

Television and Radio Baseline Survey Report

Block C First Street, Manchester

Downing Living (Manchester South) Limited Partnership Incorporated

November 2023

PLANNING SOLUTIONS FOR:

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ADMINISTRATION PAGE

Job Reference:	12469A
Author:	Andrea Mariano
Telephone:	01787 319001
Email:	andrea@pagerpower.com

Reviewed By:	Michael Sutton
Email:	michael@pagerpower.com

Issue	Date	Detail of Changes
1	August 2023	Initial issue
2	November 2023	Inclusion of final plans

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Pager Power Limited, Stour Valley Business Centre, Sudbury, CO10 7GB

T:01787 319001 E:info@pagerpower.com W:www.pagerpower.com

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EXECUTIVE SUMMARY

Report Purpose

Pager Power has been commissioned to investigate the potential impact of a proposed building development upon terrestrial television and radio reception in the surrounding area. The development is located on Newcastle Street in central Manchester.

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

Findings

Television

- 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.
- Interference would be due to shadowing effects i.e. the weakening of the transmitted signal due to the physical presence of the building.
- A site survey was undertaken on the 14th of August 2023, to confirm the relevant transmitter and record the signal quality. Negative effects upon signal strength are most likely at locations close to the development i.e. within 1km of the development.
- In the development shadow zone the terrestrial signal strength is 'good' to 'very good' for the main multiplexes and 'low' to "good" for the local (lower power) multiplexes.
- The shadow area lies over residential areas for its entire length with just few commercial buildings. In general, the residential dwellings observed had multiple storeys. A reduction in signal strength is possible based on the proximity to the development and the height of receiving aerials; however, the effects are unlikely to be noticeable for the main multiplexes based on the current signal quality. Effects may be noticeable for local multiplexes due the already low signal strength.
- At locations beyond 1km and within the shadow zone, the signal strength was, on average, 'very good' for the main multiplexes. Effects at this range are likely to be relatively small based on previous experience.

Radio

- The area surrounding the development receives radio services from numerous transmitters, including Winter Hill.
- Fine audio quality was observed for all digital radio services at all locations surveyed at close range to the development. Fine audio quality was observed for FM services.
- Degradation of the radio signal at close range (within a few hundred metres) to the development is possible. The effects are unlikely to be noticeable in practice due to the variability of services in an urban environment.

Mitigation

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. No requirement for pre-emptive mitigation has been identified.

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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 upon terrestrial television reception in the surrounding area. The development is located on Newcastle Street in central Manchester.

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

1.2 Site Location Plan

The proposed development site location plan is shown in light blue in Figure 1¹ below.

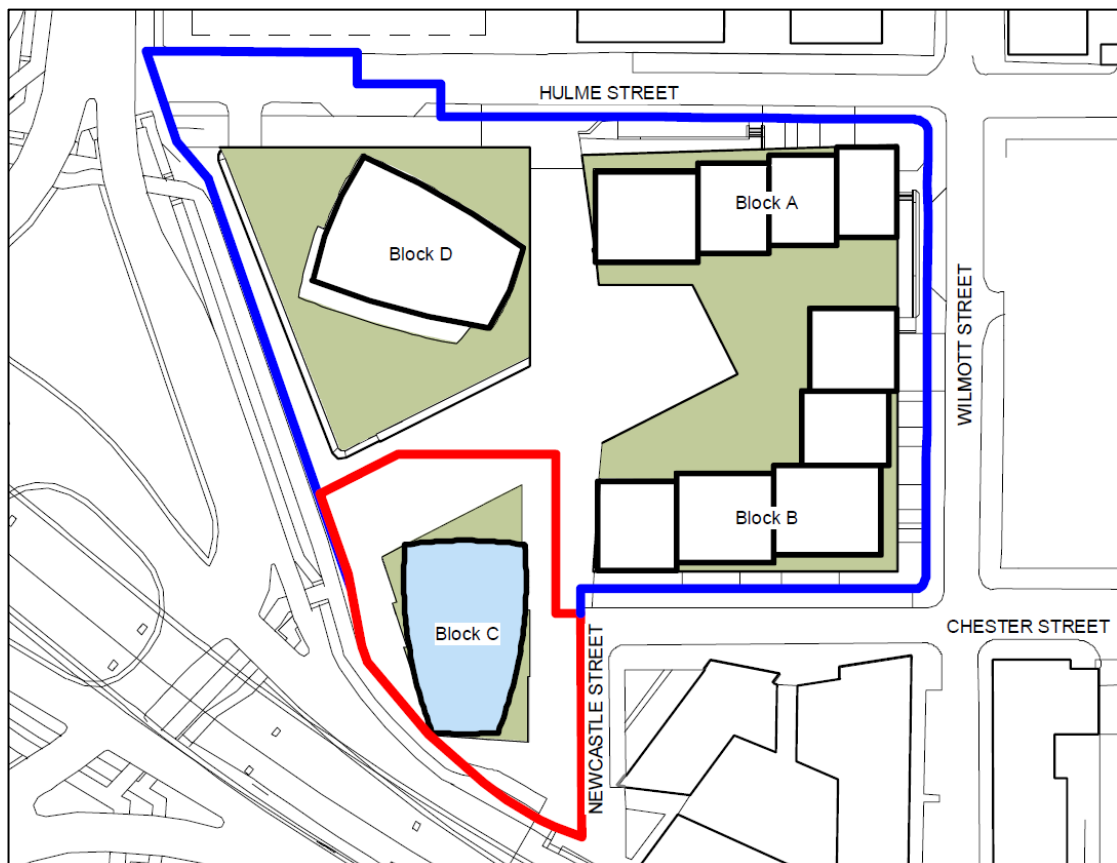


Figure 1 – Proposed development site location plan

¹ 10474-SHP-Z0-A-B5D8-G100-PL-XX-001 (cropped)

1.3 Proposed Development Boundary – Aerial image

The approximate proposed development location is shown in Figure 2 below.

