

Television Post-Construction Survey Report

Crown Street Phase 2

Renaker Build Limited

May 2023

PLANNING SOLUTIONS FOR:

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ADMINISTRATION PAGE

Job Reference:	9669N
Date:	May 2023
Author:	Waqar Qureshi
Telephone:	01787 319001
Email:	waqar@pagerpower.com

Reviewed By:	Andrea Mariano
Email:	andrea@pagerpower.com

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Stour Valley Business Centre, Brundon Lane, Sudbury, CO10 7GB

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

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EXECUTIVE SUMMARY

Report Purpose

Pager Power has been commissioned to undertake a post-construction terrestrial television survey Phase 2 of the Crown Street development in Central 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 2019), and the post-construction survey completed in May 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.

Assessment Conclusions

TV signal strength appears to have decreased in some of the surveyed locations within the shadow of the development, however, all main multiplexes that were previously available still have fine audio and picture quality.

The 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 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 survey Phase 2 of the Crown Street development in Central 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 2019), and the post-construction survey completed in May 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 Site Boundary

The site boundary is shown in Figure 1 below¹.

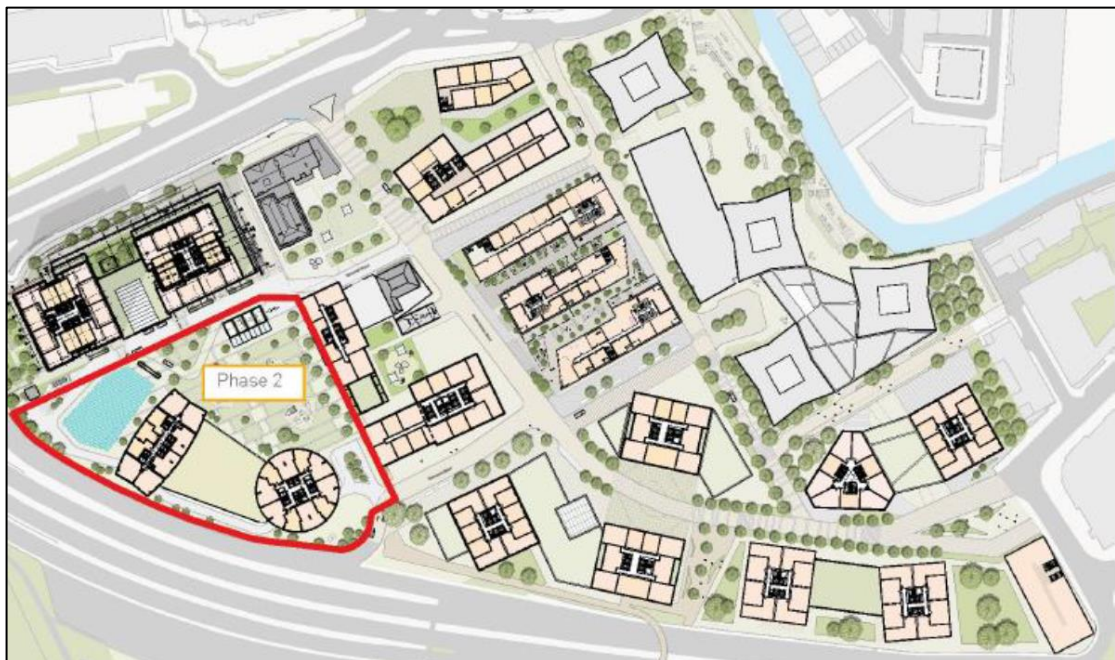


Figure 1 Site boundary

¹ Source: Renaker Build Limited.

2 TELEVISION TRANSMITTER DETAILS

2.1 Relevant Transmitter

A comprehensive search of transmitter and coverage maps revealed that the Winter Hill transmitter is the main transmitter most likely to be serving the area around the Golden Lane building development.

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

2.2 Winter Hill Main Transmitter

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

Digital television services are broadcast, details are presented in Table 1 and Table 2 below.

