

Television and Radio Baseline Survey Report

Laystall Street / Great Ancoats Street

Ancoats Manchester Ltd

November 2022

PLANNING SOLUTIONS FOR:

- Solar
- Defence
- Airports
- Telecoms
- Buildings
- Radar
- Railways
- Wind
- Mitigation

www.pagerpower.com



ADMINISTRATION PAGE

Job Reference:	11687C
Date:	October 2022
Author:	Abdul Wadud
Telephone:	01787 319001
Email:	abdul@pagerpower.com

Reviewers:	Hannah McNaul; Aaron Williams
Emails:	hannahm@pagerpower.com; aaron@pagerpower.com

Issue	Date	Detail of Changes
1	October 2022	Initial issue
2	November 2022	Updated redline boundary and minor ammendments

Confidential: The contents of this document may not be disclosed to others without permission.

Copyright © 2022 Pager Power Limited

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

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

All aerial imagery (unless otherwise stated) is taken from Google Earth. Copyright © 2022 Google.

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 Site is located in Manchester City Centre. It is bounded by Laystall Street to the north, Great Ancoats Street to the east, vacant land at Lomax Street to the south and an apart-hotel to the west.

The Site will comprise a tall building with 20 storeys, with a maximum altitude of 112.05m metres above ordnance datum and a maximum height of 65.05 metres above ground level.

Building developments have the potential to affect television and radio reception, with the most common being to cause interference.

Results

Television

- The proposed 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 25th October 2022 to confirm the relevant transmitter and record the signal quality;
- The average terrestrial signal strength is moderate in the proposed development shadow zone for the main multiplexes and low on average for the local (lower power) multiplexes;
- Negative effects upon signal strength are most likely at locations close to the proposed development i.e. within 1km of the proposed development and within its shadow zone. The average recorded signal within 1km of the proposed development was moderate and low for main and local TV multiplexes respectively. Buildings in the surrounding environment within 1km of the proposed development were mainly commercial and high-rise residential properties;
- At locations beyond 1km and within the shadow zone, no significant impacts are predicted and interference is predicted to be unlikely.

Radio

- The area surrounding the Proposed Development receive radio services from the numerous transmitters, including Winter Hill. The strength and quality of the signal from Winter Hill near the Proposed Development is variable;
- Degradation of the radio signal at close range to the Proposed Development is likely. The effects are unlikely to be noticeable in practice due to the variability of services in an urban environment.

Recommendations and Mitigation

No requirement for pre-emptive mitigation has been identified.

It is recommended any reports of interference are investigated to determine whether these are attributable to the proposed development. Comparisons between a post-construction survey and this baseline survey should be made, if undertaken.

If interference is found to be attributable to the proposed development, mitigation measures should be installed. Solutions are likely to be readily available if required, the most common options are presented in Section 6.

LIST OF CONTENTS

Administration Page	2
Executive Summary	3
Report Purpose	3
Results	3
Recommendations and Mitigation	4
List of Contents	5
List of Figures	7
List of Tables	7
1 Background	9
1.1 Introduction	9
1.2 Proposed Development Location	10
1.3 Proposed Development Roof Plan	11
1.4 3D Building Representation	12
2 Television Transmitter Details	13
2.1 Relevant Transmitter	13
2.2 Winter Hill Main Transmitter	13
3 Buildings and Television Interference	15
3.1 Technical Overview	15
3.1.1 Television	15
3.1.2 Radio	15
3.2 Interference mechanisms	15
3.2.1 Obstruction of the Signal	15
3.2.2 Reflection of the Signal	16
3.3 Radio Interference	18
4 Technical Assessment	19
4.1 Potential Interference Areas	19
4.2 Potential Diffraction Issues – Terrestrial Television	20

4.3	Potential Reflection Issues	20
5	Television Baseline Survey	22
5.1	Overview – Television Services.....	22
5.2	Survey Locations	23
5.3	Survey Results.....	23
5.3.1	Television Baseline Survey.....	23
5.3.2	Radio Baseline Survey.....	27
6	Mitigation	28
6.1	Mitigation Requirement	28
6.2	Recommended Options	28
6.3	Recommended Process	28
7	Conclusions.....	29
7.1	Results	29
7.1.1	Television	29
7.1.2	Radio	29
7.2	Recommendations and Mitigation	29
	Appendix A – Detailed Survey Results.....	30
	Location 1	30
	Location 2	31
	Location 3	32
	Location 4	33
	Location 5	34
	Location 6	35
	Location 7	36
	Appendix B – Survey Photographs.....	37
	Location 1	37
	Location 2	38
	Location 3	39
	Location 4	40
	Location 5	41

Location 6	42
Location 7	43

LIST OF FIGURES

Figure 1 Proposed development location	10
Figure 2 Proposed development roof plan	11
Figure 3 3D building representation	12
Figure 4 Diffraction loss zones.....	16
Figure 5 Reflection zones.....	17
Figure 6 Reflection and Shadow Zones.....	19
Figure 7 Interference zones onto aerial imagery	20
Figure 8 Survey locations	23

LIST OF TABLES

Table 1 Winter Hill main transmissions (main multiplexes)	13
Table 2 Winter Hill transmissions (local multiplexes)	13
Table 3 Winter Hill radio transmissions	14
Table 4 Television signal strength categories	22
Table 5 Television baseline survey results.....	26
Table 6 Radio baseline survey results.....	27

ABOUT PAGER POWER

Pager Power is a dedicated consultancy company based in Suffolk, UK. The company has undertaken projects in 54 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 and radio reception in the surrounding area. The Site is located in Manchester City Centre. It is bounded by Laystall Street to the north, Great Ancoats Street to the east, vacant land at Lomax Street to the south and an apart-hotel to the west.