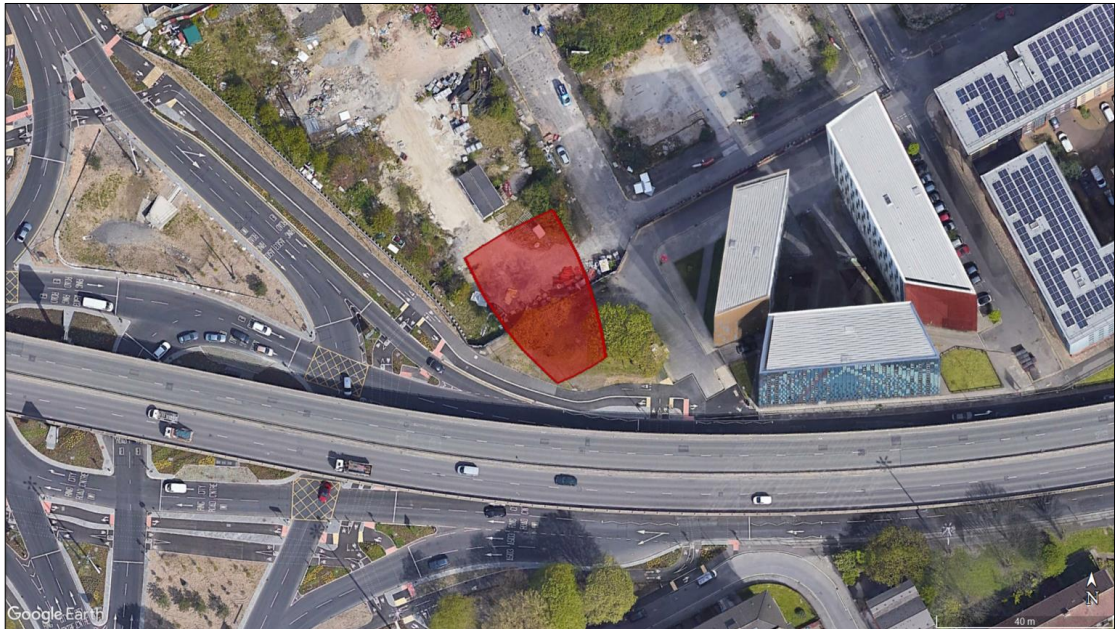


Figure 2 – Proposed development site layout (red) – aerial image

The proposed development north elevation is shown in Figure 3² below.

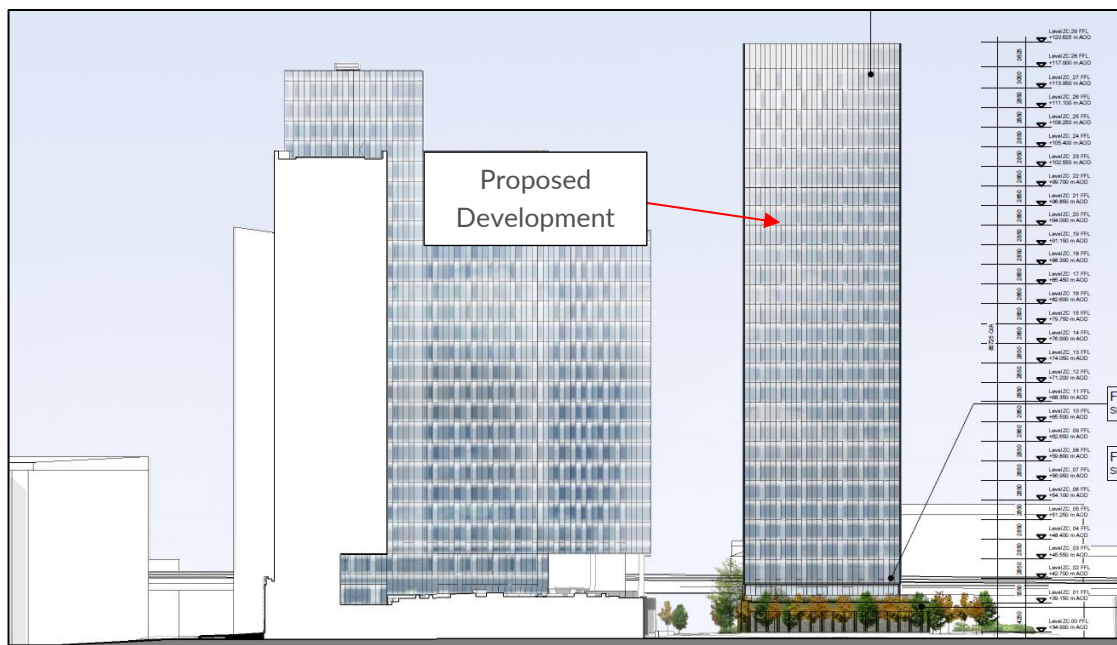


Figure 3 – Proposed development elevations

² 10474-SHP-Z0-A-B5D8-G000-EL-EN-001 (cropped)

2 TELEVISION TRANSMITTER DETAILS

2.1 Relevant Transmitter

A comprehensive search of transmitter and coverage maps revealed that the Winter Hill transmitter is the main transmitter most likely to be serving the area around the proposed development.

Digital television services are broadcast via Ultra High Frequency (UHF) signals; no analogue television signals are broadcast. The transmitter information is presented below³.

2.2 Winter Hill Main Transmitter

Winter Hill is one of the UK's main television transmitters located approximately 25.2km north northeast of the proposed development. The main digital services provided 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	200 kilo-Watts (kW)					

Table 1 – Winter Hill transmissions (main multiplexes)

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 transmissions (local multiplexes)

³ Source: [Ofcom](#), UK digital television transmitter details – DSO multiplexes, UKFreeTV and previous reception surveys.

2.3 Radio Transmissions

Radio services in the UK are broadcast from a variety of main and local transmitters. Services are currently broadcast as both analogue and digital transmissions and in many cases are broadcast from television transmitter towers.

Receivers are typically mobile or portable devices with omnidirectional aerials. Although transmissions from Winter Hill have been assessed, the relevant transmitter is dependent on the receiver's exact position and the radio channel that is being received. Therefore, radio signals tend to be more robust compared to television signals.

Radio transmissions are shown in Table 3 below.

	Digital			FM
Service	SDL National	Digital One	BBC National DAB	Various Services
Frequency	216.65MHz	220.352MHz	225.648MHz	88.8 – 105.8MHz
Power	20kW	8.7kW	10kW	Max 4 kW

Table 3 – Winter Hill radio transmissions

3 BUILDINGS AND TELEVISION INTERFERENCE

3.1 Technical Overview

3.1.1 Television

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.

3.1.2 Radio

Radio services are also received from fixed transmitters, much like terrestrial television signals. However, radio services are typically available from numerous transmitters, particularly in a dense urban environment. Services can be digital or analogue.

The quality of the received signal is dependent on its strength and the level of interference, although radio services are typically more robust to interference than television signals.

3.2 Interference mechanisms

There are two ways that buildings can cause interference to television and radio 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 northwest 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 4 below⁴, taken from Section 3.2 of an Ofcom paper⁵ regarding the impact of buildings on broadcast signals.