	Public (PSB)			Commercial (COM)		
Service	BBC A	Digital 3&4	BBC B	SDN	Arqiva A	Arqiva B
Channel	32	34	35	39	31	37

Table 1 Winter Hill Transmissions (main multiplexes)

Service	L-MAN	G-MAN
Channel	24	27

Table 2 Winter Hill Transmissions (local multiplexes)

² Source: <https://www.freeview.co.uk/help/coverage-checker/detailed-view?postcode=M343LL>

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

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 south-southwest 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 document³ 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 2⁴ below, taken from Section 3.2 of the Ofcom guidance regarding the impact of buildings on broadcast signals.

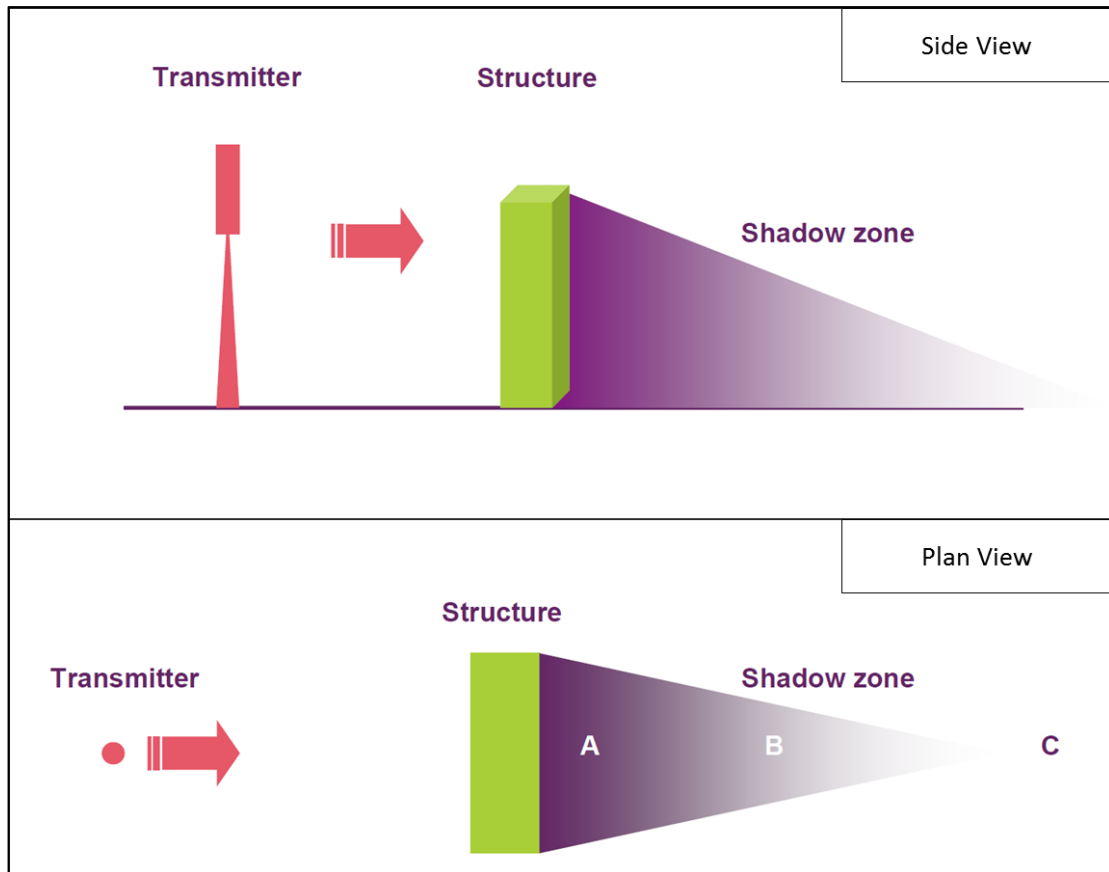


