

Television Post-Construction Survey

Sisk Group

Circle Square Affinity Living: Plot 7 and 8

July, 2020

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ADMINISTRATION PAGE

Job Reference:	9966C
Date:	July, 2020
Author:	Danny Scrivener
Telephone:	01787 319001
Email:	danny@pagerpower.com

Reviewer:	Kai Frolic
Date:	July, 2020
Telephone:	01787 319001
Email:	kai@pagerpweor.com

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

T:01787 319 001 E:info@pagerpower.com W:www.pagerpower.com

EXECUTIVE SUMMARY

Overview

A terrestrial television post-construction reception survey had been completed for Plots 7 and 8 of the Circle Square Affinity Living building development, located in Manchester City Centre, UK. Plot 7 and 8 have introduced two new tall structures into the urban environment which can consequently interact with wireless terrestrial television signals and could cause interference in the surrounding area. Both developments have now been constructed to the extent to which their impact, if any, upon terrestrial television reception can now be measured. Plot 7 and 8 building development are referred to as 'the development' throughout this report.

Report Purpose

This report presents the results of Post-Construction Reception Survey completed in July 2020. The results of the survey show whether interference has occurred and where complaints would most likely arise. Survey measurements were taken in the development's shadow zone and it has been undertaken based on guidance produced by Ofcom.

Survey Results

The signal strength nearest Plot 7 and 8 and within the shadow zone is lower than at greater distances. This is to be expected in the vicinity of built up areas such as Manchester City Centre. The availability of channels however, in particular main multiplexes, remains approximately the same throughout the whole of the shadow zone, even at greater distance where any interference effects caused by of Plot 7 and 8 would not be expected to materialise.

Additional factors including other tall buildings in the vicinity of Plot 7 and 8 will also be affecting the signal and reducing its strength. Therefore any potentially significant interference experienced in the future may be cumulative rather than solely due to any one development in isolation. This should be a consideration if a complaint is received.

Any interference complaint received from within the development's shadow should be investigated. If Plot 7 or 8 is the closest and/or newest tall building, then it will probably be the main contributor to any interference. Interference complaints should be limited to one year following completion of the main external and internal structure of the development.

Recommendations and Mitigation

It is recommended that any interference complaint received in the vicinity and south east of the development be investigated, initially via a desk-based review of its location and secondly by a survey, if required.

Technical mitigation solutions have been identified for implementation in the event that an impact attributable to the development occurs. There is no requirement for pre-emptive investigations or mitigation in the absence of a complaint from the potentially affected area. The most appropriate solution is likely to be one of the below:

- Replacement of receiving aerial with a more directional or higher gain, aerial;
- Repositioning the receiving aerial so that the received signal is stronger;
- Installation of signal amplifiers;
- Replacing terrestrial reception equipment with satellite or cable reception equipment, or internet television.

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ABOUT PAGER POWER

Pager Power is a dedicated consultancy company based in Suffolk, UK. The company has undertaken projects in 48 countries within Europe, Africa, America, Asia and Australia.

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 terrestrial television post-construction reception survey had been completed for Plots 7 and 8 of the Circle Square Affinity Living building development, located in Manchester City Centre, UK. Plot 7 and 8 have introduced two new tall structures into the urban environment which can consequently interact with wireless terrestrial television signals and could cause interference in the surrounding area. Both developments have now been constructed to the extent to which their impact, if any, upon terrestrial television reception can now be measured. Plot 7 and 8 are referred to as 'the development' throughout this report.

This report presents the results of Post-Construction Reception Survey completed in July 2020. The results of the survey show whether interference has occurred and where interference would most likely arise. Survey measurements were taken in the development's shadow zone and it has been undertaken based on guidance produced by Ofcom.

1.2 Planning Condition

An extract from the planning condition relating to the television post-construction survey is presented below:

'(c) Assess the impact of the development on television signal reception within potential impact area identified in above¹ within one month of the practical completion of the development or before the development is first occupied, whichever is the sooner, and at any other time during 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. The 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 in (b) above². 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.'

1.3 Coordinate System

Unless otherwise stated all coordinates used within this report are in British National Grid (OSGB36 datum).

¹ Understood to be a baseline television reception survey.

² As above.

2 DEVELOPMENT DETAILS

2.1 Development Layout Plan

The locations of Plots 7 and 8 within the context the overall site are presented in Figure 1³ below.

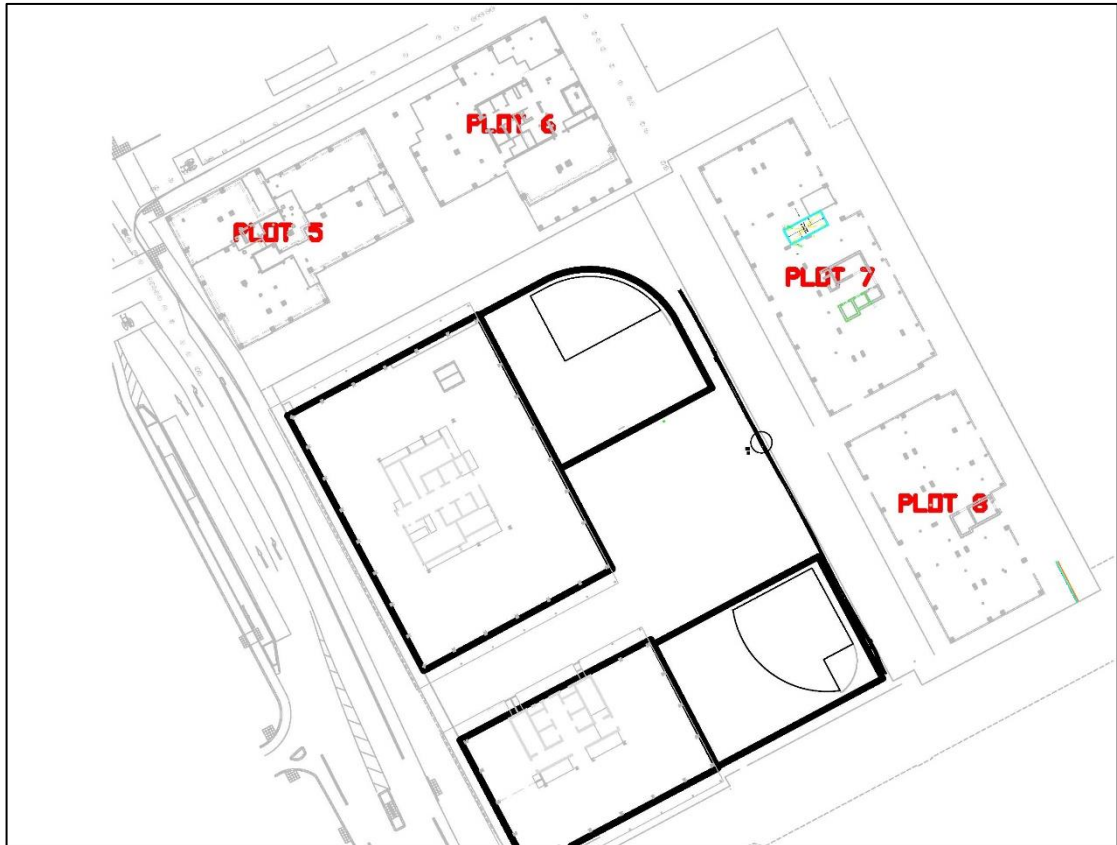


Figure 1 *Development layout plan*

³ Source: John Sisk & Son Ltd. (edited).