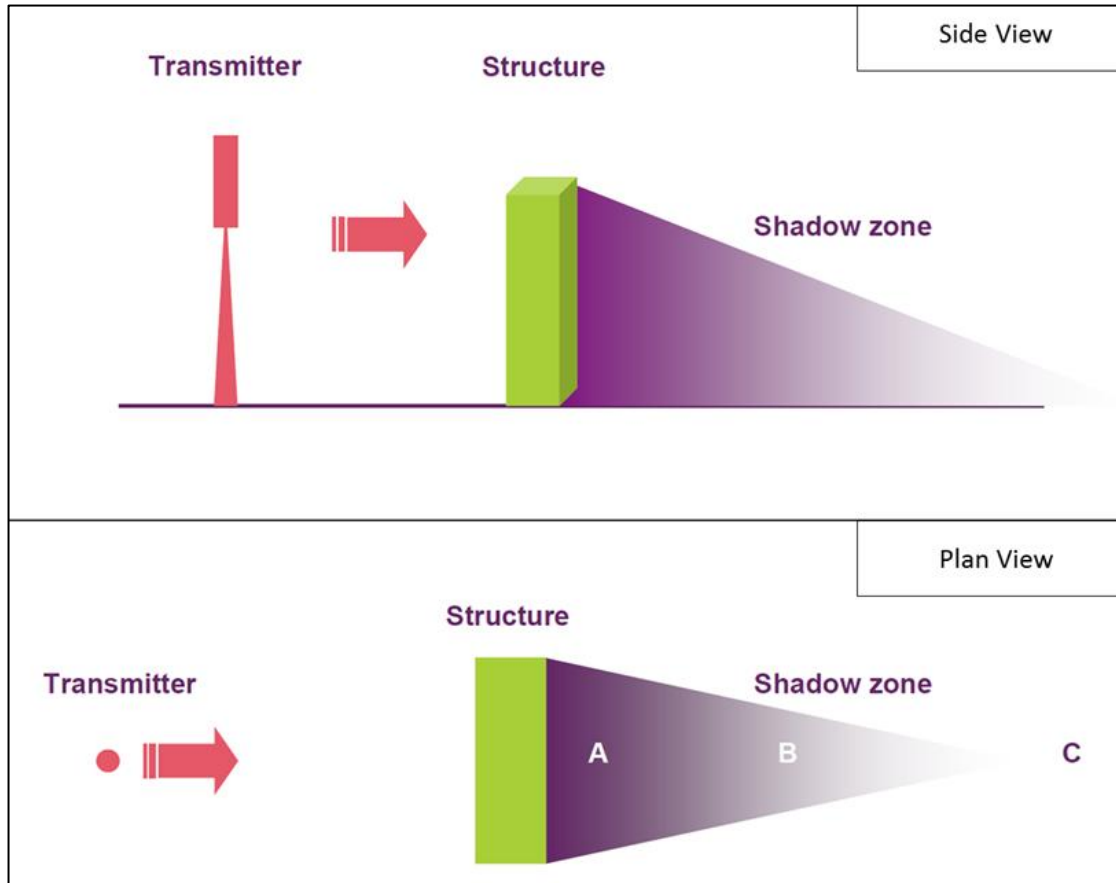


Figure 4 – Diffraction loss zones

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

⁴ Source: Ofcom (2009): Tall Structures and their impact on broadcast and other wireless services.

⁵ Reference as above.

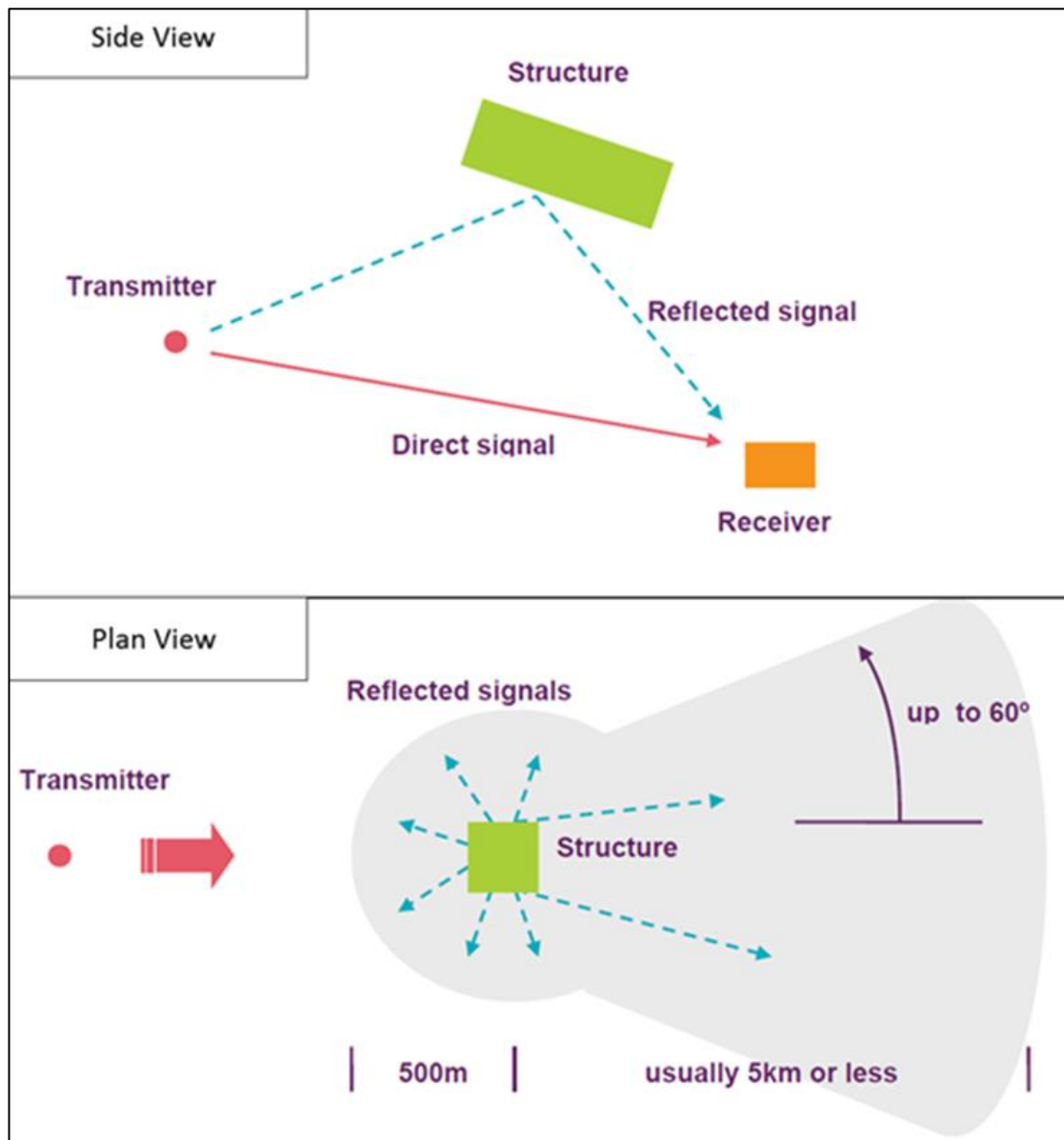


Figure 5 – Reflection zones

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 degrees⁶.

