

# Television Baseline Survey Report

iQ Student Accommodation

Echo Street, Manchester

April 2023

## PLANNING SOLUTIONS FOR:

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- Railways
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## ADMINISTRATION PAGE

|                       |                        |
|-----------------------|------------------------|
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| 2     | April 2023 | Layout update     |

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## EXECUTIVE SUMMARY

### Report Purpose

Pager Power has been commissioned to investigate the potential impact of the proposed purpose built student accommodation development at Echo Street, Manchester upon terrestrial television reception in the surrounding area. The proposed development will have a maximum height of 130.85 metres above ordnance datum.

The proposed development will introduce a new tall structure into the area – this could interact with wireless terrestrial television signals and cause interference in the surrounding area. This report produces the results of a television baseline survey along with a prediction of the expected impact.

### Findings

- Residences in the area surrounding the proposed development receive television services from the Winter Hill transmitter. The strength and quality of the signal in the residential areas varies from low to very good for the main multiplexes and low for the local multiplexes.
- A large proportion of the shadow zone (up to 1.5km from the proposed development) extends over non-residential areas, where the presence of television aerials is less likely.
- Low level receiving aerials in the proposed development's shadow, within approximately one kilometre, may experience degradation of terrestrial television reception quality.
- Residences where the aerials extend above the proposed development's shadow, or are at greater distances, are unlikely to experience noticeable impacts in practice.

### Mitigation

In the event that effects are reported, it is recommended that a reception measurement is undertaken (post-construction) to investigate the likely cause of the interference.

Mitigation measures should be installed if reported effects are found to be attributable to the proposed development. Solutions are likely to be readily available if required, the most common options are presented in Section 6.

No requirement for pre-emptive mitigation has been identified.

## LIST OF CONTENTS

|                                                                    |    |
|--------------------------------------------------------------------|----|
| Administration Page .....                                          | 2  |
| Executive Summary .....                                            | 3  |
| Report Purpose.....                                                | 3  |
| Findings .....                                                     | 3  |
| Mitigation.....                                                    | 3  |
| List of Contents .....                                             | 4  |
| List of Figures.....                                               | 5  |
| List of Tables.....                                                | 6  |
| 1    Background .....                                              | 8  |
| 1.1    Introduction.....                                           | 8  |
| 1.2    Proposed Development Details .....                          | 8  |
| 2    Television Transmitter Details.....                           | 10 |
| 2.1    Relevant Transmitter .....                                  | 10 |
| 2.2    Winter Hill Main Transmitter.....                           | 10 |
| 3    Buildings and Television Interference .....                   | 11 |
| 3.1    Technical Overview.....                                     | 11 |
| 3.2    Interference mechanisms.....                                | 11 |
| 4    Technical Assessment.....                                     | 15 |
| 4.1    Potential Interference Areas.....                           | 15 |
| 4.2    Potential Diffraction Issues – Terrestrial Television ..... | 16 |
| 4.3    Potential Reflection Issues – Terrestrial Television .....  | 16 |
| 5    Television Baseline Survey .....                              | 18 |
| 5.1    Overview.....                                               | 18 |
| 5.1    Survey Locations.....                                       | 18 |
| 5.2    Survey Results .....                                        | 20 |
| 6    Mitigation .....                                              | 23 |
| 6.1    Mitigation Requirement .....                                | 23 |
| 6.2    Recommended Options.....                                    | 23 |

|                                            |                           |    |
|--------------------------------------------|---------------------------|----|
| 6.3                                        | Recommended Process ..... | 23 |
| 7                                          | Conclusions .....         | 24 |
| 7.1                                        | Findings .....            | 24 |
| 7.2                                        | Mitigation.....           | 24 |
| Appendix A – Detailed Survey Results ..... |                           | 25 |
|                                            | Location 1 .....          | 25 |
|                                            | Location 2 .....          | 26 |
|                                            | Location 3 .....          | 27 |
|                                            | Location 4 .....          | 28 |
|                                            | Location 5 .....          | 29 |
|                                            | Location 6 .....          | 30 |
|                                            | Location 7 .....          | 31 |
| Appendix B – Survey Photographs .....      |                           | 32 |
|                                            | Location 1 .....          | 32 |
|                                            | Location 2 .....          | 33 |
|                                            | Location 3 .....          | 34 |
|                                            | Location 4 .....          | 35 |
|                                            | Location 5 .....          | 36 |
|                                            | Location 6 .....          | 37 |
|                                            | Location 7 .....          | 37 |

## LIST OF FIGURES

|          |                                     |    |
|----------|-------------------------------------|----|
| Figure 1 | Proposed development location ..... | 8  |
| Figure 2 | Building elevations.....            | 9  |
| Figure 3 | Diffraction loss zones .....        | 12 |
| Figure 4 | Reflection zones.....               | 13 |
| Figure 5 | Interference areas.....             | 15 |
| Figure 6 | Interference zones map.....         | 16 |
| Figure 7 | Survey locations .....              | 19 |

## LIST OF TABLES

|                                                    |    |
|----------------------------------------------------|----|
| Table 1 Winter Hill main transmissions .....       | 10 |
| Table 2 Winter Hill additional transmissions ..... | 10 |
| Table 3 Signal strength categories .....           | 18 |
| Table 4 Television baseline survey results .....   | 22 |

## ABOUT PAGER POWER

Pager Power is a dedicated consultancy company based in Suffolk, UK. The company has undertaken projects in 56 countries within Europe, Africa, America, Asia and Australasia.

