

Terrestrial Television Baseline Survey Report

Cambridge Halls of Residence

Unite Students and Manchester Metropolitan
University

June 2024

PLANNING SOLUTIONS FOR:

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ADMINISTRATION PAGE

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1	June 2024	Initial issue
2	March 2025	Administrative amendments

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EXECUTIVE SUMMARY

Report Purpose

A television baseline reception survey has been completed for the proposed purpose-built student accommodation redevelopment of Cambridge Halls, Manchester.

The proposed redevelopment will introduce 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 the baseline survey along with the predicted impact.

Description of Development

Demolition of existing halls of residence and erection of two buildings of 30 and 24 storeys above ground, plus basement and rooftop plant levels, comprising purpose-built student accommodation with internal and external rooftop communal amenity space (Sui Generis). Ground floor commercial and community uses (Flexible Use Classes E, F1 or F2). Hard and soft landscaping and associated highway works.

Results

- Residences in the area surrounding the proposed development receive television services predominantly from the Winter Hill main transmitter.
- A site survey was undertaken on 21st June 2024 to confirm the relevant transmitter and record the signal quality.
- The strength and quality of the signal in the shadow zone is on average good.
- Any interference would be due to shadowing effects, i.e. the weakening of the transmitted signal due to the physical presence of the proposed development.
- Negative effects upon signal strength are typically limited to within 1km of the development and within its shadow zone based on Pager Power's assessment experience.
- A reduction in signal strength for some residential properties within this range is possible based on the proximity to the proposed development; however, effects may not be noticeable considering the baseline signal strength. The majority of channels should retain good quality transmission.
- Residential properties at greater distances are unlikely to experience noticeable impacts in practice due to the baseline signal strength.

Recommendation

Any reported television interference within the shadow zone, and within close proximity of the proposed development, should be investigated by means of a reception measurement.

Mitigation

Technical mitigation solutions have been identified for implementation if an impact occurs that is attributable to the proposed development. There is no reason to install pre-emptive mitigation due to the distinct possibility that no noticeable effects will occur. The most likely options, in the event a mitigation requirement transpires, would be:

- Replacement of receiving aerial with a more directional or higher gain aerial.
- Replacement of terrestrial reception equipment with satellite reception equipment or cable.

LIST OF CONTENTS

Administration Page	2
Executive Summary	3
Report Purpose.....	3
Description of Development.....	3
Results	3
Recommendation	3
Mitigation.....	4
List of Contents	5
List of Figures.....	7
List of Tables.....	7
About Pager Power.....	8
1 Background	9
1.1 Introduction.....	9
1.2 Description of Development	9
1.3 Proposed Development Details	9
1.4 Proposed Development Boundary – Aerial image	10
2 Television Transmitter Details.....	11
2.1 Relevant Transmitter	11
2.2 Winter Hill Main Transmitter.....	11
3 Buildings and Interference Mechanisms	12
3.1 Technical Overview.....	12
3.2 Obstruction of the Signal.....	12
3.3 Reflection of the Signal	13
4 Technical Assessment.....	16
4.1 Potential Interference Areas.....	16
4.2 Potential Diffraction Issues.....	17
4.3 Potential Reflection Issues	17
5 Television Survey Results	19

5.1	Overview.....	19
5.2	Survey Locations.....	19
5.3	Survey Results	20
6	Mitigation	25
6.1	Mitigation Requirement	25
6.2	Mitigation Options	25
6.3	Recommended Options.....	25
6.4	Recommended Process.....	25
7	Conclusions	26
7.1	Results	26
7.2	Recommendation.....	26
7.3	Mitigation.....	26
	Appendix A –Survey Results	27
	Location 1 - Baseline.....	27
	Location 2 - Baseline.....	28
	Location 3 - Baseline.....	29
	Location 4 - Baseline.....	30
	Location 5 - Baseline.....	31
	Location 6 – Baseline.....	32
	Location 7 - Baseline.....	33
	Location 8 - Baseline.....	34
	Location 9 - Baseline.....	35
	Appendix B – Survey Photographs	36
	Location 1	36
	Location 2	37
	Location 3	38
	Location 4	39
	Location 5	40
	Location 6	41
	Location 7	42
	Location 8	43

Location 9	44
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LIST OF FIGURES

Figure 1 Proposed development site location.....	10
Figure 2 Proposed development boundary overlaid on aerial imagery	10
Figure 3 Diffraction Loss Zones.....	13
Figure 4 Diffraction Loss Zones.....	14
Figure 5 Interference zones - aerial image.....	17
Figure 6 Survey locations	20

LIST OF TABLES

Table 1 Winter Hill Transmissions (main multiplexes).....	11
Table 2 Winter Hill Transmissions (local multiplexes)	11
Table 3 Television signal strength categories.....	19
Table 4 Baseline and post-construction survey results	24

ABOUT PAGER POWER

Pager Power is a dedicated consultancy company based in Suffolk, UK. The company has undertaken projects in 61 countries internationally.

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

A television baseline reception survey has been completed for the proposed purpose-built student accommodation redevelopment of Cambridge Halls, Manchester.

The proposed redevelopment will introduce 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 the baseline survey along with the predicted impact.

1.2 Description of Development

Demolition of existing halls of residence and erection of two buildings of 30 and 24 storeys above ground, plus basement and rooftop plant levels, comprising purpose-built student accommodation with internal and external rooftop communal amenity space (Sui Generis). Ground floor commercial and community uses (Flexible Use Classes E, F1 or F2). Hard and soft landscaping and associated highway works.

1.3 Proposed Development Details

The location plan for the proposed development is shown in Figure 1¹ on the following page.