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

3.3 Radio Interference

There is less specific guidance for radio interference within the Ofcom guidance. The following information is given:

Although reports of new structures causing problems to radio reception are rare, the possibility of difficulties cannot be ruled out entirely. Broadcast radio (FM, AM and DAB digital radio) are transmitted on lower frequencies than those used by terrestrial TV signals. Lower frequency signals tend to pass through obstructions more easily than the higher frequency TV signals, and diffraction effects also become more significant at lower frequencies. Both these factors will tend to lessen the impact of new structures on radio reception.

Strong signal reflections will reduce the quality of FM reception leading to fluttering noises or sound distortion. In contrast, the signal format used for DAB digital radio is designed to offer high levels of robustness in difficult conditions and it is not materially affected by reflections. FM and DAB reception can be affected where a structure blocks signals and both may cease to function if signals are reduced below a certain threshold.

It is Pager Power's experience that reported interference to radio services is significantly less common than reported interference to television services. Potential impacts on radio service have nevertheless been considered within the analysis.

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 4 in the previous section. Figure 6 below shows the potential interference areas associated with the development.

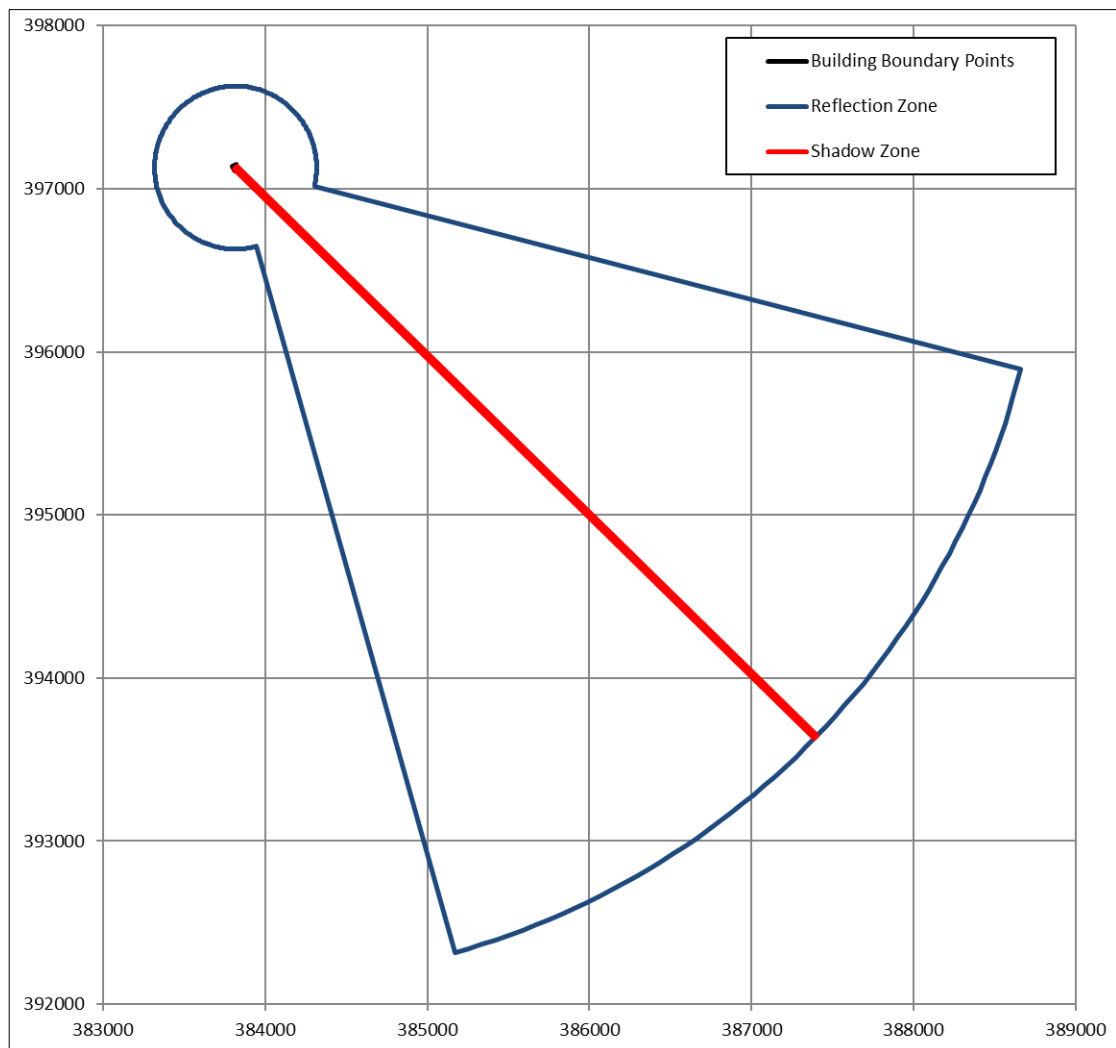


Figure 6 – Interference areas

Figure 7 below shows the interference zones overlaid onto an aerial image of the area.