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 investigate the potential impact of the proposed purpose built student accommodation development at Echo Street, Manchester upon terrestrial television reception in the surrounding area. The proposed development will have a maximum height of 130.85 metres above ordnance datum.

The proposed development will introduce a new tall structure into the area – this could interact with wireless terrestrial television signals and cause interference in the surrounding area. This report produces the results of a television baseline survey along with a prediction of the expected impact.

### 1.2 Proposed Development Details

The layout plan for the proposed development is shown in Figure 1<sup>1</sup> below.

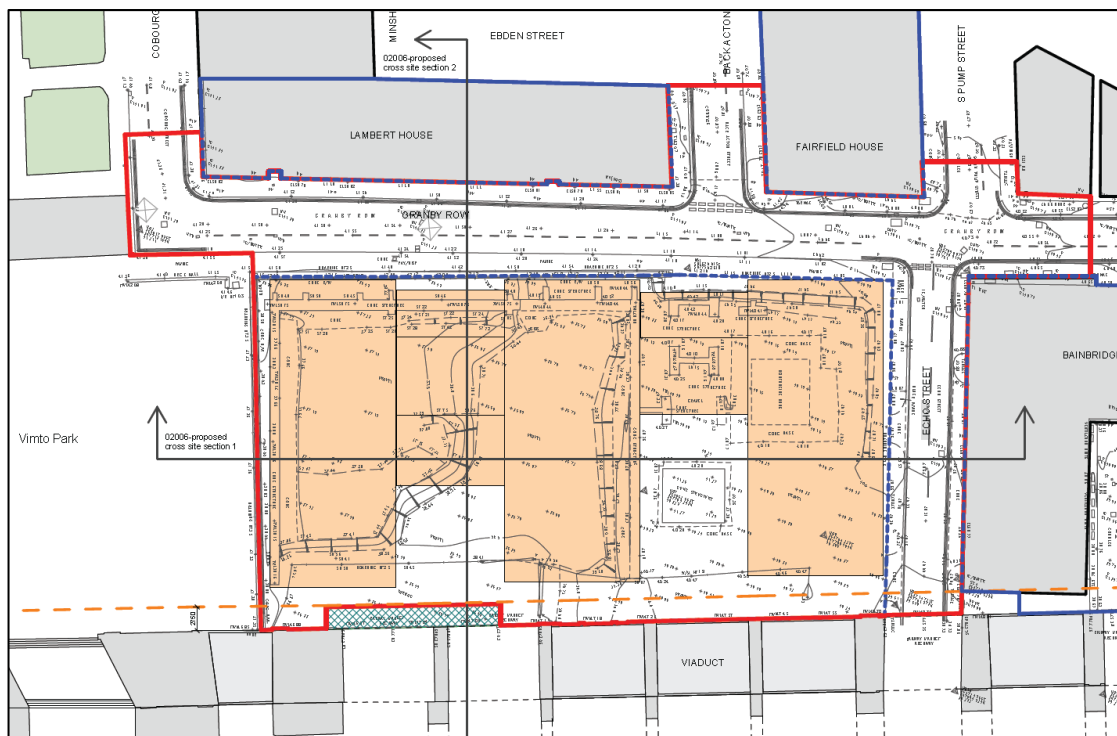


Figure 1 Proposed development location

<sup>1</sup> Source: ECHO-SRA-ZS-XX-DR-A-02003\_Existing Site Plan With Proposed Building Footprint\_S2\_P02\_0  
Television Baseline Survey Report

Figure 2 below shows the building elevations.



Figure 2 Building elevations

## 2 TELEVISION TRANSMITTER DETAILS

### 2.1 Relevant Transmitter

Winter Hill is one of the UK's main television transmitters located approximately 24.97km northwest of the proposed development. 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 below<sup>2</sup>.

### 2.2 Winter Hill Main Transmitter

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

|         | 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

Additional Winter Hill transmissions are shown in Table 2 below.

|         | Local Multiplexes |       |          |
|---------|-------------------|-------|----------|
| Service | LTVmux            | Glmux | Arqiva C |
| Channel | 24                | 27    | 55       |
| Power   | 2 kW              | 1 kW  | 23 kW    |

Table 2 Winter Hill additional transmissions

<sup>2</sup> Source: Ofcom

## 3 BUILDINGS AND TELEVISION INTERFERENCE

### 3.1 Technical Overview

Terrestrial television services are provided by means of UHF radio waves which propagate from transmitters to receiving aerials which then relay the signal to a television set.

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

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

### 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 television signal, reducing the strength of the carrier signal in the shadow of the building. In the case of Winter Hill transmissions, this would affect residences to the southeast of the proposed development. Specifically:

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

The Ofcom document states that:

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

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

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

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

The zones mentioned are illustrated in Figure 3<sup>3</sup> on the following page, taken from Section 3.2 of an Ofcom paper<sup>4</sup> regarding the impact of buildings on broadcast signals.