Figure 2 Diffraction Loss Zones

⁴Source: Ofcom publication

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

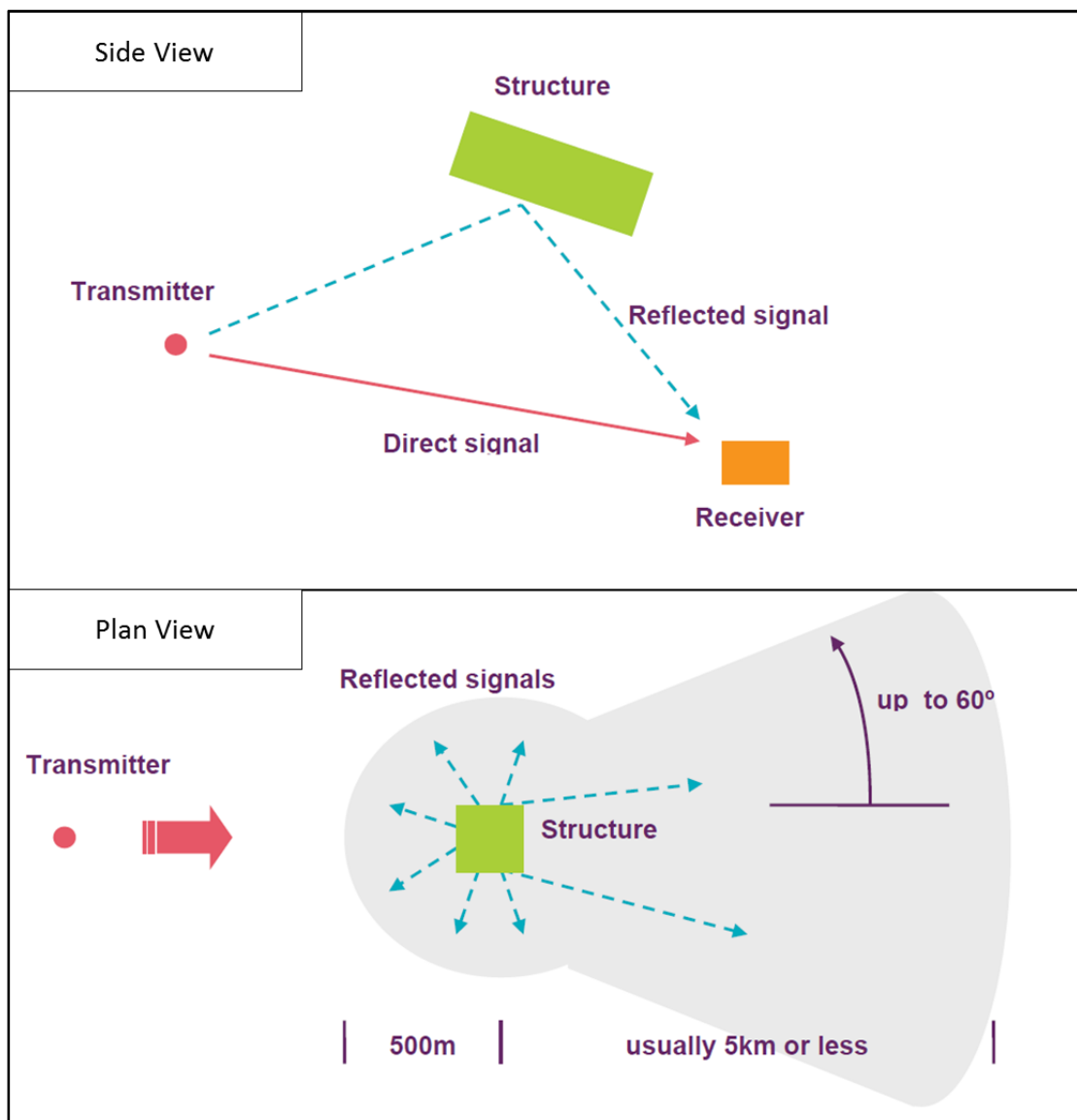


Figure 3 Reflection Zones

⁵ 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 degrees⁶.

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.

⁶ This is known to be the angle that Arqiva considers when safeguarding its Television Re-Broadcast Links with regard to reflections from wind turbines – whilst wind turbines cause issues that are different to buildings this particular issue is similar for the two.

4 TECHNICAL ASSESSMENT

4.1 Potential Interference Areas

Figure 4 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 2 in the previous section.

