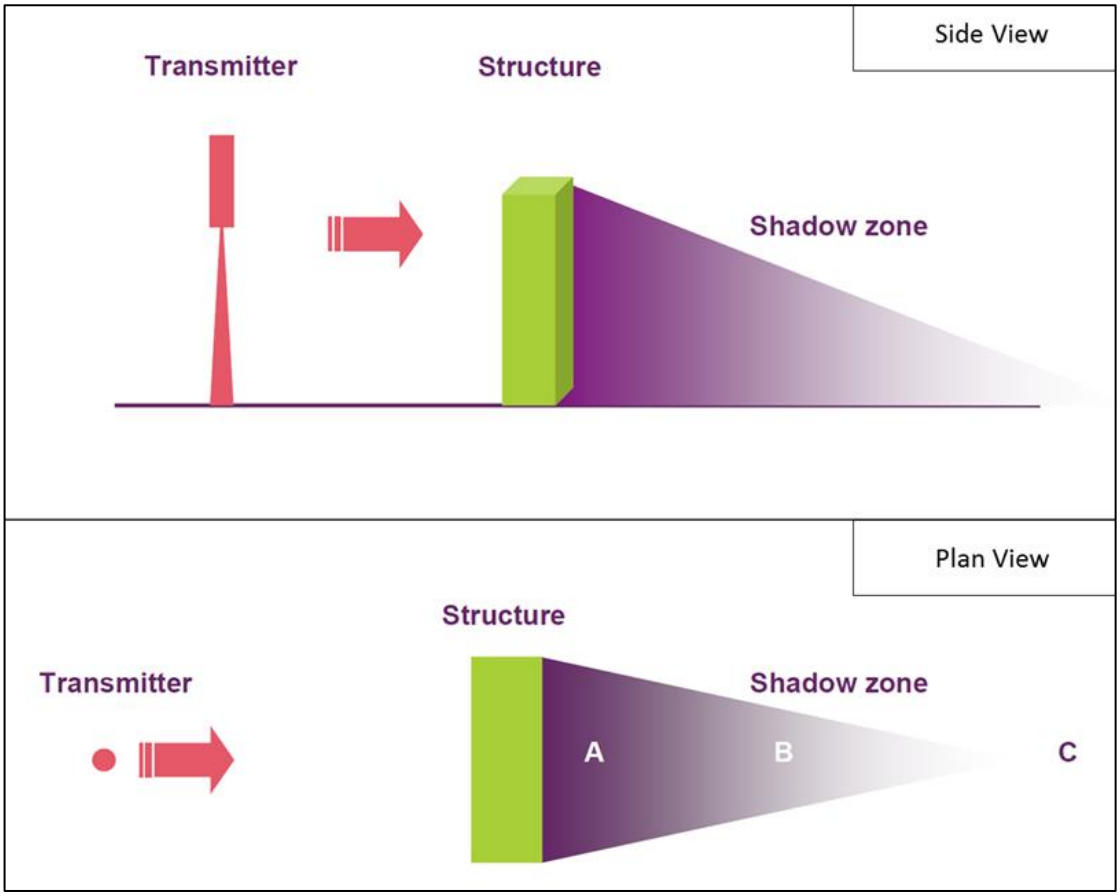


Figure 3 *Diffraction loss zones*

3.2.2 Reflection of the Signal

For large developments with straight edges, the transmitted signal can be reflected by the building itself. This causes an effect known as 'multipath interference' whereby the signal is received twice by an aerial at different times. The direct signal arrives first because it has a shorter distance to travel.

Figure 4 on the following page (taken from Section 3.3 of the Ofcom document referenced above) illustrates this effect.