2.2 Development Location – Aerial Image

The locations of Plots 7 and 8 highlighted on an aerial image is presented in Figure 2⁴ below (red line).

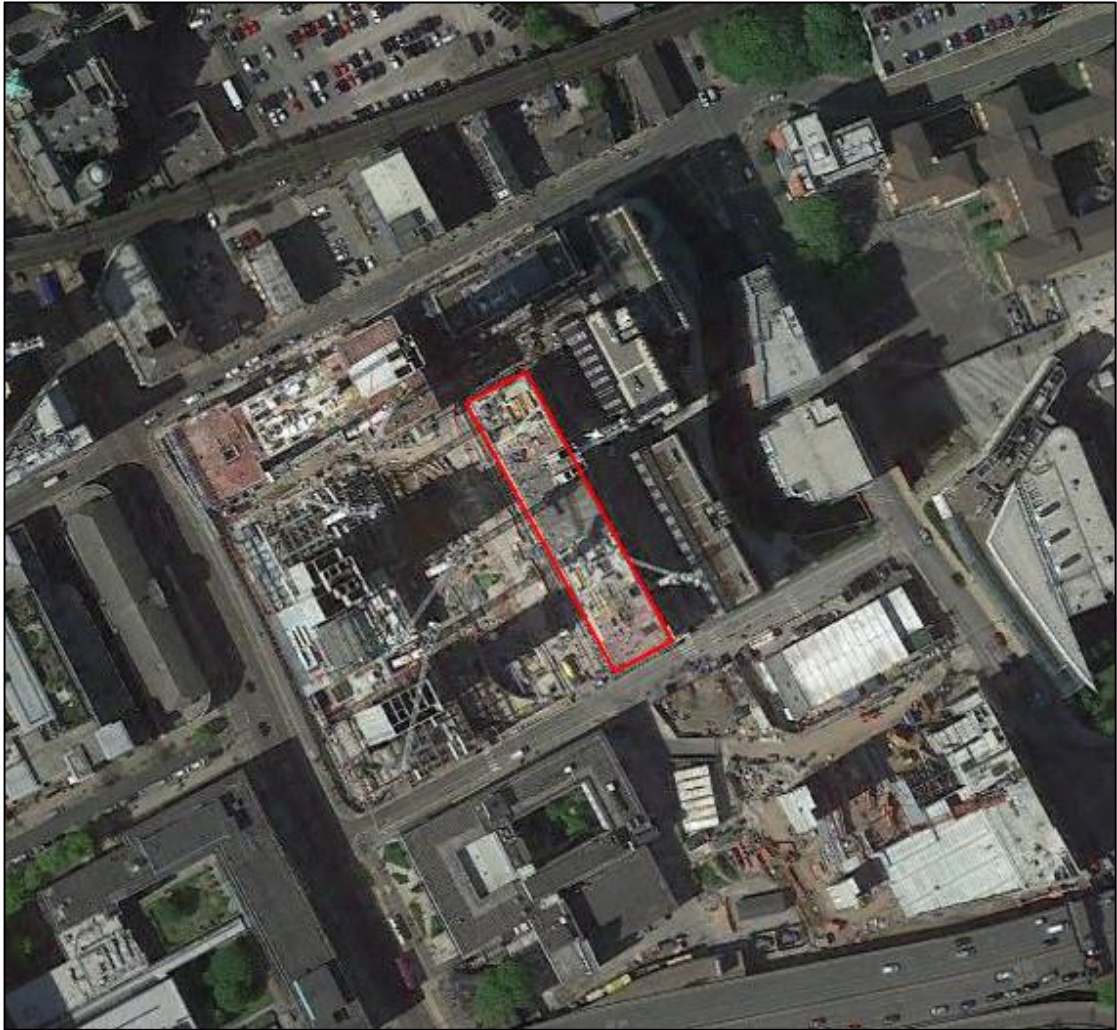


Figure 2 Development location – aerial image

⁴ Source: © 2020 Google.

2.3 Development Location – Aerial Image

An extract of the masterplan showing Plots 7 and 8 is presented in Figure 3⁵ below.



Figure 3 Masterplan showing Plots 7 and 8

⁵ Source: John Sisk & Son Ltd. (edited).

3 TELEVISION TRANSMITTER DETAILS

3.1 Relevant Transmitter

A comprehensive search of transmitter and coverage maps as well as past survey experience, confirmed that the Winter Hill transmitter serves the area around the development.

Digital television services are broadcast via Ultra High Frequency (UHF) signals; no analogue television signals are broadcast. The transmitter information is presented below⁶.

3.2 Winter Hill Main Transmitter

Winter Hill is one of the UK's main television transmitters located approximately 24.3km northwest of the development (published coordinates SD66051446). The main digital services provided are shown in the sub-sections below. Note that the channels broadcast by Winter Hill have changed in recent years.

The channels broadcast by Winter Hill during the post-construction survey are presented in Table 1 below.

	Public (PSB)			Commercial (COM)		
Service	BBC A	Digital 3&4	BBC B	SDN	Arqiva A	Arqiva B
Channel	32	59	54	58	49	24
Power	100 kilo-Watts (kW)					

Table 1 Winter Hill main transmissions

Additional Winter Hill transmissions are shown in Table 2 below.

	Local Multiplexes				Unknown	
Service	COM 7	COM8	LM/LL/LPR	GIM	-	-
Channel	55	37	56	57	50	21
Power	25.7 kW	22.6kW	2 kW	1 kW	-	-

Table 2 Winter Hill additional transmissions

⁶ Source: Ofcom

3.3 Television Transmitter Location

Figure 4 below shows the relative location of the transmitter and the development.

