PAGERPOWER
Urban & Renewables

Television Post-Construction Survey Report

Mulbury New Cross (Bendix Street)

Mulbury Homes Limited

July 2023

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1	July 2023	Initial issue

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EXECUTIVE SUMMARY

Report Purpose

Pager Power has been commissioned to undertake a post-construction terrestrial television and radio reception survey for a three-site building development located within the New Cross Area of Manchester City Centre. The building development has introduced additional tall structures into the urban environment which could consequently interact with wireless terrestrial television signals and cause interference in the surrounding area.

This report presents the results of the original television and radio baseline reception survey (completed in November 2019), and the post-construction survey completed in March 2023. The post-construction survey has been completed so that comparisons between the old baseline and the new baseline could be made to determine whether there has been a significant impact upon terrestrial television signals in the surrounding area. Survey measurements were taken in the development's shadow zone and the original locations were revisited as best as possible. This assessment has been undertaken based on guidance produced by OFCOM.

The post-construction survey intends to discharge the following planning condition:

> *31) Notwithstanding the TV reception survey stamped as received by the City Council, as Local Planning Authority, on 23 December 2019, with one month of the practical completion of the development or before the development is first occupied, whichever is sooner, and at any other time during the construction of the development if requested in writing by the City Council as local planning authority in response to identified television signal reception problems within the potential impact area a study shall identify such measures necessary to maintain at least the pre-existing level and quality of signal reception identified in the survey carried out above. The measures identified must be carried out either before the building is first occupied or within one month of the study being submitted to the City Council as local planning authority, whichever is the earlier.*
>
> *Reason – To provide an identification of the area of television signal reception likely to be affected by the development to provide a basis on which to assess the extent to which the development during construction and once built, will affect television reception and to ensure that the development at least maintains the existing level and quality of television signal reception – In the interest of residential amenity, as specified in policy of DM1 of Core Strategy.*

Assessment Conclusions

Terrestrial television signal strength has been measured to have decreased in all of the surveyed locations within the shadow of the development, with two out of four local multiplexes not decoding. However, while a significant reduction in signal strength has occurred, all main multiplexes were decoded with fine picture and audio.

The current picture and audio quality of main multiplexes in the immediate shadow has not changed, therefore mitigation is not recommended. However, any reported television interference within the immediate shadow zone (within 1km of the development) should be investigated by means of a reception measurement.

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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 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

Pager Power has been commissioned to undertake a post-construction terrestrial television and radio reception survey for a three-site building development located within the New Cross Area of Manchester City Centre. The building development has introduced additional tall structures into the urban environment which could consequently interact with wireless terrestrial television signals and cause interference in the surrounding area.

This report presents the results of the original television and radio baseline reception survey (completed in November 2019), and the post-construction survey completed in March 2023. The post-construction survey has been completed so that comparisons between the old baseline and the new baseline could be made to determine whether there has been a significant impact upon terrestrial television signals in the surrounding area. Survey measurements were taken in the development's shadow zone and the original locations were revisited as best as possible. This assessment has been undertaken based on guidance produced by OFCOM.

1.2 Description of Development

The development consists of three separate buildings built at Goulden Street (8 storeys), Oldham Road (11 storeys) and Bendix Street (9 storeys). The development boundaries overlaid on an aerial image from November 2019 are shown in Figure 1 below.

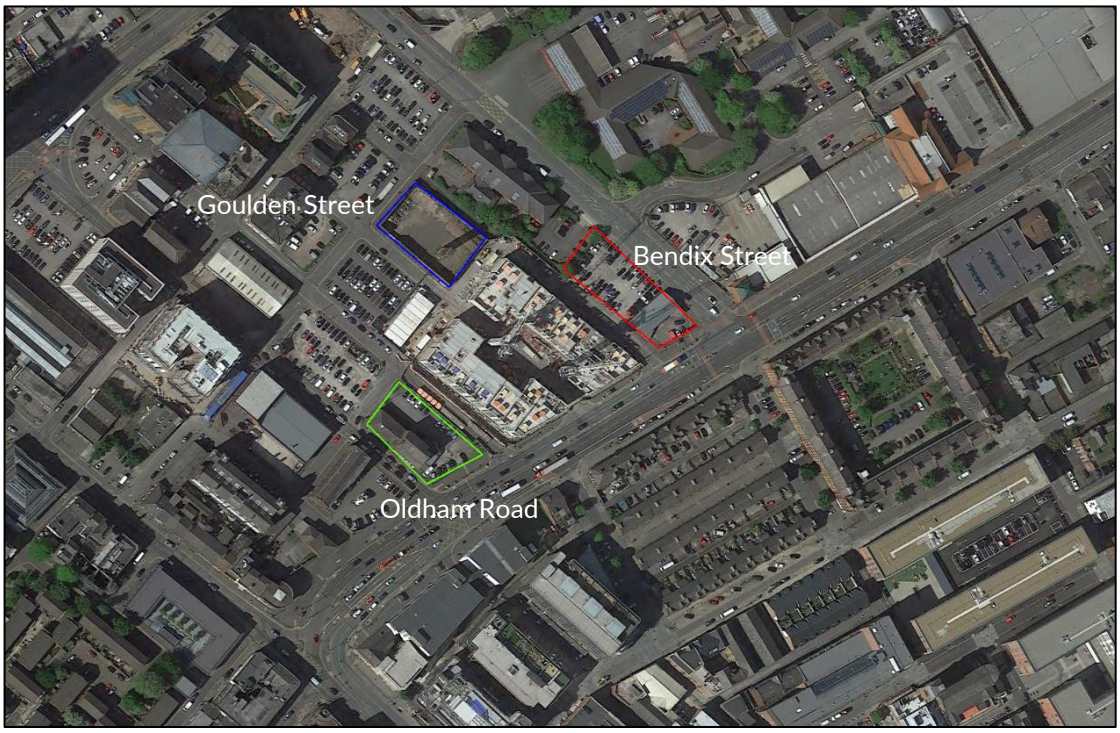

Figure 1 *Building boundaries*

2 TELEVISION TRANSMITTER DETAILS

2.1 Relevant Transmitter

A comprehensive search of transmitter and coverage maps indicates that the Winter Hill transmitter is the main transmitter most likely to be serving the area around the building developments.

