GTech Surveys Limited

Planning Condition 23 - Television Signal Reception Impact Assessment

Manchester Metropolitan University
John Dalton Building
Science and Engineering

CHANGE HISTORY

Issue	Date	Details of Changes
0.0	30/05/2023	Working draft
0.1	05/06/2023	First draft issue
1.0	06/06/2023	Final issue - no changes
Author: G Phillips		Reviewer: O Lloyd

Issue: 1.0

© GTech Surveys Limited 2023

Contents Page

GTech Surveys Limited

Executive Summary

1 - Introduction **4**

2 - Pre-Construction and Post-Construction Television Services **6**

3 - Pre-Construction and Post-Construction Signal Surveys **8**

4 - Analysis between Pre-Construction and Post-Construction Survey Reception Data **12**

5 - Mitigation Measures **14**

6 - Conclusions **15**

Appendix **17**

Television Transmitter Frequencies

Signal Measurements

An Overview of Signal Measurements

Survey Equipment

Calculation of Received Field Strength

Mapping Data

© GTech Surveys Limited 2023

GTech Surveys Limited

GTech Surveys Limited is a Midlands based broadcast and telecommunications consultancy conducting projects throughout the entire UK. We undertake mobile phone network, television and radio reception surveys (pre- and post-construction signal surveys), conduct broadcast interference and reception investigations, and support telecommunications planning work for wind energy developers, construction companies, architects, broadcasters and Local Planning Authorities.

In addition to radio interference modelling services and television reception surveys, we produce EIA and ES Telecommunications Chapters (also known as an 'Electronic Interference Chapter'); satisfying the requirements of Part 5, Regulation 18 (Parts 5a and 5b) of The Town and Country Planning EIA Regulations 2017. We peer review ES and EIA work, liaising with telecommunications providers (Arqiva, BT etc.) and advise developers with respect to associated Section 106 (Town and Country Planning Act 1990) and Section 75 (Town and Country Planning (Scotland) Act 1997) agreements.

GTech Surveys Limited is a consultant member of the Trade Association for Content Delivery - (Confederation of Aerial Industries Ltd - CAI) and the RDI - the digital sector's professional body and trade organisation. We are listed on Constructionline and verified as a Safety Schemes in Procurement (SSIP) member by Safety Management Advisory Services (SMAS), making us compliant with the industry standard PAS 91:2013 + A1:2017.

Professional broadcast trained project engineers deliver, and supply QBE insured technical products to support planning applications, discharge planning conditions (including S106 Agreements) and for due diligence. For more information about GTech Surveys Limited please visit our website - www.gtechsurveys.com

GTech Surveys Ltd.
Accountancy House,
4 Priory Road,
Kenilworth,
Warwickshire,
CV8 1LL.

T: +44(0) 1926 744771

© GTech Surveys Limited 2023

Executive Summary

A post-construction television signal survey and reception impact assessment has been undertaken to determine the effects on local television reception arising from the completion of the Manchester Metropolitan University Science and Engineering (MMU S&E) development. The work has been conducted to discharge the associated planning condition (23);

> *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 the construction of the development If requested in writing by the City Council as local planning authority in response to identified television signal reception problems within the potential impact area: an assessment of the impact of the development on television signal reception within the potential impact area identified In the Television and Radio Reception Impact Assessment by GTech Surveys Limited dated August 2018 shall be submitted to and approved in writing by the City Council as local planning authority. The study shall Identify such measures necessary to maintain at least the pre-existing level and quality of signal reception identified in the survey dated 17 December 2019. 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. The work shall be undertaken either by an aerial installer registered with the Confederation of Aerial Industries or by a body approved by the Office of Communications, and shall Include an assessment of the survey results obtained.*

During late 2019, a pre-construction signal survey and television reception impact assessment was undertaken to assess the possible reception impacts within the study area. Overall, coverage was found to be good throughout the study area.

During May 2023, the survey area was visited again to assess the post-construction reception conditions and to determine if the MMU S&E development had caused any signal interference or television reception degradation. Whilst it has not been possible to compare the pre-construction reception data with respect to the post-construction reception data (because the majority of Winter Hill digital television transmitter parameters have changed since the 2019 pre-construction survey work), it has been concluded that through the assessment of available signal levels and signal qualities, the development has had a neutral effect upon the reception of television services for local residents. No interference has been identified and consequently no mitigation measures for the restoration of television reception are required. The post-construction survey and television reception assessment was undertaken to discharge the associated planning condition (23).