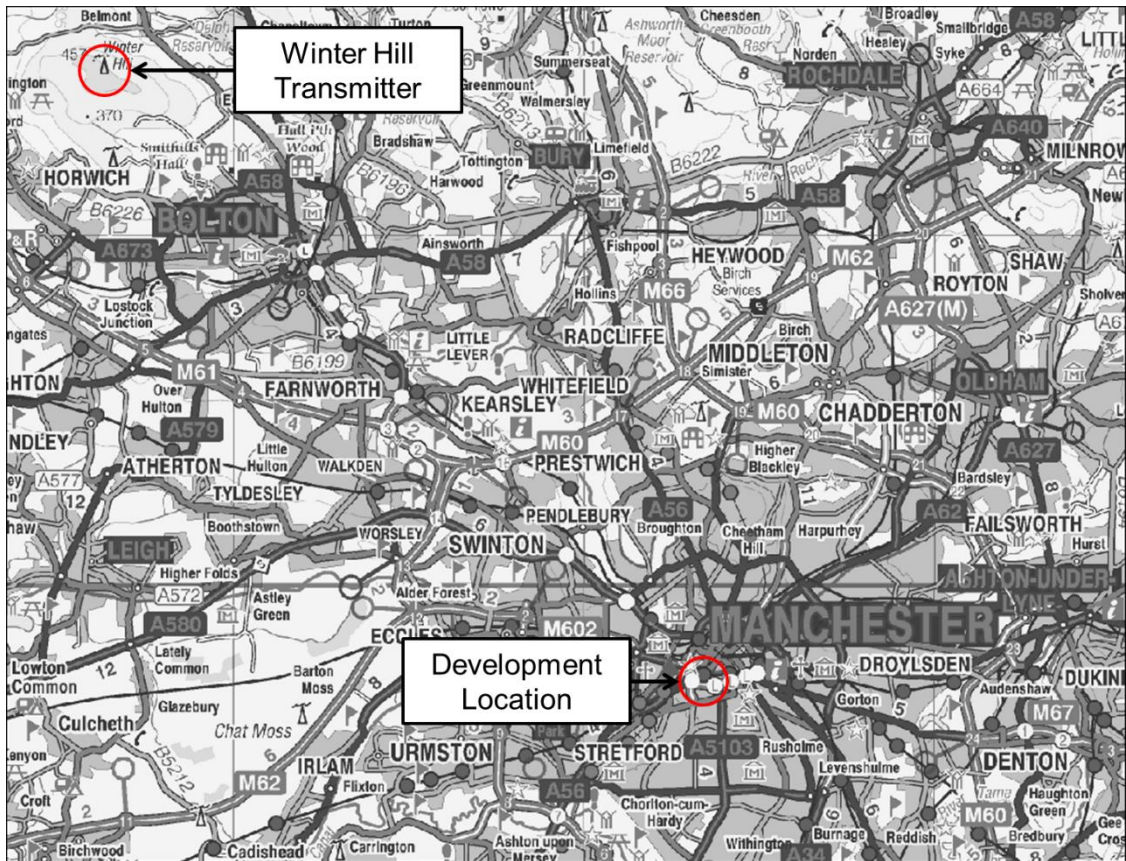


Figure 4 Television transmitter and development location

4 BUILDINGS AND INTERFERENCE MECHANISMS

4.1 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.

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

4.2 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 Winter Hill transmissions, this would affect residences to the south-southwest of the development. The following is true for television 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 document⁷ offering guidance on this issue. Relevant extracts from the documents 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."

⁷ Ofcom (2009): Tall Structures and their impact on broadcast and other wireless services

The zones mentioned are illustrated in Figure 5⁸ below, taken from Section 3.2 of the Ofcom guidance regarding the impact of buildings on broadcast signals.

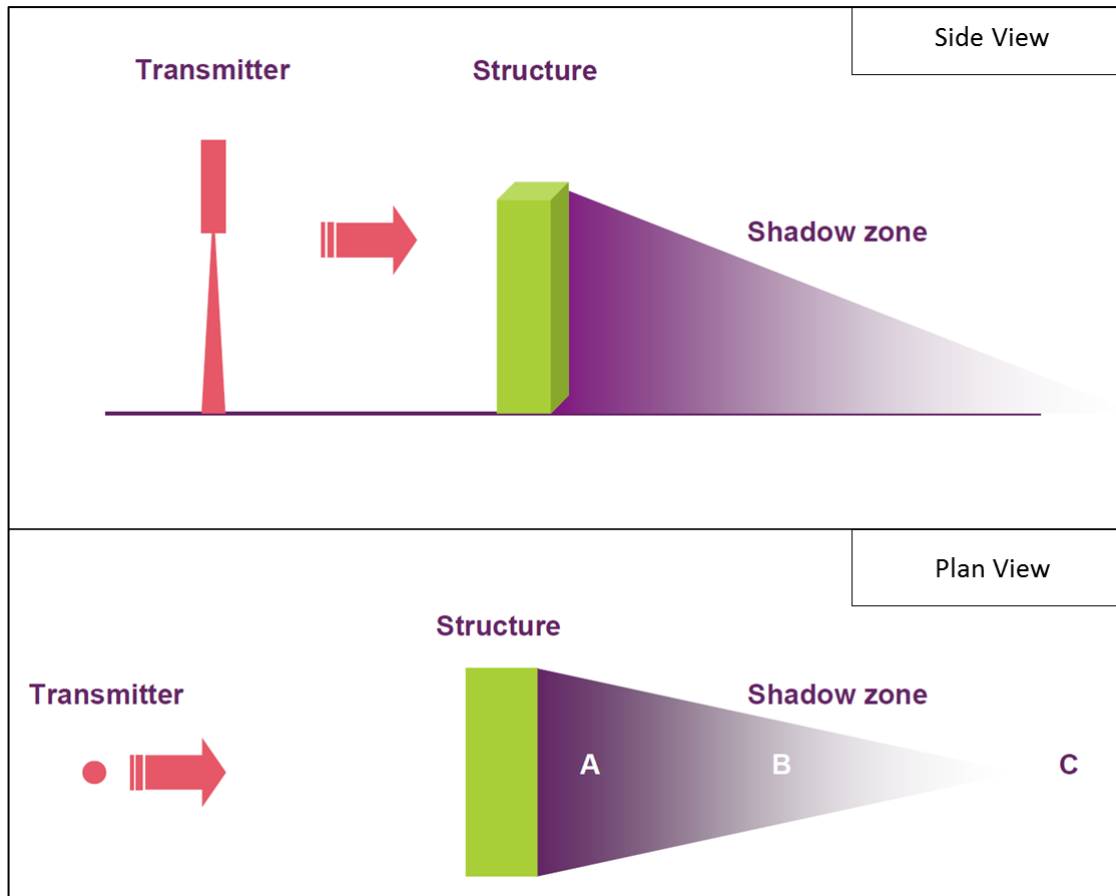


Figure 5 Diffraction loss zones

⁸ Source: Ofcom publication

4.3 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 6⁹ below (taken from Section 3.3 of the Ofcom guidance referenced above) illustrates this effect.