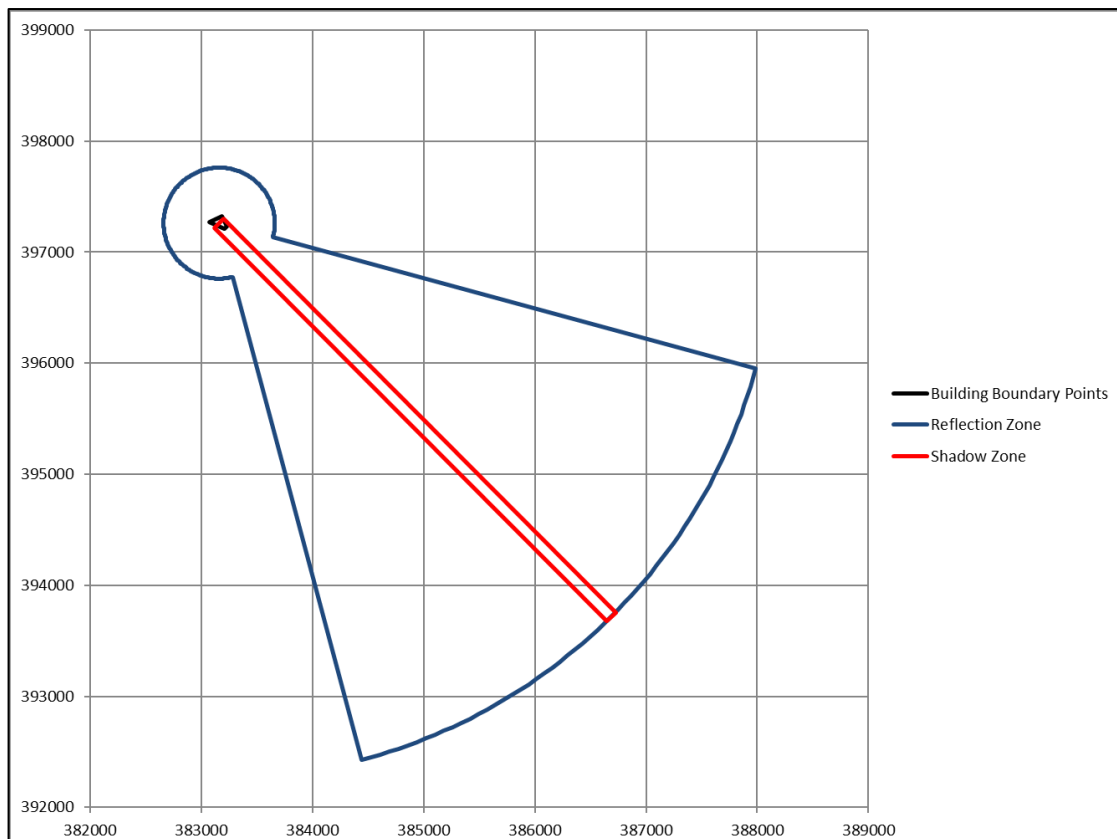


Figure 4 Key Interference areas - shadow and reflection zone

The interference zones have been constructed in accordance with Ofcom guidance presented in Section 3, 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 SURVEY RESULTS

5.1 Overview

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

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

A baseline television reception survey was undertaken on 20th November 2019.

A post-construction survey was completed on 10th May 2023 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.

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. Survey locations were chosen pre-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.



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 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 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	<u>Baseline:</u> Main TV MUX: 45 (Moderate) Local TV MUX: 37 (Moderate) <u>Post-Construction:</u> Main TV MUX: 54.8 (Good) Local TV MUX: 19.3 (Low)	Aerials were not observed at this survey location. No satellite dishes observed. <u>Baseline:</u> One main and two local multiplexes were not received at this location. Another local multiplex showed intermittent interference. The remaining multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 1dB and no signs of interference. <u>Post-Construction:</u> One local multiplex was not received at this location. The remaining local multiplex and all main multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 0.6dB and no signs of interference.	The survey location is within 200m of the closest of the Proposed Development and in front of the site relative to the Winter Hill transmitter. This location has therefore been undertaken as a reference location for baseline conditions with respect to the other survey locations within the shadow zone. <u>The TV signal strength at this location has mostly improved. There is no change in picture or audio quality and the signal strength of the main multiplexes is good.</u>

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
2	<u>Baseline:</u> Main TV MUX: 60 (Very Good) Local TV MUX: 44 (Moderate) <u>Post-Construction:</u> Main TV MUX: 51.45 (Good) Local TV MUX: 36.9 (Moderate)	Horizontally polarised aerials directed towards the Winter Hill transmitter and satellite dishes were observed. <u>Baseline:</u> All main multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 1dB and no signs of interference. One local multiplex was not decoded at this location. <u>Post-Construction:</u> All main multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 0.6dB and no signs of interference. One local multiplex was not decoded at this location.	The survey location is within 400m of the closest of the Proposed Development and within its shadow zone. <u>At this location, there has been a slight decrease in TV signal strength, however there is no change in picture or audio quality, and the signal strength of the main multiplexes is good.</u>