© GTech Surveys Limited 2023

1 - Introduction

This report details the findings of a desk-based study and post-construction signal survey to determine what impacts and effects the MMU S&E development has had on local television reception to satisfy the requirements of an associated planning condition. The planning condition 23 states;

> *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 the construction of the development If requested in writing by the City Council as local planning authority in response to identified television signal reception problems within the potential impact area: an assessment of the impact of the development on television signal reception within the potential impact area identified In the Television and Radio Reception Impact Assessment by GTech Surveys Limited dated August 2018 shall be submitted to and approved in writing by the City Council as local planning authority. The study shall Identify such measures necessary to maintain at least the pre-existing level and quality of signal reception identified in the survey dated 17 December 2019. 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. The work shall be undertaken either by an aerial installer registered with the Confederation of Aerial Industries or by a body approved by the Office of Communications, and shall Include an assessment of the survey results obtained.*

A signal reception survey has been conducted to assess the existing reception conditions around the Site.

During late 2019, a pre-construction signal survey and television reception impact assessment was undertaken to assess the possible reception impacts within the study area. The full details can be found in the report, "*Manchester Metropolitan University – Science and Engineering Television and Radio Reception Impact Assessment v1"*, dated 17th December 2019.

During May 2023, the study area was visited again to assess the post-construction reception conditions and to determine if the development had caused any signal interference or reception degradation. During the survey, signal measurements were undertaken to record the existing reception conditions and signal levels. Analysis has been undertaken to assess the differences between the pre-construction and post-construction survey data to determine what impacts the development has had on local television reception conditions. The effects on digital terrestrial television and digital satellite television reception have been assessed. This report concludes by summating the what overall effects the development has had on television reception for local residents.

© GTech Surveys Limited 2023

This report follows the following structure:

Chapter 1 introduces the work and the associated planning requirement

Chapter 2 describes the pre-construction and post-construction television services in the survey area; the locations of local transmitters, the situation regarding the ongoing digital television upgrade project, the orientation of incoming signals etc.

Chapter 3 describes the pre-construction and post-construction television reception conditions around the development and within the survey area from the results of the pre-construction survey and May 2023 post-construction survey and assessment

Chapter 4 identifies any differences between the pre-construction and post-construction survey data

Chapter 5 identifies any suitable mitigation circumstances and measures for any potentially affected television user

Chapter 6 presents the conclusion

This study was undertaken during May 2023. The report details the existing reception conditions for future reference and can be used to discharge the associated planning condition (23).

© GTech Surveys Limited 2023

2 - Pre-Construction and Post-Construction Television Services

Pre-Construction Television Services

Analogue Terrestrial Television Services

The area around the Site was not served by analogue television transmissions due to the completed Digital Television Switchover. All analogue services were switched off in Manchester and the Granada television region during 2009.

Digital Terrestrial Television (DTT) - Freeview

The survey area was served by DTT services (Granada TV region) from the Winter Hill transmitter (grid reference SD 66053 14463), on a bearing of 314° (with respect to true north) and 25km away from the Site. The transmitter is shown with respect to the Site in Figure 1.

Technical transmission information for each service at the aforementioned transmitter site is detailed in Table A, found in the Appendix - *Television Transmission Frequencies*.