Digital television services are broadcast via Ultra High Frequency (UHF) signals; no analogue television signals are broadcast. The transmitter information[1] is presented in the following subsections.

2.2 Winter Hill Main Transmitter

Winter Hill is one of the UK's main television transmitters located approximately 24.4km 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	50	59	54-	58	49	55
Power	100 kW					

Table 1 *Winter Hill Transmissions (main multiplexes)*

	Local Multiplexes			
Service	COM 7	COM8	LM/LL/LPR	GIM
Channel	31	37	56	57
Power	25.7 kW	22.6kW	2 kW	1 kW

Table 2 *Winter Hill Transmissions (local multiplexes)*

The location of the Winter Hill transmitter relative to the development site is shown in **Error! R eference source not found.** on the following page.

[1] Source: OFCOM, UK digital television transmitter details – DSO multiplexes

Figure 2 *Winter Hill transmitter relative to Mulbury New Cross*

3 BUILDINGS AND INTERFERENCE MECHANISMS

3.1 Technical Overview

Terrestrial television services are provided by means of electromagnetic waves in the Ultra High Frequency (UHF) range which propagate from land-based transmitters to receiving aerials.

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

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

3.2 Interference Mechanisms

Buildings can cause interference to terrestrial television reception by way of obstruction and reflection, outlined in the following subsections.

3.2.1 Obstruction

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

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

Relevant extracts from OFCOM relating to guidance[2] on this issue are presented below:

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

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

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

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

The zones mentioned are illustrated in Figure 3[3] on the following page, taken from Section 3.2 of the OFCOM guidance regarding the impact of buildings on broadcast signals.

[2] OFCOM (2009): Tall Structures and their impact on broadcast and other wireless services
[3] Source: OFCOM publication

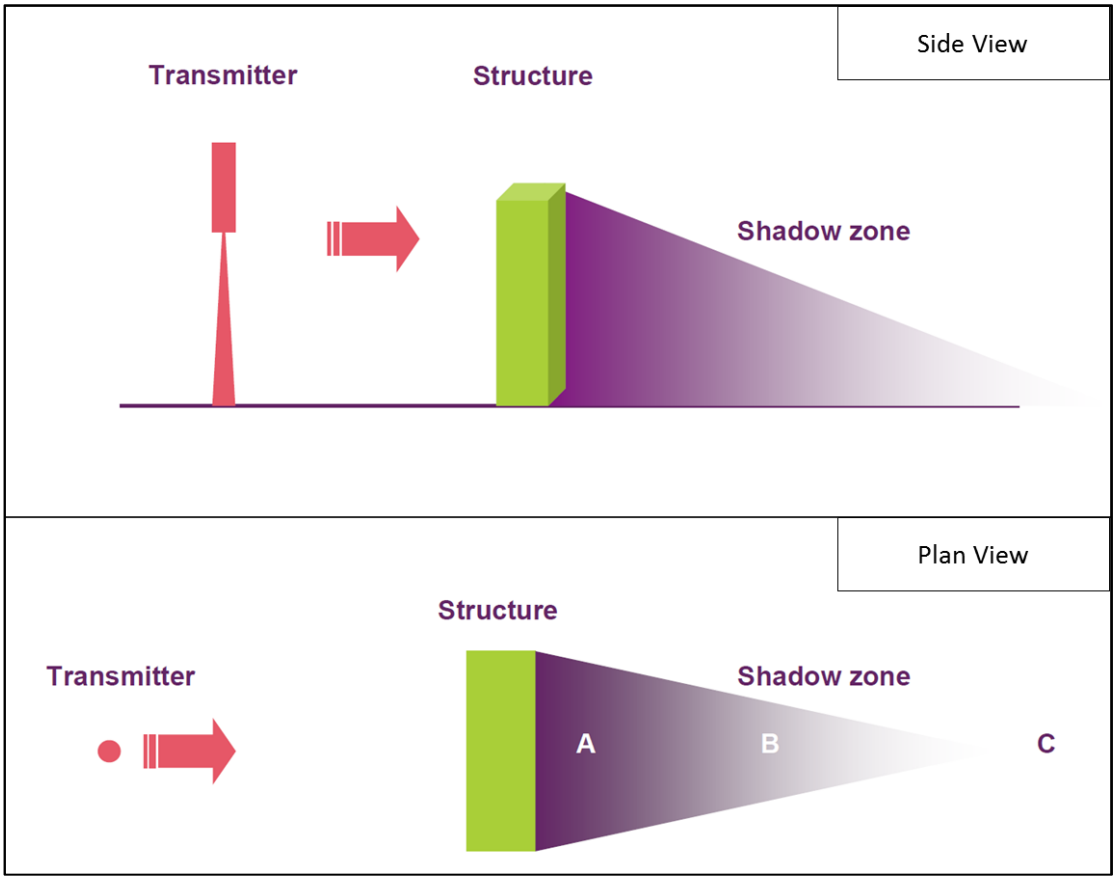

Figure 3 *Diffraction Loss Zones*

3.2.2 Reflection

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[4] on the following page (taken from Section 3.3 of the OFCOM guidance referenced previously) illustrates this effect.

