PAGERPOWER

Terrestrial Television Post-Construction Survey Report

Renaker Build Limited

Great Jackson Street – Plot F

May 2026



www.pagerpower.com

ADMINISTRATION PAGE

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EXECUTIVE SUMMARY

Report Purpose

Pager Power has been commissioned to undertake a post-construction terrestrial television reception survey of the Plot F building development at Great Jackson Street, Manchester. The building development has introduced an additional tall structure 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 baseline reception survey (completed in 2023), and the post-construction survey completed in May 2026. The post-construction survey has been completed so that comparisons between the original 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 due to the building development.

Assessment Conclusions

TV signal strength has been measured to have decreased in surveyed locations within the shadow of the development; although there is no change in the channels that decoded, or the picture or audio quality for the channels that decoded. All main multiplexes that were previously available still have fine audio and picture quality.

The current TV picture/audio quality 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 specialist technical consultancy based in the United Kingdom and has been providing independent expertise on planning issues for solar, wind, and building developments for over 20 years.

Established in 1997, the company initially specialised in assessing the impact of wind turbines on radar systems. Pager Power has since expanded into a multidisciplinary technical planning consultancy that offers a comprehensive range of services and has supported renewable and building projects in more than 60 countries.

Pager Power's core competencies now include:

- Aviation and Radar;
- Daylight, Sunlight and Overshadowing;
- Glint and Glare;
- Shadow Flicker;
- Telecommunications.

Using proprietary modelling software, each study is tailored to the individual project, ensuring that results are relevant, defensible, and aligned with current national and international standards. The company also provides planning support and stakeholder consultation across all service areas, helping clients to understand constraints, explore potential mitigation options, and forge a path forward for their projects.

Pager Power's work helps our clients identify potential risks, inform project design, and support the decision-making process, and can provide support at any stage of a project, from initial feasibility through to completion. Pager Power's assessments – recognised for their objectivity, accuracy, and technical integrity – are designed to withstand legal scrutiny and trusted by developers and stakeholders alike.

1 DEVELOPMENT DETAILS

1.1 Site Boundary

The redline boundary[1] is shown in Figure 1 on the following page.