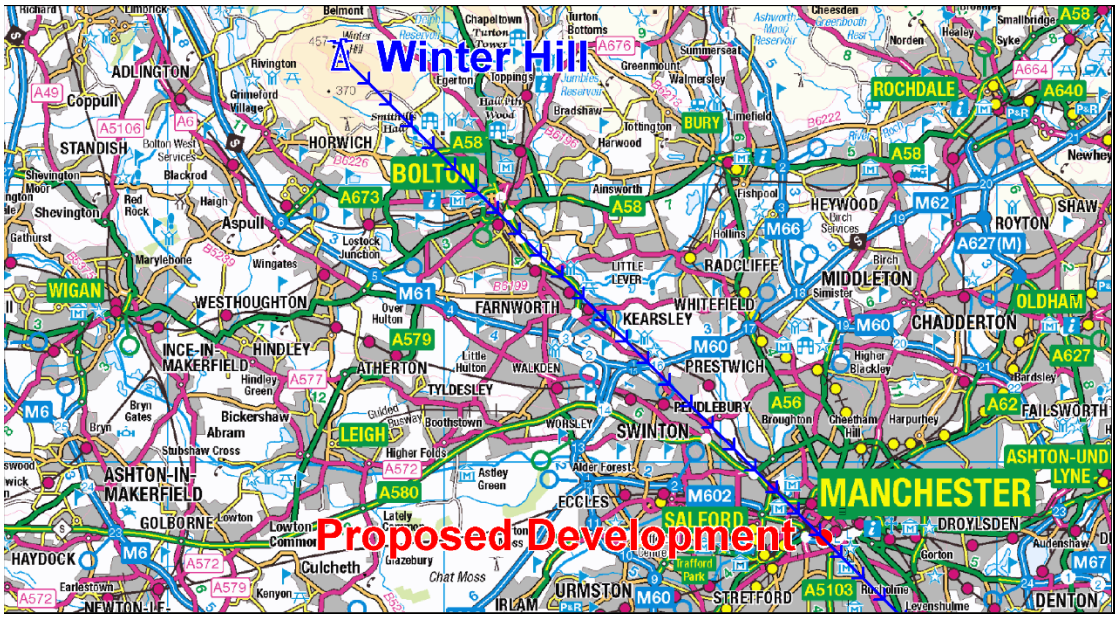

Figure 1 - The Location of the Winter Hill Transmitter, the location of the Proposed Development and the direction of the incoming DTT signals at the Site (shown by the blue arrow)

Non-Terrestrial Television Services (Digital Satellite Television)

For the reception of the 28.2 degrees east ASTRA satellite cluster (Freesat and Sky services), dish elevations of 22.8 degrees are required at this latitude. Optimal receive dish azimuths are 143.8 degrees with respect to true north.

© GTech Surveys Limited 2023

Post-Construction Television Services

Analogue Terrestrial Television Services

The areas around the Site are not served by analogue television transmissions.

Digital Terrestrial Television (DTT) - Freeview

The area is still served by DTT services from the Winter Hill transmitter. Since the pre-construction survey, significant technical changes have occurred to all terrestrial television transmissions emanating from the Winter Hill transmitter as a result of the introduction of new 4G mobile phone networks in the region. These technical changes include;

- The Digital 3 and 4 (D 3 & 4) multiplex, now transmitted on UHF channel number 34 with respect to the pre-construction UHF channel number 59;
- The BBC B multiplex, now transmitted on UHF channel number 35 with respect to the pre-construction UHF channel number 54, offset-;
- The SDN multiplex, now transmitted on UHF channel number 29 with respect to the pre-construction UHF channel number 58;
- The Arqiva A multiplex, now transmitted on UHF channel number 31 with respect to the pre-construction UHF channel number 49;
- The COM 7 multiplex has been shut down (during 2021); and
- The COM 8 multiplex has been shut down (late June 2022).

The shutdown of COM 7 and COM 8 has reduced the number of high definition (HD) channels available for DTT viewers.

Technical transmission information for each service at the Winter Hill transmitter site is detailed in Table B, found in the Appendix - *Television Transmission Frequencies.*

Non-Terrestrial Television Services (Digital Satellite Television)

For the reception of the 28.2 degrees east ASTRA satellite cluster, dish elevations of 22.8 degrees are still required at this latitude. Optimal receive dish azimuths are still 143.8 degrees with respect to true north.

© GTech Surveys Limited 2023

3 - Pre-Construction and Post-Construction Signal Surveys

Pre-Construction Survey Overview

The pre-construction survey was undertaken during late 2019. 12 locations were visited within the possible signal shadow areas. In this study, field measurements were undertaken up to two kilometres away from the development site, however, the study mainly focused around the site and areas to the immediate northwest and southeast. Additionally, investigations are carried out in all areas where predicted (modelled) interference may occur. These are identified in Figure 2, and the measurements are detailed in Table C, found in the Appendix - *Signal Measurements*. In particular, the following data was recorded:

- Field strength and technical signal measurements of DTT transmissions from the main serving transmitter

- Viewing preference (choice of television transmitter) of residents in all areas visited

All television measurements were carried out using a UHF log-periodic receive antenna, mounted on GTech Surveys's broadcast survey vehicle, at a receive height of 10 metres AGL (above ground level), industry standard height for such work. During the survey, no assessment was made of reception conditions within viewers' homes. Equipment details are detailed in the Appendix - *Survey Equipment*.