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

<sup>4</sup> Reference as above.

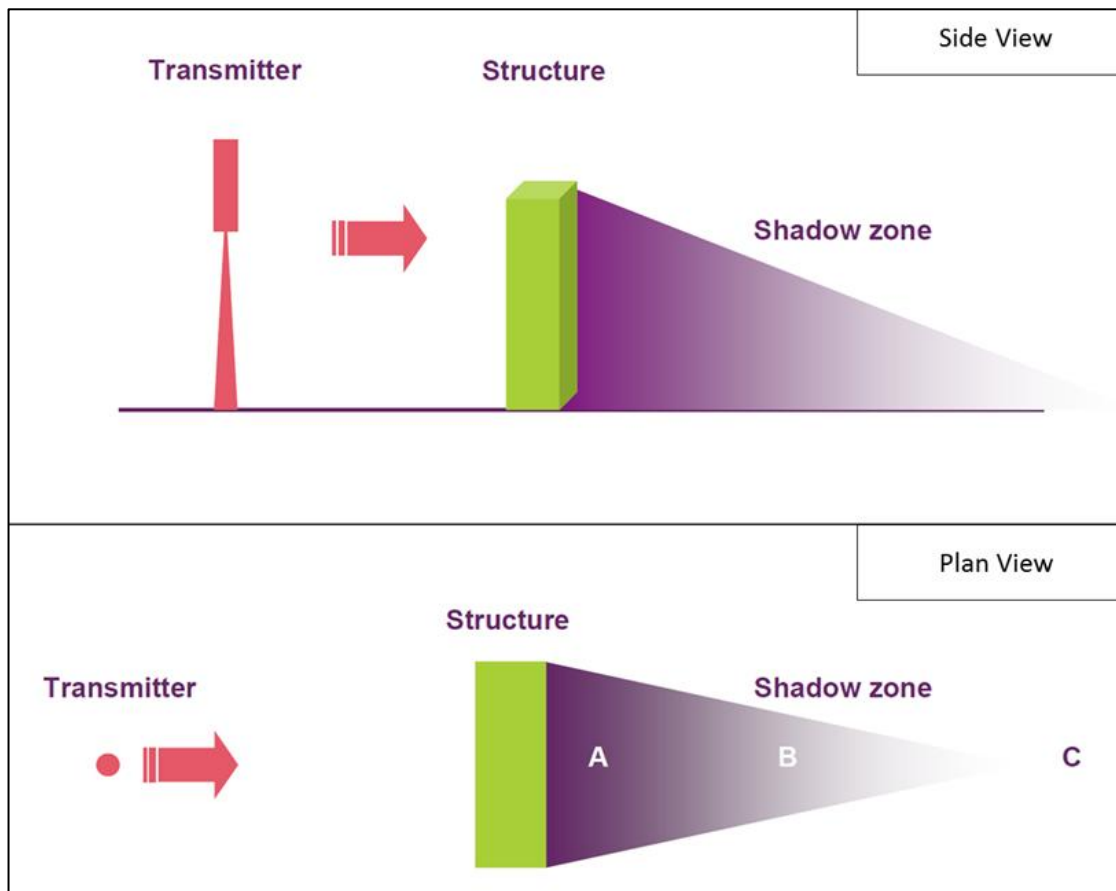


Figure 3 Diffraction loss zones

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

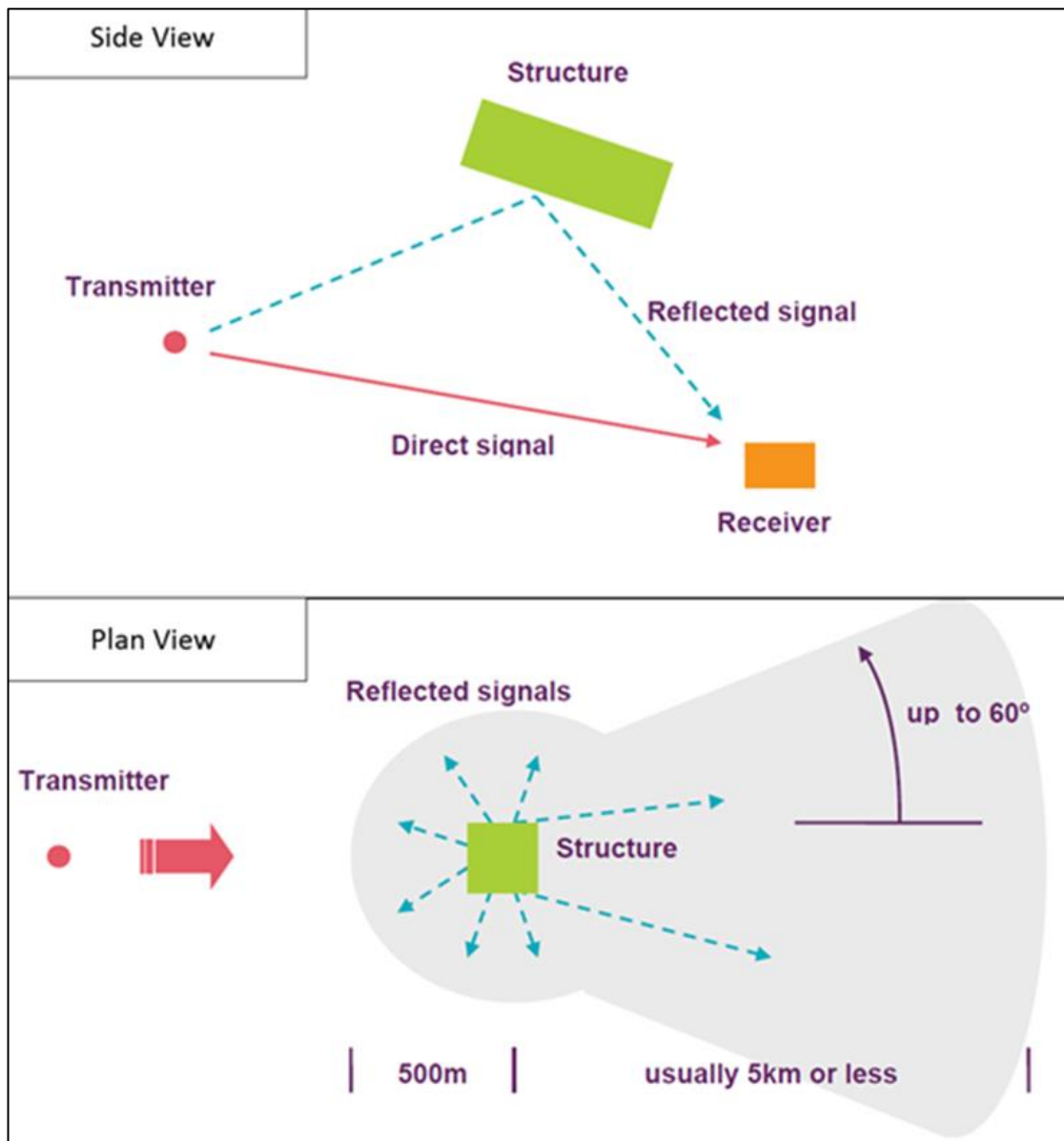


Figure 4 Reflection zones

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

<sup>5</sup> 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 building is strong (e.g. clear radio line of sight from the transmitter to the building and the building to the receiver).

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

## 4 TECHNICAL ASSESSMENT

### 4.1 Potential Interference Areas

The shadow and reflection zones have been defined based on the geometry as set out in the previous section. Both zones extend to a distance of 5km beyond the proposed development location in accordance with the Ofcom guidance.

In the case of the shadow zone, this has been modelled as having straight sides in order to be conservative. In actuality, due to diffraction effects, the zone would have a more triangular shape as shown in Figure 4 in the previous section. Figure 5 below shows the potential interference areas associated with the proposed development.