The Site will comprise a tall building with 20 storeys, with a maximum altitude of 112.05m metres above ordnance datum and a maximum height of 65.05 metres above ground level.

Building developments have the potential to affect television and radio reception, with the most common being to cause interference.

The interference zones have been modelled in accordance with Ofcom guidance (Section 3) and a baseline reception survey has been undertaken within potentially affected areas (Section 5).

1.2 Proposed Development Site Plan

The proposed development redline boundary is shown in Figure 1¹ below.



Figure 1 *Proposed development redline boundary*

¹ 10403-SHP-A-Z460-PL-00-0002 PDF (cropped)

1.3 Proposed Development Roof Plan

The proposed development roof plan is shown in Figure 2² below.

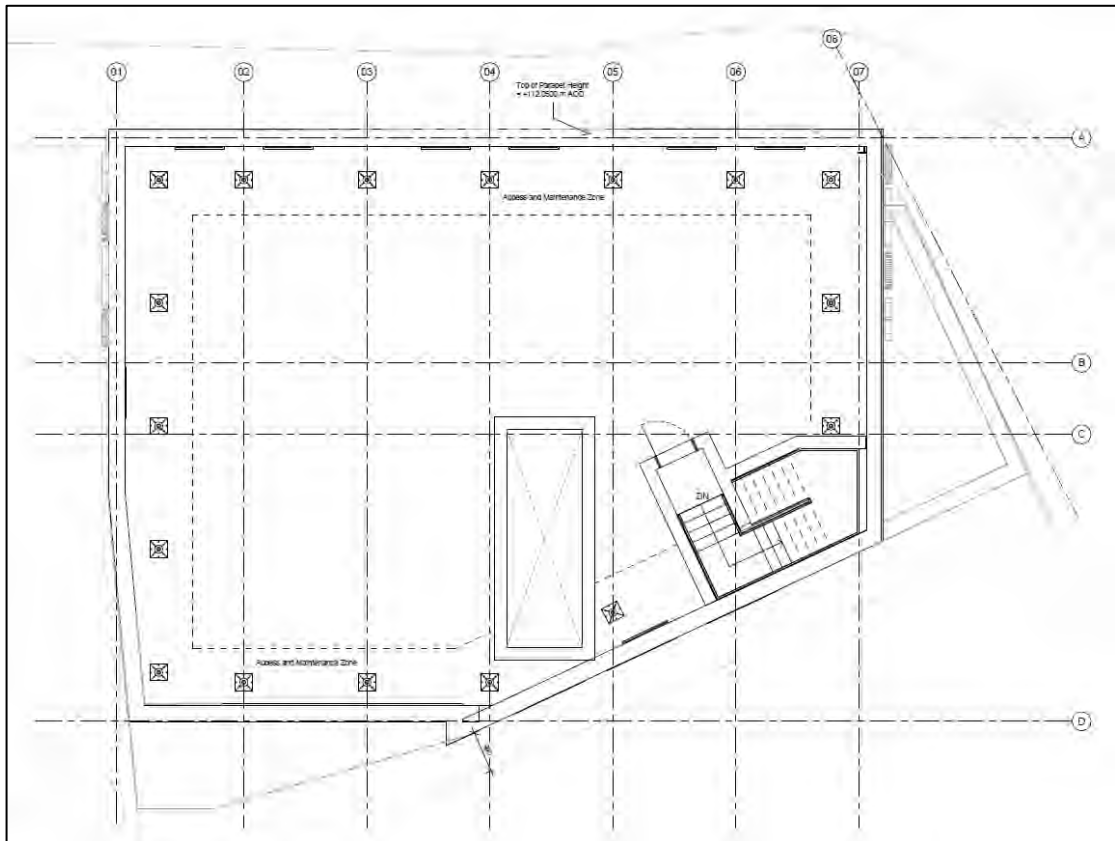


Figure 2 Proposed development roof plan

² 10403-SHP-A-G200-PL-RF-001 (cropped).

1.4 3D Building Representation

A 3D aerial image of the proposed development is shown in Figure 3 below.