¹ Source: Cambridge Halls.pdf

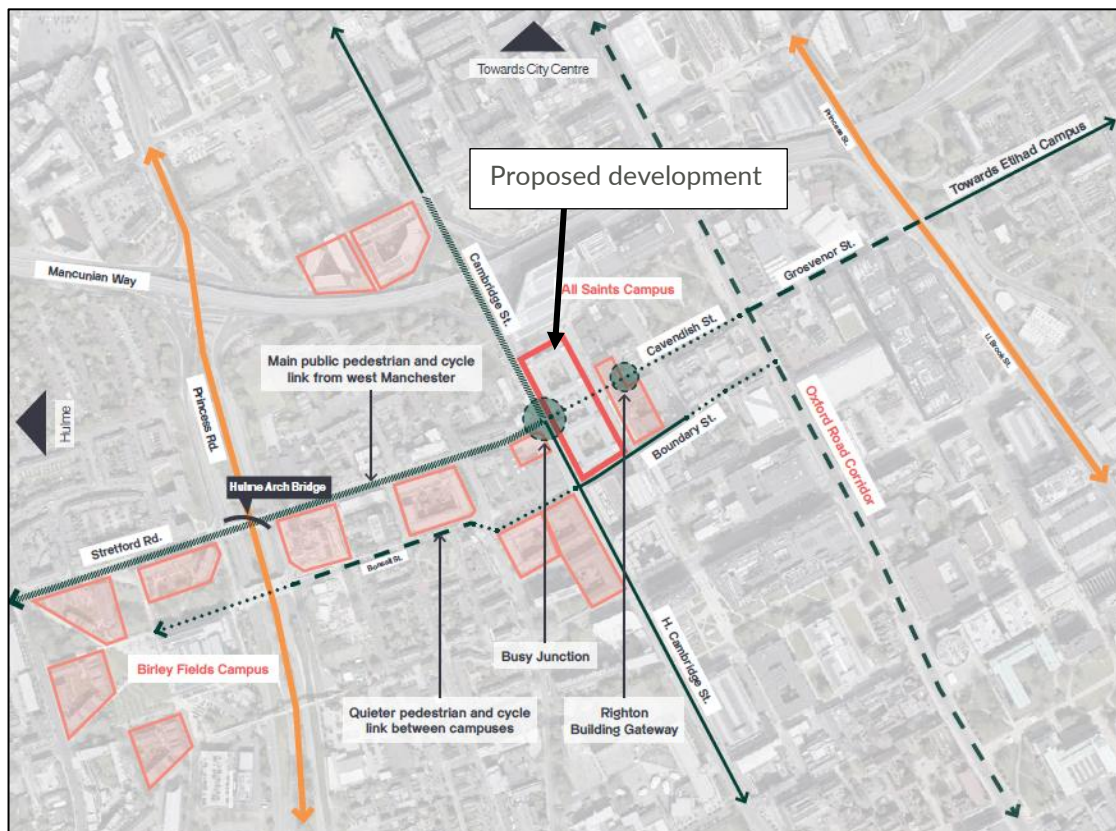


Figure 1 Proposed development site location

1.4 Proposed Development Boundary – Aerial image

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

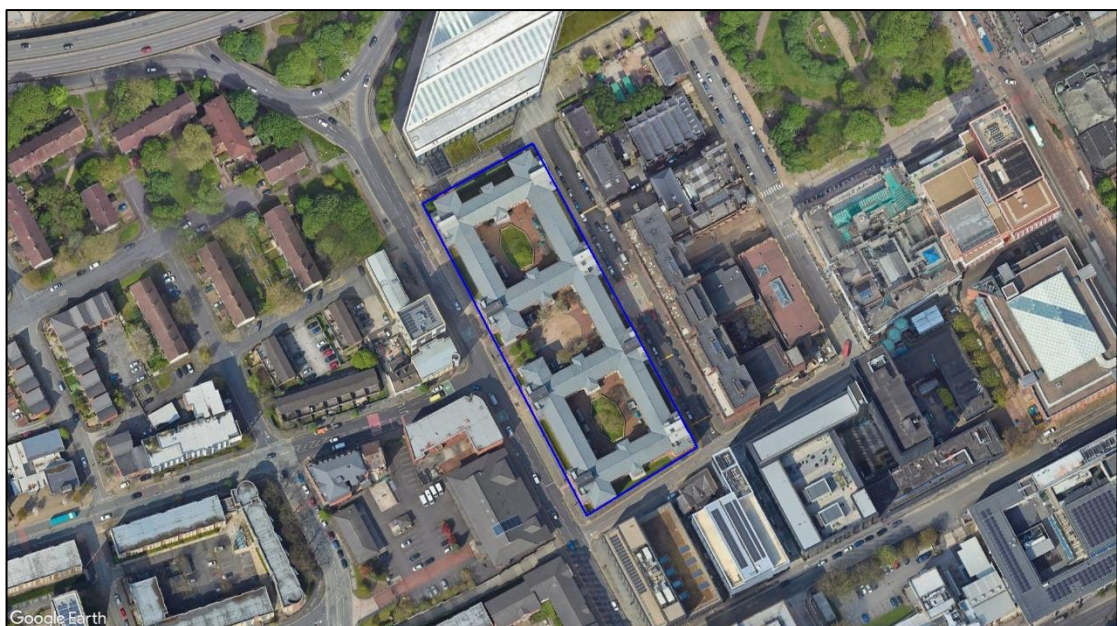


Figure 2 Proposed development boundary overlaid on aerial imagery

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 building development.

Digital television services are broadcast via Ultra High Frequency (UHF) signals; no analogue television signals are broadcast. The transmitter information is presented below².