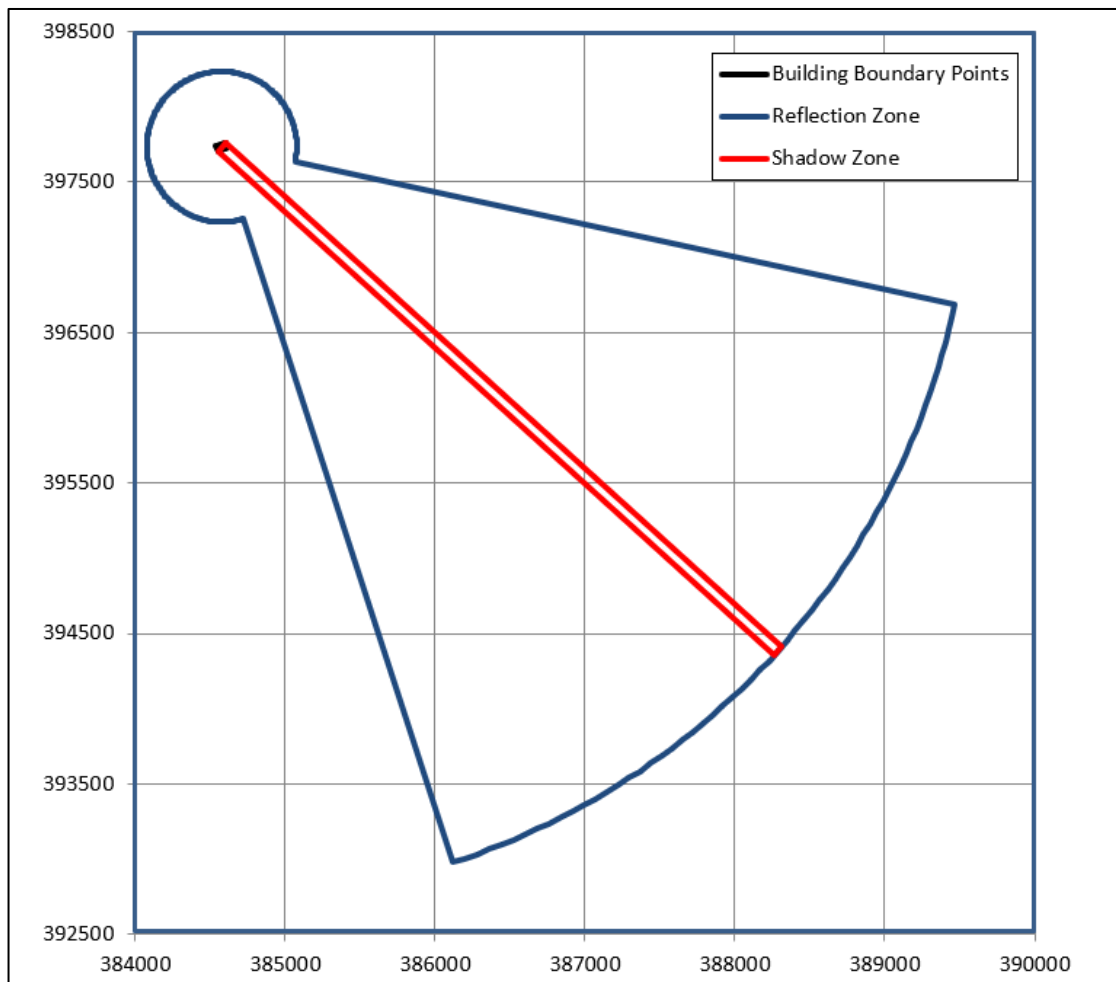


Figure 5 Interference areas

Figure 6 below shows the interference zones overlaid onto an aerial image of the area.



Figure 6 Interference zones map

#### 4.2 Potential Diffraction Issues – Terrestrial Television

Urban areas closest to the proposed development are at the highest risk of experiencing television interference. However, based on a review of the aerial imagery, the shadow zone passes over the city centre which contains shops and non-residential buildings.

The closest urban areas with low-rise residential properties within the shadow zone are located approximately 1.5km from the proposed development.

#### 4.3 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.

The predicted coverage of the Winter Hill transmitter is generally good in the surrounding area. Interference due to reflections are most likely when:

- The receiving aerial is unobstructed by existing obstacles.
- The reflected signal path via the proposed development is unobstructed.
- The angle between the reflected signal via the proposed development and the direct signal would be small.

Interference is most likely if all of the above criteria are met. Interference is least likely if none of the above criteria are met.

In practice it is unlikely that all of the above criteria would be met for the proposed development. In particular, locations that are below radio line-of-sight from the transmitter are unlikely to have an unobstructed path to the proposed development, due to their relative heights. Impacts due to reflections are considered unlikely.

## 5 TELEVISION BASELINE SURVEY

### 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 (for television).
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.
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 for the proposed development on the 15<sup>th</sup> March 2023.

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 signals is categorised in accordance with Table 3 below.

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

Table 3 *Signal strength categories*

### 5.1 Survey Locations

Figure 7 on the following page shows the survey locations overlaid onto aerial photography. The interference zones are also shown.

Locations were selected considering potential residential areas within the building's shadow zone. The locations are deliberately spaced close together nearest the proposed development, as this is the area where effects would generally be the most likely and multiple measurements within a relatively short distance could be the most relevant.

Survey locations were chosen pre-survey (within the shadow zone); however, safe and available access influenced the specific position on the day.



Figure 7 Survey locations

## 5.2 Survey Results

A summary of the television survey results is presented in Table 4 below. Full survey results are shown in Appendix A. Survey photographs are shown in Appendix B.

| Location | Average Measured Signal Strength (dB)                                          | Remarks                                                                                                                                                                                                                                                                                                                                  | High-Level Conclusion                                                                                                                                                                                                                                                                                                                                |
|----------|--------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1        | <p>Main TV<br/>MUX: 31.8<br/>(Low)</p> <p>Local TV<br/>MUX: 20.9<br/>(Low)</p> | <p>No aerials observed at this location. It is likely none of the surrounding buildings are residential properties or the aerials are higher than 10m agl<sup>6</sup>.</p> <p>Five out of six multiplexes displayed fine picture and audio quality with no signs of interference.</p> <p>All three local multiplexes did not decode.</p> | <p>The survey location is within 5m of the proposed development and within its shadow zone.</p> <p>Considering the distance from the proposed development, a reduction in signal strength is possible.</p> <p>Noticeable effects are not predicted in practice due to the lack of residential properties or height of any aerials in the area.</p>   |
| 2        | <p>Main TV<br/>MUX: 34.3<br/>(Low)</p> <p>Local TV<br/>MUX: 20.7<br/>(Low)</p> | <p>No aerials observed at this location. It is likely none of the surrounding buildings are residential properties or the aerials are higher than 10m agl.</p> <p>All main multiplexes displayed fine picture and audio quality with no signs of interference.</p> <p>All three local multiplexes did not decode.</p>                    | <p>The survey location is within 400m of the proposed development and within its shadow zone.</p> <p>Considering the distance from the proposed development, a reduction in signal strength is possible.</p> <p>Noticeable effects are not predicted in practice due to the lack of residential properties or height of any aerials in the area.</p> |

<sup>6</sup>If any aerials are present, they are unlikely to be situated on low-rise properties.