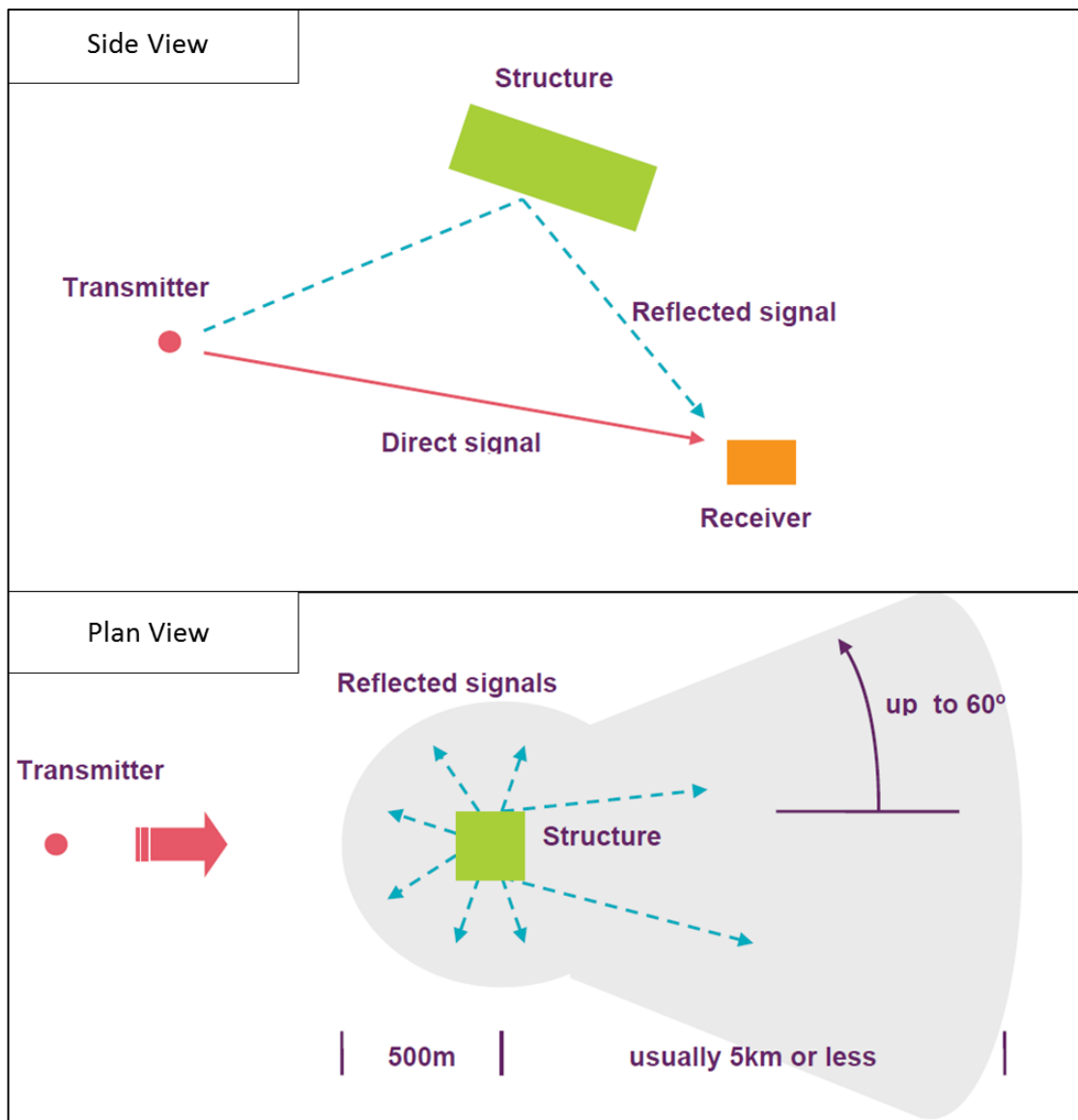


Figure 6 Reflection zones

⁹ Source: Ofcom publication

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 degrees¹⁰.

The reflection zone has been constructed in accordance with the Ofcom approach, however the angle considered is 30 degrees rather than 60 degrees. This is in order to represent a more realistic scenario for digital transmissions.

Reflection issues are most likely to cause a noticeable impact if:

- The direct signal from transmitter to receiver is weak (e.g. obstructed by terrain or buildings);
- The reflected signal from the building is strong (e.g. clear radio line of sight from the transmitter to the building and the building to the receiver).

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

¹⁰ 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.

5 TECHNICAL ASSESSMENT

5.1 Potential Interference Areas

Figure 7 below shows the potential interference areas associated with the 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 building 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 5 in the previous section.