[4] Source: OFCOM publication

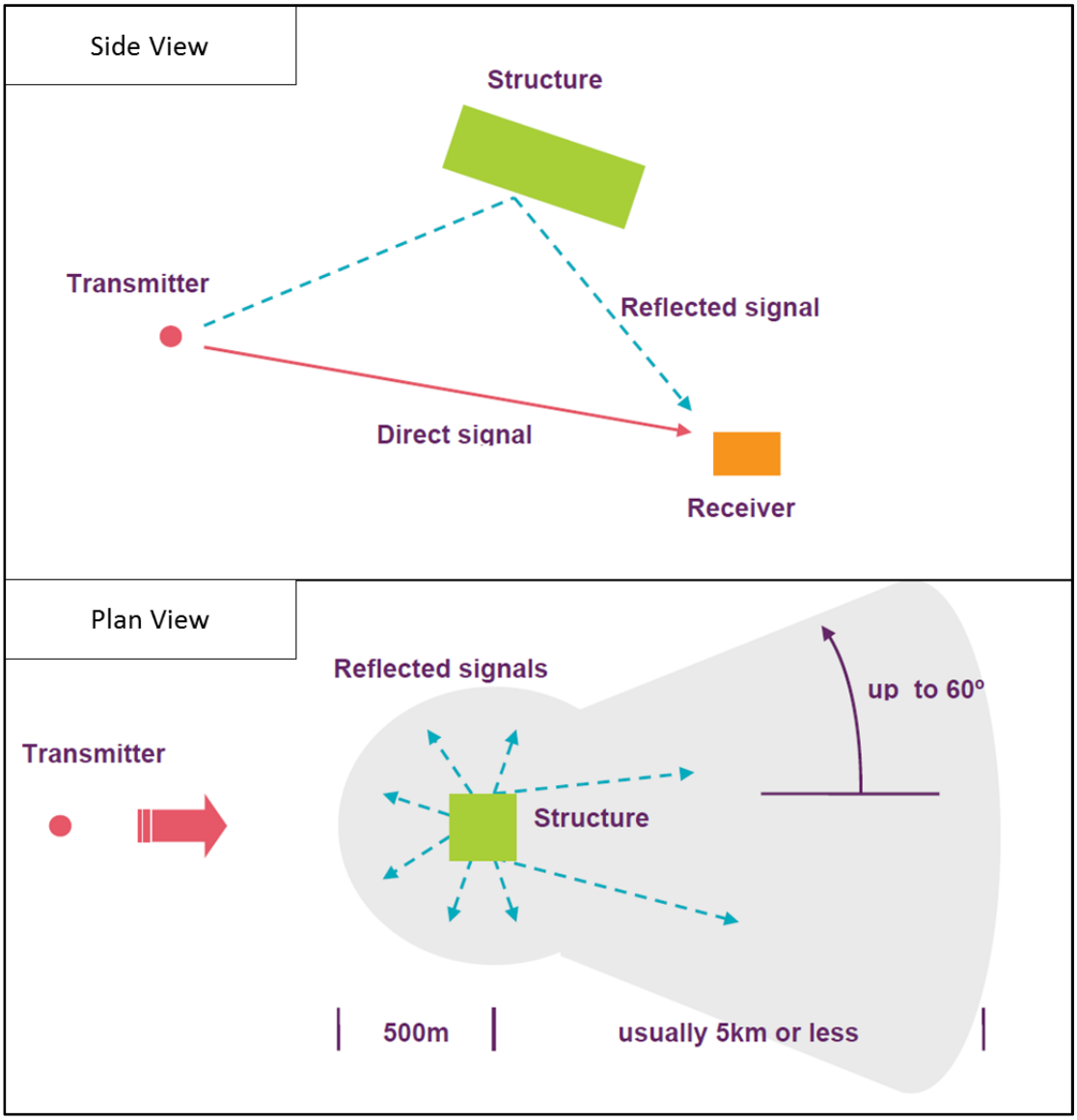

Figure 4 *Reflection Zones*

In practice, it is considered highly unlikely that reflections will have an effect for receivers in front of the building or on either side when viewed from the location of the transmitter. For digital transmissions in particular, it is unlikely that issues will occur if the angle between the direct signal and the reflected signal is more than 30 degrees[5] .

[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.

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 development site 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 below shows the potential interference areas associated with the development site.

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 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.