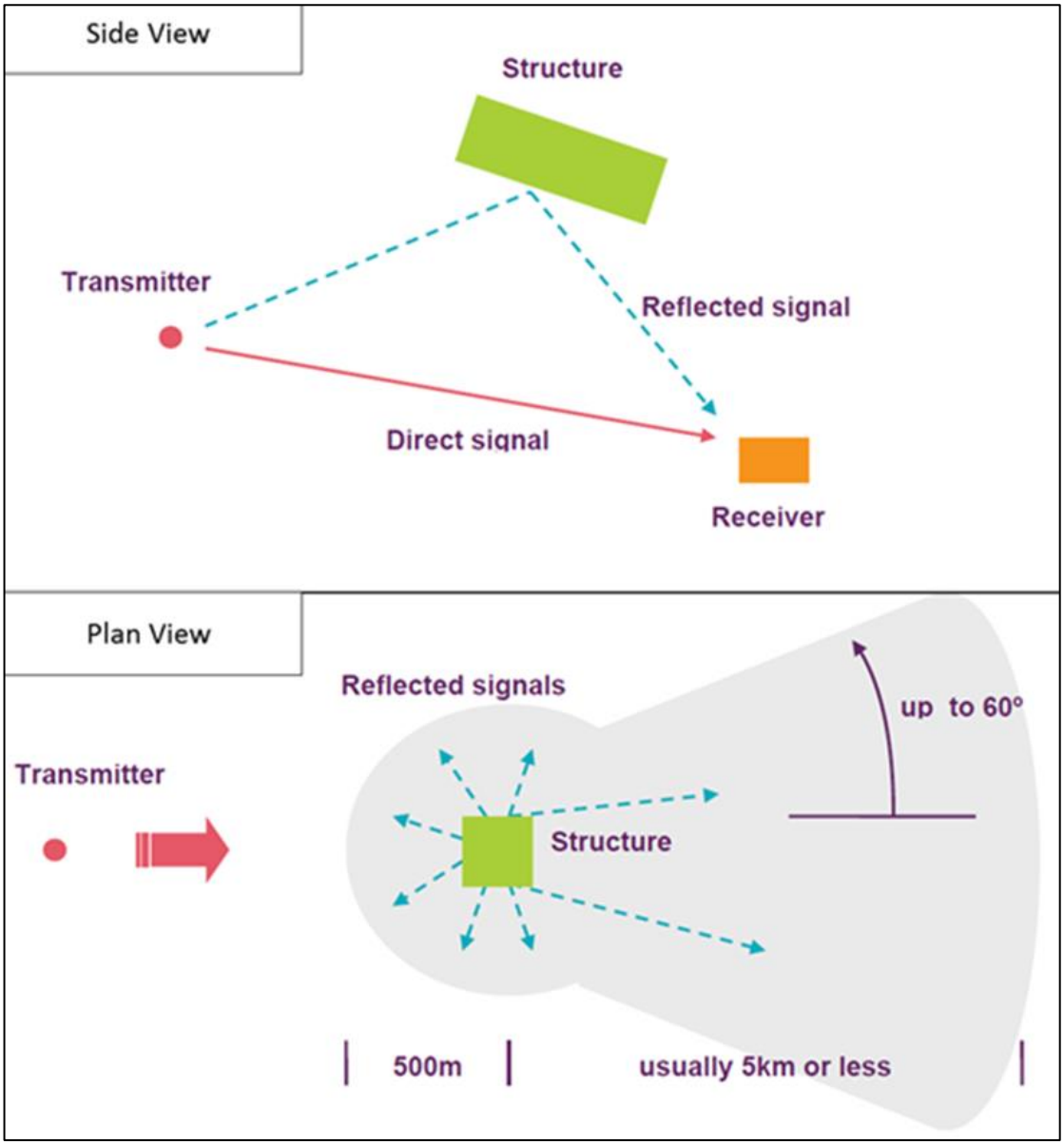


Figure 4 *Reflection zones*

In practice, it is considered highly unlikely that reflections will have an effect for receivers in front of the building or on either side when viewed from the location of the transmitter. For digital transmissions in particular, it is unlikely that issues will occur if the angle between the direct signal and the reflected signal is more than 30 degrees[6].

[6] This is known to be the angle that Arqiva considers when safeguarding its Television Re-Broadcast Links with regard to reflections from wind turbines – whilst wind turbines cause issues that are different to buildings this particular issue is similar for the two.

The reflection zone has been constructed in accordance with the Ofcom approach, however the angle considered is 30 degrees rather than 60 degrees. This is in order to represent a more realistic scenario for digital transmissions.

Reflection issues are most likely to cause a noticeable impact if:

- The direct signal from transmitter to receiver is weak (e.g. obstructed by terrain or buildings).
- The reflected signal from the building is strong (e.g. clear radio line of sight from the transmitter to the building and the building to the receiver).

The worst-case scenario is for both of the above conditions to be satisfied. The best-case scenario is for neither of the above conditions to be satisfied.