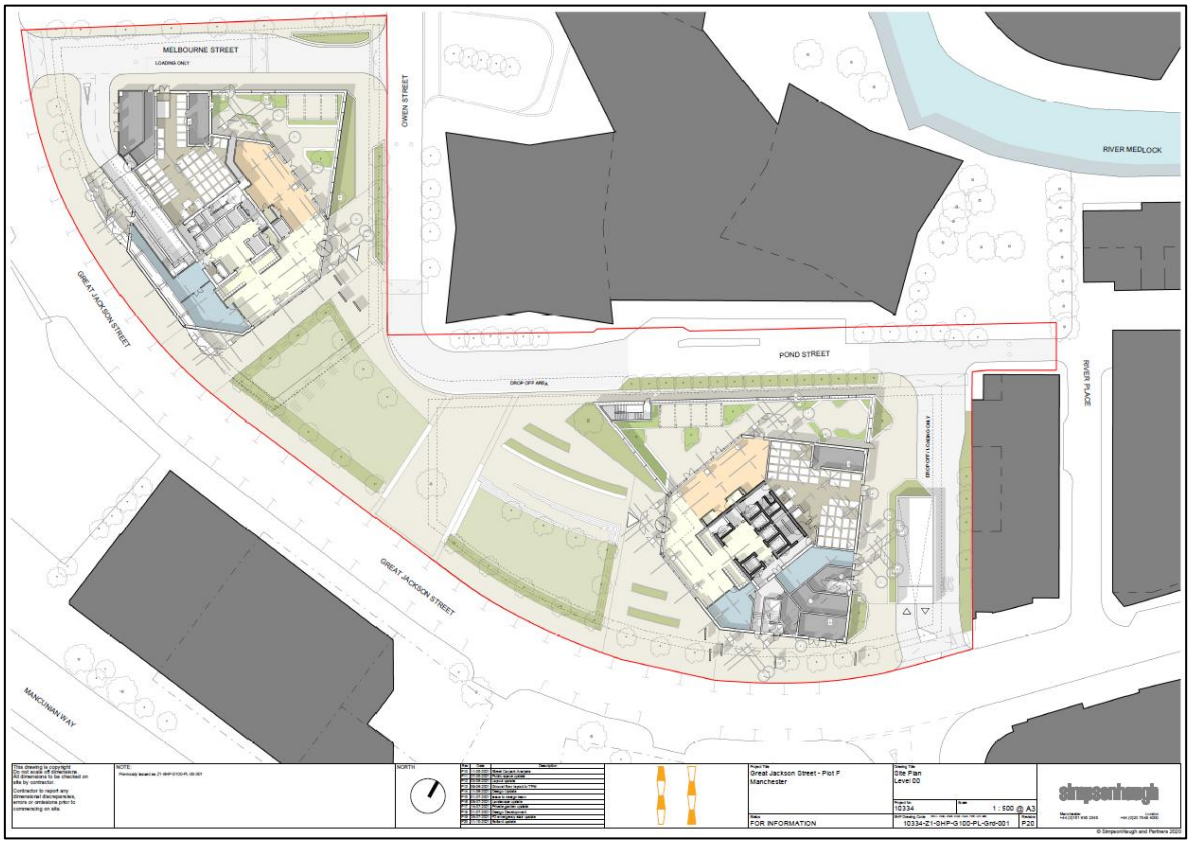


Figure 1 *Site boundary*

[1] Source: Z1-SHP-G100-PL-Grd-001

2 TELEVISION TRANSMITTER DETAILS

2.1 Relevant Transmitter

The Winter Hill transmitter predominantly serves the area around the development[2]. 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 24km 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)	GImux	COM 7
Channel	24	27	55
Power	2 kW	1 kW	25.7 kW

Table 2 *Winter Hill transmissions (local multiplexes)*

[2] Based on coverage maps and Digital UK information.

3 BUILDINGS AND TELEVISION INTERFERENCE

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

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

3.2.1 Obstruction of the signal

This is caused by the building physically blocking the transmitted signal, reducing the strength of the carrier signal in the shadow of the building. In the case of Crystal Palace transmissions, this would affect residences to the north-east of the development. In the case of radio transmissions, the shadow zone will vary based on the transmitter providing the service. The following is true for both television and radio signals:

- 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).

Ofcom has produced a document[3] offering guidance on this issue. Relevant extracts from the documents are presented on the following page.

"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."

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

The zones mentioned are illustrated in Figure 2[4] below, taken from Section 3.2 of the Ofcom guidance regarding the impact of buildings on broadcast signals