2.2 Winter Hill Main Transmitter

Winter Hill is one of the UK's main television transmitters located approximately 24.2km northwest of the Proposed Development (published coordinates SD66051446).

Digital television services are broadcast, details are presented in Table 1 and Table 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 Transmissions (main multiplexes)

Service	L-MAN	G-MAN
Channel	24	27
Power	2 kW	1 kW

Table 2 Winter Hill Transmissions (local multiplexes)

² Source: <https://www.freeview.co.uk/help/coverage-checker/detailed-view?postcode=M156TT>

3 BUILDINGS AND INTERFERENCE MECHANISMS

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.

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

3.2 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 south-east 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 3³ on the following page, taken from Section 3.2 of an Ofcom paper⁴ regarding the impact of buildings on broadcast signals.

³ Source: Ofcom (2009): Tall Structures and their impact on broadcast and other wireless services.

⁴ Reference as above.

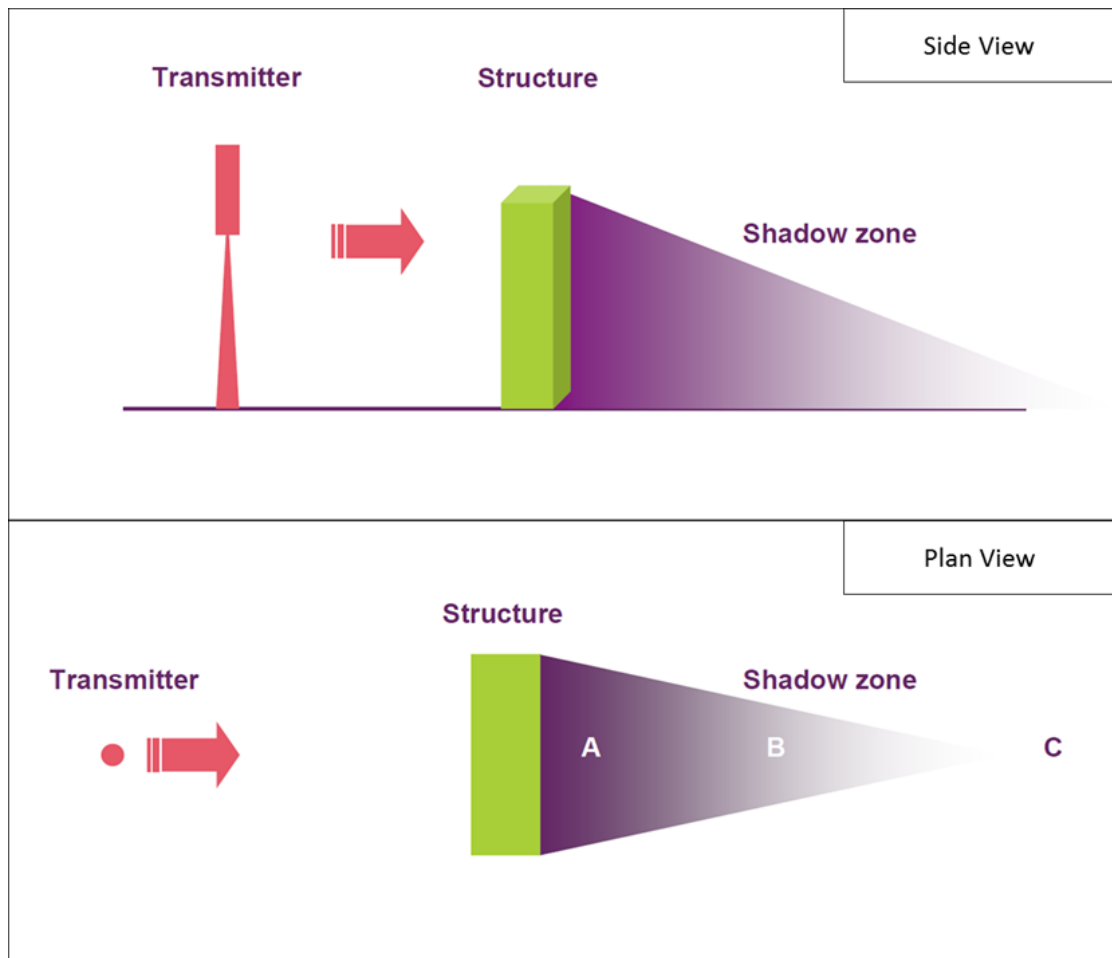


Figure 3 Diffraction Loss Zones

3.3 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 on the previous page) illustrates this effect.