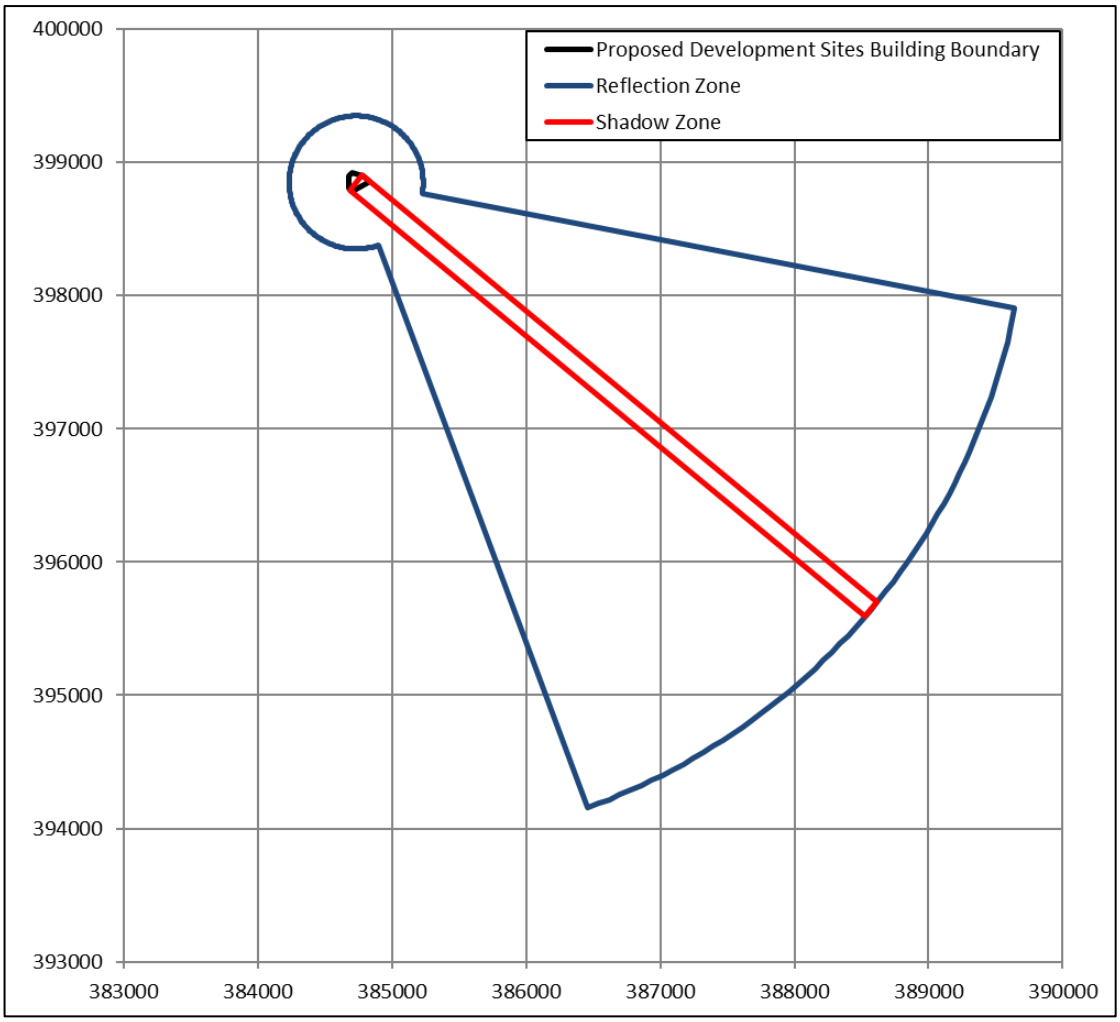

Figure 5 *Shadow and reflection zone*

Figure 6 below shows the interference zones overlaid onto mapping of the area.