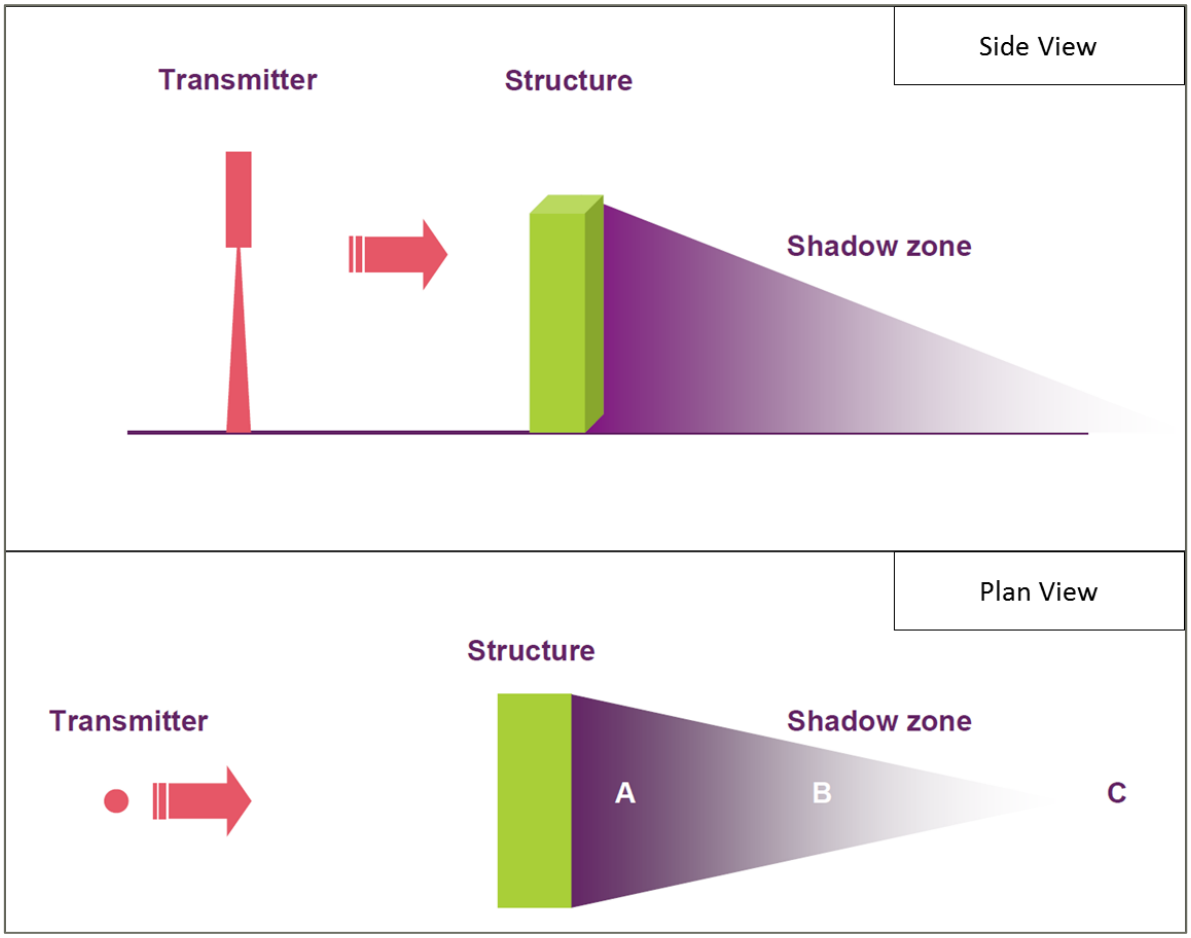


Figure 2 *Diffraction loss zones*

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

[4] Source: Ofcom publication.