| Location | Average Measured Signal Strength (dB)                                | Remarks                                                                                                                                                                                                                                                                                                                      | High-Level Conclusion                                                                                                                                                                                                                                                                                                                                         |
|----------|----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3        | <p>Main TV MUX: 31.8 (Low)</p> <p>Local TV MUX: 19.7 (Low)</p>       | <p>No aerials observed at this location. It is likely none of the surrounding buildings are residential properties or the aerials are higher than 10m agl.</p> <p>Five out of six multiplexes displayed fine picture and audio quality with no signs of interference.</p> <p>All three local multiplexes did not decode.</p> | <p>The survey location is approximately 570m from the proposed development and within its shadow zone.</p> <p>Considering the distance from the proposed development, a reduction in signal strength is possible.</p> <p>Noticeable effects are not predicted in practice due to the lack of residential properties or height of any aerials in the area.</p> |
| 4        | <p>Main TV MUX: 56.6 (Very good)</p> <p>Local TV MUX: 27.0 (Low)</p> | <p>Multiple aerials directed towards Winter Hill and satellite dishes observed.</p> <p>All main multiplexes displayed fine picture and audio quality with no signs of interference.</p> <p>One out of three of the local multiplexes displayed fine picture and audio quality. Two did not decode.</p>                       | <p>The survey location is approximately 1.5km from the proposed development and within its shadow zone.</p> <p>Considering the distance from the proposed development and current signal strength, interference is not anticipated.</p>                                                                                                                       |
| 5        | <p>Main TV MUX: 56.7 (Very good)</p> <p>Local TV MUX: 33.4 (Low)</p> | <p>Multiple aerials directed towards Winter Hill and satellite dishes observed.</p> <p>All main multiplexes displayed fine picture and audio quality with no signs of interference.</p> <p>One out of three of the local multiplexes displayed fine picture and audio quality. Two did not decode.</p>                       | <p>The survey location is approximately 2.3km from the proposed development and within its shadow zone.</p> <p>Considering the distance from the proposed development and current signal strength, interference is not anticipated.</p>                                                                                                                       |

| Location | Average Measured Signal Strength (dB)                                | Remarks                                                                                                                                                                                                                                                                                                | High-Level Conclusion                                                                                                                                                                                                                   |
|----------|----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6        | <p>Main TV MUX: 56.7 (Very good)</p> <p>Local TV MUX: 33.8 (Low)</p> | <p>Multiple aerials directed towards Winter Hill and satellite dishes observed.</p> <p>All main multiplexes displayed fine picture and audio quality with no signs of interference.</p> <p>Two out of three of the local multiplexes displayed fine picture and audio quality. One did not decode.</p> | <p>The survey location is approximately 2.8km from the proposed development and within its shadow zone.</p> <p>Considering the distance from the proposed development and current signal strength, interference is not anticipated.</p> |
| 7        | <p>Main TV MUX: 53.3 (Very good)</p> <p>Local TV MUX: 30.9 (Low)</p> | <p>Multiple aerials directed towards Winter Hill and satellite dishes observed.</p> <p>All main multiplexes displayed fine picture and audio quality with no signs of interference.</p> <p>One out of three of the local multiplexes displayed fine picture and audio quality. Two did not decode.</p> | <p>The survey location is approximately 3.7km from the proposed development and within its shadow zone.</p> <p>Considering the distance from the proposed development and current signal strength, interference is not anticipated.</p> |

Table 4 Television baseline survey results

## 6 MITIGATION

### 6.1 Mitigation Requirement

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

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.
- A combination of the above.
- Replacing terrestrial reception equipment with satellite reception equipment or cable.

### 6.2 Recommended Options

If interference 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, the best option may be to upgrade and/or elevate the existing aerial.

It is also possible that the television services could be supplied by an alternate transmitter in the surrounding area.

### 6.3 Recommended Process

It is possible that no adverse effects will occur due to the current reception quality in the surrounding area and the scarcity of residential receptors at a low height in the immediate shadow zone.

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

The results of the survey suggest there is no reason to install pre-emptive mitigation.

## 7 CONCLUSIONS

### 7.1 Findings

- Residences in the area surrounding the proposed development receive television services from the Winter Hill transmitter. The strength and quality of the signal in the residential areas varies from low to very good for the main multiplexes and low for the local multiplexes.
- A large proportion of the shadow zone (up to 1.5km from the proposed development) extends over non-residential areas, where the presence of television aerials is less likely.
- Low level receiving aerials in the proposed development's shadow, within approximately one kilometre, may experience degradation of terrestrial television reception quality.
- Residences where the aerials extend above the proposed development's shadow, or are at greater distances, are unlikely to experience noticeable impacts in practice.

### 7.2 Mitigation

In the event that effects are reported, it is recommended that a reception measurement is undertaken (post-construction) to investigate the likely cause of the interference.

Mitigation measures should be installed if reported effects are found to be attributable to the proposed development. Solutions are likely to be readily available if required, the most common options are presented in Section 6.

No requirement for pre-emptive mitigation has been identified.