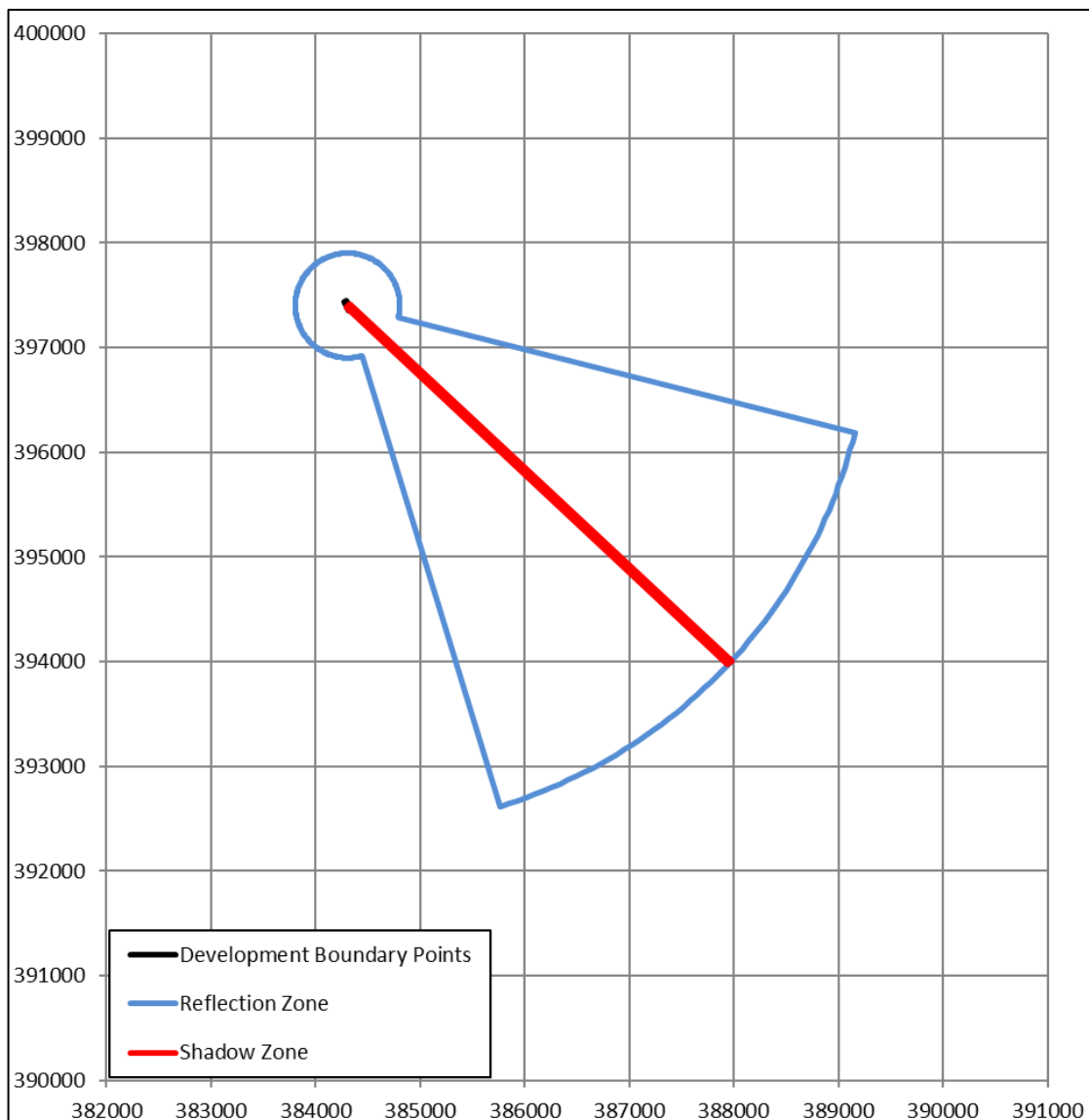


Figure 7 Interference zones

Figure 8¹¹ below shows the interference zones overlaid onto aerial photography of the area.

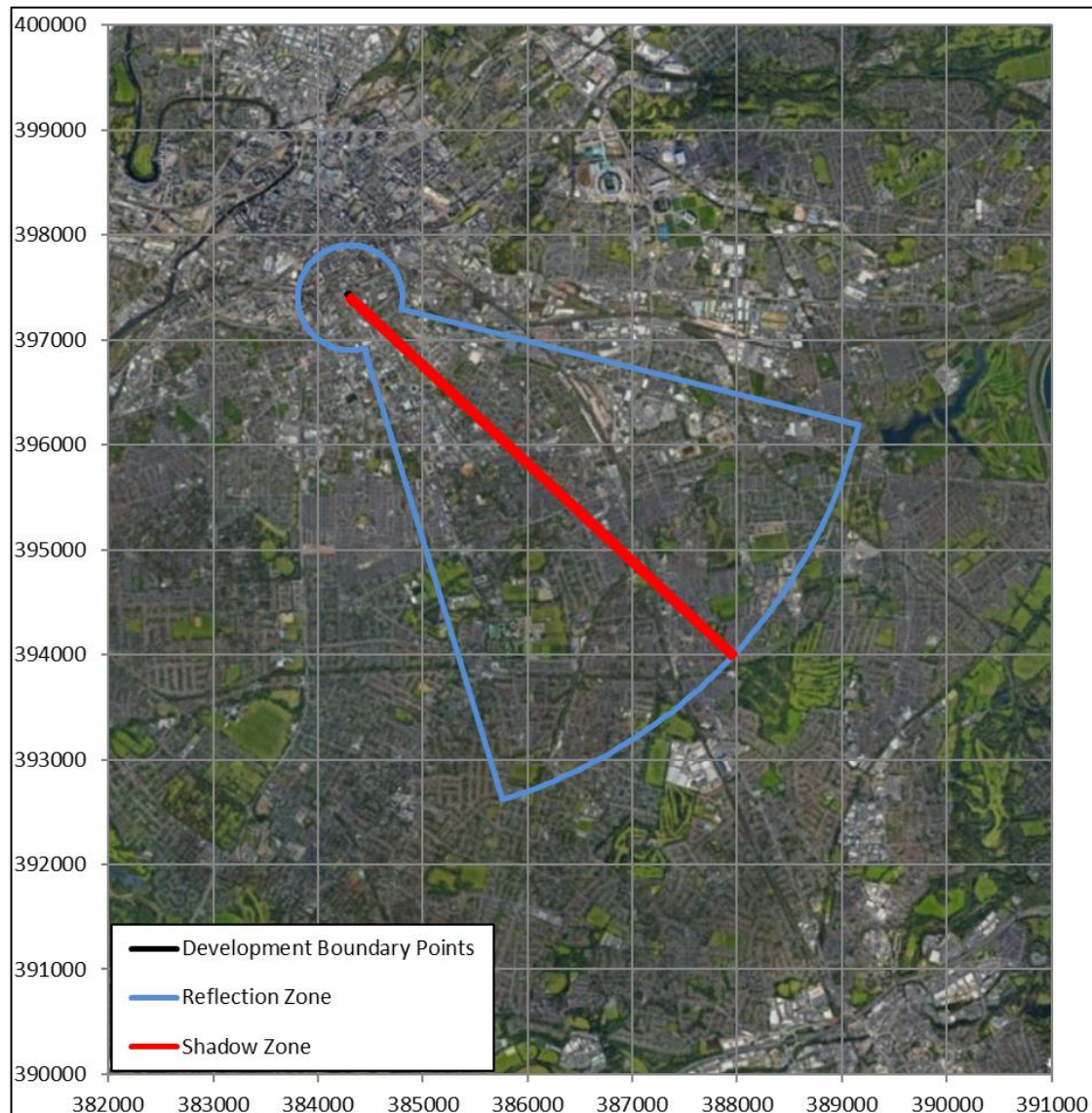


Figure 8 Interference zones – aerial image

5.2 Potential Diffraction Issues – Terrestrial Television

It can be seen that the shadow zone passes over both urban and industrial buildings as well as high and low-rise residential developments. Areas closest to the development are generally¹² at the highest risk of experiencing television interference.

¹¹ Source: © 2020 Google.

¹² Under some circumstances, this is not the case e.g. if the pre-existing signal quality was exceptional at close range but borderline at longer range.

5.3 Potential Reflection Issues – Terrestrial Television

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 not 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. Impacts due to reflections are considered unlikely.

6 TERRESTRIAL TELEVISION SURVEYS

6.1 Overview

The purpose of a baseline survey is to establish existing television signal strength and quality in the area. The baseline survey serves three purposes, these are:

1. It confirmed which transmitter is serving most homes in the areas surveyed;
2. It provided an indicator regarding the likelihood of interference. If pre-existing signals are of good quality, minor degradation is less likely to have a noticeable effect; and
3. It allowed a 'before and after' comparison to be made in the event that a complaint is received.

The purpose of a post-construction survey is as follows:

1. To establish the reception quality post-construction;
2. To determine the variation to television signal strength and quality from baseline to post-construction;
3. To determine whether significant interference (reported or otherwise) is occurring and to identify the specific development to which the interference is attributable.

A baseline survey specific to Plots 7 and 8 has not been completed and the channels broadcast by Winter Hill have subsequently changed since the planning application was submitted. Therefore, this study has identified areas where interference complaints are most likely to be experienced so that interference can be mitigated, if required.