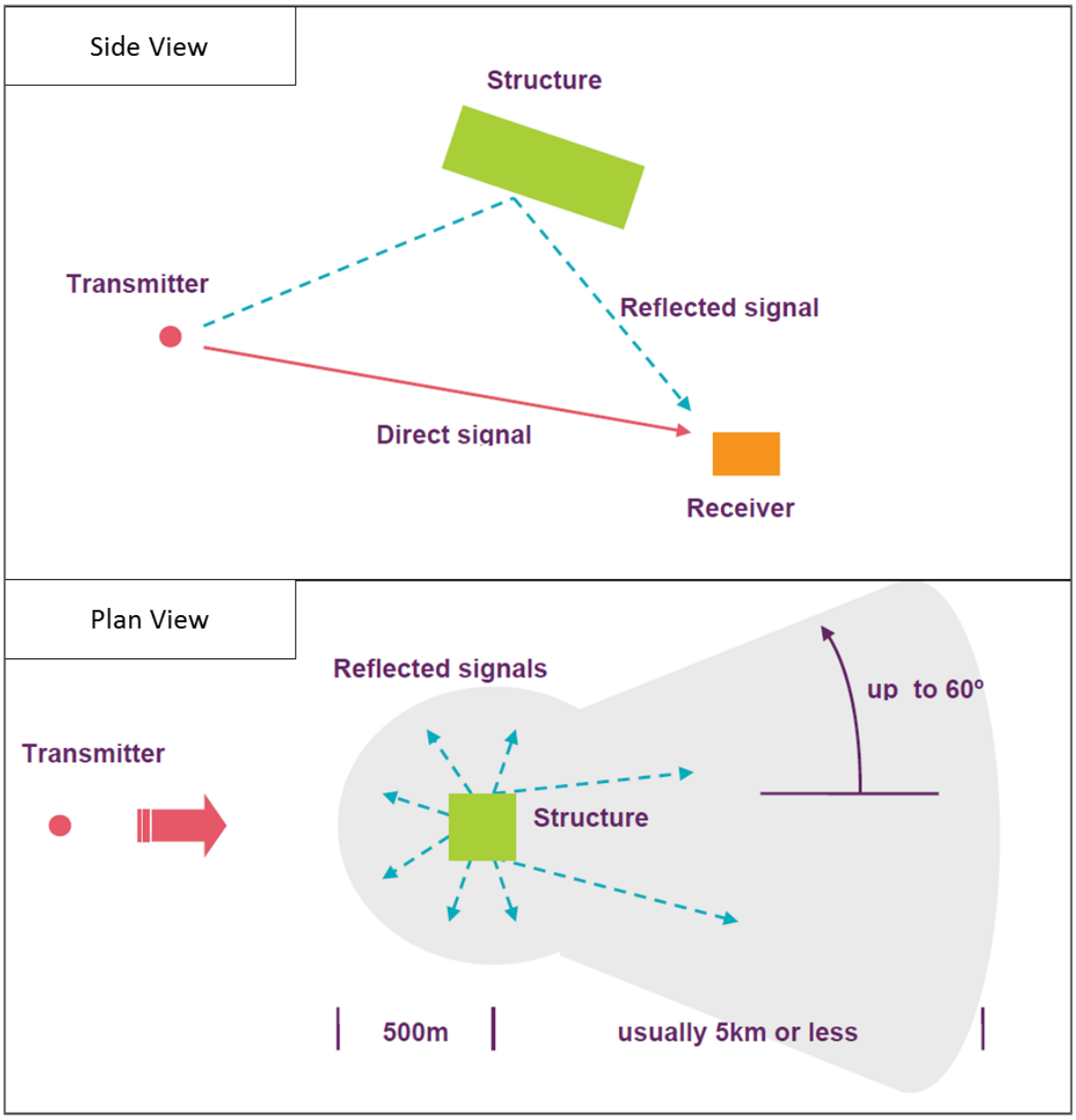


Figure 3 *Reflection zones*

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 4 on the following page 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 2 in the previous section.



Figure 4 *Key interference areas – shadow and reflection zone*

The interference zones have been constructed in accordance with Ofcom guidance presented in Section 3.2 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.

Based on bare-earth terrain, the Crystal Palace 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 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 POST-CONSTRUCTION SURVEY RESULTS

5.1 Overview

A post-construction survey was completed on 12nd May 2026 so that comparisons between the original 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 baseline 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 5 on the following page shows the survey locations overlaid onto aerial photography with the icons showing where television measurements were taken. The shadow and reflection zones are also shown. The survey locations chosen for the baseline survey were revisited as best as possible for the post-construction survey[6]. The survey locations are illustrated on the following page. The coordinates of these points can be found in Appendix A.

[6] Safe and available access influenced the specific position on the day. Post-construction survey locations are within 50m of the baseline survey locations.