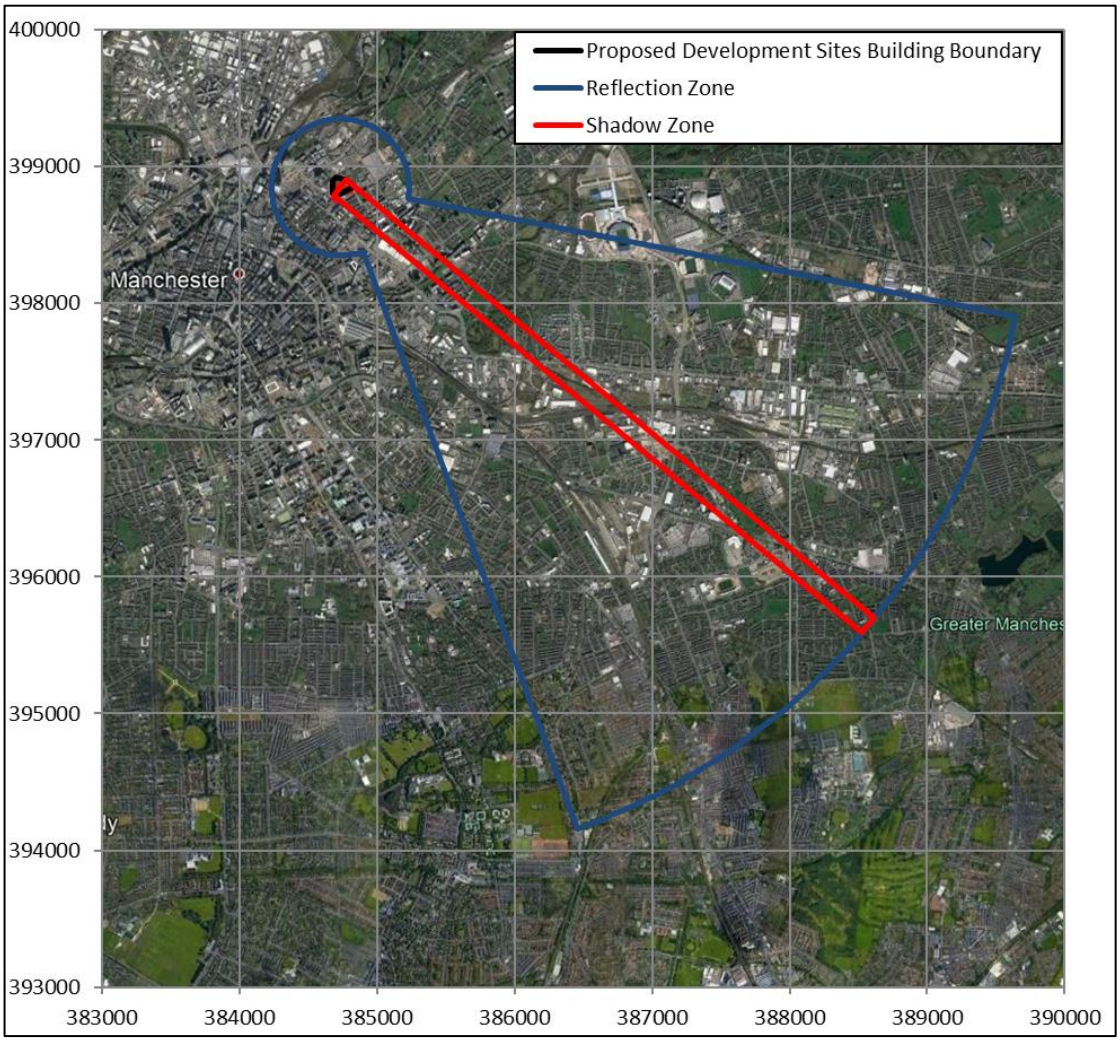

Figure 6 *Interference zones map*

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 areas that are mostly urban containing industrial buildings as well as high and low-rise residential developments. Areas closest to the Proposed 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.

Based on bare-earth terrain, the Winter Hill transmitter has coverage below ten metres for the populated areas within the reflection zone. This means that any receivers that have a low signal

strength are likely to be affected by existing obstructions. For interference to occur due to reflections, the following criteria would need to be met:

- The receiving aerial would be already obstructed by a building or other existing obstacle;
- The reflected signal path via the development would have to be relatively unobstructed;
- The angle between the reflected signal via the development and the direct signal would have to be small.

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

5 TELEVISION SURVEY RESULTS

5.1 Overview

The purpose of the 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 20th November 2019.

A post-construction survey was completed on 17th July 2023 so comparisons between the pre-construction and post-construction signal strength levels could be made to determine whether there has been a significant impact upon terrestrial television signals in the surrounding area. Survey measurements were taken in the development's shadow zone and the original locations were revisited as best as possible.

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.

5.2 Survey Locations

Figure 7 on the following page shows the survey locations overlaid onto aerial photography with the icons showing where television reception measurements were taken. The shadow and reflection zones (grey area highlighted red) are also shown. Survey locations were chosen prior to the survey (within the shadow zone); however, safe and available access influenced the specific position on the day. The locations on the following page show the actual survey locations. The coordinates of these points can be found in Appendix A and B.

Figure 7 *Survey locations*

5.3 Survey Results

5.3.1 Overview

The strength of the recorded television signal 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*

The survey confirmed that the Winter Hill transmitter is serving the area within the shadow zone. At some locations terrestrial aerials were not observed however terrestrial aerials may be located internally or on the roof of high-rise accommodation which were both not visible from the survey location.

5.3.2 Table of Results

Table 4 on the following page summarises the results of the surveys. The following abbreviations are used:

- MUX – multiplex (group of television channels).

The average signal strength is given separately for the main television multiplexes and 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.

Baseline survey results, post-construction survey results and survey photos at each individual survey location are shown in Appendices A, B and C respectively.

Location	Average Measured Signal Strength (dB)	Remarks	Conclusions
1	**Baseline** Main TV MUX: 41 Local TV MUX: 37	Horizontally polarised aerials directed towards the Winter Hill transmitter and satellite dishes were observed. **Baseline:** All main multiplexes displayed fine picture and audio quality Two out of four local multiplexes were not decoded at this location **Post-Construction:** All main multiplexes displayed fine picture and audio Two out of four local multiplexes were not decoded at this location	The survey location is within 200m of the closest of the Mulbury New Cross development and within its shadow zone **The reduction in TV signal strength at this location could be attributed to the Mulbury New Cross development. However, there is no change in picture or audio quality to channels that did decode. Results are also consistent to channels that did/did not decode**
	Post-Construction Main TV MUX: 32 Local TV MUX: 34		

Location	Average Measured Signal Strength (dB)	Remarks	Conclusions
2	**Baseline** Main TV MUX: 49 Local TV MUX: 39	External aerials were not visible at this location. **Baseline:** All main multiplexes displayed fine picture and audio quality Two out of four local multiplexes were not decoded at this location **Post-Construction:** All main multiplexes displayed fine picture and audio Two out of four local multiplexes were not decoded at this location	The survey location is within 700m of the Mulbury New Cross development site and within its shadow zone **The reduction in TV signal strength at this location could be attributed to the Mulbury New Cross development. However, there is no change in picture or audio quality to channels that did decode. Results are also consistent to channels that did/did not decode**
	Post-Construction Main TV MUX: 38 Local TV MUX: 31		

Location	Average Measured Signal Strength (dB)	Remarks	Conclusions
3	**Baseline** Main TV MUX: 42 Local TV MUX: 36	Horizontally polarised aerials directed towards the Winter Hill transmitter and satellite dishes were observed. **Baseline:** All main multiplexes displayed fine picture and audio quality Two out of four local multiplexes were not decoded at this location **Post-Construction:** All main multiplexes displayed fine picture and audio Two out of four local multiplexes were not decoded at this location	The survey location was within 1.3km of the Mulbury New Cross development site and within its shadow zone **The reduction in TV signal strength at this location is not likely to be attributed to the Mulbury New Cross development. However, there is no change in picture or audio quality to channels that did decode. Results are also consistent to channels that did/did not decode**
	Post-Construction Main TV MUX: 35 Local TV MUX: 35		