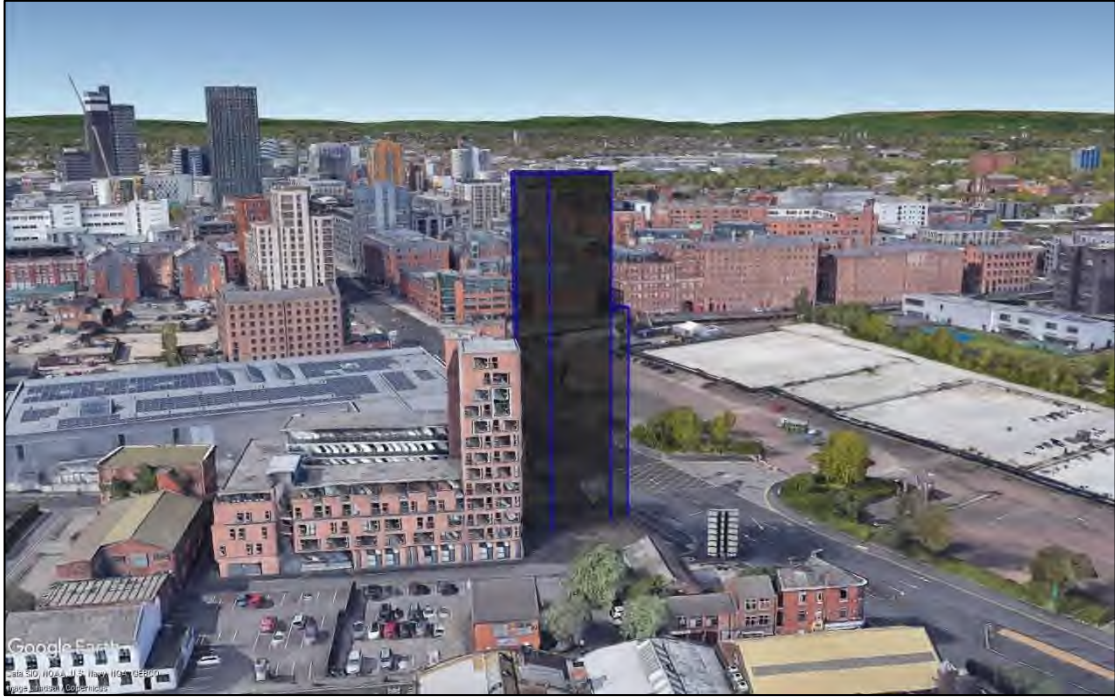


Figure 3 3D building representation

2 TELEVISION TRANSMITTER DETAILS

2.1 Relevant Transmitter

The Winter Hill transmitter predominantly serves the area around the development³. Digital television services are broadcast via Ultra High Frequency (UHF) signals.

2.2 Winter Hill Main Transmitter

Winter Hill is one of the UK's main television transmitters located approximately 25km northwest of the development.

Digital television services are broadcast, details are presented in Tables 1 and 2 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 (main multiplexes)

Service	LTVmux (Manchester)	Glmux	COM 7
Channel	24	27	55
Power	2 kW	1 kW	25.7 kW

Table 2 Winter Hill transmissions (local multiplexes)

³ Based on coverage maps and Digital UK information.

Radio transmission details are presented in Table 3 below.

	Digital				FM
Service	CE Manchester	Digital One	Bauer Central Lancashire	BBC National DAB	Various Services
Frequency	220.352 MHz	222.064 MHz	223.936 MHz	225.648 MHz	88.6 – 105.4 MHz
Power	0.25 kW	10 kW	1.5 kW	10 kW	Max 5 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 southeast of the proposed 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.

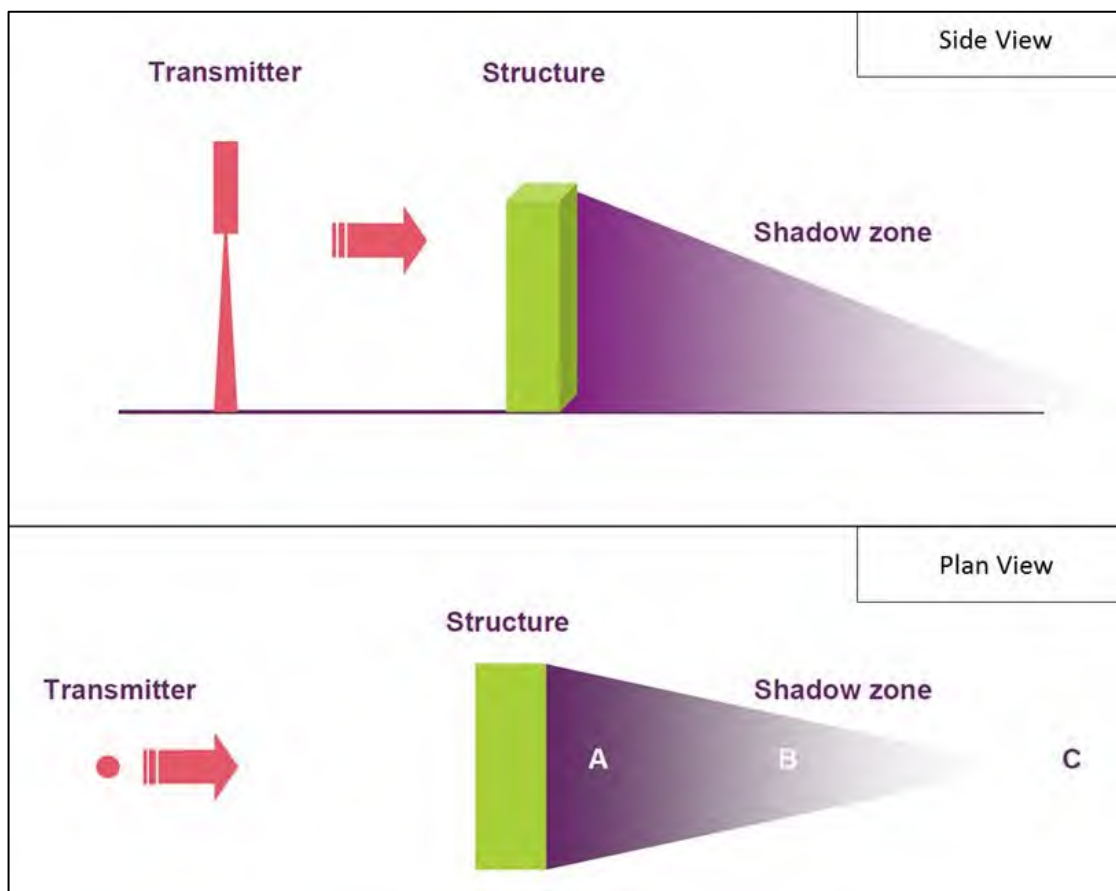


Figure 4 Diffraction loss zones

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.