## APPENDIX A – DETAILED SURVEY RESULTS

### Location 1

| Coordinates: Lon: -2.231626, Lat: 53.475693 |             |                        |       |                  |       |
|---------------------------------------------|-------------|------------------------|-------|------------------|-------|
| Television                                  |             |                        |       |                  |       |
| Channel                                     | Service     | Signal Strength (dBμV) | BER   | Picture          | Audio |
| 24                                          | LTVmux      | 23.5 +/- 0.1           | -     | DND              | DND   |
| 27                                          | Glmux       | 18.9 +/- 0.2           | -     | DND <sup>7</sup> | DND   |
| 29                                          | SDN         | 29.4 +/-0.1            | -     | DND              | DND   |
| 31                                          | Arqiva A    | 33.7 +/- 0.2           | 1E-08 | Fine             | Fine  |
| 32                                          | BBC A       | 32.3 +/-0.3            | 1E-08 | Fine             | Fine  |
| 34                                          | Digital 3&4 | 31.6 +/- 0.2           | 1E-05 | Fine             | Fine  |
| 35                                          | BBC B       | 32.5 +/- 0.1           | 1E-07 | Fine             | Fine  |
| 37                                          | Arqiva B    | 31.2+/- 0.3            | 1E-04 | Fine             | Fine  |
| 55                                          | Arqiva C    | 20.5 +/- 0.2           | -     | DND              | DND   |

Notes: No HP UHF aerials directed towards the Winter Hill transmitter and satellites were observed.

<sup>7</sup> Did not decode

## Location 2

| Coordinates: Lon: -2.228211, Lat: 53.473478 |             |                        |       |         |       |
|---------------------------------------------|-------------|------------------------|-------|---------|-------|
| Television                                  |             |                        |       |         |       |
| Channel                                     | Service     | Signal Strength (dBμV) | BER   | Picture | Audio |
| 24                                          | LTVmux      | 21.2 +/- 0.3           | -     | DND     | DND   |
| 27                                          | Glmux       | 20.2 +/- 0.5           | -     | DND     | DND   |
| 29                                          | SDN         | 33.6 +/- 0.3           | 1E-03 | Fine    | Fine  |
| 31                                          | Arqiva A    | 36.5 +/- 0.2           | 1E-08 | Fine    | Fine  |
| 32                                          | BBC A       | 35.3 +/- 0.3           | 1E-08 | Fine    | Fine  |
| 34                                          | Digital 3&4 | 32.6 +/- 0.3           | 1E-08 | Fine    | Fine  |
| 35                                          | BBC B       | 34.2 +/- 0.3           | 1E-04 | Fine    | Fine  |
| 37                                          | Arqiva B    | 33.6 +/- 0.2           | 1E-05 | Fine    | Fine  |
| 55                                          | Arqiva C    | 20.8 +/- 0.5           | -     | DND     | DND   |

Notes: No HP UHF aerials directed towards the Winter Hill transmitter and satellites were observed.

### Location 3

| Coordinates: Lon: -2.226514, Lat: 53.472460 |             |                              |       |         |       |
|---------------------------------------------|-------------|------------------------------|-------|---------|-------|
| Television                                  |             |                              |       |         |       |
| Channel                                     | Service     | Signal Strength (dB $\mu$ V) | BER   | Picture | Audio |
| 24                                          | LTVmux      | 20.5 +/- 0.3                 | -     | DND     | DND   |
| 27                                          | Glmux       | 18.5 +/- 0.3                 | -     | DND     | DND   |
| 29                                          | SDN         | 28.0 +/- 0.2                 | -     | DND     | DND   |
| 31                                          | Arqiva A    | 33.8 +/- 0.4                 | 1E-08 | Fine    | Fine  |
| 32                                          | BBC A       | 32.3 +/- 0.5                 | 1E-06 | Fine    | Fine  |
| 34                                          | Digital 3&4 | 32.8 +/- 0.3                 | 1E-08 | Fine    | Fine  |
| 35                                          | BBC B       | 32.0 +/- 0.3                 | 1E-05 | Fine    | Fine  |
| 37                                          | Arqiva B    | 31.6 +/- 0.1                 | 1E-04 | Fine    | Fine  |
| 55                                          | Arqiva C    | 20.0 +/- 0.1                 | -     | DND     | DND   |

Notes: No HP UHF aerials directed towards the Winter Hill transmitter and satellites were observed.

#### Location 4

| Coordinates: Lon: -2.215052, Lat: 53.466056 |             |                              |       |         |       |
|---------------------------------------------|-------------|------------------------------|-------|---------|-------|
| Television                                  |             |                              |       |         |       |
| Channel                                     | Service     | Signal Strength (dB $\mu$ V) | BER   | Picture | Audio |
| 24                                          | LTVmux      | 36.0 +/- 0.4                 | 1E-08 | Fine    | Fine  |
| 27                                          | Glmux       | 24.8 +/- 0.2                 | -     | DND     | DND   |
| 29                                          | SDN         | 55.7 +/- 0.3                 | 1E-08 | Fine    | Fine  |
| 31                                          | Arqiva A    | 58.0 +/- 0.3                 | 1E-08 | Fine    | Fine  |
| 32                                          | BBC A       | 56.6 +/- 0.4                 | 1E-08 | Fine    | Fine  |
| 34                                          | Digital 3&4 | 56.5 +/- 0.3                 | 1E-08 | Fine    | Fine  |
| 35                                          | BBC B       | 56.4 +/- 0.3                 | 1E-08 | Fine    | Fine  |
| 37                                          | Arqiva B    | 56.1 +/- 0.1                 | 1E-08 | Fine    | Fine  |
| 55                                          | Arqiva C    | 20.2 +/- 0.1                 | -     | DND     | DND   |

Notes: Multiple HP UHF aerials directed towards the Winter Hill transmitter and satellites were observed.