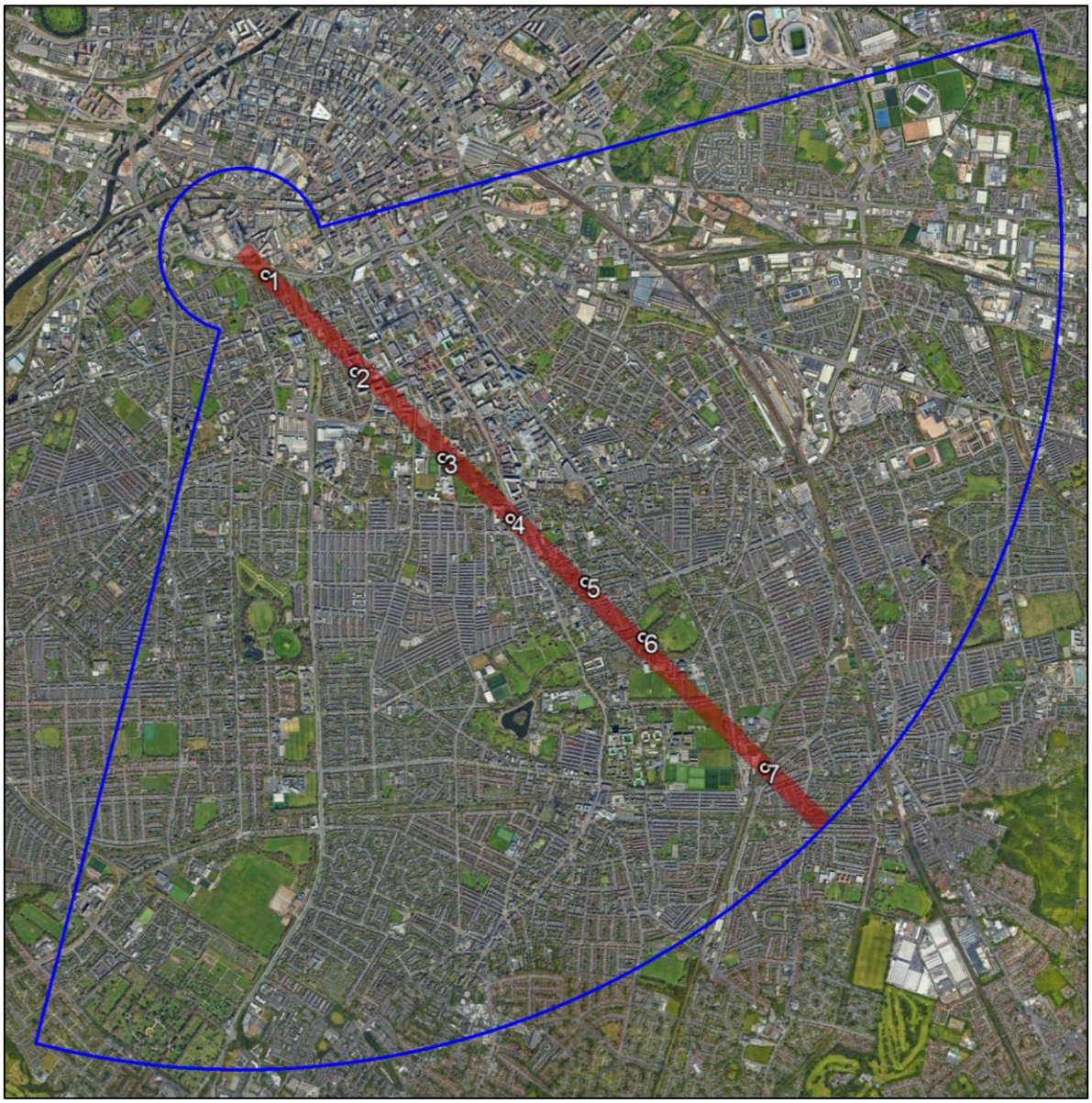


Figure 5 *Survey locations*

5.3 Survey Results

5.3.1 Overview

The strength of the recorded television signals is categorised in accordance within 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 surveys 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 pages 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 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	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
1	**Baseline:** Main TV MUX: 49.2 (Moderate) Local TV MUX: 25.7 (Low) **Post-Construction:** Main TV MUX: 38.55 (Moderate) Local TV MUX: 23.67 (Low)	**Baseline:** All main multiplexes decoded with good picture and good sound on all channels. No local multiplexes decoded. **Post-Construction:** All main multiplexes decoded with good picture and good sound on all channels with signal fluctuations of less than 1dB and no signs of interference. No local multiplexes decoded.	The survey location was within 210m of the proposed development and within its shadow zone. This location has therefore been undertaken as a reference location for baseline conditions with respect to the other survey locations within the shadow zone. **The TV signal strength at this location has decreased, although there is no change in the channels that decoded, or the picture or audio quality for the channels that decoded.**