Location	Average Measured Signal Strength (dB)	Remarks	Conclusions
4	**Baseline** Main TV MUX: 50 Local TV MUX: 38	Very few external aerials were visible at this location **Baseline:** All main multiplexes displayed fine picture and audio quality One out of four local multiplexes were not decoded at this location **Post-Construction:** All main multiplexes displayed fine picture and audio Two out of four local multiplexes were not decoded at this location	The survey location was within 1.9km of the Mulbury New Cross development site and within its shadow zone **The reduction in TV signal strength at this location is not likely to be attributed to the Mulbury New Cross development. However, there is no change in picture or audio quality to channels that did decode. The reduction in local multiplexes is likely due to signal strength from weaker transmissions**
	Post-Construction Main TV MUX: 36 Local TV MUX: 38		

Location	Average Measured Signal Strength (dB)	Remarks	Conclusions
5	**Baseline** Main TV MUX: 70 Local TV MUX: 51	Horizontally polarised aerials directed towards the Winter Hill transmitter and satellite dishes were observed **Baseline:** All main multiplexes displayed fine picture and audio quality One out of four local multiplexes were not decoded at this location **Post-Construction:** All main multiplexes displayed fine picture and audio Two out of four local multiplexes were not decoded at this location	The survey location was within 3.2km of the Mulbury New Cross development site and within its shadow zone. **The reduction in TV signal strength at this location is not likely to be attribed to the Mulbury New Cross development. However, there is no change in picture or audio quality to channels that did decode. The reduction in local multiplexes is likely due to signal strength from weaker transmissions**
	Post-Construction Main TV MUX: 40 Local TV MUX: 45		

Location	Average Measured Signal Strength (dB)	Remarks	Conclusions
6	**Baseline** Main TV MUX: 64 Local TV MUX: 48	Horizontally polarised aerials directed towards the Winter Hill transmitter and satellite dishes were observed. **Baseline:** All main multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 1dB and no signs of interference One out of four local multiplexes were not decoded at this location	The survey location was within 4.5km of the proposed development and within its shadow zone **The reduction in TV signal strength at this location is not likely to be attributed to the Mulbury New Cross development. However, there is no change in picture or audio quality to channels that did decode. The reduction in local multiplexes is likely due to signal strength from weaker transmissions**
	Post-Construction Main TV MUX: 49 Local TV MUX: 39	**Post-Construction:** All main multiplexes displayed fine picture and audio Two out of four local multiplexes were not decoded at this location	

Table 4 *Baseline and post-construction survey results*

5.4 Local Multiplexes

The Winter Hill transmitter broadcasts four local channels at lower power than the main multiplexes (Table 2 in Section 2.2). Any interference to these local multiplexes is judged to be unrelated to the development. The determination regarding the buildings' influence is made solely based on the comparison of the main multiplexes, because this is considered the most reliable indicator of interference effects.

6 MITIGATION

6.1 Mitigation Requirement

The results of the post-construction survey, with respect to the baseline survey, have suggested there is no reason to install mitigation. If an adverse effect on television services occurs and is attributable to the built 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 to terrestrial television 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/dishes, the best option may be to upgrade and/or elevate the existing aerial/dish.

It may also be possible for television services to be supplied by an alternate transmitter in the surrounding area.

6.4 Recommended Process

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

7 CONCLUSIONS

7.1 Assessment Conclusions

Terrestrial television signal strength has been measured to have decreased in all of the surveyed locations within the shadow of the development, with two out of four local multiplexes not decoding. Terrestrial television signal strength has been measured to have decreased in all of the surveyed locations within the shadow of the development, with two out of four local multiplexes not decoding. However, while a significant reduction in signal strength has occurred, all main multiplexes were decoded with fine picture and audio.

The current picture and audio quality of main multiplexes in the immediate shadow has not changed, therefore mitigation is not recommended. However, any reported television interference within the immediate shadow zone (within 1km of the development) should be investigated by means of a reception measurement.

APPENDIX A – BASELINE SURVEY RESULTS (2019)

Location 1

Location 1 (GPS Coordinates: SJ 84876 98748 +/- 27 ft)					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
31	COM7	42.2 ± 0.2	0%	Fine	Fine
37	COM8	52.1 ± 0.2	$1x10^{-8}$	Fine	Fine
49	Arqiva A	42.2 ± 0.2	$3x10^{-6}$	Fine	Fine
50	BBC A	43.3 ± 0.2	$4x10^{-7}$	Fine	Fine
54-	BBC B	43.5 ± 0.2	0%	Fine	Fine
55	Arqiva B	37.5 ± 0.2	0%	Fine	Fine
56	LM/LL/LPR	25.6 ± 0.2	DND		
57	GIM	27.1 ± 0.2	DND		
58	SDN	41.0 ± 0.3	$4x10^{-7}$	Fine	Fine
59	Digital 3&4	39.6 ± 0.3	$8x10^{-8}$	Fine	Fine

Notes: UHF aerials directed towards the Winter Hill transmitter and satellite dishes were observed.