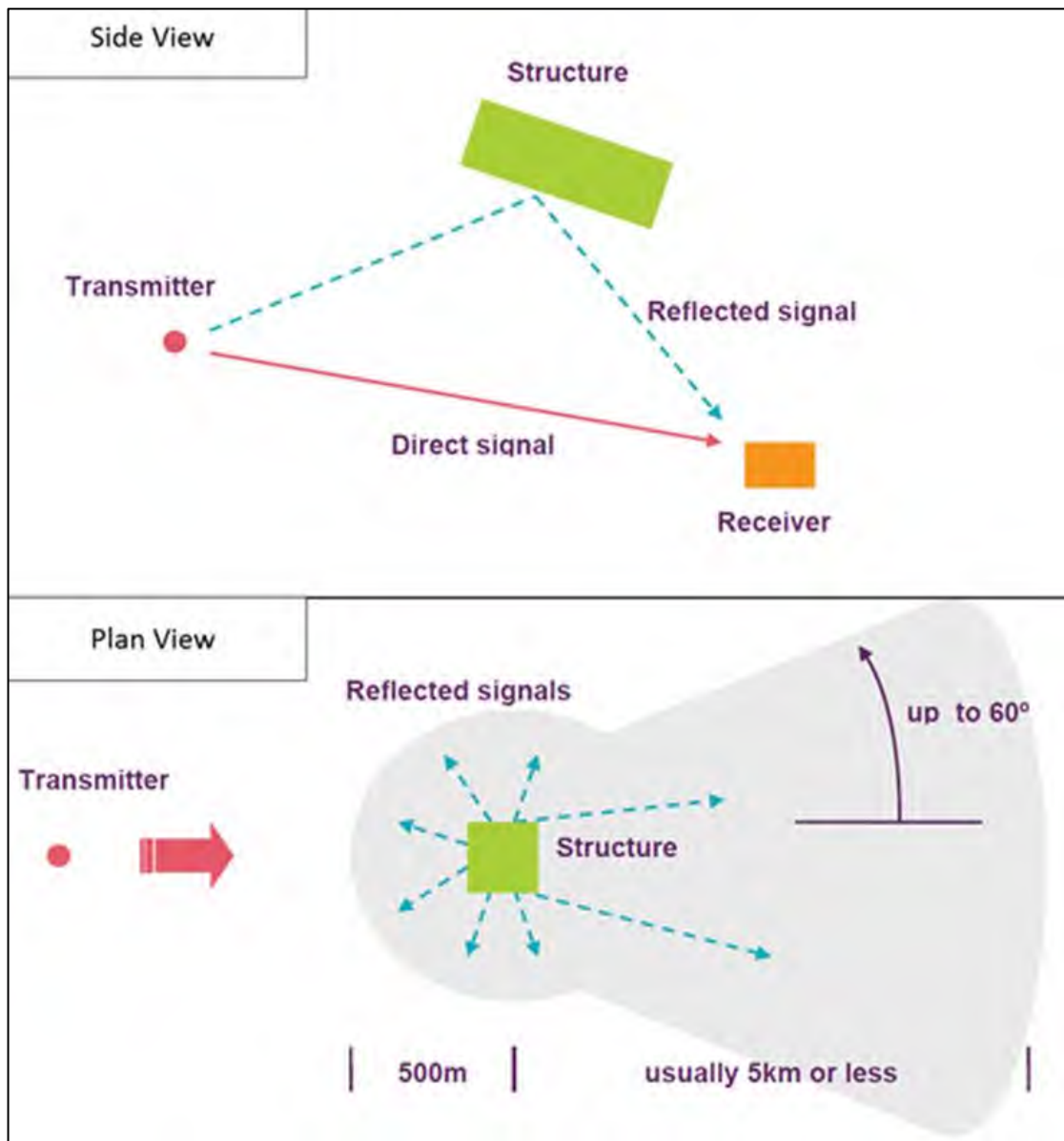


Figure 5 Reflection zones

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 of the above conditions 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 have nevertheless been considered within the analysis for the sake of completeness.

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 proposed 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 reflection and shadow areas, or interference zones, associated with the proposed development.