4 TECHNICAL ASSESSMENT

4.1 Potential Interference Areas

The shadow and reflection zones have been defined based on the geometry as set out in the previous section. Both zones extend to a distance of 5km beyond the development location in accordance with the Ofcom guidance.

In the case of the shadow zone, this has been modelled as having straight sides in order to be conservative. In actuality, due to diffraction effects, the zone would have a more triangular shape as shown in Figure 3 in the previous section. Figure 5 below shows the potential interference areas associated with the development.

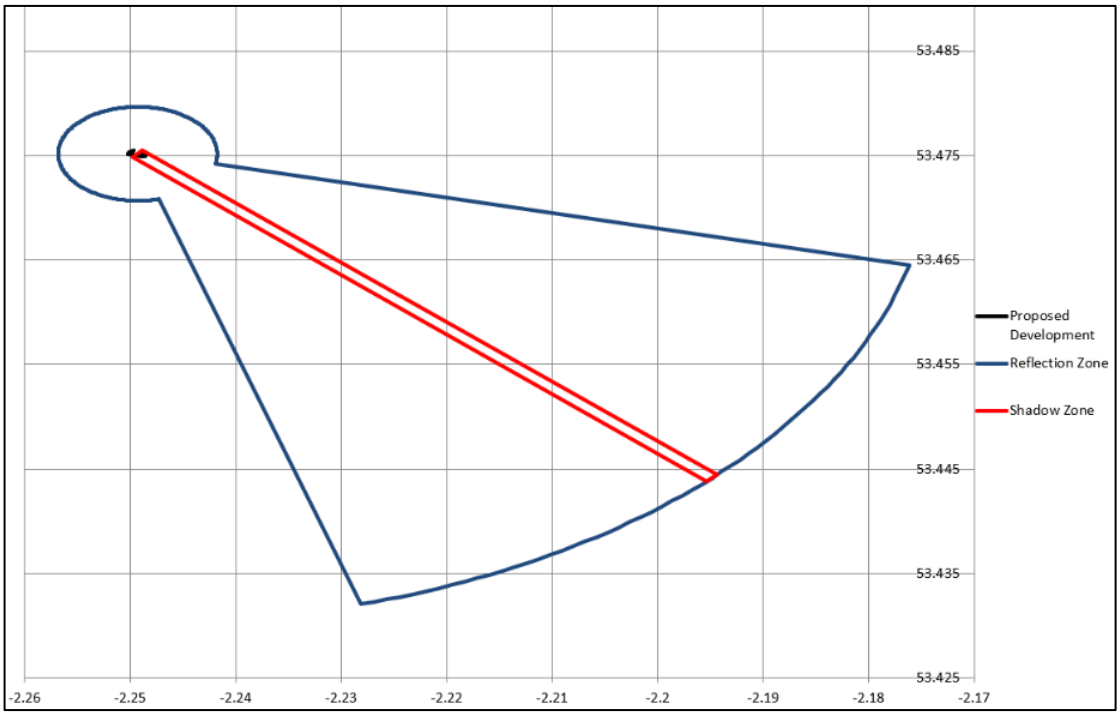


Figure 5 *Interference areas*

Figure 6 below shows the interference zones overlaid onto an aerial image.