Location 2

Location 2 (GPS Coordinates: SJ 85340 98356 +/- 24 ft)					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
31	COM7	45.1 ± 0.2	0%	Fine	Fine
37	COM8	54.2 ± 0.4	$6x10^{-8}$	Fine	Fine
49	Arqiva A	54.0 ± 0.2	$2x10^{-8}$	Fine	Fine
50	BBC A	55.0 ± 0.2	$1x10^{-8}$	Fine	Fine
54-	BBC B	51.2 ± 0.2	0%	Fine	Fine
55	Arqiva B	43.8 ± 0.3	0%	Fine	Fine
56	LM/LL/LPR	25.6 ± 0.2	DND		
57	GIM	29.2 ± 0.2	DND		
58	SDN	45.7 ± 0.3	$3x10^{-6}$	Fine	Fine
59	Digital 3&4	46.5 ± 0.2	$2x10^{-8}$	Fine	Fine

Notes: External aerials were not observed at this location

Location 3

Location 3 (GPS Coordinates: SJ 85728 97982 +/- 12 ft)					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
31	COM7	42.0 ± 0.2	0%	Fine	Fine
37	COM8	49.1 ± 0.2	$1x10^{-8}$	Fine	Fine
49	Arqiva A	42.0 ± 0.2	$2x10^{-6}$	Fine	Fine
50	BBC A	44.2 ± 0.2	$1x10^{-8}$	Fine	Fine
54-	BBC B	42.8 ± 0.2	0%	Fine	Fine
55	Arqiva B	36.7 ± 0.2	0%	Fine	Fine
56	LM/LL/LPR	25.6 ± 0.2	DND		
57	GIM	26.1 ± 0.2	DND		
58	SDN	42.3 ± 0.2	$1x10^{-8}$	Fine	Fine
59	Digital 3&4	42.9 ± 0.2	$1x10^{-8}$	Fine	Fine

Notes: UHF aerials directed towards the Winter Hill transmitter and satellite dishes were observed

Location 4

Location 4 (GPS Coordinates: SJ 86201 97642 +/- 19 ft)					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
31	COM7	42.4 ± 0.5	0%	Fine	Fine
37	COM8	52.0 ± 0.3	$3x10^{-7}$	Fine	Fine
49	Arqiva A	47.5 ± 0.4	$4x10^{-7}$	Fine	Fine
50	BBC A	49.9 ± 0.2	$1x10^{-8}$	Fine	Fine
54-	BBC B	50.1 ± 0.2	0%	Fine	Fine
55	Arqiva B	44.8 ± 1.2	0%	Fine	Fine
56	LM/LL/LPR	25.7 ± 0.1	DND		
57	GIM	31.2 ± 0.2	$1x10^{-5}$	Fine	Fine
58	SDN	53.2 ± 0.2	$1x10^{-8}$	Fine	Fine
59	Digital 3&4	51.8 ± 0.2	$1x10^{-9}$	Fine	Fine

Notes: Very few external aerials were visible at this location.

Location 5

Location 5 (GPS Coordinates: SJ 87220 96759 +/- 29 ft)					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
31	COM7	65.8 ± 0.3	0%	Fine	Fine
37	COM8	75.6 ± 0.2	$1x10^{-8}$	Fine	Fine
49	Arqiva A	74.3 ± 0.2	$1x10^{-8}$	Fine	Fine
50	BBC A	75.1 ± 0.3	$1x10^{-8}$	Fine	Fine
54-	BBC B	71.2 ± 0.2	0%	Fine	Fine
55	Arqiva B	71.2 ± 0.2	0%	Fine	Fine
56	LM/LL/LPR	26.4 ± 0.2	DND		
57	GIM	37.9 ± 0.2	$1x10^{-8}$	Fine	Fine
58	SDN	65.0 ± 0.3	$1x10^{-8}$	Fine	Fine
59	Digital 3&4	64.4 ± 0.2	$1x10^{-8}$	Fine	Fine

Notes: UHF aerials directed towards the Winter Hill transmitter were observed.

Location 6

Location 6 (GPS Coordinates: SJ 88289 95937)					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
31	COM7	60.7 ± 0.2	0%	Fine	Fine
37	COM8	69.4 ± 0.2	$1x10^{-8}$	Fine	Fine
49	Arqiva A	67.4 ± 0.2	$1x10^{-8}$	Fine	Fine
50	BBC A	68.7 ± 0.2	$1x10^{-8}$	Fine	Fine
54-	BBC B	65.6 ± 0.2	0%	Fine	Fine
55	Arqiva B	58.1 ± 0.2	0%	Fine	Fine
56	LM/LL/LPR	25.6 ± 0.2	DND		
57	GIM	35.6 ± 0.2	$1x10^{-8}$	Fine	Fine
58	SDN	61.4 ± 0.2	$1x10^{-8}$	Fine	Fine
59	Digital 3&4	60.5 ± 0.2	$1x10^{-9}$	Fine	Fine

Notes: UHF aerials directed towards the Winter Hill transmitter were observed.

APPENDIX B – POST-CONSTRUCTION SURVEY RESULTS (2023)

Location 1

Location 1 (GPS Coordinates: SJ 84876 98748 +/- 27 ft)					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
31	COM7	34.8 ± 0.3	$1x10^{-8}$	Fine	Fine
37	COM8	42.6 ± 0.5	$1x10^{-8}$	Fine	Fine
49	Arqiva A	30.2 ± 0.2	$1x10^{-8}$	Fine	Fine
50	BBC A	34.8 ± 0.4	$1x10^{-8}$	Fine	Fine
54-	BBC B	29.3 ± 0.6	$1x10^{-8}$	Fine	Fine
55	Arqiva B	27.4 ± 0.3	$1x10^{-8}$	Fine	Fine
56	LM/LL/LPR	27.7 ± 0.1	DND		
57	GIM	33.6 ± 0.2	DND		
58	SDN	39.7 ± 0.4	$1x10^{-8}$	Fine	Fine
59	Digital 3&4	33.1 ± 0.3	$1x10^{-8}$	Fine	Fine

Notes: UHF aerials directed towards the Winter Hill transmitter and satellite dishes were observed.