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
3	<u>Baseline:</u> Main TV MUX: 51 (Good) Local TV MUX: 41 (Moderate) <u>Post-Construction:</u> Main TV MUX: 52.1 (Good) Local TV MUX: 33.7 (Low)	Horizontally polarised aerials directed towards the Winter Hill transmitter and many satellite dishes were observed. <u>Baseline:</u> All main multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 1dB and no signs of interference. Two local multiplexes were not decoded at this location. <u>Post-Construction:</u> All main multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 0.6dB and no signs of interference. One local multiplex was not decoded at this location.	The survey location is approximately 500 m of the closest of the Proposed Development. <u>There is no significant change in TV signal strength at this location. There is no change in picture or audio quality and the signal strength of the main multiplexes is good.</u>

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
4	<u>Baseline:</u> Main TV MUX: 47 (Good) Local TV MUX: 39 (Moderate) <u>Post-Construction:</u> Main TV MUX: 50.8 (Good) Local TV MUX: 32.3 (Low)	Horizontally polarised aerials directed towards the Winter Hill transmitter and satellite dishes were observed. <u>Baseline:</u> All main multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 1dB and no signs of interference. Two local multiplexes were not decoded at this location. <u>Post-Construction:</u> All main multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 0.4dB and no signs of interference. One local multiplex was not decoded at this location.	The survey location is more than 1 km from the Proposed Development and within its shadow zone. <u>There is no significant change in TV signal strength at this location. There is no change in picture or audio quality and the signal strength of the main multiplexes is good.</u>

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
5	<u>Baseline:</u> Main TV MUX: 58 (Very Good) Local TV MUX: 38 (Moderate) <u>Post-Construction:</u> Main TV MUX: 52.6 (Good) Local TV MUX: 33.95 (Low)	Horizontally polarised aerials directed towards the Winter Hill transmitter and many satellite dishes were observed. <u>Baseline:</u> All main multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 1dB and no signs of interference. One local multiplex was not decoded at this location. <u>Post-Construction:</u> All main multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 0.6dB and no signs of interference. One local multiplex was intermittent at this location.	The survey location is more than 2 km from the Proposed Development and within its shadow zone. <u>At this location, there has been a slight decrease in TV signal strength, however there is no change in picture or audio quality, and the signal strength of the main multiplexes is good. Given the distance from the built development (more than 1km), any change in signal strength or quality is not likely to be attributable to the development.</u>

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
6	<u>Baseline:</u> Main TV MUX: 70 (Very Good) Local TV MUX: 52 (Good) <u>Post-Construction:</u> Main TV MUX: 63.15 (Very Good) Local TV MUX: 43.4 (Moderate)	Horizontally polarised aerials directed towards the Winter Hill transmitter and satellite dishes were observed. <u>Baseline:</u> All main multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 1dB and no signs of interference. One local multiplex was not decoded at this location. <u>Post-Construction:</u> All main and local multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 0.3dB and no signs of interference.	The survey location is more than 3 km from the Proposed Development and within its shadow zone. <u>At this location, there has been a slight decrease in TV signal strength, however there is no change in picture or audio quality, and the signal strength of the main multiplexes is good. Given the distance from the built development (more than 1km), any change in signal strength or quality is not likely to be attributable to the development.</u>
7	<u>Baseline:</u> Main TV MUX: 68 (Very Good) Local TV MUX: 50 (Good) <u>Post-Construction:</u> Main TV MUX: 63.2 (Very Good)	Horizontally polarised aerials directed towards the Winter Hill transmitter and some satellite dishes were observed. <u>Baseline:</u> All main multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 1dB and no signs of interference. One local multiplex was not decoded at this location. <u>Post-Construction:</u> All main and local multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 1dB and no signs of interference.	The survey location is more than 4 km from the Proposed Development and within its shadow zone. <u>At this location, there has been a slight decrease in TV signal strength, however there is no change in picture or audio quality, and the signal strength of the main multiplexes is good. Given the distance from the built development (more than 1km), any change in signal strength</u>

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
	Local TV MUX: 46 (Good)		<u>or quality is not likely to be attributable to the development.</u>

Table 4 Baseline and post-construction survey results

5.4 Local Multiplexes

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

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.