6.2 Survey Locations

Figure 9¹³ on the following shows the survey locations overlaid onto aerial photography with the icons showing where television measurements were taken. The development outline is shown in the top left (red outline) and the shadow zone is highlighted by the orange lines.

¹³ Source: Copyright © 2019.

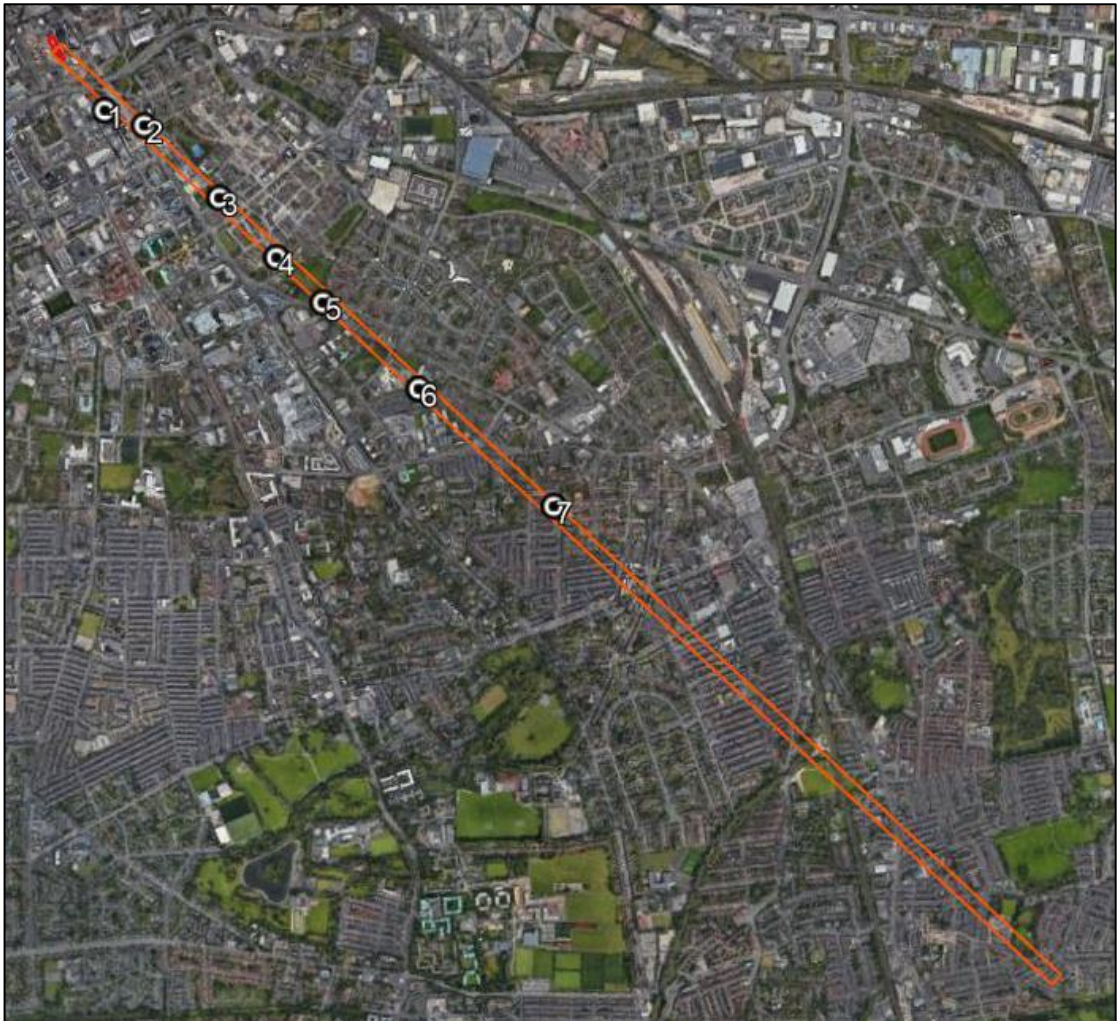


Figure 9 Survey locations

Note survey location 1 is just outside of the shadow one. This was due to access and safety on the day.

6.3 Survey Results

The post-construction survey was completed on 22 July 2020. The weather on the day was calm and overcast.

Survey measurements were taken using Pager Power's custom survey vehicle with a wideband UHF aerial extended to a height of 10 metres above ground level. This was connected to television analyser to record the signal strength and stability.

The strength of the recorded 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*

6.4 Post-Construction Results

Table 4 on the following page summarises the results of the post-construction reception survey.

The average signal strength is given. A number of factors, including variable weather and foliage conditions, can lead to minor fluctuations of signal strength.

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

Location	Average Measured Signal Strength (dB)	Distance from development	Remarks	Conclusion
1	Main multiplexes = 41.8 (Moderate) Local multiplexes = 37.8 (Moderate)	0.24km Just outside the development's shadow zone.	All main multiplexes decoded with fine picture and sound quality. Two local multiplexes did not decode. HP¹⁴ UHF aerials and satellite dishes observed.	The signal strength was moderate at this location for main multiplexes. New tall buildings in this area of the city will be having some effect on the quality of the signal at this location, not just Plot 7 and 8. The results for this location (the closest to the development) are not significantly different to the results for other survey locations in terms of the channels that decoded. Any interference complaint at this location within the shadow zone should however be investigated due to its proximity.

¹⁴ Horizontally polarised. This means the aerial is orientated towards a main television transmitter rather than a relay television transmitter.

Location	Average Measured Signal Strength (dB)	Distance from development	Remarks	Conclusion
2	Main multiplexes = 38.8 (Moderate) Local multiplexes = 36.0 (Moderate)	0.38km Within the development's shadow zone.	All but one main multiplexes decoded with fine picture and sound quality. Two local multiplexes did not decode. HP UHF aerials and satellite dishes observed.	The signal strength was moderate at this location for main multiplexes. New tall buildings in this area of the city will be having some effect on the quality of the signal at this location, not just Plot 7 and 8. Any interference complaint at this location within the shadow zone should be investigated.
3	Main multiplexes = 45.0 (Moderate) Local multiplexes = 39.6 (Moderate)	0.77km Within the development's shadow zone.	All main multiplexes decoded with fine picture and sound quality. Two local multiplexes did not decode. HP UHF aerials and satellite dishes observed.	The signal strength was moderate at this location for main multiplexes. Any interference complaint at this location within the shadow zone should be investigated.