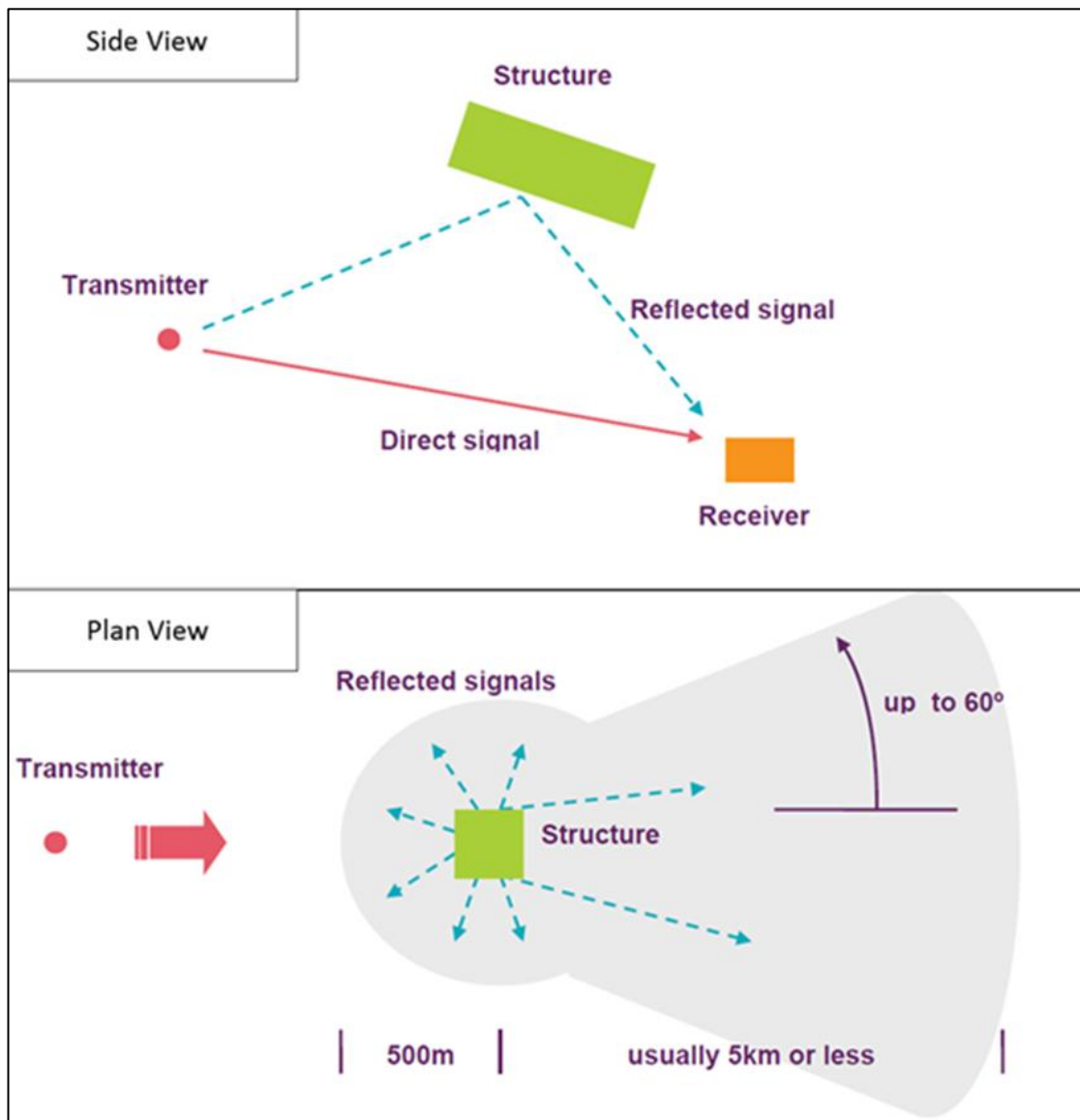


Figure 4 Diffraction Loss Zones

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 degrees⁵.

⁵ 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.

No location can be affected by both diffraction (shadowing) and direct reflections.

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

Figure 5 on the following page shows the potential interference areas associated with the proposed development with respect to the Winter Hill main Transmitter overlaid onto aerial imagery. This is the main transmitter predominantly providing digital television services to the area around the proposed development.

These have been defined based on the geometry of the potential interference zones 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 3 in the previous section.