There is no reason to install pre-emptive mitigation.

7 CONCLUSIONS

7.1 Overall

TV signal strength appears to have decreased in some of the surveyed locations within the shadow of the development, however, 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.

APPENDIX A – SURVEY RESULTS

Location 1 - Baseline

GPS Coordinates: SJ 83331 97119 +/- 30 ft					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
31	COM7	41.1 ± 1.5	0%	Intermittent interference	Intermittent interference
37	COM8	52.9 ± 0.4	5x10 ⁻⁸	Good	Good
49	Arqiva A	49.4 ± 0.4	5x10 ⁻⁸	Good	Good
50	BBC A	51.0 ± 0.4	1x10 ⁻⁸	Good	Good
54-	BBC B	42.8 ± 0.5	0%	Good	Good
55	Arqiva B	36.6 ± 1.5	-	-	-
56	LM/LL/LPR	25.7 ± 0.2	-	-	-
57	GIM	27.4 ± 0.2	-	-	-
58	SDN	42.8 ± 0.5	2x10 ⁻⁷	Good	Good
59	Digital 3&4	44.7 ± 0.8	2x10 ⁻⁸	Good	Good

Notes: UHF aerials were not observed. The survey aerial was screened by a nearby tree.

Location 1 - Post Construction

Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	L-MAN	38.6 ± 0.3	1x10 ⁻⁷	Good	Good
27	G_MAN	DND	DND	DND	DND
29	SDN	51.2 ± 0.3	3x10 ⁻⁸	Good	Good
31	Arqiva A	52.4 ± 0.5	8x10 ⁻⁸	Good	Good
32	BBC A	55 ± 0.3	1x10 ⁻⁷	Good	Good
34	D3&4	58.1 ± 0.3	1x10 ⁻⁷	Good	Good
35	BBC B	57.3 ± 0.1	1x10 ⁻⁷	Good	Good
37	Arqiva B	55.0 ± 0.5	9x10 ⁻⁷	Good	Good

Notes: UHF aerials were not observed. The survey aerial was screened by a nearby tree.

Location 2 - Baseline

GPS Coordinates: SJ 83470 96964 +/- 18 ft					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
31	COM7	54.4 ± 0.2	0%	Good	Good
37	COM8	61.6 ± 0.2	1x10 ⁻⁸	Good	Good
49	Arqiva A	63.5 ± 0.2	1x10 ⁻⁸	Good	Good
50	BBC A	64.1 ± 0.2	1x10 ⁻⁸	Good	Good
54-	BBC B	61.3 ± 0.3	0%	Good	Good
55	Arqiva B	55.6 ± 0.1	0%	Good	Good
56	LM/LL/LPR	25.7 ± 0.2	DND	DND	DND
57	GIM	32.9 ± 0.3	2x10 ⁻⁶	Good	Good
58	SDN	58.9 ± 0.2	1x10 ⁻⁸	Good	Good
59	Digital 3&4	57.7 ± 0.3	1x10 ⁻⁸	Good	Good

Notes: UHF aerials directed towards the Winter Hill transmitter were observed. The survey aerial was not fully erected due to a tree at the survey location.

Location 2 - Post Construction

Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	L-MAN	39.7 ± 0.3	5x10 ⁻⁷	Good	Good
27	G_MAN	34.1 ± 0.3	DND	DND	DND
29	SDN	54.8 ± 0.2	1x10 ⁻⁷	Good	Good
31	Arqiva A	53.8 ± 0.3	2x10 ⁻⁷	Good	Good
32	BBC A	50 ± 0.3	2x10 ⁻⁸	Good	Good
34	D3&4	47.1 ± 0.5	3x10 ⁻⁶	Good	Good
35	BBC B	53 ± 0.3	1x10 ⁻⁷	Good	Good
37	Arqiva B	50.0 ± 0.1	9x10 ⁻⁷	Good	Good