Location	Average Measured Signal Strength (dB)	Distance from development	Remarks	Conclusion
4	Main multiplexes = 44.3 (Moderate) Local multiplexes = 39.3 (Moderate)	1.07km Within the development's shadow zone.	All main multiplexes decoded with fine picture and sound quality. Two local multiplexes did not decode. HP UHF aerials and satellite dishes observed.	The signal strength was moderate at this location for main multiplexes. It begins to rise in strength from this location outward from Plot 7 and 8. Considering the results and the distance, it is unlikely that any interference would be attributable to the development.
5	Main multiplexes = 48.4 (Good) Local multiplexes = 42.7 (Moderate)	1.31km Within the development's shadow zone.	All main multiplexes decoded with fine picture and sound quality. One local multiplex did not decode. HP UHF aerials and satellite dishes observed.	The signal strength was good at this location for main multiplexes. Considering the results and the distance, it is unlikely that any interference would be attributable to the development.

Location	Average Measured Signal Strength (dB)	Distance from development	Remarks	Conclusion
6	Main multiplexes = 49.1 (Good) Local multiplexes = 42.4 (Moderate)	1.78km Within the development's shadow zone.	All main multiplexes decoded with fine picture and sound quality. One local multiplex did not decode. HP UHF aerials and satellite dishes observed.	The signal strength was good at this location for main multiplexes. Considering the results and the distance, it is unlikely that any interference would be attributable to the development.
7	Main multiplexes = 53.6 (Good) Local multiplexes = 43.7 (Moderate)	2.43km Within the development's shadow zone.	All main multiplexes decoded with fine picture and sound quality. Two local multiplexes did not decode. HP UHF aerials and satellite dishes observed.	The signal strength was good at this location for main multiplexes. Considering the results and the distance, it is very unlikely that any interference would be attributable to the development.

Table 4 Post-construction survey results

7 MITIGATION

7.1 Mitigation Requirement

The post-construction survey results have shown that there is a reduction in terrestrial television signal strength with the development's shadow, with the greatest reduction closest the development. There is however no evidence of significant interference. If a complaint is made and the adverse effect on television services is attributable to the development, mitigation will be required. A number of options are presented below. There is no requirement for pre-emptive mitigation.

7.2 Mitigation Options

The most effective form of mitigation is dependent on the specific impact. Common options are shown below.

- 1) Replacement of receiving aerial with a more directional or higher gain aerial.
- 2) Repositioning the receiving aerial so that the received signal is stronger.
- 3) Directing the receiving aerial to an alternative transmitter that covers the area and retuning the television accordingly.
- 4) Upgrading antenna cabling and connections.
- 5) Installation of signal amplifiers.
- 6) Development of a bespoke local solution using a receiving aerial some distance from the dwelling.
- 7) A combination of the above.
- 8) Replacing terrestrial reception equipment with satellite reception equipment, cable or internet television.

7.3 Recommended Option

If interference were to occur for a small number of homes or for numerous locations that were far from each other, it is likely that installation of satellite television would be the most suitable option.

8 CONCLUSIONS

8.1 Findings

The signal strength nearest Plot 7 and 8 and within the shadow zone is lower than at greater distances. This is to be expected in the vicinity of built up areas such as Manchester City Centre. The availability of channels however, in particular main multiplexes, remains approximately the same throughout the whole of the shadow zone, even at greater distance where any interference effects caused by of Plot 7 and 8 would not be expected to materialise.

Additional factors including other tall buildings in the vicinity of Plot 7 and 8 will also be affecting the signal and reducing its strength. Therefore any potentially significant interference experienced in the future may be cumulative rather than solely due to any one development in isolation. This should be a consideration if a complaint is received.

Any interference complaint received from within the development's shadow should be investigated. If Plot 7 or 8 is the closest and/or newest tall building, then it will probably be the main contributor to any interference. Interference complaints should be limited to one year following completion of the main external and internal structure of the development.

It is recommended that any interference complaint received in the vicinity and south east of the development be investigated, initially via a desk-based review of its location and secondly by a survey, if required. No pre-emptive mitigation is required.

APPENDIX A – POST-CONSTRUCTION SURVEY RESULTS

Post-construction reception survey results are presented in the following section.

Location 1 (GPS coordinates: SJ 84482 97177 +/- 30ft)					
Channel	Service	Signal Strength ¹⁵ (dBμV)	BER ¹⁶	Picture Quality	Audio Quality
21	Tiny Pop	30.9 +/-0.1	DND ¹⁷		
24	That's TV (COM6)	35.4 +/-0.1	3.1E-7	Fine	Fine
32	BBC One NW (BBC A)	47.7 +/-0.1	1E-8	Fine	Fine
37	Ideal World (COM8) Yesterday	47.6 +/-0.1	1E-7	Fine	Fine
49	Pick (COM5)	50.2 +/-0.1	1E-8	Fine	Fine
50	BBC News with sign language	46.9 +/-0.2	1.6E-8	Fine	Fine
54	ITV HD (BBC B) BBC 2 HD	43.8 +/-0.3	1E-8	Fine	Fine
55	BBC News HD (COM7)	40.1 +/-0.1	1E-8	Fine	Fine
56	QVC (LM) CBeebies HD	31.2 +/-0.1	DND		
57	Sony Channel +1	32.2 +/-0.1	DND		
58	5 Star (COM4)	39.2 +/-0.1	1.3E-3	Fine	Fine

¹⁵ +/- followed by a number represents the approximate signal fluctuation.

¹⁶ E = 1 x10 to the power of the following number e.g. -8.

¹⁷ Did not decode i.e. the channel was not watchable

Location 1 (GPS coordinates: SJ 84482 97177 +/- 30ft)					
Channel	Service	Signal Strength ¹⁵ (dBμV)	BER ¹⁶	Picture Quality	Audio Quality
59	ITV3 (PSB2) ITV	40.5 +/-0.2	1.6E-7	Fine	Fine

Notes: All aerals observed orientated towards Winter Hill. Satellite dishes observed. Survey location amongst taller buildings. New commercial building under construction directly behind survey location and also directly south of the built up city.

Location 2 (GPS coordinates: SJ 84634 97129 +/- 19ft)					
Channel	Service	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
21	Tiny Pop	30.7 +/-0.1	DND		
24	That's TV (COM6)	33.5 +/-0.1	2.35E-6	Fine	Fine
32	BBC One NW (BBC A)	46.5 +/-0.1	1E-8	Fine	Fine
37	Ideal World (COM8) Yesterday	46.5 +/-0.1	5.5E-7	Fine	Fine
49	Pick (COM5)	41.9 +/-0.2	3.3E-5	Fine	Fine
50	BBC News with sign language	42.9 +/-0.1	4.4E-7	Fine	Fine
54	ITV HD (BBC B) BBC 2 HD	37.6 +/-0.2	DND		
55	BBC News HD (COM7)	34.6 +/-0.1	DND		
56	QVC (LM) CBeebies HD	31.2 +/-0.1	DND		
57	Sony Channel +1	31.5 +/-0.1	DND		
58	5 Star (COM4)	39.6 +/-0.2	1.3E-4	Fine	Fine
59	ITV3 (PSB2) ITV	37.9 +/-0.1	1E-4	Fine	Fine

Notes: All aerials observed orientated towards Winter Hill. Satellite dishes observed. Survey location had few dwellings but also fewer aerials. The survey location was relatively flat but directly south of the built up city.