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
2	**Baseline:** Main TV MUX: 55.8 (Very good) Local TV MUX: 32.6 (Low) **Post-Construction:** Main TV MUX: 40.77 (Moderate) Local TV MUX: 21.67 (Low)	**Baseline:** All main multiplexes decoded with good picture and good sound on all channels. One out of three local multiplexes decoded. **Post-Construction:** All main multiplexes decoded with good picture and good sound on all channels with signal fluctuations of less than 1dB and no signs of interference. One out of three local multiplexes decoded.	The survey location is approximately 1.0km from the proposed development. **The TV signal strength at this location has decreased, although there is no change in the channels that decoded, or the picture or audio quality for the channels that decoded.**

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
3	**Baseline:** Main TV MUX: 49.8 (Moderate) Local TV MUX: 29.1 (Low) **Post-Construction:** Main TV MUX: 39.92 (Moderate) Local TV MUX: 25.53 (Low)	**Baseline:** All main multiplexes decoded with good picture and good sound on all channels. One out of three local multiplexes decoded. **Post-Construction:** All main multiplexes decoded with good picture and good sound on all channels with signal fluctuations of less than 1dB and no signs of interference. One out of three local multiplexes decoded.	The survey location is approximately 1.76km from the proposed development. **The TV signal strength at this location has decreased, although there is no change in the channels that decoded, or the picture or audio quality for the channels that decoded.**

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
4	**Baseline:** Main TV MUX: 41.9 (Moderate) Local TV MUX: 28.7 (Low) **Post-Construction:** Main TV MUX: 34.27 (Low) Local TV MUX: 18.87 (Low)	**Baseline:** All main multiplexes decoded with good picture and good sound on all channels. One out of three local multiplexes decoded. **Post-Construction:** All main multiplexes decoded with good picture and good sound on all channels with signal fluctuations of less than 1dB and no signs of interference. One out of three local multiplexes decoded.	The survey location is approximately 2.32km from the proposed development. **The TV signal strength at this location has decreased, although there is no change in the channels that decoded, or the picture or audio quality for the channels that decoded.**

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
5	**Baseline:** Main TV MUX: 44.8 (Moderate) Local TV MUX: 30.3 (Low) **Post-Construction:** Main TV MUX: 32.5 (Low) Local TV MUX: 21.40 (Low)	**Baseline:** All main multiplexes decoded with good picture and good sound on all channels. Two out of three local multiplexes decoded. **Post-Construction:** All main multiplexes decoded with good picture and good sound on all channels with signal fluctuations of less than 1dB and no signs of interference. Two out of three local multiplexes decoded.	The survey location is approximately 2.92km from the proposed development. **The TV signal strength at this location has decreased, although there is no change in the channels that decoded, or the picture or audio quality for the channels that decoded.**

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
6	**Baseline:** Main TV MUX: 47.2 (Good) Local TV MUX: 28.7 (Low) **Post-Construction:** Main TV MUX: 37.32 (Low) Local TV MUX: 24.2 (Low)	**Baseline:** All main multiplexes decoded with good picture and good sound on all channels. One out of three local multiplexes decoded. **Post-Construction:** All main multiplexes decoded with good picture and good sound on all channels with signal fluctuations of less than 1dB and no signs of interference. One out of three local multiplexes decoded.	The survey location is approximately 3.40km from the proposed development. **The TV signal strength at this location has decreased, although there is no change in the channels that decoded, or the picture or audio quality for the channels that decoded.**