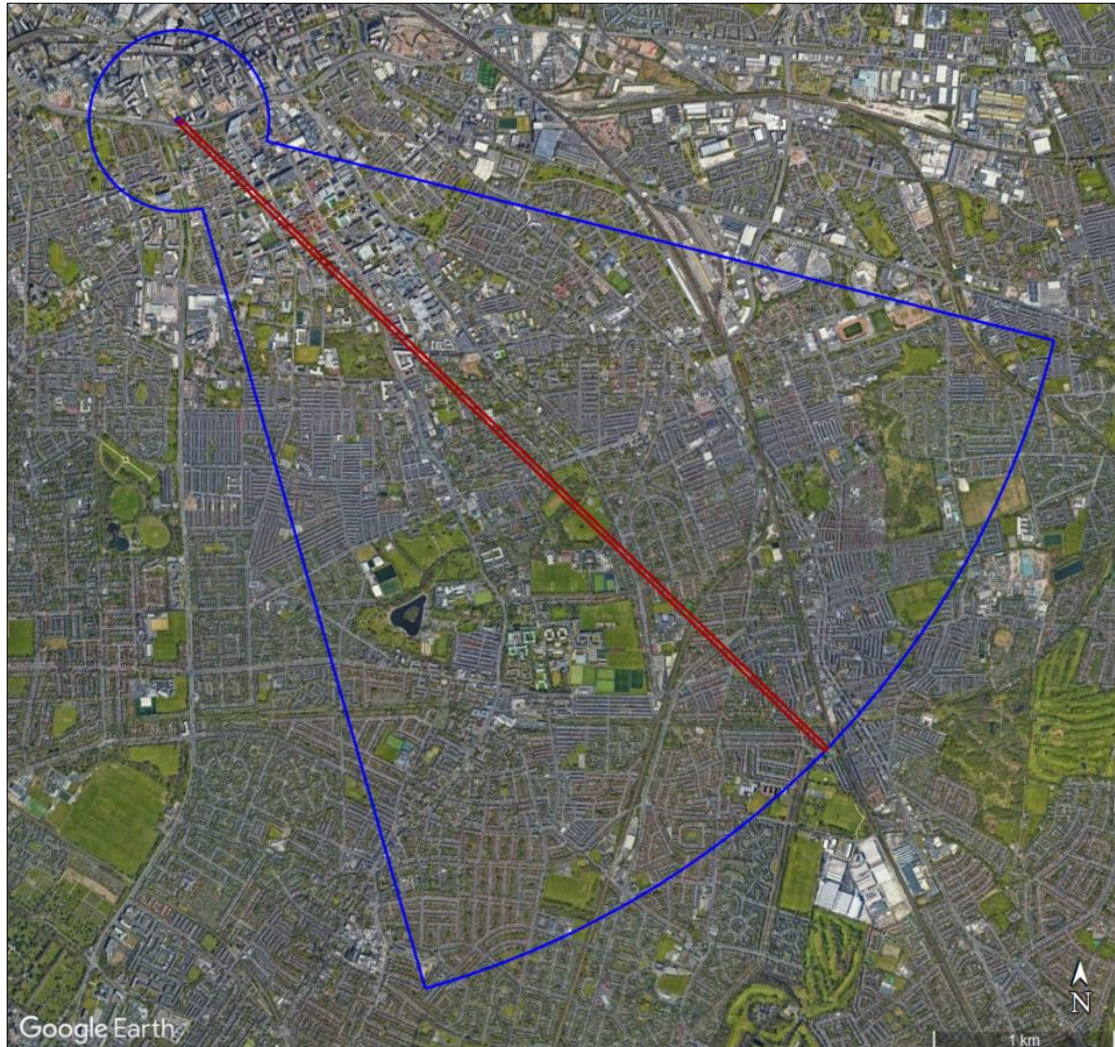


Figure 7 – Interference zones map

4.2 Potential Diffraction Issues – Terrestrial Television

The shadow zone passes over urban areas that contain predominately 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. Two-storey dwellings are located within 1km of the development shadow zone. Beyond this range and within the shadow zone, interference effects attributable to the development are unlikely.

4.3 Potential Reflection Issues – Terrestrial Television

Reflection effects are most likely if the transmitter does not have a 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 is 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 is met.

In practice, it is unlikely that all of the above criteria would be met for the development. In particular, locations that are below the 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.

4.4 Interference Areas – Radio Services

Due to the number of potential transmitters and the nature of most radio receivers (mobile), the potential interference areas are less well-defined than for television services. In general terms, interference is more likely at small distances (within a few hundred metres) from the building.

5 TELEVISION AND RADIO 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 and radio reception survey was undertaken for the development on the 14th of August 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 a television analyser to record the signal strength and stability.

The strength of the recorded signals is categorised in accordance with Table 4 below.

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

Table 4 – Signal strength categories

5.2 Survey Locations

Figure 8 on the following page shows the survey locations overlaid onto aerial photography. The development location and the shadow zone are also shown. Survey locations were chosen pre-survey; however, safe and available access influenced the specific position on the day (no reading was carried out at location 4 due to access). The locations shown on the following page show the actual survey locations. More readings were carried out closer to the development location. This is because interference is generally more likely the closer the location is to the obstruction. Television measurements were taken at survey locations 1 to 8. Radio measurements (see Figure 9 on page 22) were taken at survey locations Radio 1, Radio 2 and 1.