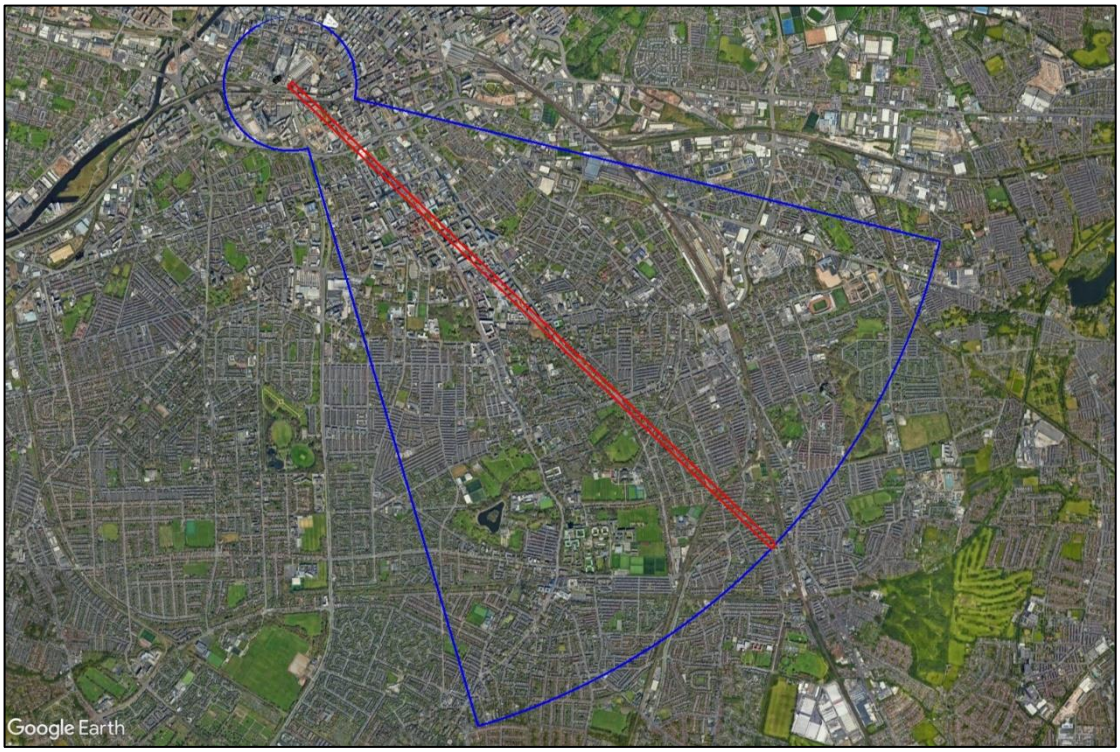


Figure 6 *Interference zones map*

4.2 Potential Diffraction Issues

The shadow zone passes over urban areas that contain commercial and residential buildings. Areas closest to the development are at the highest risk of experiencing television interference. This is typically limited to 1km based on Pager Power's assessment experience. Commercial buildings and multi-storey flats are located within 1km of the development shadow zone.

4.3 Potential Reflection Issues

Reflection effects are most likely if the transmitter does not have direct radio line of sight to the receiving aerial.

The predicted coverage of the Winter Hill transmitter is generally good in the surrounding area. Interference due to reflections are most likely when:

- The receiving aerial is unobstructed by existing obstacles.
- The reflected signal path via the development is unobstructed.
- The angle between the reflected signal via the development and the direct signal is small.

Interference is most likely if all of the above criteria are met. Interference is least likely if none of the above criteria are met.

In practice it is unlikely that all of the above criteria would be met for the development. In particular, locations that are below radio line of sight from the transmitter are unlikely to have an unobstructed path to the development, due to their relative heights. Impacts due to reflections are considered unlikely.

5 TELEVISION BASELINE SURVEY

5.1 Overview

The purpose of a baseline survey is to establish current signal strength and quality in the area. The baseline survey serves three purposes these are:

1. It confirms which transmitter is serving most homes in the areas surveyed (for television).
2. It provides an indicator regarding the likelihood of interference. If current signals are of good quality, minor degradation is less likely to have a noticeable effect.
3. It allows a 'before and after' comparison to be made in the event that a complaint is received.

A baseline television reception survey was undertaken for the development on the 13th December 2023.

Survey measurements were taken using Pager Power's custom survey vehicle with a wideband UHF aerial extended to a height of 10 metres above ground level. This was connected to television analyser to record the signal strength and stability.

The strength of the recorded signals is categorised in accordance with Table 3 below.

Average Signal Strength (dB)	Subjective Signal Strength Definition
<35	Low
35-45	Moderate
45-55	Good
55+	Very Good

Table 3 *Signal strength categories*

5.2 Survey Locations

Figure 7 below shows the survey locations overlaid onto aerial photography. The development location and the shadow zone are also shown. More readings are typically carried out closer to the building. This is because interference is generally more likely the closer the location is to the obstruction. Survey locations were chosen pre-survey (within the shadow zone); however, safe and available access influenced the specific position on the day. The locations on the following page show the actual survey locations. Television measurements were taken at survey locations 1 to 8. No suitable survey locations within the shadow zone that were accessible during the survey were found between locations 2 and 3, and 3 and 4.



Figure 7 *Survey locations*

5.3 Survey Results

A summary of the television survey results is presented in Table 4 below. Full survey results are shown in Appendix A. Survey photographs are shown in Appendix B.