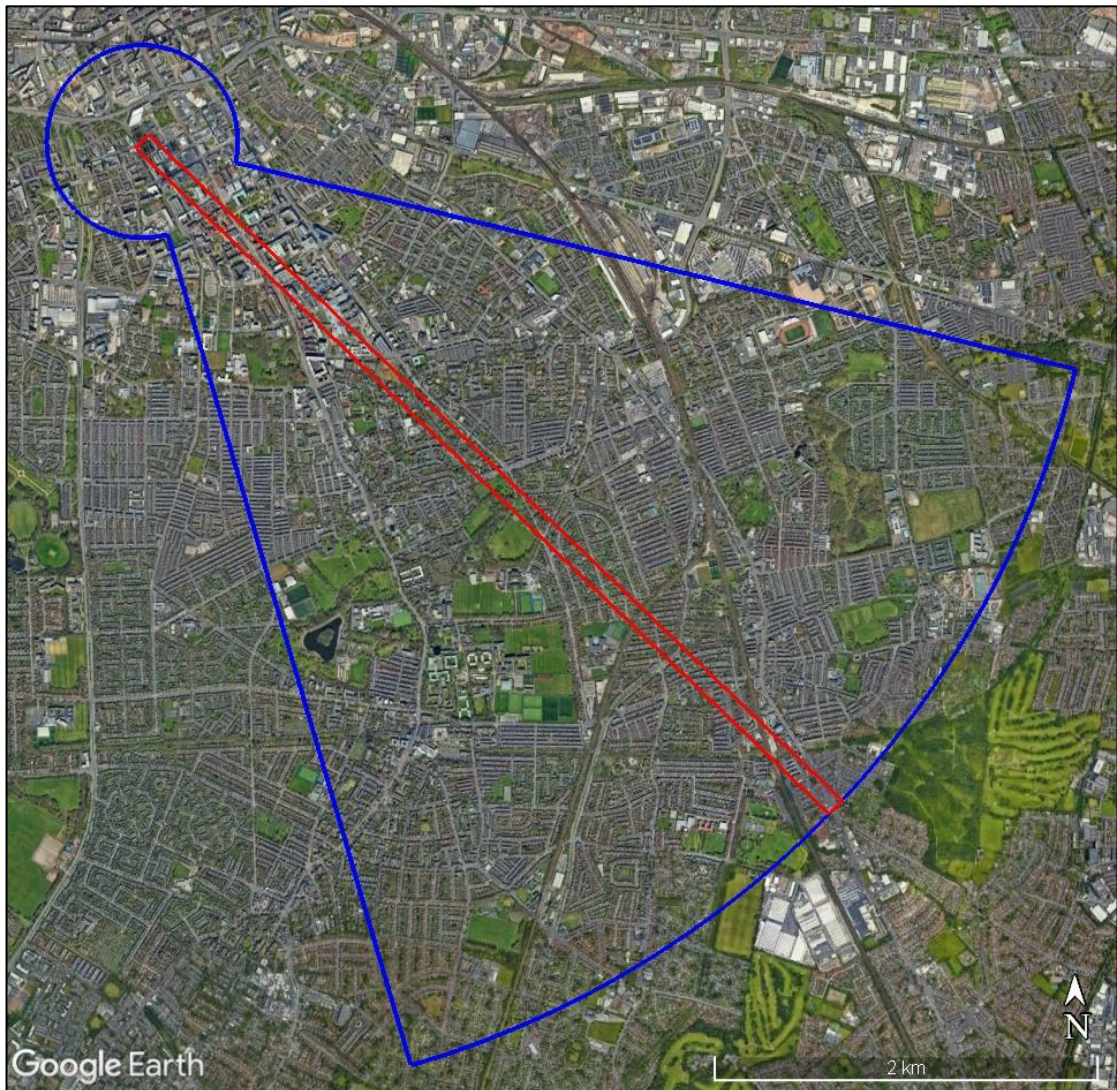


Figure 5 Interference zones - aerial image

The interference zones have been constructed in accordance with Ofcom guidance presented in Section 3, which gives fixed dimensions that do not vary with building size. The survey results and previous experience have informed the overall judgement of where effects are predicted.

4.2 Potential Diffraction Issues

It can be seen that the shadow zone passes over mostly high and low-rise residential developments. Areas closest to the built development are at the highest risk of experiencing television interference.

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.

For interference to occur due to reflections, the following criteria would need to be met:

- The receiving aerial would not be already obstructed by a building or other existing obstacle;
- The reflected signal path via the built development would have to be relatively unobstructed;
- The angle between the reflected signal via the built development and the direct signal would have to be small.

In practice it is unlikely that all of the above criteria would be met. Impacts due to reflections are considered unlikely.

5 TELEVISION SURVEY RESULTS

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;
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; and
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 on 21st June 2024.

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 3 below.

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

Table 3 *Television signal strength categories*

5.2 Survey Locations

Figure 6 on the following page shows the survey locations overlaid onto aerial photography. The interference zones are also shown. Locations were selected considering residential areas within the building's shadow zone. The locations are deliberately spaced close together nearest the proposed development, as this is the area where effects would generally be the most likely. Survey locations were chosen pre-survey (within the shadow zone); however safe and available access influenced the specific position on the day. The locations show the actual survey locations.