Location 3 (GPS coordinates: SJ 84903 96869 +/- 40ft)					
Channel	Service	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
21	Tiny Pop	30.9 +/-0.1	DND		
24	That's TV (COM6)	37.2 +/-0.1	1E-8	Fine	Fine
32	BBC One NW (BBC A)	52.2 +/-0.1	1E-8	Fine	Fine
37	Ideal World (COM8) Yesterday	53.3 +/-0.1	1E-8	Fine	Fine
49	Pick (COM5)	52.0 +/-0.1	1E-8	Fine	Fine
50	BBC News with sign language	54.4 +/-0.2	1E-8	Fine	Fine
54	ITV HD (BBC B) BBC 2 HD	49.3 +/-0.1	1E-8	Fine	Fine
55	BBC News HD (COM7)	41.7 +/-0.1	1E-8	Fine	Fine
56	QVC (LM) CBeebies HD	31.2 +/-0.1	DND		
57	Sony Channel +1	32.2 +/-0.1	DND		
58	5 Star (COM4)	43.4 +/-0.1	1.3E-8	Fine	Fine
59	ITV3 (PSB2) ITV	40.6 +/-0.2	1E-8	Fine	Fine

Notes: All aerials observed orientated towards Winter Hill. Satellite dishes observed. One vertically polarised aerial observed.

Location 4 (GPS coordinates: SJ 85117 96643 +/- 29ft)					
Channel	Service	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
21	Tiny Pop	31.7 +/-0.2	6E-3	Fine	Fine
24	That's TV (COM6)	39.8 +/-0.1	1E-8	Fine	Fine
32	BBC One NW (BBC A)	55.2 +/-0.1	1E-8	Fine	Fine
37	Ideal World (COM8) Yesterday	53.2 +/-0.1	6E-8	Fine	Fine
49	Pick (COM5)	50.7 +/-0.1	1E-8	Fine	Fine
50	BBC News with sign language	49.7 +/-0.2	1E-8	Fine	Fine
54	ITV HD (BBC B) BBC 2 HD	47.9 +/-0.2	1E-8	Fine	Fine
55	BBC News HD (COM7)	40.5 +/-0.1	1E-8	Fine	Fine
56	QVC (LM) CBeebies HD	31.1 +/-0.1	DND		
57	Sony Channel +1	32.3 +/-0.1	DND		
58	5 Star (COM4)	40.5 +/-0.2	4E-5	Fine	Fine
59	ITV3 (PSB2) ITV	39.0 +/-0.1	8E-6	Fine	Fine

Notes: All aerials observed orientated towards Winter Hill. Satellite dishes observed.

Location 5 (GPS coordinates: SJ 85285 96482 +/-20 ft)					
Channel	Service	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
21	Tiny Pop	30.5 +/-0.1	DND		
24	That's TV (COM6)	42.3 +/-0.2	1E-8	Fine	Fine
32	BBC One NW (BBC A)	55.6 +/-0.2	1E-8	Fine	Fine
37	Ideal World (COM8) Yesterday	59.1 +/-0.2	1E-8	Fine	Fine
49	Pick (COM5)	57.7 +/-0.1	1E-8	Fine	Fine
50	BBC News with sign language	59.3 +/-0.2	1E-8	Fine	Fine
54	ITV HD (BBC B) BBC 2 HD	53.2 +/-0.1	1E-8	Fine	Fine
55	BBC News HD (COM7)	47.0 +/-0.1	1E-8	Fine	Fine
56	QVC (LM) CBeebies HD	31.2 +/-0.1	DND		
57	Sony Channel +1	33.4 +/-0.1	1.2E-3	Fine	Fine
58	5 Star (COM4)	45.3 +/-0.2	3E-6	Fine	Fine
59	ITV3 (PSB2) ITV	43.0 +/-0.2	1E-8	Fine	Fine

Notes: All aerials observed orientated towards Winter Hill. Satellite dishes observed.

Location 6 (GPS coordinates: SJ 85642 96153 +/- 21ft)					
Channel	Service	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
21	Tiny Pop	31.1 +/-0.1	1E-3	Varied and broke up. DND after a little while	
24	That's TV (COM6)	40.8 +/-0.1	1E-8	Fine	Fine
32	BBC One NW (BBC A)	57.0 +/-0.2	1E-8	Fine	Fine
37	Ideal World (COM8) Yesterday	54.4 +/-0.2	1E-8	Fine	Fine
49	Pick (COM5)	53.7 +/-0.1	1E-8	Fine	Fine
50	BBC News with sign language	57.4 +/-0.2	1E-8	Fine	Fine
54	ITV HD (BBC B) BBC 2 HD	52.5 +/-0.2	1E-8	Fine	Fine
55	BBC News HD (COM7)	48.8 +/-0.2	1E-8	Fine	Fine
56	QVC (LM) CBeebies HD	31.1 +/-0.1	DND		
57	Sony Channel +1	35.4 +/-0.2	1E-8	Fine	Fine
58	5 Star (COM4)	49.9 +/-0.2	1E-8	Fine	Fine
59	ITV3 (PSB2) ITV	50.1 +/-0.2	1E-8	Fine	Fine

Notes: All aerials observed orientated towards Winter Hill. Satellite dishes observed.

Location 7 (GPS coordinates: SJ 86132 95736+/- 22ft)					
Channel	Service	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
21	Tiny Pop	35.4 +/-0.1	1E-8	Fine	Fine
24	That's TV (COM6)	46.3 +/-0.2	1.5E-8	Fine	Fine
32	BBC One NW (BBC A)	64.9 +/-0.1	1E-8	Fine	Fine
37	Ideal World (COM8) Yesterday	62.2 +/-0.1	1E-8	Fine	Fine
49	Pick (COM5)	59.7 +/-0.1	1E-8	Fine	Fine
50	BBC News with sign language	61.3 +/-0.1	1E-8	Fine	Fine
54	ITV HD (BBC B) BBC 2 HD	58.3 +/-0.1	1E-8	Fine	Fine
55	BBC News HD (COM7)	50.2 +/-0.1	1E-8	Fine	Fine
56	QVC (LM) CBeebies HD	30.8 +/-0.1	DND		
57	Sony Channel +1	31.7 +/-0.1	DND		
58	5 Star (COM4)	52.1 +/-0.1	1E-8	Fine	Fine
59	ITV3 (PSB2) ITV	50.8 +/-0.2	1E-8	Fine	Fine

Notes: All aerials observed orientated towards Winter Hill. Satellite dishes observed.

APPENDIX B – POST-CONSTRUCTION SURVEY PHOTOGRAPHS

Location 1







Location 2







Location 3





Location 4





Location 5





Location 6



Location 7







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

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