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
1	Average: 44.2 (Moderate) Main TV MUX: 47.7 (Good) Local TV MUX: 33.5 (Low)	No satellite dishes or aerials were observed. It is possible more satellite dishes and aerials are located on top of the nearby buildings. All main multiplexes displayed fine picture and audio quality. An average of good signal strength and signal fluctuations of less than or equal to 0.5dB. One local multiplex displayed fine picture and audio quality, the other did not decode. An average of low signal strength and signal fluctuations of less than or equal to 0.5dB.	The survey location was within 290m of the development and within its shadow zone. Predominately multistorey flats and/or commercial property are located adjacent to location 1. A reduction in signal strength is possible based on the proximity to the development. Effects are not predicted experienced in practice due to the height (or existence) of any aerials in the area.

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
2	Average: 47.4 (Good) Main TV MUX: 50.9 (Good) Local TV MUX: 36.8 (Moderate)	One HP[7] UHF[8] aerial was observed. One satellite dish was observed. It is possible more satellite dishes and aerials are located on top of the nearby buildings. Best signal was found when facing the aerial west. All main multiplexes displayed fine picture and audio quality. An average of good signal strength and signal fluctuations of less than or equal to 0.4dB. One local multiplex displayed fine picture and audio quality. The other local multiplex did not decode. An average of moderate signal strength and signal fluctuations of less than or equal to 0.3dB.	The survey location was within 460m of the development and within its shadow zone. Predominately multistorey flats and/or commercial property are located adjacent to location 2. A reduction in signal strength is possible based on the proximity to the development. Effects are not predicted experienced in practice due to the height (or existence) of any aerials in the area.

[7] Horizontally Polarised
[8] Ultra-High Frequency

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
3	Average: 49.1 (Good) Main TV MUX: 52.5 (Good) Local TV MUX: 38.6 (Moderate)	No aerials or satellite dishes were observed during survey. All main multiplexes displayed fine picture and audio quality. An average of good signal strength and signal fluctuations of less than or equal to 0.3dB. Both local multiplexes displayed fine picture and audio quality. An average of moderate signal strength and signal fluctuations of less than or equal to 0.2dB.	The survey location was within 1 km of the development and within its shadow zone. Predominately multistorey flats and/or commercial property are located adjacent to location 3. A reduction in signal strength is possible based on the proximity to the development. Effects are not predicted experienced in practice due to the height (or existence) of any aerials in the area.
4	Average: 40.0 (Moderate) Main TV MUX: 43.4 (Moderate) Local TV MUX: 29.8 (Low)	No aerials or satellite dishes were observed during survey. Four main multiplexes displayed fine picture and audio quality. Two main multiplexes displayed intermittent picture and audio quality. An average of moderate signal strength and signal fluctuations of less than or equal to 0.5dB. One local multiplex displayed fine picture and audio quality. The other local multiplex did not decode. An average of moderate signal strength and signal fluctuations of less than or equal to 0.1dB.	The survey location was within 1.6km of the development and within its shadow zone. Effects at this range are likely to be relatively small based on previous experience. Predominately two to three-storey residential properties are located adjacent to location 4.

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
5	Average: 51.8 (Good) Main TV MUX: 56.3 (Very Good) Local TV MUX: 38.6 (Moderate)	Multiple HP[9] UHF[10] aerials, orientated towards the Winter Hill transmitter, located on two to three-storey residential properties adjacent to location 5 were observed. Multiple satellite dishes were observed. All main multiplexes displayed fine picture and audio quality. An average of very good signal strength and signal fluctuations of less than or equal to 0.2dB. Both local multiplexes displayed fine picture and audio quality. An average of moderate signal strength and signal fluctuations of less than or equal to 0.3dB.	This location is approximately 3.3km from the development. Effects at this range are likely to be relatively small based on previous experience. Based on the current signal quality, effects are unlikely to be noticeable.