Figure 8 – TV Survey locations

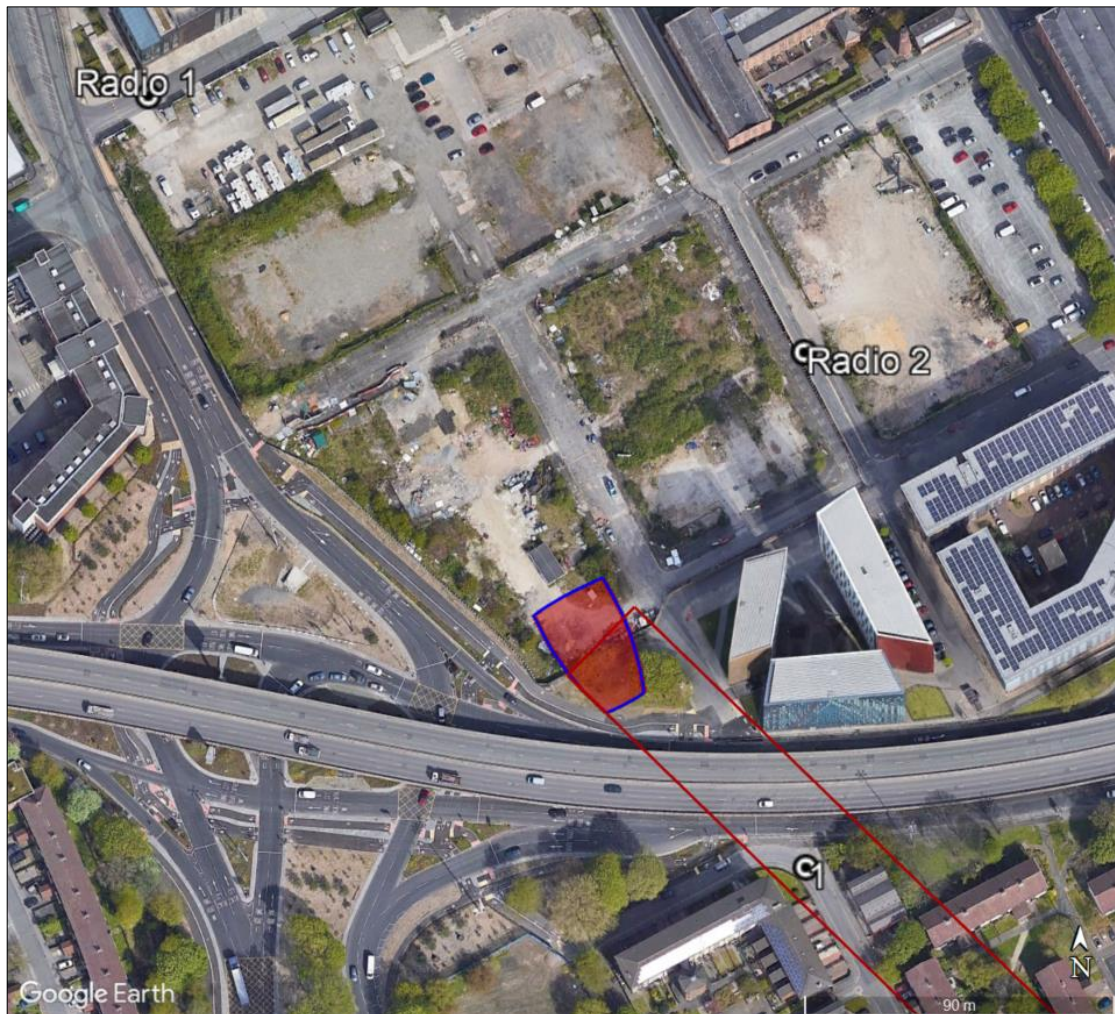


Figure 9 – Radio Survey locations

5.3 Survey Results (Television)

A summary of the television survey results is presented in Table 5 on the following pages. 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	<p>Main TV MUX: 54.4 (Good)</p> <p>Local TV MUX: 36.3 (Moderate)</p>	<p>One HP⁷ UHF⁸ aerial directed towards the Winter Hill transmitter was observed. No satellite dishes were observed.</p> <p>All main multiplexes displayed fine picture and audio quality. Signal fluctuations of less than or equal to 0.5dB. The local multiplex displayed fine picture and audio. Signal fluctuations of less than or equal to 0.3dB.</p>	<p>This location is approximately 70 metres from the development.</p> <p>Two-stories properties are located near this location.</p> <p>A reduction in signal strength is likely based on the proximity to the development and the height of receiving aerials; however, the effects are unlikely to be noticeable for the main multiplexes based on the current signal quality. Effects may be noticeable for local multiplexes.</p>
2	<p>Main TV MUX: 48.5 (Good)</p> <p>Local TV MUX: 30.1 (Low)</p>	<p>Multiple HP UHF aerials directed towards the Winter Hill transmitter were observed. No satellite dishes were observed.</p> <p>All six main multiplexes displayed fine picture and audio quality. Signal fluctuations of less than or equal to 0.5dB. One local multiplex displayed fine picture and audio. The other local multiplex did not decode. Signal fluctuations of less than or equal to 0.2dB.</p>	<p>This location is approximately 170 metres from the development.</p> <p>Four-stories properties are located near this location.</p> <p>A reduction in signal strength is likely based on the proximity to the development and the height of receiving aerials; however, for the main multiplexes, the effects are unlikely to be noticeable based on the current signal quality. Effects will likely be noticeable for local multiplexes.</p>

⁷ Horizontally Polarised.

⁸ Ultra-High Frequency

Location	Average Measured Signal Strength (dB)	Remarks	High-Level Conclusion
3	<p>Main TV MUX: 44.3 (Moderate)</p> <p>Local TV MUX: 27.5 (Low)</p>	<p>No aerials or satellite dishes observed. It is likely they are located on the roof of the surrounding tall buildings.</p> <p>All six main multiplexes displayed fine picture and audio quality. Signal fluctuations of less than or equal to 0.3dB. One local multiplex displayed fine picture and audio. The other local multiplex did not decode. Signal fluctuations of less than or equal to 0.3dB.</p>	<p>This location is approximately 450 metres from the development.</p> <p>Four-stories properties are located near this location.</p> <p>A reduction in signal strength is likely based on the proximity to the development and the height of receiving aerials; however, for the main multiplexes, the effects are unlikely to be noticeable based on the current signal quality. Effects may be noticeable for local multiplexes.</p>
4	No access available at location 4		
5	<p>Main TV MUX: 43.9 (Moderate)</p> <p>Local TV MUX: 27.5 (Low)</p>	<p>Multiple HP UHF aerials directed towards the Winter Hill transmitter were observed. No satellite dishes were observed.</p> <p>All six main multiplexes displayed fine picture and audio quality. Signal fluctuations of less than or equal to 0.4dB. One local multiplex displayed fine picture and audio. The other local multiplex did not decode. Signal fluctuations of less than or equal to 0.2dB.</p>	<p>This location is approximately 1.42km from the development.</p> <p>Two-stories properties are located near this location.</p> <p>A reduction in signal strength is unlikely based on the proximity to the development; therefore, effects are unlikely to be noticeable, despite the low signal quality.</p>

Location	Average Measured Signal Strength (dB)	Remarks	High-Level Conclusion
6	<p>Main TV MUX: 65.8 (Very Good)</p> <p>Local TV MUX: 46.8 (Good)</p>	<p>Multiple HP UHF aerials directed towards the Winter Hill transmitter were observed. No satellite dishes were observed.</p> <p>All six main multiplexes displayed fine picture and audio quality. Signal fluctuations of less than or equal to 0.5dB. The local multiplex displayed fine picture and audio. Signal fluctuations of less than or equal to 0.2dB.</p>	<p>This location is approximately 2.01km from the development.</p> <p>Two-storey properties are located near this location with aerials directed towards Winter Hill.</p> <p>A reduction in signal strength is unlikely based on the proximity to the development; therefore, effects are unlikely to be noticeable, also considering the high signal quality.</p>
7	<p>Main TV MUX: 60.4 (Very Good)</p> <p>Local TV MUX: 46.7 (Good)</p>	<p>Multiple HP UHF aerials directed towards the Winter Hill transmitter were observed. No satellite dishes were observed.</p> <p>All six main multiplexes displayed fine picture and audio quality. Signal fluctuations of less than or equal to 0.4dB. The local multiplex displayed fine picture and audio. Signal fluctuations of less than or equal to 0.3dB.</p>	<p>This location is approximately 2.79km from the development.</p> <p>Two-stories properties are located near this location.</p> <p>A reduction in signal strength is unlikely based on the proximity to the development; therefore, effects are unlikely to be noticeable, also considering the high signal quality.</p>

Location	Average Measured Signal Strength (dB)	Remarks	High-Level Conclusion
8	Main TV MUX: 69.7 (Very Good) Local TV MUX: 53.1 (Good)	Multiple HP UHF aerials directed towards the Winter Hill transmitter were observed. No satellite dishes were observed. All six main multiplexes displayed fine picture and audio quality. Signal fluctuations of less than or equal to 0.2dB. The local multiplex displayed fine picture and audio. Signal fluctuations of less than or equal to 0.2dB.	This location is approximately 3.60km from the development. Two-stories properties are located near this location. A reduction in signal strength is unlikely based on the proximity to the development; therefore, effects are unlikely to be noticeable, also considering the high signal quality.

Table 5 – Television baseline survey results

5.4 Survey Results (Radio)

Fine audio quality was observed for all radio services at all locations surveyed at close range to the development. Fine audio quality was observed for FM services. Detailed results are shown in Appendix A.

Overall, some degradation of the radio signal at close range to the development is possible. The effects are unlikely to be noticeable in practice due to the variability of services in an urban environment.

6 MITIGATION

6.1 Mitigation Requirement

If an adverse effect on television or radio 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 for television 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.

Mitigation options for radio include:

- Re-tuning the radio.
- Relocation of the radio.
- Upgrading the aerial or the radio itself.
- Provision of an external aerial for receiving radio services.