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

Location 3 - Baseline

Location 3 (GPS Coordinates: SJ 83572 96829 +/- 9 ft)					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
31	COM7	52.3 ± 0.2	0%	Good	Good
37	COM8	55.9 ± 0.2	1x10 ⁻⁸	Good	Good
49	Arqiva A	54.5 ± 0.3	1x10 ⁻⁸	Good	Good
50	BBC A	55.1 ± 0.3	1x10 ⁻⁸	Good	Good
54-	BBC B	52.4 ± 0.3	0%	Good	Good
55	Arqiva B	46.9 ± 0.3	0%	Good	Good
56	LM/LL/LPR	25.6 ± 0.2	-	-	-
57	GIM	30.4 ± 0.2	-	-	-
58	SDN	48.9 ± 0.3	5x10 ⁻⁸	Good	Good
59	Digital 3&4	49.2 ± 0.3	1x10 ⁻⁸	Good	Good

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

Location 3 – Post Construction

Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	L-MAN	36.1 ± 0.3	1x10 ⁻⁶	Good	Good
27	G_MAN	31.3 ± 0.3	DND	DND	DND
29	SDN	48.3 ± 0.1	6x10 ⁻⁷	Good	Good
31	Arqiva A	49.2 ± 0.5	2x10 ⁻⁷	Good	Good
32	BBC A	54.8 ± 0.2	1x10 ⁻⁷	Good	Good
34	D3&4	55.0 ± 0.1	1x10 ⁻⁷	Good	Good
35	BBC B	51.5 ± 0.5	1x10 ⁻⁷	Good	Good
37	Arqiva B	53.8 ± 0.3	3x10 ⁻⁸	Good	Good

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

Location 4 - Baseline

GPS Coordinates: SJ 83918 96492 +/- 25 ft					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
31	COM7	47.3 ± 0.2	0%	Good	Good
37	COM8	55.6 ± 0.3	1x10 ⁻⁸	Good	Good
49	Arqiva A	50.2 ± 0.2	1x10 ⁻⁸	Good	Good
50	BBC A	51.0 ± 0.2	1x10 ⁻⁸	Good	Good
54-	BBC B	50.3 ± 0.2	0%	Good	Good
55	Arqiva B	40.6 ± 0.2	0%	Good	Good
56	LM/LL/LPR	25.7 ± 0.2	-	-	-
57	GIM	28.6 ± 0.2	-	-	-
58	SDN	45.2 ± 0.3	1x10 ⁻⁵	Good	Good
59	Digital 3&4	44.0 ± 0.2	8x10 ⁻⁸	Good	Good

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

Location 4 – Post Construction

Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	L-MAN	34.6 ± 0.1	1x10 ⁻⁵	Good	Good
27	G_MAN	30	DND	DND	DND
29	SDN	50.2 ± 0.2	8 x10 ⁻⁷	Good	Good
31	Arqiva A	51.8 ± 0.1	6 x10 ⁻⁷	Good	Good
32	BBC A	52.1 ± 0.1	1 x10 ⁻⁷	Good	Good
34	D3&4	50.1 ± 0.1	4 x10 ⁻⁷	Good	Good
35	BBC B	51.5 ± 0.1	1 x10 ⁻⁷	Good	Good
37	Arqiva B	49.2 ± 0.3	3x10 ⁻⁵	Good	Good

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

Location 5 - Baseline

GPS Coordinates: SJ 84764 95635 +/- 19 ft					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
31	COM7	47.3 ± 0.3	0%	Good	Good
37	COM8	47.0 ± 2.0	1x10 ⁻⁸	Good	Good
49	Arqiva A	62.1 ± 0.3	1x10 ⁻⁸	Good	Good
50	BBC A	61.3 ± 0.3	1x10 ⁻⁸	Good	Good
54-	BBC B	60.3 ± 0.2	0%	Good	Good
55	Arqiva B	53.0 ± 0.3	0%	Good	Good
56	LM/LL/LPR	25.7 ± 0.2	-	-	-
57	GIM	33.3 ± 0.2	1x10 ⁻⁸	Good	Good
58	SDN	56.7 ± 0.2	1x10 ⁻⁸	Good	Good
59	Digital 3&4	55.3 ± 0.3	1x10 ⁻⁸	Good	Good