[9] Horizontally Polarised
[10] Ultra-High Frequency

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
6	Average: 59.3 (Very Good) Main TV MUX: 64.2 (Very Good) Local TV MUX: 44.4 (Moderate)	Multiple HP UHF aerials, orientated towards the Winter Hill transmitter, located on two to three-storey residential properties adjacent to location 6 were observed. Multiple satellite dishes were observed. All main multiplexes displayed fine picture and audio quality. An average of very good signal strength and signal fluctuations of less than or equal to 0.3dB. Both local multiplexes displayed fine picture and audio quality. An average of moderate signal strength and signal fluctuations of less than or equal to 0.1dB.	This location is approximately 3.6km from the development. Effects at this range are likely to be relatively small based on previous experience. Based on the current signal quality, effects are unlikely to be noticeable.

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
7	Average: 60.9 (Very Good) Main TV MUX: 65.0 (Very Good) Local TV MUX: 48.7 (Good)	Multiple HP UHF aerials, orientated towards the Winter Hill transmitter, located on two to three-storey residential properties adjacent to location 7 were observed. Multiple satellite dishes were observed. All main multiplexes displayed fine picture and audio quality. An average of good signal strength and signal fluctuations of less than or equal to 0.2dB. Both local multiplexes displayed fine picture and audio quality. An average of low signal strength and signal fluctuations of less than or equal to 0.1dB.	This location is approximately 4.0km from the development. Effects at this range are likely to be relatively small based on previous experience. Based on the current signal quality, effects are unlikely to be noticeable.

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
8	Average: 54.7 (Good) Main TV MUX: 59.5 (Very Good) Local TV MUX: 40.3 (Moderate)	Multiple HP UHF aerials, orientated towards the Winter Hill transmitter, located on two storey residential properties adjacent to location 8 were observed. Multiple satellite dishes were observed. All main multiplexes displayed fine picture and audio quality. An average of very good signal strength and signal fluctuations of less than or equal to 0.2dB. Both local multiplexes displayed fine picture and audio quality. An average of moderate signal strength and signal fluctuations of less than or equal to 0.1dB.	This location is approximately 4.9km from the development. Effects at this range are likely to be relatively small based on previous experience. Based on the current signal quality, effects are unlikely to be noticeable.

Table 4 *Television baseline survey results*

6 MITIGATION

6.1 Mitigation Requirement

If an adverse effect on television services occurs and is attributable to the development, mitigation may be required. The most effective form of mitigation is dependent on the specific impact. Common options are shown below.

Mitigation options include:

- Replacement of receiving aerial with a more directional or higher gain aerial.
- Repositioning the receiving aerial so that the received signal is stronger.
- Directing the receiving aerial to an alternative transmitter that covers the area and retuning the television accordingly.
- Upgrading antenna cabling and connections.
- Installation of signal amplifiers.
- Development of a bespoke local solution using a receiving aerial some distance from the dwelling.
- A combination of the above.
- Replacing terrestrial reception equipment with satellite reception equipment or cable.

6.2 Recommended Options

If interference were to occur for a small number of dwellings, it is likely that the installation of a satellite television receiver would be the most suitable option.

If effects are experienced for dwellings with poor quality or low receiving aerials, the best option may be to upgrade and/or elevate the existing aerial.

6.3 Recommended Process

It is possible that no adverse effects will occur due to the current reception quality in the surrounding area and the scarcity of residential receptors at a low height in the immediate shadow zone.

It is therefore recommended to investigate any reports of interference in order to determine whether these are attributable to the development. If this is found to be the case, mitigation can be applied.

There is no reason to install pre-emptive mitigation.

7 CONCLUSIONS

7.1 Findings

- The development is within the coverage area for the Winter Hill television transmitter. The baseline survey confirmed it was the main transmitter serving the area.
- Any interference would be due to shadowing effects i.e. the weakening of the transmitted signal due to the physical presence of the buildings.
- A site survey was undertaken on the 13th of December 2023 to confirm the relevant transmitter and record the signal quality.
- The average terrestrial signal strength is good in the development shadow zone for the main multiplexes and moderate on average for the local (lower power) multiplexes.
- Negative effects upon signal strength are typically limited to within 1km of the development and within its shadow zone based on Pager Power's industry experience.
- Predominately multistorey flats and/or commercial property are located from 150m to 1km of the development. The signal strength within this range was recorded as good for the main multiplexes. A reduction in signal strength is possible; however, effects are unlikely to be noticeable considering the baseline signal strength and the existence or height of any aerials within this range.
- At locations beyond 1km and within the shadow zone, the signal strength was on average 57.68dB for the main multiplexes. Effects at this range are likely to be relatively small based on previous experience.