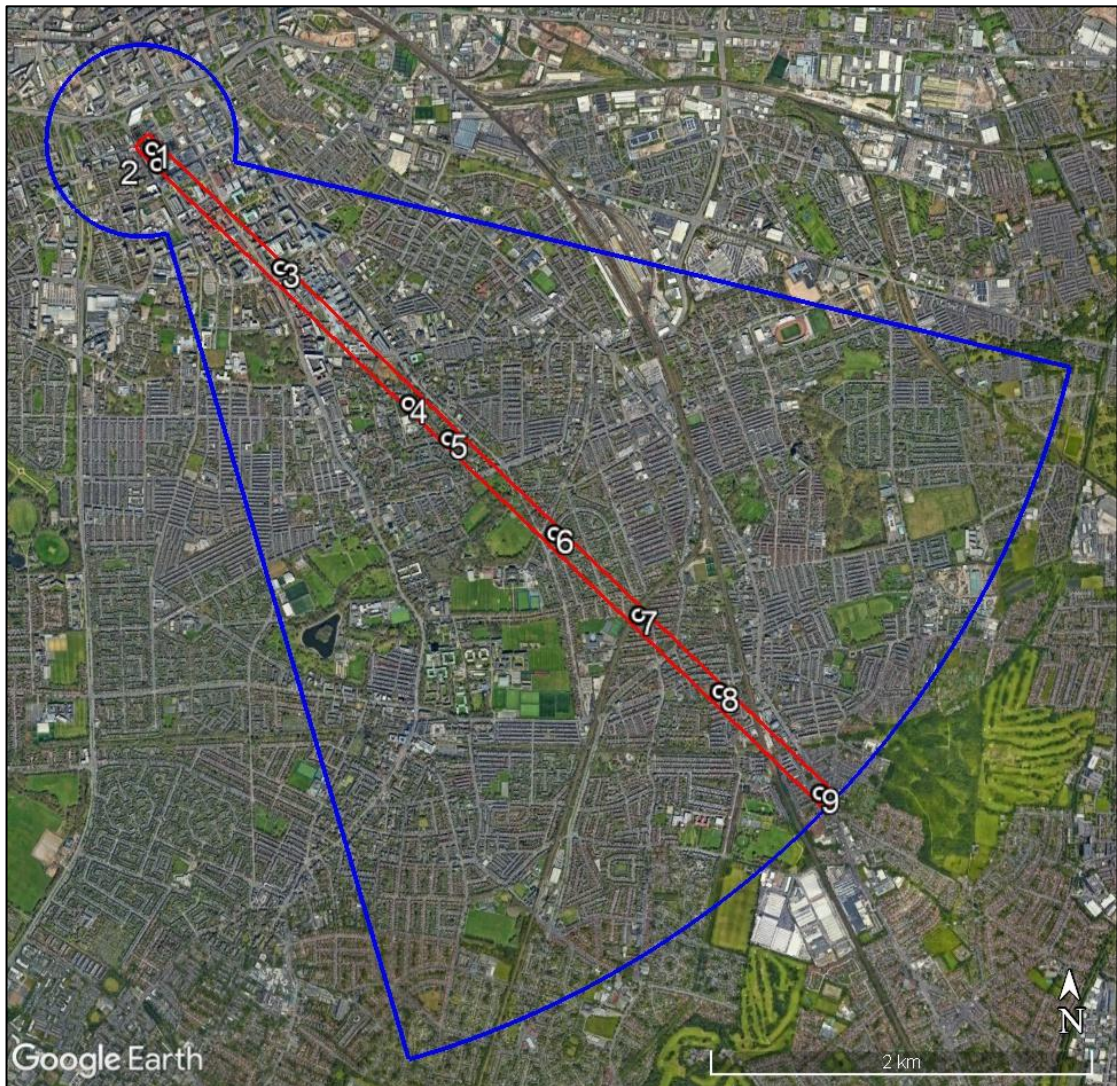


Figure 6 Survey locations

5.3 Survey Results

An overview of the survey results is presented in Table 4 on the following pages.

The following abbreviation is used where appropriate:

- MUX – multiplex (group of television channels).

The average signal strength is given separately for the main television multiplexes and the local television multiplexes. This is because the difference in power for these transmissions is significant, such that a single average figure would not be meaningful.

Detailed survey results are shown in Appendix A. Photos taken at the individual survey locations are shown in Appendix B.

Location	Measured Signal Strength (dB)	Remarks	High Level Conclusion
1	Average: 41.7 (Moderate) Main TV MUX: 45.4 (Good) Local TV MUX: 30.9 (Low)	No aerials or satellite dishes observed in the area. All main multiplexes displayed fine picture and audio quality, with signal fluctuations of 0.7dB or less and no signs of interference. One of the local multiplexes did not decode.	The survey location is within 50 metres of the proposed development location, in the nearest residential area which is within the shadow zone. A reduction in signal strength is possible based on the proximity to the proposed development (within 50m); however, effects may not be noticeable in practice considering the lack of low-rise residential buildings and aerials, and the baseline main signal strength (good).
2	Average: 41.5 (Moderate) Main TV MUX: 45.1 (Good) Local TV MUX: 30.7 (Low)	No aerials or satellite dishes observed in the area. All main multiplexes displayed fine picture and audio quality, with signal fluctuations of 0.4dB or less and no signs of interference. Both local multiplexes did not decode.	The survey location is within 100 metres of the proposed development location. A reduction in signal strength is possible based on the proximity to the proposed development (within 100m); however, effects may not be noticeable in practice considering the lack of low-rise residential buildings and aerials, and the baseline main signal strength (good).

Location	Measured Signal Strength (dB)	Remarks	High Level Conclusion
3	Average: 35.5 (Moderate) Main TV MUX: 38.6 (Moderate) Local TV MUX: 26.3 (Low)	No aerials or satellite dishes observed in the area. Four main multiplexes did not decode. One main multiplex had intermittent picture and audio. The one remaining main multiplex displayed fine picture and audio quality, with signal fluctuations of 0.3dB or less and no signs of interference. Both local multiplexes did not decode.	The survey location is within 950 metres of the proposed development. A reduction in signal strength is possible based on the distance to the proposed development (within 1km); however, effects may not be noticeable in practice considering the lack of low-rise residential buildings and aerials, and the baseline main signal strength (good).
4	Average: 48.5 (Good) Main TV MUX: 53.5 (Good) Local TV MUX: 33.3 (Low)	Multiple aerials orientated towards Winter Hill observed – appeared to be taller than 10m. Satellite dishes observed. All main multiplexes displayed fine picture and audio quality, with signal fluctuations of 0.3dB or less and no signs of interference. One of the local multiplexes did not decode.	This location is approximately 1.9km from the proposed development. Effects at this range are likely to be relatively small based on previous experience. Based on the current main signal quality, effects are unlikely to be noticeable.

Location	Measured Signal Strength (dB)	Remarks	High Level Conclusion
5	Average: 41.5 (Moderate) Main TV MUX: 46.3 (Good) Local TV MUX: 27 (Low)	Multiple aerials orientated towards Winter Hill observed in the distance – appear to be taller than 10m. Satellite dishes observed in the distance. All main multiplexes displayed fine picture and audio quality, with signal fluctuations of 0.7dB or less and no signs of interference. Both local multiplexes did not decode.	This location is approximately 2.2km from the proposed development. Effects at this range are likely to be relatively small based on previous experience. Based on the current main signal quality, effects are unlikely to be noticeable.
6	Average: 54.2 (Good) Main TV MUX: 59.8 (Very Good) Local TV MUX: 37.4 (Moderate)	Multiple aerials orientated towards Winter Hill observed – some appear to be taller than 10m. Satellite dishes observed. All main multiplexes displayed fine picture and audio quality, with signal fluctuations of 0.5dB or less and no signs of interference. One of the local multiplexes did not decode.	This location is approximately 2.95km 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.