6.2 Recommended Options

6.2.1 Television

If interference were to occur for a small number of dwellings it is likely that installation of 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.

It is also possible that the television services could be supplied by an alternate transmitter in the surrounding area.

6.2.2 Radio

The most appropriate solution if radio services at residences are affected may be provision of a new radio or an external 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

7.1.1 Television

- 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.
- Interference would be due to shadowing effects i.e. the weakening of the transmitted signal due to the physical presence of the building.
- A site survey was undertaken on the 14th of August 2023, to confirm the relevant transmitter and record the signal quality. Negative effects upon signal strength are most likely at locations close to the development i.e. within 1km of the development.
- In the development shadow zone the terrestrial signal strength is 'good' to 'very good' for the main multiplexes and 'low' to "good" for the local (lower power) multiplexes.
- The shadow area lies over residential areas for its entire length with just few commercial buildings. In general, the residential dwellings observed had multiple storeys. A reduction in signal strength is possible based on the proximity to the development and the height of receiving aerials; however, the effects are unlikely to be noticeable for the main multiplexes based on the current signal quality. Effects may be noticeable for local multiplexes due the already low signal strength.
- At locations beyond 1km and within the shadow zone, the signal strength was, on average, 'very good' for the main multiplexes. Effects at this range are likely to be relatively small based on previous experience.

7.1.2 Radio

- The area surrounding the development receives radio services from numerous transmitters, including Winter Hill.
- Fine audio quality was observed for all digital radio services at all locations surveyed at close range to the development. Fine audio quality was observed for FM services.
- Degradation of the radio signal at close range (within a few hundred metres) to the development is possible. The effects are unlikely to be noticeable in practice due to the variability of services in an urban environment.

7.2 Mitigation

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. No requirement for pre-emptive mitigation has been identified.

APPENDIX A – DETAILED SURVEY RESULTS

Radio Location 1

Radio				
Frequency	Block	Service	Signal Strength (dBμV)	Typical Fluctuation (dBμV)
216.928 MHz	11A	SDL National	45.5	0.4
222.064 MHz	11D	Digital One	65.0	0.4
223.936 MHz	12A	Lancashire	20.1	0.1
225.648 MHz	12B	BBC National DAB	57.9	0.4
227.360 MHz	12C	CE Manchester	58.4	0.5
88-106 MHz (221.4)	N/A	Various FM	66.5	0.3

Radio Location 2

Radio				
Frequency	Block	Service	Signal Strength (dBμV)	Typical Fluctuation (dBμV)
216.928 MHz	11A	SDL National	51.0	0.2
222.064 MHz	11D	Digital One	69.5	0.5
223.936 MHz	12A	Lancashire	50.0	0.2
225.648 MHz	12B	BBC National DAB	74.3	0.3
227.360 MHz	12C	CE Manchester	73.5	0.3
88-106 MHz (221.4)	N/A	Various FM	64.3	0.4

Location 1

Television					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	39.3 +/- 0.3	1×10^{-8}	Fine	Fine
27	Glmux	33.2 +/- 0.3	1×10^{-3}	Fine	Fine
29	SDN	54.3 +/- 0.5	1×10^{-8}	Fine	Fine
31	Arqiva A	56.2 +/- 0.4	1×10^{-8}	Fine	Fine
32	BBC A	54.5 +/- 0.2	1×10^{-8}	Fine	Fine
34	Digital 3&4	52.1 +/- 0.2	1×10^{-8}	Fine	Fine
35-	BBC B	54.0 +/- 0.1	1×10^{-8}	Fine	Fine
37	Arqiva B	55.1 +/- 0.4	1×10^{-8}	Fine	Fine

Notes: One Horizontally Polarised (HP) aerial orientated towards Winter Hill observed

Radio				
Frequency	Block	Service	Signal Strength (dBμV)	Typical Fluctuation (dBμV)
216.928 MHz	11A	SDL National	43.0	0.3
222.064 MHz	11D	Digital One	68.7	0.5
223.936 MHz	12A	Lancashire	16.5	0.5
225.648 MHz	12B	BBC National DAB	65.0	0.5
227.360 MHz	12C	CE Manchester	65.7	0.4
88-106 MHz	N/A	Various FM	58.4	0.2

Location 2

Television					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	31.4 +/- 0.2	1×10^{-5}	Fine	Fine
27	Glmux	28.8 +/- 0.2	3×10^{-3}	Originally decoded then lost signal	
29	SDN	47.5 +/- 0.5	1×10^{-8}	Fine	Fine
31	Arqiva A	50.2 +/- 0.2	1×10^{-8}	Fine	Fine
32	BBC A	50.7 +/- 0.3	1×10^{-8}	Fine	Fine
34	Digital 3&4	49.0 +/- 0.4	1×10^{-8}	Fine	Fine
35-	BBC B	49.4 +/- 0.2	1×10^{-8}	Fine	Fine
37	Arqiva B	44.0 +/- 0.4	1×10^{-5}	Fine	Fine

Notes: Multiple HP aerials orientated towards Winter Hill observed

Location 3

Television					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	29.7 +/- 0.1	1×10^{-6}	Fine	Fine
27	Glmux	25.3 +/- 0.3	DND	-	-
29	SDN	45.7 +/- 0.3	1×10^{-7}	Fine	Fine
31	Arqiva A	43.0 +/- 0.3	1×10^{-5}	Fine	Fine
32	BBC A	44.7 +/- 0.2	1×10^{-8}	Fine	Fine
34	Digital 3&4	42.8 +/- 0.2	1×10^{-8}	Fine	Fine
35-	BBC B	44.3 +/- 0.1	1×10^{-8}	Fine	Fine
37	Arqiva B	45.0 +/- 0.2	1×10^{-8}	Fine	Fine

Notes: No aerials or satellite dishes observed. It is likely they are located on the roof of the surrounding tall buildings.