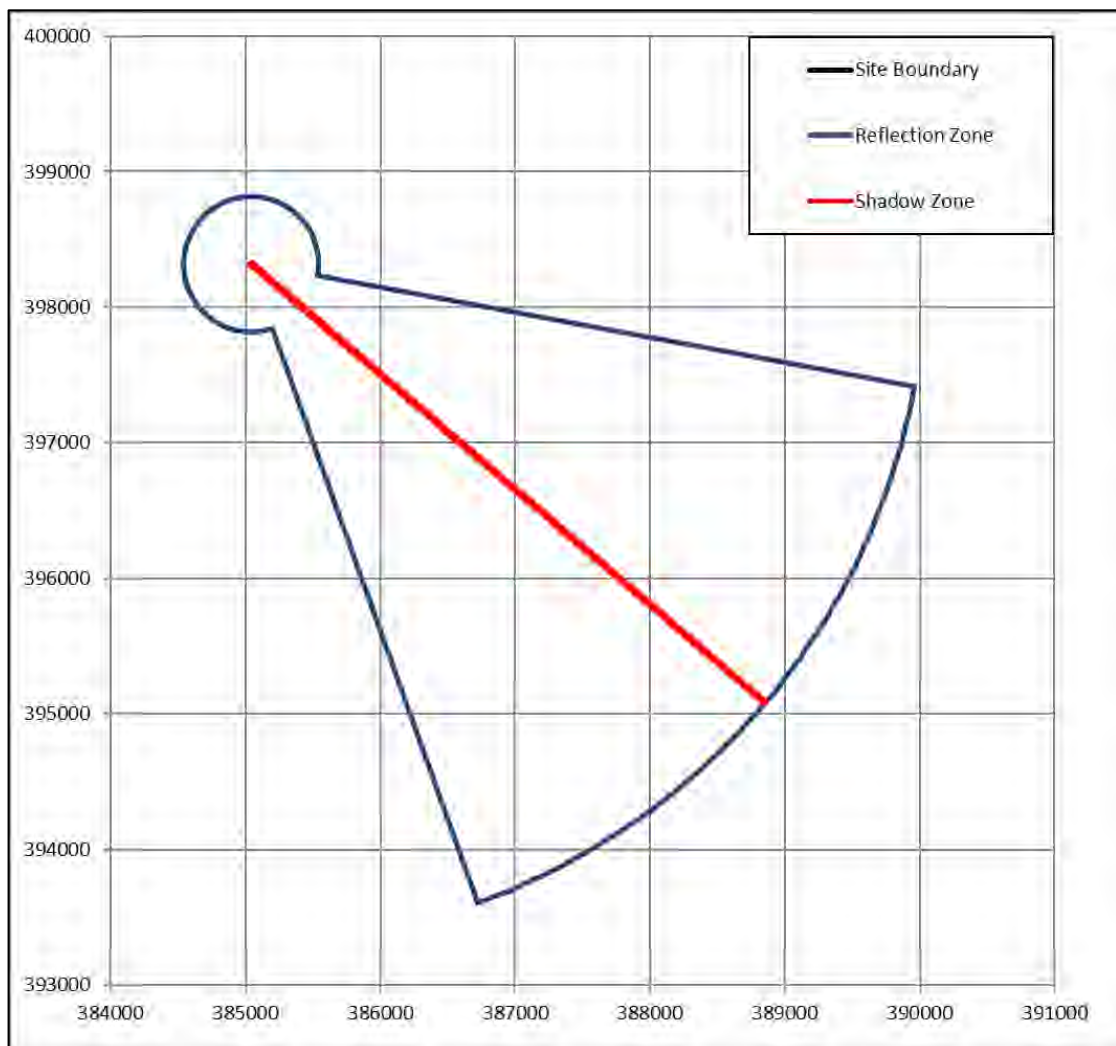


Figure 6 Reflection and Shadow Zones

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

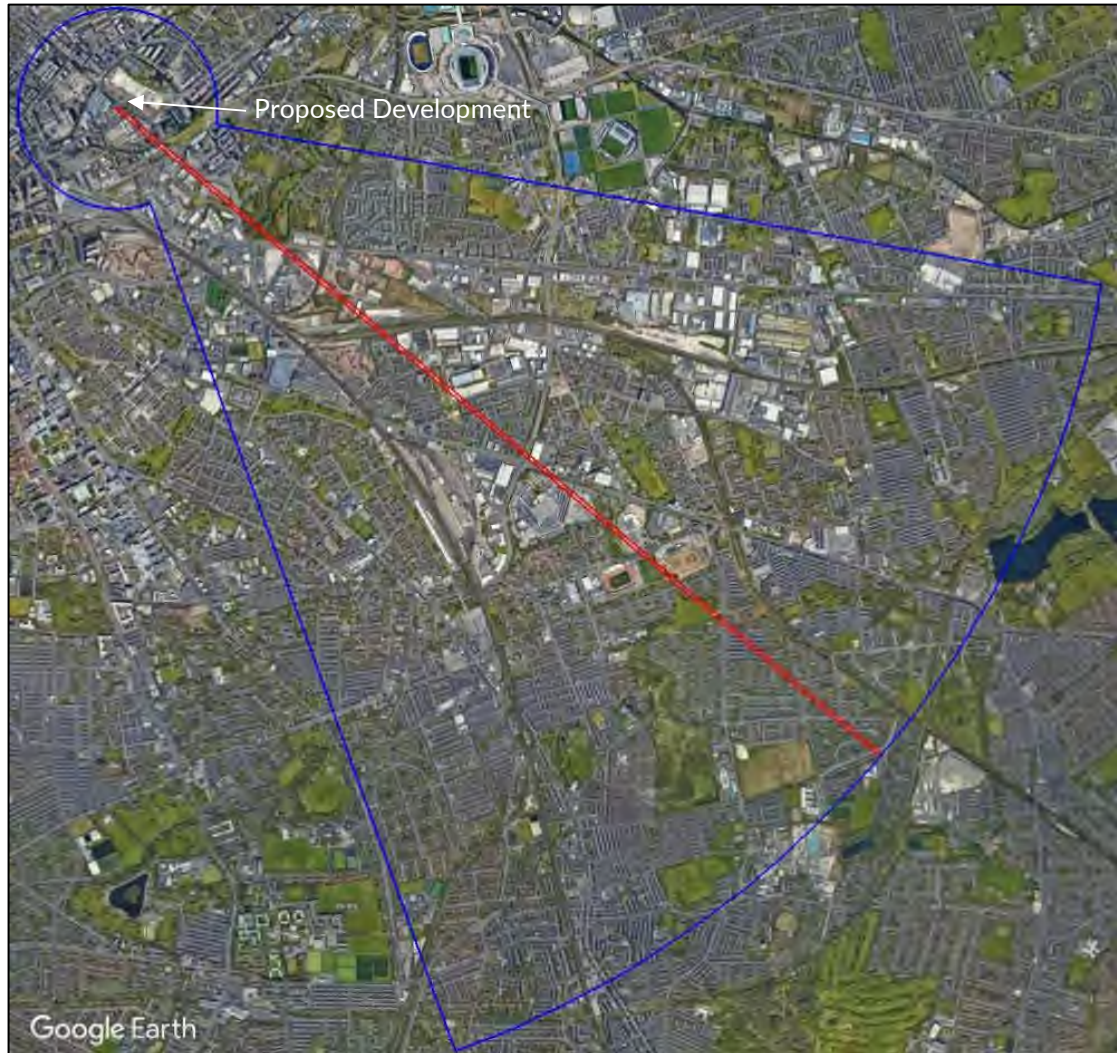


Figure 7 Interference zones onto aerial imagery

4.2 Potential Diffraction Issues – Terrestrial Television

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

The 1km assessment area predominantly features commercial and high-rise residential property. Therefore, interference is unlikely due to the lack of existence or height of any aerials. Beyond 1km, commercial and low-rise properties exist. Interference is unlikely to be experienced at this range.

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 proposed development is unobstructed;
- The angle between the reflected signal via the proposed development and the direct signal would be 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 proposed development. In particular, locations that are below radio line of sight from the transmitter are unlikely to have an unobstructed path to the proposed development, due to their relative heights. Impacts due to reflections are considered unlikely.

5 TELEVISION BASELINE SURVEY

5.1 Overview – Television Services

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 proposed development on 25th October 2022.

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 4 below.

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

Table 4 Television signal strength categories

5.2 Survey Locations

Figure 8 below shows the survey locations overlaid onto aerial photography. Survey locations were chosen pre-survey (within the shadow zone) however safe and available access influenced the specific position on the day. The locations below show the actual survey locations. Survey locations are more closely grouped nearer the proposed development because interference is generally more likely the closer the location is to the obstruction. Radial white icons represent both television and radio survey locations.



Figure 8 Survey locations

5.3 Survey Results

Full survey results are shown in Appendix A. Survey photographs are shown in Appendix B.

5.3.1 Television Baseline Survey

A summary of the survey results for television reception is presented in Table 4 on the following page.

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
1	Main TV MUX: 44.3 (Moderate) Local TV MUX: 29.7 (Low)	Three out of six main multiplexes displayed fine picture and audio quality. Two of the remaining multiplexes displayed intermittent picture and audio, and the remaining one did not decode. All three local multiplexes did not decode.	This location is approximately 57 metres from the proposed development. A two-storey building is located adjacent to location 1, and no aerials or satellite dishes were observed. A reduction in signal strength is possible based on the proximity to the Proposed Development. Based on the current signal strength, effects are unlikely to be experienced due to the lack of existence of or height of aerials.