Location	Measured Signal Strength (dB)	Remarks	High Level Conclusion
7	Average: 55.5 (Very Good) Main TV MUX: 61.8 (Very Good) Local TV MUX: 36.6 (Moderate)	Multiple aerials orientated towards Winter Hill observed – appear to be taller than 10m. Satellite dishes observed. All multiplexes displayed fine picture and audio quality, with signal fluctuations of 0.5dB or less and no signs of interference. One of the local multiplexes did not decode.	This location is approximately 3.55km 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.
8	Average: 56.3 (Very Good) Main TV MUX: 60.9 (Very Good) Local TV MUX: 42.7 (Moderate)	Multiple aerials orientated towards Winter Hill and satellite dishes observed. All multiplexes displayed fine picture and audio quality, with signal fluctuations of 0.2dB or less and no signs of interference.	This location is approximately 4.1km 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.
9	Average: 58.1 (Very Good) Main TV MUX: 63.2 (Very Good) Local TV MUX: 42.8 (Moderate)	Multiple aerials orientated towards Winter Hill observed – most are taller than 10m. Multiple satellite dishes observed. All multiplexes displayed fine picture and audio quality, with signal fluctuations of 0.3dB or less and no signs of interference.	This location is approximately 4.85km 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.

Table 4 Baseline and post-construction survey results

6 MITIGATION

6.1 Mitigation Requirement

If an adverse effect on television services occurs and is attributable to the proposed development, mitigation will be required.

6.2 Mitigation Options

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.
- Replacing terrestrial reception equipment with satellite reception equipment, cable or provision via the internet.

6.3 Recommended Options

If interference were to occur for a small number of homes, it is likely that installation of satellite television 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.

6.4 Recommended Process

It is possible that no adverse effects will occur due to the current reception quality in the majority of the surrounding area.

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.

There is no reason to install pre-emptive mitigation.

7 CONCLUSIONS

7.1 Results

- Residences in the area surrounding the proposed development receive television services predominantly from the Winter Hill main transmitter.
- A site survey was undertaken on 21st June 2024 to confirm the relevant transmitter and record the signal quality.
- The strength and quality of the signal in the shadow zone is on average good.
- Any interference would be due to shadowing effects, i.e. the weakening of the transmitted signal due to the physical presence of the proposed development.
- Negative effects upon signal strength are typically limited to within 1km of the development and within its shadow zone based on Pager Power's assessment experience.
- A reduction in signal strength for some residential properties within this range is possible based on the proximity to the proposed development; however, effects may not be noticeable considering the baseline signal strength. The majority of channels should retain good quality transmission.
- Residential properties at greater distances are unlikely to experience noticeable impacts in practice due to the baseline signal strength.

7.2 Recommendation

Any reported television interference within the shadow zone, and within close proximity of the proposed development, should be investigated by means of a reception measurement.

7.3 Mitigation

Technical mitigation solutions have been identified for implementation if an impact occurs that is attributable to the proposed development. There is no reason to install pre-emptive mitigation due to the distinct possibility that no noticeable effects will occur. The most likely options, in the event a mitigation requirement transpires, would be:

- Replacement of receiving aerial with a more directional or higher gain aerial.
- Replacement of terrestrial reception equipment with satellite reception equipment or cable.

APPENDIX A –SURVEY RESULTS

Location 1 - Baseline

GPS Coordinates: 53.468931°, -2.239214°					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	L-MAN	34.1 ± 0.3	1x10 ⁻⁵	Good	Good
27	G-MAN	27.7 ± 0.3	DND	-	-
29	SDN	45.9 ± 0.4	1x10 ⁻⁴	Good	Good
31	Arqiva A	44.7 ± 0.5	1x10 ⁻³	Good	Good
32	BBC A	46.1 ± 0.6	1x10 ⁻⁵	Good	Good
34	D3&4	46.0 ± 0.7	1x10 ⁻⁶	Good	Good
35	BBC B	46.1 ± 0.3	1x10 ⁻⁷	Good	Good
37	Arqiva B	43.7 ± 0.2	5x10 ⁻⁴	Good	Good

Notes: No aerials or satellite dishes observed in the area.

Location 2 - Baseline

GPS Coordinates: 53.468193°, -2.238826°					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	L-MAN	31.6 ± 0.2	DND	-	-
27	G-MAN	29.8 ± 0.2	DND	-	-
29	SDN	46.2 ± 0.3	1x10 ⁻³	Good	Good
31	Arqiva A	44.2 ± 0.2	2x10 ⁻⁴	Good	Good
32	BBC A	46.9 ± 0.3	2x10 ⁻⁷	Good	Good
34	D3&4	45.2 ± 0.2	1x10 ⁻⁴	Good	Good
35	BBC B	43.3 ± 0.4	1x10 ⁻⁷	Good	Good
37	Arqiva B	45.0 ± 0.3	3x10 ⁻⁴	Good	Good

Notes: No aerials or satellite dishes observed in the area.

Location 3 - Baseline

GPS Coordinates: 53.463328°, -2.229089°					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	L-MAN	27.1 ± 0.2	DND	-	-
27	G-MAN	25.6 ± 0.2	DND	-	-
29	SDN	37.3 ± 0.2	DND	-	-
31	Arqiva A	39.3 ± 0.2	DND	-	-
32	BBC A	40.7 ± 0.2	1x10 ⁻²	Pixelated and glitching	
34	D3&4	37.5 ± 0.4	DND	-	-
35	BBC B	36.5 ± 0.5	DND	-	-
37	Arqiva B	40.7 ± 0.3	8x10 ⁻³	Good	Good

Notes: No aerials or satellite dishes observed in the area.