7.2 Mitigation

No requirement for pre-emptive mitigation has been identified.

In the event that effects are reported, it is recommended that a reception measurement is undertaken (post-construction) to investigate the likely cause of the interference.

Mitigation measures should be installed if reported effects are found to be attributable to the development. Solutions are likely to be readily available if required, the most common options are presented in Section 6.

APPENDIX A – DETAILED SURVEY RESULTS

Location 1

Coordinates: Lon: -2.243000, Lat: 53.472428					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
24	LTVmux	35.0 +/- 0.5	$1x10^{-5}$	Fine	Fine
27	Glmux	32.0 +/- 0.3	Did not decode (DND)	DND	DND
29	SDN	47.9 +/-0.5	$3.5x10^{-5}$	Fine	Fine
31	Arqiva A	49.1 +/- 0.3	$2.5x10^{-5}$	Fine	Fine
32	BBC A	46.0 +/- 0.4	$1x10^{-7}$	Fine	Fine
34	Digital 3&4	47.8 +/- 0.2	$3x10^{-7}$	Fine	Fine
35-	BBC B	49.0 +/- 0.3	$1x10^{-7}$	Fine	Fine
37	Arqiva B	46.5 +/- 0.5	$2.7x10^{-6}$	Fine	Fine

Notes: No satellite dishes or aerials where observed.

Location 2

Coordinates: Lon: -2.241685, Lat: 53.471779					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
24	LTVmux	40.2 +/- 0.2	$1x10^{-7}$	Fine	Fine
27	Glmux	33.4 +/- 0.2	DND	DND	DND
29	SDN	51.5 +/- 0.1	$5x10^{-7}$	Fine	Fine
31	Arqiva A	52.2 +/- 0.4	$1.5x10^{-5}$	Fine	Fine
32	BBC A	48.1 +/-0.2	$2x10^{-5}$	Fine	Fine
34	Digital 3&4	50.9 +/-0.2	$3x10^{-8}$	Fine	Fine
35-	BBC B	50.2 +/- 0.3	$1x10^{-3}$	Fine	Fine
37	Arqiva B	52.3 +/- 0.4	$5x10^{-6}$	Fine	Fine

Notes: One satellite dish and one HP[11] UHF[12] aerial was observed. Best signal strength found when orientated west.

[11] Horizontally Polarised
[12] Ultra-High Frequency

Location 3

Coordinates: Lon: -2.230927, Lat: 53.465453					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
24	LTVmux	40.2 +/- 0.2	$1x10^{-7}$	Fine	Fine
27	Glmux	37.0 +/- 0.1	$7.8x10^{-5}$	Fine	Fine
29	SDN	55.0 +/- 0.2	$9x10^{-8}$	Fine	Fine
31	Arqiva A	50.4 +/- 0.2	$3.6x10^{-6}$	Fine	Fine
32	BBC A	50.8 +/- 0.3	$1x10^{-7}$	Fine	Fine
34	Digital 3&4	53.7 +/- 0.2	$1x10^{-7}$	Fine	Fine
35-	BBC B	52.0 +/-0.2	$1x10^{-7}$	Fine	Fine
37	Arqiva B	53.3 +/- 0.1	$1x10^{-7}$	Fine	Fine

Notes: No satellite dishes or aerials where observed.

Location 4

Coordinates: Lon: -2.220160, Lat: 53.459603					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
24	LTVmux	32.5 +/- 0.1	$2.5x10^{-7}$	Fine	Fine
27	Glmux	27.0 +/- 0.1	DND	DND	DND
29	SDN	45.4 +/- 0.1	$15x10^{-8}$	Fine	Fine
31	Arqiva A	42.9 +/- 0.2	$2.5x10^{-6}$	Fine	Fine
32	BBC A	37.8 +/- 0.5	N/A	INT	INT
34	Digital 3&4	47.6 +/- 0.1	$1x10^{-7}$	Fine	Fine
35-	BBC B	45.2 +/- 0.1	$1x10^{-7}$	Fine	Fine
37	Arqiva B	41.2 +/- 0.2	$1.6x10^{-2}$	Intermittent	Intermittent

Notes: No satellite dishes or aerials where observed.