2	Main TV MUX: 37.2 (Moderate) Local TV MUX: 24.6 (Low)	Three of the six main multiplexes displayed fine picture and audio quality. One main multiplex displayed intermittent picture and audio quality. The remaining two main multiplexes did not decode. One local multiplex displayed fine picture and audio, and the remaining two did not decode.	This location is approximately 645 metres from the proposed development. Predominately commercial properties are located adjacent to location 2. A reduction in signal strength is possible based on the proximity to the Proposed Development. Based on the current signal strength, effects are unlikely to be experienced due to the lack of existence of or height of aerials.

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
3	Main TV MUX: 40.8 (Moderate) Local TV MUX: 23.4 (Low)	All six main multiplexes displayed fine picture and audio quality. One local multiplex displayed fine picture and audio, and the remaining two did not decode.	This location is approximately 1.6km from the proposed 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. Interference is unlikely.
4	Main TV MUX: 35.1 (Moderate) Local TV MUX: 19.1 (Low)	Four main multiplexes displayed fine picture and audio quality. One main multiplex displayed intermittent picture and audio quality, and the remaining multiplex did not decode. All three local multiplexes did not decode.	This location is approximately 1.8km from the proposed 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. Interference is unlikely.
5	Main TV MUX: 44.3 (Moderate) Local TV MUX: 19.5 (Low)	Five main multiplexes displayed fine picture and audio quality. The remaining one multiplex displayed intermittent picture and audio quality. All three local multiplexes did not decode.	This location is approximately 2.1km from the proposed 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. Interference is unlikely.

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
6	Main TV MUX: 59.4 (Very good) Local TV MUX: 30.1 (Low)	All main multiplexes displayed fine picture and audio quality. One local multiplex displayed fine picture and audio, and the remaining two did not decode.	This location is approximately 3.4km from the proposed 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. Interference is unlikely.
7	Main TV MUX: 41.2 (Moderate) Local TV MUX: 18.8 (Low)	All main multiplexes displayed fine picture and audio quality. One local multiplex displayed fine picture and audio, and the remaining two did not decode.	This location is approximately 4.4km from the proposed 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. Interference is unlikely.

Table 5 *Television baseline survey results*

5.3.2 Radio Baseline Survey

A summary of the survey results for radio reception is presented in Table 6 below.

Location	Frequencies Decoded	High-Level Conclusions
1	Three out of five frequencies decoded with fine audio quality. Frequencies 220.352 MHz and 223.936 MHz did not decode for all survey locations.	Overall, some degradation of the radio signal at close range to the Proposed Development is likely. The effects are unlikely to be noticeable in practice due to the variability of services in an urban environment.
2		
3		
4		
5		
6		
7		

Table 6 Radio baseline survey results

6 MITIGATION

The result of the baseline survey suggest there is no reason to install pre-emptive mitigation. Mitigation and recommendations have been included for completeness.