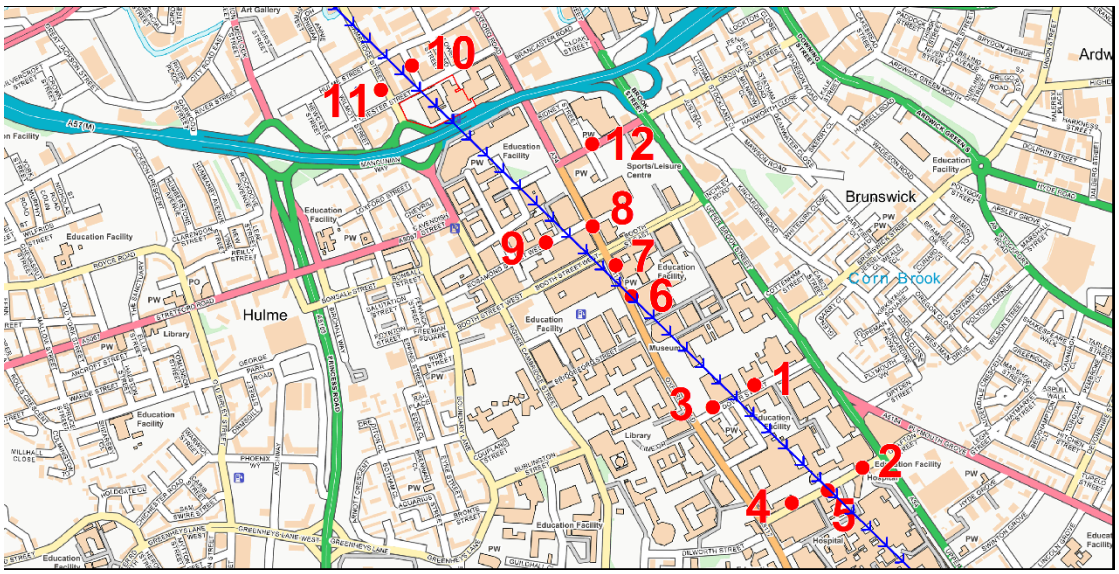

Figure 2 - Surveyed Locations. The Site is delineated in red. The blue arrow indicates the direction of the incoming DTT signals from Winter Hill transmitter

© GTech Surveys Limited 2023

Survey Results and Observations

In general, building use around the proposed development was mainly for educational, mixed commercial and multi-dwelling residential use. There were a number of existing tall buildings around the site and significant development work ongoing in the wider study area. All signal receive antenna systems are mounted on building sides or rooftops, ensuring optimal reception conditions. All terrestrial television antennas are directed towards the Winter Hill transmitter, however, due to the heights of existing buildings, few antennas could be seen during the survey work.

Analogue Terrestrial Television

Due to the completed Digital Television Switchover, analogue television signals were no longer available in the study area.

Digital Terrestrial Television - Freeview

DTT services were available at all surveyed locations from the Winter Hill transmitter. At all locations, received signal levels were in excess of recommended minimum amounts and the technical quality of received signals was found to be good[1]. DTT services provided good coverage and service throughout the study area.

Digital Satellite Television - Freesat & Sky

During the survey, few satellite dishes were seen mounted on existing properties. More dishes may be mounted on rooftops and at the rear of properties; however, these would not be visible from the street. No existing interference has been identified for any satellite television platform.

1- Signal levels as specified by -

- *The Digital TV Group - Digital TV Group R-Book 5, 2005 Edition*
- *The Digital TV Group - UK Digital TV Receiver Recommendations, Version 1.4, dated 18 June 2008*
- *The UK Collaboration Centre for Innovation in Digital Media Technology - R-Book 6, 2015*

The BBC A and D3&4 multiplexes operate with 64QAM modulation, coding rate 2/3 & 8K FFT. A minimum recommended signal level at the receiver is 50 dBµV. Minimum recommended MER levels are 23dB.

The SDN, Arqiva A and Arqiva B multiplexes operate with 64QAM modulation, coding rate 3/4 & 8K FFT. A minimum recommended signal level at the receiver is 50 dBµV. Minimum recommended MER levels are 25dB.

The BBC HD, COM 7 and COM 8 multiplexes operate using the DVB-T2 standard - 256QAM modulation, coding rate 2/3 & 32K FFT. A minimum recommended signal level at the receiver is 50 dBµV. Minimum recommended MER levels are 26dB.

The Local TV multiplex operates using QPSK modulation, coding rate 3/4 & 8K FFT. A minimum recommended signal level at the receiver is 50 dBµV.

Technical information regarding the Freeview signal can be found in the Appendix - *An Overview of Signal Measurements*

© GTech Surveys Limited 2023

Post-Construction Survey Overview

The survey was undertaken during late May 2023. 12 locations were visited in similar areas as identified in Figure 2 and signal measurements were undertaken to assess the quality and availability of terrestrial television services. the measurements are detailed in Appendix - *Signal Measurements.* The following data was recorded:

Field strength and technical signal measurements of DTT transmissions from the Winter Hill transmitter

Viewing preference (choice of television transmitter) of residents in all areas visited

All television measurements were carried out using a log-periodic receive antenna. During the survey, no assessment was made of reception conditions within viewers' homes. Survey procedures, signal measurements and the survey equipment used are detailed in the Appendix - *Survey Equipment*.