Location 5

Coordinates: Lon: -2.208772, Lat: 53.453156					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
24	LTVmux	41.6 +/- 0.1	$1x10^{-7}$	Fine	Fine
27	Glmux	35.5 +/- 0.3	$1x10^{-2}$	Fine	Fine
29	SDN	55.5 +/- 0.1	$1x10^{-7}$	Fine	Fine
31	Arqiva A	55.2 +/- 0.2	$1x10^{-7}$	Fine	Fine
32	BBC A	55.8 +/-0.2	$1x10^{-7}$	Fine	Fine
34	Digital 3&4	57.8 +/- 0.1	$1x10^{-7}$	Fine	Fine
35-	BBC B	57.8 +/- 0.1	$1x10^{-7}$	Fine	Fine
37	Arqiva B	55.5 +/- 0.2	$1x10^{-7}$	Fine	Fine

Notes: Multiple HP UHF aerials, orientated towards the Winter Hill transmitter, located on two storey residential properties adjacent to location 6 were observed. Multiple satellite dishes were observed.

Location 6

Coordinates: Lon: -2.202454, Lat: 53.449602					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
24	LTVmux	45.4 +/- 0.1	$1x10^{-7}$	Fine	Fine
27	Glmux	43.4 +/- 0.1	$1x10^{-7}$	Fine	Fine
29	SDN	63.3 +/- 0.1	$1x10^{-7}$	Fine	Fine
31	Arqiva A	63.0 +/- 0.3	$1x10^{-7}$	Fine	Fine
32	BBC A	64.4 +/- 0.1	$1x10^{-7}$	Fine	Fine
34	Digital 3&4	65.1 +/- 0.1	$1x10^{-7}$	Fine	Fine
35-	BBC B	64.9 +/- 0.1	$1x10^{-7}$	Fine	Fine
37	Arqiva B	64.6 +/- 0.1	$1x10^{-7}$	Fine	Fine

Notes: Multiple HP UHF aerials, orientated towards the Winter Hill transmitter, located on two storey residential properties adjacent to location 7 were observed. Multiple satellite dishes were observed.

Location 7

Coordinates: Lon: -2.198528, Lat: 53.447109					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
24	LTVmux	49.2 +/- 0.1	$1x10^{-7}$	Fine	Fine
27	Glmux	48.1 +/- 0.1	$1x10^{-7}$	Fine	Fine
29	SDN	47.8 +/- 0.1	$1x10^{-7}$	Fine	Fine
31	Arqiva A	68.7 +/- 0.1	$1x10^{-7}$	Fine	Fine
32	BBC A	68.5 +/- 0.1	$1x10^{-7}$	Fine	Fine
34	Digital 3&4	68.3 +/- 0.2	$1x10^{-7}$	Fine	Fine
35-	BBC B	68.7 +/- 0.2	$1x10^{-7}$	Fine	Fine
37	Arqiva B	67.8 +/- 0.1	$1x10^{-7}$	Fine	Fine

Notes: Multiple HP UHF aerials, orientated towards the Winter Hill transmitter, located on two storey residential properties adjacent to location 8 were observed. Multiple satellite dishes were observed.

Location 8

Coordinates: Lon: -2.194430, Lat: 53.444787					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
24	LTVmux	41.4 +/- 0.1	$1x10^{-7}$	Fine	Fine
27	Glmux	39.2 +/- 0.1	$1x10^{-7}$	Fine	Fine
29	SDN	59.9 +/- 0.1	$1x10^{-8}$	Fine	Fine
31	Arqiva A	59.4 +/- 0.2	$1x10^{-7}$	Fine	Fine
32	BBC A	59.9 +/- 0.1	$1x10^{-7}$	Fine	Fine
34	Digital 3&4	60.0 +/- 0.2	$1x10^{-7}$	Fine	Fine
35-	BBC B	59.5 +/- 0.2	$1x10^{-7}$	Fine	Fine
37	Arqiva B	58.4 +/- 0.1	$1x10^{-7}$	Fine	Fine

Notes: Multiple HP UHF aerials, orientated towards the Winter Hill transmitter, located on two storey residential properties adjacent to location 9 were observed. Multiple satellite dishes were observed.

APPENDIX B – SURVEY PHOTOGRAPHS

Location 1



Location 2



Location 3



Location 4



Location 5


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Urban & Renewables
SURVEYING
E015 0EY
SURVEYING

Location 6



Location 7



Location 8



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