6.1 Mitigation Requirement

If an adverse effect on television services occurs and is attributable to the proposed 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.

6.2 Recommended Options

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.

6.3 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 proposed development. If this is found to be the case, mitigation can be applied.

7 CONCLUSIONS

7.1 Results

7.1.1 Television

- The proposed 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 25th October 2022 to confirm the relevant transmitter and record the signal quality;
- The average terrestrial signal strength is moderate in the proposed development shadow zone for the main multiplexes and low on average for the local (lower power) multiplexes;
- Negative effects upon signal strength are most likely at locations close to the proposed development i.e. within 1km of the proposed development and within its shadow zone. The average recorded signal within 1km of the proposed development was moderate and low for main and local TV multiplexes respectively. Buildings in the surrounding environment within 1km of the proposed development were mainly commercial and high-rise residential properties;
- At locations beyond 1km and within the shadow zone, no significant impacts are predicted and interference is predicted to be unlikely.

7.1.2 Radio

- The area surrounding the Proposed Development receive radio services Winter Hill transmitter. The strength and quality of the signal from Winter Hill near the Proposed Development is variable;
- Degradation of the radio signal at close range to the Proposed Development is likely. The effects are unlikely to be noticeable in practice due to the variability of services in an urban environment.

7.2 Recommendations and Mitigation

No requirement for pre-emptive mitigation has been identified.

It is recommended any reports of interference are investigated to determine whether these are attributable to the proposed development. Comparisons between a post-construction survey and this baseline survey should be made, if undertaken.

If interference is found to be attributable to the proposed development, mitigation measures should be installed. 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 -2.226234°, Lat: 53.480940°					
Channel	Service	Signal Strength ⁷ (dBμV)	BER ⁸	Picture	Audio
24	LTVmux	29.9 +/- 0.1	DND ⁹	-	-
27	Glmax	28.9 +/- 0.1	DND	-	-
29	SDN	42.7 +/- 0.2	1E-02	INT ¹⁰	INT
31	Arq A	40.5 +/- 0.3	1E-02	INT	INT
32	BBC A	45.2 +/- 0.2	1E-06	Fine	Fine
34	D3+4	46.9 +/- 0.3	1E-08	Fine	Fine
35	BBC B	45.2 +/- 0.1	DND	-	-
37	Arq B	45.0 +/- 0.1	1E-04	Fine	Fine
55	COM7	30.4 +/- 0.2	DND	-	-

Television reception readings

Frequency (MHz)	Service	Signal Strength (dBμV)	Audio
220.352	CE Manchester	20.3 +/- 0.2	DND
222.064	Digital One	72.0 +/- 0.5	Fine
223.936	Bauer Central Lancashire	19.5 +/- 0.5	DND
225.648	BBC National DAB	66.0 +/- 0.3	Fine
88-106	Various FM	80.1 +/- 1.0	Fine

Radio reception readings

⁷ +/- followed by a number represents the approximate signal fluctuation.

⁸ E = 1 x10 to the power of the following number e.g. -8.

⁹ Did not decode

¹⁰ Intermittent

Notes: No HP¹¹ UHF¹² aerials and one satellite dish was observed.

Location 2

Coordinates: Lon: -2.219444°, Lat: 53.477518°					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	27.5 +/- 0.2	2E-04	Fine	Fine
27	Glmax	25.4 +/- 0.3	DND	-	-
29	SDN	41.4 +/- 0.2	1E-08	Fine	Fine
31	Arq A	37.0 +/- 0.2	1E-08	Fine	Fine
32	BBC A	35.0 +/- 0.2	1E-08	Fine	Fine
34	D3+4	37.5 +/- 0.2	1E-04	INT	INT
35	BBC B	37.1 +/- 0.2	DND	-	-
37	Arq B	35.4 +/- 0.2	DND	-	-
55	COM7	20.8 +/- 0.1	DND	-	-

Television reception readings

Frequency (MHz)	Service	Signal Strength (dBμV)	Audio
220.352	CE Manchester	15.9 +/- 0.3	DND
222.064	Digital One	70.5 +/- 0.2	Fine
223.936	Bauer Central Lancashire	20.0 +/- 0.4	DND
225.648	BBC National DAB	71.7 +/- 0.5	Fine
88-106	Various FM	60.3 +/- 0.0	Fine

Radio reception readings

Notes: No HP UHF aerials or satellite dishes were observed.

¹¹ Horizontally Polarised.

¹² Ultra-High Frequency

Location 3

Coordinates: Lon: -2.208545°, Lat: 53.472022°					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	27.0 +/- 0.2	1E-02	INT	INT
27	Glmax	22.9 +/-0.3	DND	-	-
29	SDN	41.4 +/- 0.2	1E-05	Fine	Fine
31	Arq A	41.4 +/- 0.2	1E-05	Fine	Fine
32	BBC A	41.8 +/- 0.1	1E-08	Fine	Fine
34	D3+4	39.6 +/- 0.1	1E-05	Fine	Fine
35	BBC B	40.5 +/- 0.2	-	Fine	Fine
37	Arq B	40.0 +/- 0.2	1E-04	Fine	Fine
55	COM7	20.4 +/- 0.2	DND	-	-

Television reception readings

Frequency (MHz)	Service	Signal Strength (dBμV)	Audio
220.352	CE Manchester	16.6 +/-0.4	DND
222.064	Digital One	69.1 +/- 0.4	Fine
223.936	Bauer Central Lancashire	20.8 +/- 0.4	DND
225.648	BBC National DAB	70.0 +/- 0.3	Fine
88-106	Various FM	69.2 +/-1.0	Fine

Radio reception readings

Notes: No HP UFH aerials or satellite dishes were observed.