## Location 5

| Coordinates: Lon: -2.206465, Lat: 53.461810 |             |                              |       |         |       |
|---------------------------------------------|-------------|------------------------------|-------|---------|-------|
| Television                                  |             |                              |       |         |       |
| Channel                                     | Service     | Signal Strength (dB $\mu$ V) | BER   | Picture | Audio |
| 24                                          | LTVmux      | 48.2 +/- 0.3                 | 1E-08 | Fine    | Fine  |
| 27                                          | Glmux       | 26.9 +/- 0.4                 | -     | DND     | DND   |
| 29                                          | SDN         | 45.0 +/- 0.3                 | 1E-08 | Fine    | Fine  |
| 31                                          | Arqiva A    | 45.7 +/- 0.1                 | 1E-08 | Fine    | Fine  |
| 32                                          | BBC A       | 55.5 +/- 0.2                 | 1E-08 | Fine    | Fine  |
| 34                                          | Digital 3&4 | 64.6 +/- 0.2                 | 1E-08 | Fine    | Fine  |
| 35                                          | BBC B       | 64.9 +/- 0.3                 | 1E-06 | Fine    | Fine  |
| 37                                          | Arqiva B    | 64.7 +/- 0.5                 | 1E-08 | Fine    | Fine  |
| 55                                          | Arqiva C    | 25.0 +/- 0.1                 | -     | DND     | DND   |

Notes: Multiple HP UHF aerials directed towards the Winter Hill transmitter and satellites were observed.

## Location 6

| Coordinates: Lon: -2.201570, Lat: 53.458723 |             |                              |       |         |       |
|---------------------------------------------|-------------|------------------------------|-------|---------|-------|
| Television                                  |             |                              |       |         |       |
| Channel                                     | Service     | Signal Strength (dB $\mu$ V) | BER   | Picture | Audio |
| 24                                          | LTVmux      | 40.5 +/- 0.2                 | 1E-08 | Fine    | Fine  |
| 27                                          | Glmux       | 35.9 +/- 0.3                 | 1E-08 | Fine    | Fine  |
| 29                                          | SDN         | 57.0 +/- 0.2                 | 1E-08 | Fine    | Fine  |
| 31                                          | Arqiva A    | 57.5 +/- 0.1                 | 1E-08 | Fine    | Fine  |
| 32                                          | BBC A       | 56.2 +/- 0.1                 | 1E-08 | Fine    | Fine  |
| 34                                          | Digital 3&4 | 57.0 +/- 0.1                 | 1E-08 | Fine    | Fine  |
| 35                                          | BBC B       | 56.0 +/- 0.4                 | 1E-04 | Fine    | Fine  |
| 37                                          | Arqiva B    | 56.2 +/- 0.3                 | 1E-08 | Fine    | Fine  |
| 55                                          | Arqiva C    | 24.9 +/- 0.1                 | -     | DND     | DND.  |

Notes: Multiple HP UHF aerials or satellite dishes observed at this survey location.

## Location 7

| Coordinates: Lon: -2.191278, Lat: 53.453398 |             |                              |       |         |       |
|---------------------------------------------|-------------|------------------------------|-------|---------|-------|
| Television                                  |             |                              |       |         |       |
| Channel                                     | Service     | Signal Strength (dB $\mu$ V) | BER   | Picture | Audio |
| 24                                          | LTVmux      | 38.1 +/- 0.2                 | 1E-08 | Fine    | Fine  |
| 27                                          | Glmux       | 29.1 +/- 0.3                 | -     | DND     | DND   |
| 29                                          | SDN         | 50.5 +/- 0.2                 | 1E-08 | Fine    | Fine  |
| 31                                          | Arqiva A    | 54.3 +/- 0.1                 | 1E-08 | Fine    | Fine  |
| 32                                          | BBC A       | 53.5 +/- 0.2                 | 1E-08 | Fine    | Fine  |
| 34                                          | Digital 3&4 | 52.9 +/- 0.3                 | 1E-08 | Fine    | Fine  |
| 35                                          | BBC B       | 54.8 +/- 0.2                 | 1E-05 | Fine    | Fine  |
| 37                                          | Arqiva B    | 53.6 +/- 0.1                 | 1E-08 | Fine    | Fine  |
| 55                                          | Arqiva C    | 25.2 +/- 0.1                 | -     | DND     | DND   |

Notes: Multiple HP UHF aerials directed towards the Winter Hill transmitter and satellites were observed.

## APPENDIX B – SURVEY PHOTOGRAPHS

### Location 1



Location 2



Location 3



Location 4



Location 5



### Location 6

No picture was taken at this location.

### Location 7





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