Survey Results and Observations

In general, building use around the proposed development was still mainly for educational, mixed commercial and multi-dwelling residential use. All signal receive antenna systems were mounted on rooftops, ensuring optimal reception conditions. All terrestrial television antennas were directed towards the Winter Hill transmitter. No existing interference has been identified for any satellite television platform.

Analogue Terrestrial Television Services

Analogue television services are still unavailable in the study area.

Digital Terrestrial Television (DTT) - Freeview

DTT services were available at all surveyed locations from the Winter Hill transmitter. At all locations, received signal levels were well in excess of recommended minimum amounts and the technical quality of received signals was found to be good[2]. DTT services provide good coverage and service throughout the study area even though a number of new buildings have been constructed in the wider area.

2 - Signal levels as specified by the *CAI - Association for Audio Visual Professionals*

Code of Practice (COP) For the Installation of Aerials/Antennas & Receiving Equipment in the Single Dwelling Unit CAI COP 2: September 2022

Additional technical information regarding the Freeview signal can be found in the Appendix - *An Overview of Signal Measurements*

© GTech Surveys Limited 2023

Digital Satellite Television - Freesat and Sky

As before, few dishes were noted during the survey. Dishes may also be mounted on rooftops or at the rear of properties which would not be visible from street level. No existing interference was identified for any satellite television platform.

© GTech Surveys Limited 2023

4 - Analysis between Pre-Construction and Post-Construction Survey Reception Data

An assessment of the survey data analysis is presented below and summated in Table 1.

Digital Terrestrial Television (DTT) - Freeview

Due to the fundamental changes that have been made at the Winter Hill transmitter as a result of radio spectrum clearance for regional 4G mobile phone networks (the majority of services have been reallocated to new frequencies), no precise assessments can be made with respect to how the reception environment has changed since the pre-construction time period. However, based on existing signal and technical measurements, all signal levels are above recommended minimum amounts (as specified in Code of Practice (COP) For the Installation of Aerials / Antennas & Receiving Equipment in the Single Dwelling Unit CAI COP 2: September 2022)[3].

DTT transmissions emanating from the Winter Hill transmitter employ a guard interval[4] in the digital video broadcasting - terrestrial (DVB-T) data stream, which ensures resilience against the interference caused by signal multipath in cluttered urban areas. In addition to the embedded protection in DVB-T data stream offered by forward error correction (FEC) techniques, the guard interval enables the DTT receiver to make advantageous use of constructive multipath interference created in typical urban environments. In addition to the use of FEC, DTT transmissions now utilise eight thousand (8K) sub-carriers per digital multiplex. The use of 8K helps overcome the problems associated with impulse interference, which is more common in large towns and cities where many electrical items and systems are in use[5].

Overall, the survey work has indicated that the reception of DTT services have not been disrupted by signal interference generated by the development. Consequently, it can be demonstrated that the development has currently had a neutral effect upon the quality of received television signals within the survey area.

---

3 - Signal levels as specified by the *CAI - Association for Audio Visual Professionals*

Code of Practice (COP) For the Installation of Aerials/Antennas & Receiving Equipment in the Single Dwelling Unit CAI COP 2: September 2022

Additional technical information regarding the Freeview signal can be found in the Appendix - *An Overview of Signal Measurements*

4 - In the UK's DTT network, guard intervals are used to ensure that distinct transmissions do not interfere with one another, or otherwise cause overlapping transmissions. The purpose of the guard interval is to introduce immunity to propagation delays, echoes and reflections, to which digital data is normally very sensitive. In a cluttered city environment, existing structures (buildings etc.) can cause numerous signal echoes and reflections.

5 - At the launch of DTT, the DTT signal was split into 2000 (2k) sub-carriers, because receivers were not technically advanced. The standard now is to use 8000 sub-carriers (8k), which allows the data to be sent 4 times slower. This is advantageous because slower data is more resilient against impulse interference. This is likely to particularly benefit reception using indoor aerials and antennas located in city environments, as they are closer to sources of impulse interference (unwanted interference).

© GTech Surveys Limited 2023

Digital Satellite Television - Freesat and Sky

Unless interference has been reported, it is unlikely that the development has adversely impacted the reception of digital satellite television services such as Sky and Freesat.

Overall, the survey work has indicated that digital satellite television services have not been disrupted by signal interference generated by the development.