Location 4 - Baseline

GPS Coordinates: 53.456941°, -2.219005°					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	L-MAN	35.4 ± 0.4	1x10 ⁻⁸	Good	Good
27	G-MAN	31.3 ± 0.1	DND	-	-
29	SDN	54.1 ± 0.3	1x10 ⁻⁸	Good	Good
31	Arqiva A	51.9 ± 0.1	1x10 ⁻⁸	Good	Good
32	BBC A	52.1 ± 0.1	1x10 ⁻⁸	Good	Good
34	D3&4	52.2 ± 0.2	1x10 ⁻⁸	Good	Good
35	BBC B	55.1 ± 0.3	1x10 ⁻⁸	Good	Good
37	Arqiva B	56.0 ± 0.2	1x10 ⁻⁸	Good	Good

Notes: Multiple aerials orientated towards Winter Hill observed – appear to be taller than 10m. Satellite dishes observed.

Location 5 - Baseline

GPS Coordinates: 53.455290°, -2.215891°					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	L-MAN	28.5 ± 0.1	DND	-	-
27	G-MAN	25.5 ± 0.3	DND	-	-
29	SDN	47.5 ± 0.4	1x10 ⁻⁸	Good	Good
31	Arqiva A	48.4 ± 0.4	1x10 ⁻⁸	Good	Good
32	BBC A	47.1 ± 0.7	1x10 ⁻⁸	Good	Good
34	D3&4	45.1 ± 0.5	1x10 ⁻⁷	Good	Good
35	BBC B	46.9 ± 0.5	1x10 ⁻⁸	Good	Good
37	Arqiva B	43.1 ± 0.4	1x10 ⁻⁴	Good	Good

Notes: Multiple aerials orientated towards Winter Hill observed in the distance – appear to be taller than 10m.
Satellite dishes observed in the distance.

Location 6 – Baseline

GPS Coordinates: 53.450828°, -2.207533°					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	L-MAN	42.6 ± 0.2	1x10 ⁻⁸	Good	Good
27	G-MAN	32.3 ± 0.2	DND	-	-
29	SDN	60.6 ± 0.5	1x10 ⁻⁸	Good	Good
31	Arqiva A	60.0 ± 0.4	1x10 ⁻⁸	Good	Good
32	BBC A	59.3 ± 0.2	1x10 ⁻⁸	Good	Good
34	D3&4	61.1 ± 0.3	1x10 ⁻⁸	Good	Good
35	BBC B	60.1 ± 0.5	1x10 ⁻⁸	Good	Good
37	Arqiva B	58.0 ± 0.3	1x10 ⁻⁸	Good	Good

Notes: Multiple aerials orientated towards Winter Hill observed – some appear to be taller than 10m. Satellite dishes observed.

Location 7 - Baseline

GPS Coordinates: 53.447004°, -2.200911°					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	L-MAN	43.8 ± 0.2	1x10 ⁻⁸	Good	Good
27	G-MAN	29.5 ± 0.5	DND	-	-
29	SDN	60.0 ± 0.1	1x10 ⁻⁸	Good	Good
31	Arqiva A	61.7 ± 0.1	1x10 ⁻⁸	Good	Good
32	BBC A	62.7 ± 0.2	1x10 ⁻⁸	Good	Good
34	D3&4	64.9 ± 0.2	1x10 ⁻⁸	Good	Good
35	BBC B	61.8 ± 0.2	1x10 ⁻⁸	Good	Good
37	Arqiva B	60.0 ± 0.2	1x10 ⁻⁸	Good	Good

Notes: Multiple aerials orientated towards Winter Hill observed – appear to be taller than 10m. Satellite dishes observed.

Location 8 - Baseline

GPS Coordinates: 53.443413°, -2.194561°					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	L-MAN	45.8 ± 0.1	1x10 ⁻⁸	Good	Good
27	G-MAN	39.6 ± 0.1	1x10 ⁻⁶	Good	Good
29	SDN	61.1 ± 0.1	1x10 ⁻⁸	Good	Good
31	Arqiva A	60.7 ± 0.1	1x10 ⁻⁸	Good	Good
32	BBC A	59.9 ± 0.1	1x10 ⁻⁸	Good	Good
34	D3&4	59.7 ± 0.1	1x10 ⁻⁸	Good	Good
35	BBC B	60.9 ± 0.2	1x10 ⁻⁸	Good	Good
37	Arqiva B	63.2 ± 0.2	1x10 ⁻⁸	Good	Good

Notes: Multiple aerials orientated towards Winter Hill and satellite dishes observed.

Location 9 - Baseline

GPS Coordinates: 53.438644°, -2.186684°					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	L-MAN	46.9 ± 0.2	1x10 ⁻⁸	Good	Good
27	G-MAN	38.7 ± 0.1	5x10 ⁻⁸	Good	Good
29	SDN	63.1 ± 0.2	1x10 ⁻⁸	Good	Good
31	Arqiva A	63.8 ± 0.3	1x10 ⁻⁸	Good	Good
32	BBC A	62.9 ± 0.2	1x10 ⁻⁸	Good	Good
34	D3&4	63.4 ± 0.2	1x10 ⁻⁸	Good	Good
35	BBC B	64.3 ± 0.1	1x10 ⁻⁸	Good	Good
37	Arqiva B	61.9 ± 0.2	1x10 ⁻⁸	Good	Good

Notes: Multiple aerials orientated towards Winter Hill observed – most are taller than 10m. Multiple satellite dishes observed.

APPENDIX B – SURVEY PHOTOGRAPHS

Location 1



Location 1 (baseline survey)

Location 2



Location 2 (baseline survey)

Location 3



Location 3 (baseline survey)

Location 4



Location 4 (baseline survey)

Location 5



Location 5 (baseline survey)

Location 6



Location 6 (baseline survey)

Location 7



Location 7 (baseline survey)

Location 8



Location 8 (baseline survey)

Location 9



Location 9 (baseline survey)



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