Location 4

Coordinates: Lon: - 2.206275°, Lat: 53.470910°					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	23.7 +/- 0.2	DND	-	-
27	Glmax	18.0 +/- 0.4	DND	-	-
29	SDN	36.9 +/- 0.2	DND	-	-
31	Arq A	36.3 +/- 0.2	1E-03	INT	INT
32	BBC A	37.9 +/- 0.1	1E-06	Fine	Fine
34	D3+4	36.8 +/- 0.3	1E-05	Fine	Fine
35	BBC B	36.4 +/- 0.3	-	Fine	Fine
37	Arq B	26.5 +/- 0.2	1E-04	Fine	Fine
55	COM7	15.7 +/- 0.1	DND	-	-

Television reception readings

Frequency (MHz)	Service	Signal Strength (dBμV)	Audio
220.352	CE Manchester	15.5 +/- 0.5	DND
222.064	Digital One	64.4 +/- 0.4	Fine
223.936	Bauer Central Lancashire	15.5 +/- 1.0	DND
225.648	BBC National DAB	59.7 +/- 0.3	Fine
88-106	Various FM	67.0 +/- 0.3	Fine

Radio reception readings

Notes: Multiple HP UHF aerials directed towards the Winter Hill transmitter was observed.
Multiple satellite dishes were observed.

Location 5

Coordinates: Lon: -2.202065°, Lat: 53.468842°					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	22.8 +/- 0.1	DND	-	-
27	Glmax	20.4 +/- 0.2	DND	-	-
29	SDN	37.8 +/- 0.2	1E-03	INT	INT
31	Arq A	38.0 +/- 0.3	1E-04	Fine	Fine
32	BBC A	41.9 +/- 0.3	1E-08	Fine	Fine
34	D3+4	36.5 +/- 0.2	1E-02	Fine	Fine
35	BBC B	38.3 +/- 0.5	-	Fine	Fine
37	Arq B	39.5 +/- 0.3	1E-06	Fine	Fine
55	COM7	20.2 +/- 0.1	DND	-	-

Television reception readings

Frequency (MHz)	Service	Signal Strength (dBμV)	Audio
220.352	CE Manchester	14.8 +/- 0.5	DND
222.064	Digital One	60.7 +/- 0.2	Fine
223.936	Bauer Central Lancashire	14.0 +/- 0.3	DND
225.648	BBC National DAB	56.2 +/- 0.2	Fine
88-106	Various FM	57.0 +/- 1.0	Fine

Radio reception readings

Notes: No HP UFH aerials or satellite dishes were observed.

Location 6

Coordinates: Lon -2.187234°, Lat: 53.461330°					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	36.0 +/- 0.2	1E-07	Fine	Fine
27	Glmax	29.3 +/- 0.3	DND	-	-
29	SDN	59.3 +/- 0.2	1E-07	Fine	Fine
31	Arq A	59.2 +/- 0.1	1E-07	Fine	Fine
32	BBC A	61.0 +/- 0.1	1E-07	Fine	Fine
34	D3+4	59.2 +/- 0.4	1E-07	Fine	Fine
35	BBC B	58.4 +/- 0.2	1E-04	Fine	Fine
37	Arq B	59.3 +/- 0.1	1E-06	Fine	Fine
55	COM7	25.2 +/- 0.1	DND	-	-

Television reception readings

Frequency (MHz)	Service	Signal Strength (dBμV)	Audio
220.352	CE Manchester	14.7 +/- 1.0	DND
222.064	Digital One	63.3 +/- 0.3	Fine
223.936	Bauer Central Lancashire	18.0 +/- 0.3	DND
225.648	BBC National DAB	56.0 +/- 0.5	Fine
88-106	Various FM	63.0 +/- 0.1	Fine

Radio reception readings

Notes: Multiple HP UHF aerials directed towards the Winter Hill transmitter was observed.
Multiple satellite dishes were observed.

Location 7

Coordinates: Lon: -2.175797°, Lat: 53.455534°					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	23.6 +/- 0.2	1E-05	Fine	Fine
27	Glmax	17.5 +/- 0.1	DND	-	-
29	SDN	37.0 +/- 0.2	1E-05	Fine	Fine
31	Arq A	39.7 +/- 0.2	1E-08	Fine	Fine
32	BBC A	42.0 +/- 0.2	1E-02	Fine	Fine
34	D3+4	43.7 +/- 0.1	1E-03	Fine	Fine
35	BBC B	41.4 +/- 0.3	1E-02	Fine	Fine
37	Arq B	43.2 +/- 0.1	1E-04	Fine	Fine
55	COM7	15.2 +/- 0.1	DND	-	-

Television reception readings

Frequency (MHz)	Service	Signal Strength (dBμV)	Audio
220.352	CE Manchester	10.8 +/- 0.3	DND
222.064	Digital One	56.0 +/- 0.5	Fine
223.936	Bauer Central Lancashire	14.4 +/- 0.3	DND
225.648	BBC National DAB	53.4 +/- 0.2	Fine
88-106	Various FM	67.0 +/- 0.5	Fine

Radio reception readings

Notes: Multiple HP UHF aerials directed towards the Winter Hill transmitter was observed.
Multiple satellite dishes were observed.

APPENDIX B – SURVEY PHOTOGRAPHS

Location 1



Location 2



Location 3



Location 4



Location 5



Location 6



Location 7





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

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