Summary of Post-Construction Survey Findings after Data Analysis

Broadcast platform	**Has interference occurred?**	**Mitigation required?**
DTT - Freeview	Not possible to verify due to the transmitter changes, but very unlikely based on existing signal levels	No
Digital Satellite TV - Freesat and Sky	Not possible to verify, but unlikely	No

Table 1 - Summary of Existing Television Reception Conditions

Effects on Television Reception - Conclusions

Interference to DTT service reception is unlikely to have occurred

Interference to digital satellite television reception is unlikely to have occurred

© GTech Surveys Limited 2023

5 - Mitigation Measures

With respect to the requirement of mitigation, the associated planning condition (23) states;

> *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 the construction of the development If requested in writing by the City Council as local planning authority in response to identified television signal reception problems within the potential impact area: an assessment of the impact of the development on television signal reception within the potential impact area identified in the Television and Radio Reception Impact Assessment by GTech Surveys Limited dated August 2018 shall be submitted to and approved in writing by the City Council as local planning authority. The study shall Identify such measures necessary to maintain at least the pre-existing level and quality of signal reception identified in the survey dated 17 December 2019. 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. The work shall be undertaken either by an aerial installer registered with the Confederation of Aerial Industries or by a body approved by the Office of Communications, and shall Include an assessment of the survey results obtained.*

However, as no interference has been identified, no mitigation measures are required to restore the optimal reception of any television service.

© GTech Surveys Limited 2023

6 - Conclusions

A post-construction signal survey has been performed to assess the possible effects and impacts on the reception of television broadcast services from the completed MMU S&E development. The work has been conducted to discharge the associated planning condition (23);

> *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 the construction of the development If requested in writing by the City Council as local planning authority in response to identified television signal reception problems within the potential impact area: an assessment of the impact of the development on television signal reception within the potential impact area identified in the Television and Radio Reception Impact Assessment by GTech Surveys Limited dated August 2018 shall be submitted to and approved in writing by the City Council as local planning authority. The study shall Identify such measures necessary to maintain at least the pre-existing level and quality of signal reception identified in the survey dated 17 December 2019. 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. The work shall be undertaken either by an aerial installer registered with the Confederation of Aerial Industries or by a body approved by the Office of Communications, and shall Include an assessment of the survey results obtained.*

During late 2019, a pre-construction television reception impact assessment was undertaken to assess the baseline reception conditions and to determine the possible reception impacts within the study area. Overall, reception conditions were deemed to be good throughout the survey area.

During May 2023, the study area was visited again to assess the post-construction reception conditions and to determine if the development had caused any signal interference or reception degradation. The study focused on the television broadcast platforms that could possibly be affected by the development; digital terrestrial television and digital satellite television services. During the survey work, to assess the possible impacts to local television reception, twelve locations were visited which were located in and near to the theoretical signal shadow zones. The pre-construction and post-construction survey data has been compared and the impacts and effects on local television reception have been assessed.

<u>Digital Terrestrial Television (DTT) - Freeview</u>

DTT reception is robust and coverage is good in the survey area. All services received were above minimum required levels. The survey work has indicated that the reception of Freeview services has not been disrupted by signal interference generated by the structures or the development.

© GTech Surveys Limited 2023

Digital Satellite Television - Freesat and Sky

The development is unlikely to have had any adverse effect upon the reception of digital satellite television services such as Freesat and Sky.

From the results of the post-construction signal survey and this comparative assessment, it has been concluded that the development has had a neutral effect upon the reception of television broadcast services for local residents. No mitigation measures are required, and no interference has been created for any television broadcast platform. This assessment can be used to discharge planning condition 23.

© GTech Surveys Limited 2023

APPENDIX

Television Transmitter Frequencies

Signal Measurements

An Overview of Signal Measurements

Survey Equipment

Calculation of Received Field Strength

Mapping Data

© GTech Surveys Limited 2023

Television Transmitter Frequencies

Digital TV Multiplex	Multiplex Operator	UHF Channel Number *	Channel Frequency Fc (MHz) **	Transmitter Power (kW)
BBC A	BBC	50	562.000	100.0
D3&4	Digital 3 & 4	59	778.000	100.0
BBC B - HD	BBC	54-	737.866	100.0
SDN	SDN	58	770.000	100.0
Arqiva A	Arqiva	49	698.000	100.0
Arqiva B	Arqiva	37	602.000	100.0
COM7 - HD	Arqiva	55	746.000	22.9
COM8 - HD	Arqiva	56	554.000	24.5

Table A - Pre-Construction Winter Hill Digital Terrestrial Television Services

Digital TV Multiplex	Multiplex Operator	UHF Channel Number *	Channel Frequency Fc (MHz) **	Transmitter Power (kW)
BBC A	BBC	32	562.000	100.0
D3&4	Digital 3 & 4	34	578.000	100.0
BBC B - HD	BBC	35	586.000	100.0
SDN	SDN	29	538.000	100.0
Arqiva A	Arqiva	31	554.000	100.0
Arqiva B	Arqiva	37	602.000	100.0

Table B - 2022 Winter Hill Digital Terrestrial Television Services

Public Service Broadcaster (PSB) Digital Multiplexes
Commercial (COM) Digital Multiplexes

* - Digital multiplexes with a "+" or "-" sign operate with a frequency offset making the channel frequency + or - 167 kHz.