Location 2

Location 2 (GPS Coordinates: SJ 85340 98356 +/- 24 ft)					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
31	COM7	35.6 ± 0.3	$1x10^{-8}$	Fine	Fine
37	COM8	40.1 ± 0.7	$1x10^{-8}$	Fine	Fine
49	Arqiva A	36.4 ± 0.5	$1x10^{-8}$	Fine	Fine
50	BBC A	37.5 ± 0.3	$1x10^{-8}$	Fine	Fine
54-	BBC B	42.2 ± 0.4	$1x10^{-8}$	Fine	Fine
55	Arqiva B	41.2 ± 0.3	$1x10^{-8}$	Fine	Fine
56	LM/LL/LPR	22.9 ± 0.1	DND		
57	GIM	26.7 ± 0.2	DND		
58	SDN	34.9 ± 0.6	$1x10^{-8}$	Fine	Fine
59	Digital 3&4	39.7 ± 0.4	$1x10^{-8}$	Fine	Fine

Notes: External aerials were not observed at this location

Location 3

Location 3 (GPS Coordinates: SJ 85728 97982 +/- 12 ft)					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
31	COM7	40.0 ± 0.3	$1x10^{-8}$	Fine	Fine
37	COM8	38.4 ± 0.2	$1x10^{-8}$	Fine	Fine
49	Arqiva A	33.3 ± 0.1	$1x10^{-8}$	Fine	Fine
50	BBC A	35.4 ± 0.5	$1x10^{-8}$	Fine	Fine
54-	BBC B	29.7 ± 0.7	$1x10^{-8}$	Fine	Fine
55	Arqiva B	30.8 ± 0.4	$1x10^{-8}$	Fine	Fine
56	LM/LL/LPR	34.4 ± 0.3	$1x10^{-8}$	Fine	Fine
57	GIM	27.6 ± 0.1	DND		
58	SDN	33.9 ± 0.1	DND		
59	Digital 3&4	45.7 ± 0.4	$1x10^{-8}$	Fine	Fine

Notes: UHF aerials directed towards the Winter Hill transmitter and satellite dishes were observed

Location 4

Location 4 (GPS Coordinates: SJ 86201 97642 +/- 19 ft)					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
31	COM7	53.6 ± 0.4	$1x10^{-8}$	Fine	Fine
37	COM8	50.6 ± 0.7	$1x10^{-8}$	Fine	Fine
49	Arqiva A	30.9 ± 0.5	$1x10^{-8}$	Fine	Fine
50	BBC A	33.3 ± 0.3	$1x10^{-8}$	Fine	Fine
54-	BBC B	39.7 ± 0.4	$1x10^{-8}$	Fine	Fine
55	Arqiva B	37.5 ± 0.3	$1x10^{-8}$	Fine	Fine
56	LM/LL/LPR	27.2 ± 0.8	$1x10^{-8}$	Fine	Fine
57	GIM	22.6 ± 0.4	DND		
58	SDN	25.5 ± 0.3	DND		
59	Digital 3&4	50.7 ± 0.5	$1x10^{-8}$	Fine	Fine

Notes: Very few external aerials were visible at this location.

Location 5

Location 5 (GPS Coordinates: SJ 87220 96759 +/- 29 ft)					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
31	COM7	60.2 ± 0.3	$1x10^{-8}$	Fine	Fine
37	COM8	61.9 ± 0.2	$1x10^{-8}$	Fine	Fine
49	Arqiva A	31.1 ± 0.5	$1x10^{-8}$	Fine	Fine
50	BBC A	30.5 ± 0.4	$1x10^{-8}$	Fine	Fine
54-	BBC B	35.9 ± 0.6	$1x10^{-8}$	Fine	Fine
55	Arqiva B	36.0 ± 0.4	$1x10^{-8}$	Fine	Fine
56	LM/LL/LPR	29.7 ± 0.7	DND		
57	GIM	31.1 ± 0.2	DND		
58	SDN	55.4 ± 0.2	$1x10^{-8}$	Fine	Fine
59	Digital 3&4	51.4 ± 0.3	$1x10^{-8}$	Fine	Fine

Notes: UHF aerials directed towards the Winter Hill transmitter were observed.

Location 6

Location 6 (GPS Coordinates: SJ 88289 95937)					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
31	COM7	51.5 ± 0.3	$1x10^{-8}$	Fine	Fine
37	COM8	48.6 ± 0.3	$1x10^{-8}$	Fine	Fine
49	Arqiva A	44.2 ± 0.5	$1x10^{-8}$	Fine	Fine
50	BBC A	45.7 ± 0.4	$1x10^{-8}$	Fine	Fine
54-	BBC B	60.9 ± 0.8	$1x10^{-8}$	Fine	Fine
55	Arqiva B	47.8 ± 0.4	$1x10^{-8}$	Fine	Fine
56	LM/LL/LPR	27.3 ± 0.3	DND		
57	GIM	29.4 ± 0.2	DND		
58	SDN	42.1 ± 0.3	$1x10^{-8}$	Fine	Fine
59	Digital 3&4	56.2 ± 0.6	$1x10^{-8}$	Fine	Fine

Notes: UHF aerials directed towards the Winter Hill transmitter were observed.

APPENDIX C – SURVEY PHOTOGRAPHS

Location 1

Location 1 (baseline survey)

Location 1 (post-construction survey)

Location 2

Location 2 (baseline survey)

Location 2 (post-construction survey)

Location 3

Location 3 (baseline survey)

Location 3 (post-construction survey)

Location 4

Location 4 (baseline survey)

Location 4 (post-construction survey)

Location 5

Location 5 (baseline survey)

Location 5 (post-construction survey)

Location 6

Location 6 (baseline survey)

Location 6 (post-construction survey)

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