Location 5

Television					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	29.7 +/- 0.2	8×10^{-7}	Fine	Fine
27	Glmux	25.2 +/- 0.1	7×10^{-3}	-	-
29	SDN	45.0 +/- 0.1	1×10^{-8}	Fine	Fine
31	Arqiva A	44.4 +/- 0.2	1×10^{-8}	Fine	Fine
32	BBC A	43.2 +/- 0.4	1×10^{-8}	Fine	Fine
34	Digital 3&4	43.0 +/- 0.2	1×10^{-8}	Fine	Fine
35-	BBC B	45.0 +/- 0.4	1×10^{-8}	Fine	Fine
37	Arqiva B	42.6 +/- 0.4	5×10^{-6}	Fine	Fine

Notes: Multiple HP aerials orientated towards Winter Hill observed

Location 6

Television					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	51.2 +/- 0.1	1×10^{-8}	Fine	Fine
27	Glmux	42.4 +/- 0.2	1×10^{-8}	Fine	Fine
29	SDN	66.3 +/- 0.2	1×10^{-8}	Fine	Fine
31	Arqiva A	66.6 +/- 0.3	1×10^{-8}	Fine	Fine
32	BBC A	66.3 +/- 0.2	1×10^{-8}	Fine	Fine
34	Digital 3&4	65.4 +/- 0.2	1×10^{-8}	Fine	Fine
35-	BBC B	65.5 +/- 0.5	1×10^{-8}	Fine	Fine
37	Arqiva B	64.5 +/- 0.3	1×10^{-8}	Fine	Fine

Notes: Multiple HP aerials orientated towards Winter Hill observed

Location 7

Television					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	50.4 +/- 0.2	1 x 10 ⁻⁸	Fine	Fine
27	Glmux	42.9 +/- 0.3	1 x 10 ⁻⁸	Fine	Fine
29	SDN	62.9 +/- 0.4	1 x 10 ⁻⁸	Fine	Fine
31	Arqiva A	62.0 +/- 0.2	1 x 10 ⁻⁸	Fine	Fine
32	BBC A	60.3 +/- 0.1	1 x 10 ⁻⁸	Fine	Fine
34	Digital 3&4	60.3 +/- 0.2	1 x 10 ⁻⁸	Fine	Fine
35-	BBC B	60.2 +/- 0.3	1 x 10 ⁻⁸	Fine	Fine
37	Arqiva B	56.4 +/- 0.2	1 x 10 ⁻⁸	Fine	Fine

Notes: Multiple HP aerials orientated towards Winter Hill observed

Location 8

Television					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	53.1 +/- 0.2	1 x 10 ⁻⁸	Fine	Fine
27	Glmux	49.5 +/- 0.2	1 x 10 ⁻⁸	Fine	Fine
29	SDN	70.6 +/- 0.1	1 x 10 ⁻⁸	Fine	Fine
31	Arqiva A	69.5 +/- 0.2	1 x 10 ⁻⁸	Fine	Fine
32	BBC A	68.6 +/- 0.1	1 x 10 ⁻⁸	Fine	Fine
34	Digital 3&4	69.3 +/- 0.1	1 x 10 ⁻⁸	Fine	Fine
35-	BBC B	70.0 +/- 0.1	1 x 10 ⁻⁸	Fine	Fine
37	Arqiva B	70.0 +/- 0.2	1 x 10 ⁻⁸	Fine	Fine

Notes: Multiple HP aerials orientated towards Winter Hill observed

APPENDIX B – SURVEY PHOTOGRAPHS

Location Radio 1



Location Radio 2



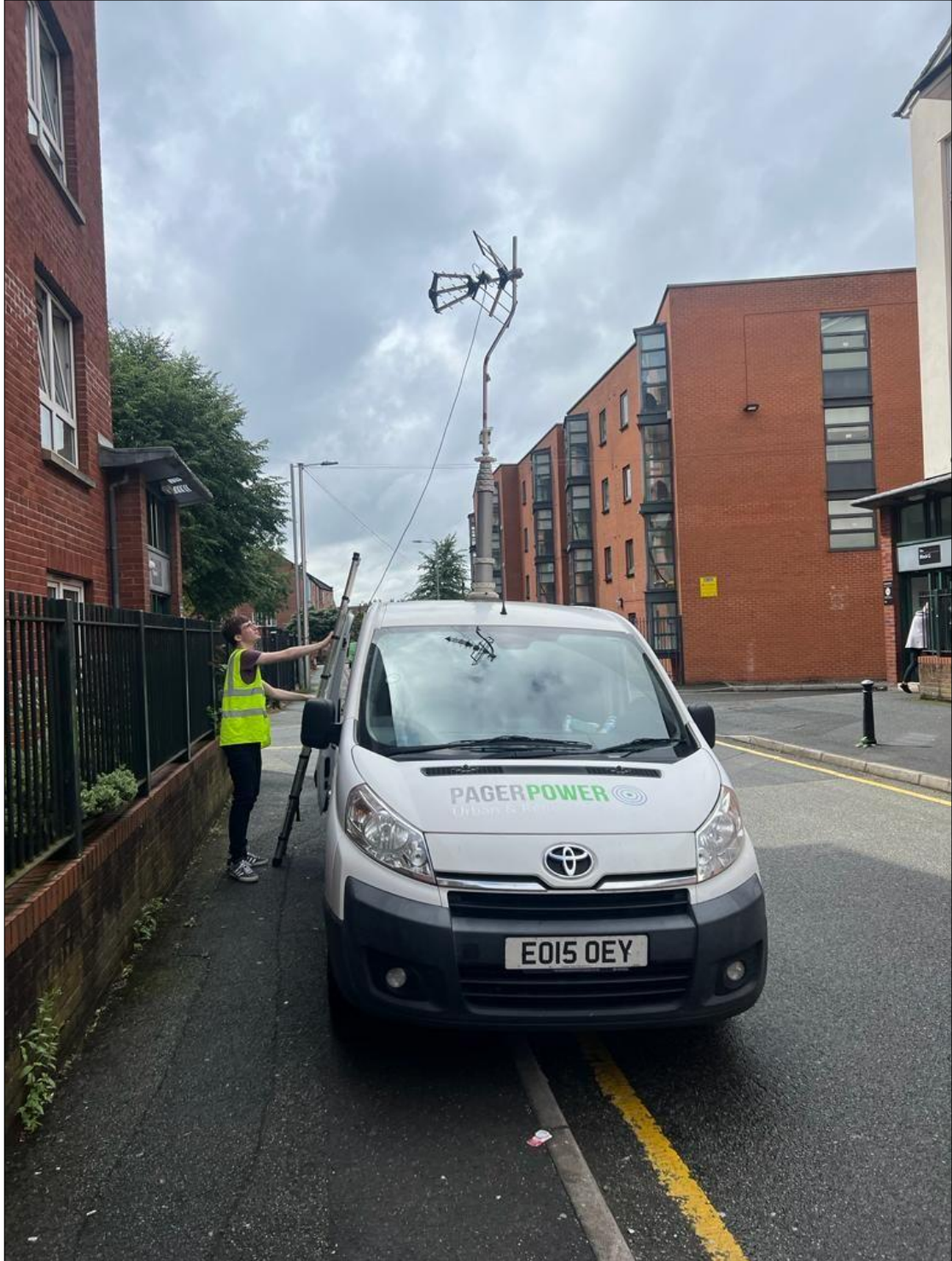
Location 1



Location 2



Location 3



Location 5



Location 6



Location 7



Location 8





Pager Power Limited
Stour Valley Business Centre
Sudbury
Suffolk
CO10 7GB

Tel: +44 1787 319001 **Email:** info@pagerpower.com **Web:** www.pagerpower.com