** - The nominal channel frequency, Fc (in Megahertz) of the multiplex can be calculated using Fc = 8n+306, where ‘n’ is the UHF channel number.

© GTech Surveys Limited 2023

Signal Measurements

Measurement Point Number	Channel	50	59	54	58	49	37	55	31
	Frequency	706.00	778.00	738.00	770.00	698.00	602.00	746.00	554.00
	Service	BBC A	D3&4	BBC B -	SDN	Arqiva A	Arqiva B -	COM7	COM8
1	FS	86.6	89.0	78.9	89.8	90.3	81.3	73.6	75.8
	CSI	21.6	21.0	-	23.1	19.7	21.3	-	-
	MER	31.3	30.9	-	31.7	31.1	30.5	-	-
2	FS	94.2	89.8	85.9	91.6	90.4	79.0	78.2	75.8
	CSI	22.1	25.8	-	22.8	23.9	21.5	-	-
	MER	30.9	32.6	-	30.9	30.2	32.1	-	-
3	FS	92.5	85.7	87.7	89.9	92.9	87.6	74.6	74.4
	CSI	19.7	18.1	-	19.5	19.6	16.9	-	-
	MER	31.1	30.4	-	30.3	29.5	32.1	-	-
4	FS	78.6	82.5	87.5	91.2	94.4	77.8	78.1	79.3
	CSI	19.4	22.3	-	22.6	19.3	18.9	-	-
	MER	31.7	31.2	-	31.9	32.0	30.9	-	-
5	FS	92.5	96.5	94.4	94.4	90.2	80.0	74.2	71.8
	CSI	15.6	19.7	-	23.1	22.7	23.8	-	-
	MER	32.1	32.0	-	32.0	30.9	31.1	-	-
6	FS	87.0	82.4	80.4	83.9	87.1	89.6	78.1	76.3
	CSI	19.6	21.2	-	21.6	22.7	21.0	-	-
	MER	32.5	30.5	-	31.2	31.1	29.3	-	-
7	FS	90.5	86.2	80.0	87.5	91.0	87.8	75.5	75.5
	CSI	20.9	20.4	-	20.9	18.7	23.1	-	-
	MER	31.8	32.4	-	31.7	31.3	30.6	-	-
8	FS	85.7	92.3	84.6	89.7	93.6	79.2	77.8	76.0
	CSI	20.5	22.2	-	22.5	19.1	21.9	-	-
	MER	30.3	31.5	-	31.4	31.5	30.3	-	-
9	FS	92.7	81.4	86.0	86.3	91.5	87.2	78.5	79.5
	CSI	17.8	16.9	-	19.6	19.3	16.9	-	-
	MER	31.0	31.4	-	31.5	32.3	32.2	-	-
10	FS	80.9	90.9	93.5	93.7	86.9	92.9	79.0	82.0
	CSI	28.7	23.1	-	22.6	20.5	18.9	-	-
	MER	31.0	30.1	-	31.9	31.0	30.3	-	-
11	FS	92.1	82.3	83.1	87.5	88.3	85.3	77.2	80.3
	CSI	18.8	19.4	-	20.5	18.5	18.3	-	-
	MER	31.5	31.1	-	30.2	31.3	31.5	-	-
12	FS	89.7	87.6	91.6	91.4	88.1	85.2	80.9	77.7
	CSI	23.4	23.9	-	20.2	29.9	21.3	-	-
	MER	32.4	30.1	-	31.7	31.7	32.9	-	-

Table C - 2019 Measurements of Winter Hill Digital Television Services

Frequencies listed are in MHz
Field strength (FS) values are indicated in dBμV/m
CSI Channel Status Information (%)
MER Modulation Error Ratio (dB)