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
7	**Baseline:** Main TV MUX: 58.7 (Very good) Local TV MUX: 34.9 (Low) **Post-Construction:** Main TV MUX: 46.15 (Good) Local TV MUX: 23.2 (Low)	**Baseline:** All main multiplexes decoded with good picture and good sound on all channels. Two out of three local multiplexes decoded. **Post-Construction:** All main multiplexes decoded with good picture and good sound on all channels with signal fluctuations of less than 1dB and no signs of interference. Two out of three local multiplexes decoded.	The survey location is approximately 4.49km from the proposed development. **The TV signal strength at this location has decreased, although there is no change in the channels that decoded, or the picture or audio quality for the channels that decoded.**

Table 4 *Baseline and post-construction survey results*

5.4 Local Multiplexes

The Winter Hill transmitter broadcasts local channels at lower power than the main multiplexes (see Tables 1 and 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

A pre-emptive mitigation requirement has not been identified.

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

A pre-emptive mitigation requirement has not been identified, and interference is not predicted based on industry experience of projects in Manchester. The following options are outlined for reference:

- 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.

APPENDIX A – SURVEY RESULTS

Measured Signal Strength

The table on the following page summarises the measures signal strength (dBµV) for the baseline (B) and post-construction (P) surveys. Cells in red indicate channels that did not decode at a survey location.

Notes

Location	Notes
1	HP[7] aerials and UHF[8] satellite dishes were observed.
2	HP aerials and UHF satellite dishes were observed.
3	HP aerials and UHF satellite dishes were observed.
4	HP aerials and UHF satellite dishes were observed.
5	HP aerials and UHF satellite dishes were observed.
6	HP aerials and UHF satellite dishes were observed.
7	HP aerials and UHF satellite dishes were observed.

Coordinate Data

Location	Longitude (°)	Latitude (°)	Location	Longitude (°)	Latitude (°)
1	-2.24915	53.47041	5	-2.21975	53.45357
2	-2.24093	53.46508	6	-2.21445	53.45054
3	-2.23286	53.46037	7	-2.20324	53.44340
4	-2.22662	53.45705			

[7] Horizontally Polarised.

[8] Ultra-High Frequency

	Location	1		2		3		4		5		6		7	
	Survey	B	P	B	P	B	P	B	P	B	P	B	P	B	P
Channel	24	24.5	28.0	38.0	19.0	34.8	26.6	32.3	20.6	32.7	22.0	34.0	24.6	40.8	27.0
	29	43.0	37.7	55.0	39.5	47.9	38.6	45.0	35.6	44.1	33.0	42.5	37.1	58.2	46.0
	31	43.0	40.8	55.6	37.5	53.4	41.9	42.2	37.2	46.2	32.0	48.0	35.6	57.5	51.0
	32	43.0	41.0	53.5	41.5	48.5	38.4	41.6	32.8	45.8	30.1	58.1	37.3	58.8	44.6
	34	42.0	38.0	56.7	41.6	50.0	40.6	41.2	30.0	44.4	31.0	49.3	38.1	59.6	47.8
	35	40.0	37.8	58.1	43.2	49.0	40.5	40.7	34.0	43.0	35.0	47.4	38.2	59.7	36.1
	37	44.0	36.0	56.0	41.3	50.0	39.5	40.9	36.0	45.5	34.0	44.8	37.6	58.9	51.4
	27	27.6	23.0	33.2	22.0	26.7	25.0	28.0	17.0	32.2	19.2	26.2	24.0	38.0	27.0
	55	25.1	20.0	26.0	24.0	25.8	25.0	25.9	19.0	26.1	23.0	26.0	24.0	26.0	15.6

APPENDIX B – SURVEY PHOTOGRAPHS

Survey photographs are presented on the following pages.

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)

Location 7



Location 7 (baseline survey)



Location 7 (post-construction survey)



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