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

Location 5 – Post Construction

Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	L-MAN	34.5 ± 0.5	1 x10 ⁻⁷	Good	Good
27	G_MAN	33.4 ± 0.3	1 x10 ⁻²	Intermittent	Intermittent
29	SDN	51.7 ± 0.3	1 x10 ⁻⁷	Good	Good
31	Arqiva A	52.1 ± 0.3	1 x10 ⁻⁷	Good	Good
32	BBC A	53.4 ± 0.5	1 x10 ⁻⁷	Good	Good
34	D3&4	53.2 ± 0.5	1 x10 ⁻⁷	Good	Good
35	BBC B	52.3 ± 1	1x10 ⁻⁸	Good	Good
37	Arqiva B	53 ± 0.5	1x10 ⁻⁸	Good	Good

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

Location 6 – Baseline

GPS Coordinates: SJ 85548 94864 +/- 13 ft					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
31	COM7	67.2 ± 0.2	0%	Good	Good
37	COM8	73.0 ± 0.2	1x10 ⁻⁸	Good	Good
49	Arqiva A	74.2 ± 0.2	1x10 ⁻⁸	Good	Good
50	BBC A	74.6 ± 0.2	1x10 ⁻⁸	Good	Good
54-	BBC B	72.7 ± 0.2	0%	Good	Good
55	Arqiva B	65.3 ± 0.3	0%	Good	Good
56	LM/LL/LPR	26.5 ± 0.2	-	-	-
57	GIM	41.8 ± 0.2	1x10 ⁻⁸	Good	Good
58	SDN	68.3 ± 0.3	1x10 ⁻⁸	Good	Good
59	Digital 3&4	66.3 ± 0.3	1x10 ⁻⁸	Good	Good

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

Location 6 – Post Construction

Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	L-MAN	46.4 ± 0.1	1 x10 ⁻⁷	Good	Good
27	G_MAN	40.4 ± 0.1	1 x10 ⁻⁷	Good	Good
29	SDN	64.3 ± 0.1	1 x10 ⁻⁷	Good	Good
31	Arqiva A	62.7 ± 0.1	1 x10 ⁻⁷	Good	Good
32	BBC A	62.2±0.1	1 x10 ⁻⁷	Good	Good
34	D3&4	62.5±0.1	1 x10 ⁻⁷	Good	Good
35	BBC B	63.8±0.1	1 x10 ⁻⁷	Good	Good
37	Arqiva B	63.4 ± 0.2	1 x10 ⁻⁷	Good	Good

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

Location 7 - Baseline

GPS Coordinates: SJ 86626 93822 +/- 11ft					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
31	COM7	58.6 ± 0.2	0%	Good	Good
37	COM8	70.9 ± 0.1	1x10 ⁻⁸	Good	Good
49	Arqiva A	71.2 ± 0.1	1x10 ⁻⁸	Good	Good
50	BBC A	72.4 ± 0.2	1x10 ⁻⁸	Good	Good
54-	BBC B	71.0 ± 0.1	0%	Good	Good
55	Arqiva B	61.6 ± 0.1	0%	Good	Good
56	LM/LL/LPR	26.3 ± 0.1	-	-	-
57	GIM	42.9 ± 0.1	1x10 ⁻⁸	Good	Good
58	SDN	65.4 ± 0.2	1x10 ⁻⁸	Good	Good
59	Digital 3&4	64.1 ± 0.1	1x10 ⁻⁸	Good	Good

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

Location 7 – Post Construction

Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	L-MAN	48.7 ± 0.1	1 x10 ⁻⁷	Good	Good
27	G_MAN	43.3 ± 0.1	1 x10 ⁻⁷	Good	Good
29	SDN	61.8 ± 0.2	1 x10 ⁻⁷	Good	Good
31	Arqiva A	62.5 ± 0.1	1 x10 ⁻⁷	Good	Good
32	BBC A	63.7 ± 0.1	1 x10 ⁻⁷	Good	Good
34	D3&4	63.5 ± 0.1	1 x10 ⁻⁷	Good	Good
35	BBC B	64 ± 0.1	1 x10 ⁻⁷	Good	Good
37	Arqiva B	63.8 ± 0.1	1 x10 ⁻⁸	Good	Good

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

APPENDIX B – 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)

Location 7



Location 7 (baseline survey)



Location 7 (post-construction survey)



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

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