© GTech Surveys Limited 2023

Measurement Point Number	Channel	32	34	35	29	31	37
	Frequency	562.00	578.00	586.00	538.00	554.00	602.00
	Service	BBC A	D3&4	BBC B	SDN	Arqiva A	Arqiva B
1	FS	88.2	87.4	87.4	88.0	90.8	92.0
	CSI	22.4	21.8	-	19.7	21.2	24.0
	MER	31.5	32.0	-	31.0	32.2	32.8
2	FS	92.7	92.1	89.4	93.1	87.6	89.0
	CSI	19.3	17.9	-	23.7	25.6	17.8
	MER	30.3	30.9	-	31.7	31.2	31.8
3	FS	90.7	91.6	93.4	91.9	90.9	88.2
	CSI	24.1	27.4	-	23.7	21.6	19.9
	MER	33.2	31.7	-	31.5	30.1	30.1
4	FS	89.5	84.8	91.0	90.9	88.6	86.0
	CSI	26.2	24.0	-	20.4	20.9	27.4
	MER	33.1	30.9	-	30.8	31.0	32.3
5	FS	89.5	89.0	94.9	87.0	90.6	92.3
	CSI	22.4	27.6	-	21.3	20.3	30.4
	MER	30.8	30.8	-	32.0	32.0	33.2
6	FS	92.3	87.4	92.0	90.9	89.0	88.4
	CSI	20.6	19.1	-	22.9	29.1	22.9
	MER	32.5	31.5	-	31.2	32.0	31.7
7	FS	87.4	93.7	91.2	92.4	89.1	90.5
	CSI	19.7	20.7	-	16.2	20.5	21.2
	MER	31.1	33.2	-	32.7	32.0	31.5
8	FS	86.1	89.0	94.3	89.4	86.5	88.0
	CSI	19.6	18.4	-	23.1	23.4	16.7
	MER	30.2	31.0	-	31.7	31.6	33.7
9	FS	93.1	92.8	87.2	94.1	91.1	84.9
	CSI	22.9	27.5	-	21.3	21.5	19.0
	MER	32.1	31.6	-	32.2	32.6	33.5
10	FS	90.1	88.0	92.3	91.2	90.0	84.1
	CSI	25.5	22.0	-	19.5	17.8	27.0
	MER	33.3	32.2	-	31.1	32.4	32.1
11	FS	92.6	86.8	85.3	86.5	87.0	93.0
	CSI	21.7	27.6	-	22.6	18.7	28.6
	MER	32.9	32.0	-	31.4	31.7	32.2
12	FS	86.8	88.7	93.4	89.1	87.6	89.5
	CSI	19.5	17.3	-	20.4	22.4	25.0
	MER	31.7	31.0	-	32.3	31.7	31.0

Table D - 2023 Measurements of Winter Hill Digital Television Services

Frequencies listed are in MHz
Field strength (FS) values are indicated in dBμV/m
CSI Channel Status Information (%)
MER Modulation Error Ratio (dB)

© GTech Surveys Limited 2023

An Overview of Signal Measurements

The first and easiest parameter to check is signal level (also referred to as amplitude or terminated signal strength). In many cases this gives a good indication of the available decoding margin, or the extent of any shortfall.

At the receiver input, the terminated level of a DTT signal is measured in the usual units of dBμV (a maximum signal level of 70 dBμV and a minimum signal level of 50 dBμV). It is helpful to understand that the level of a DTT signal represents the total power of all the carriers in the Coded Orthogonal Frequency Division Multiplexing (COFDM) signal and not the level of each individual COFDM carrier. For satisfactory reception of digital signals, it is important the signals applied to the receiver are within these ranges. These maximum and minimum levels define a so-called window of operation for the receiver.

Common practice dictates that in order to measure the quality of a received DTT signal we have to look at one or more of the following parameters: Bit-Error Rate (BER), Channel BER (CBER), Carrier-to-Noise Ratio (CNR) and Modulation Error Ratio (MER). The Channel State Information (CSI) feature available in DTT measurement equipment is a very valuable tool providing additional insight into the quality of reception in a typical domestic or professional DTT installation.

Using the BER alone is an ill-advised “hit-or-miss” strategy because of the 'cliff-edge effect' characteristic of any digital TV system. A BER reading below the reference quasi error free (QEF) value of 2×10-4 might wrongly lead us to conclude that the receiving conditions are satisfactory.

However, the BER provides a very narrow signal measurement range. Even for vanishingly small BER readings, a small drop in the level of received DTT signal can push the DTT receiver over the digital cliff edge beyond the point of system failure. The CBER is closely related to the BER providing a wider signal measurement range. Depending on the type(s) of unknown disturbance(s) affecting our DTT installation (noise, co-channel or adjacent PAL, co-channel DTT, etc.), the CBER corresponding to the reference QEF BER of 2×10-4 varies between 4 and 7 in 100. Unfortunately, the CBER is not a reliable indicator of how far the digital cliff edge is.

DTT engineers need a tool with a wide measurement range that solves the shortcomings of the BER and CBER. This measurement tool should provide some estimate of the noise margin of the DTT installation. A first candidate comes to mind: CNR or, alternatively, its sibling the MER.

The CNR is defined as the ratio of the average RF power of the DTT signal to the power of the noise present in the UHF channel. Similarly, the MER is defined as the ratio of the average power of the DTT signal to the average power of the constellation errors. It can therefore be used to give a more direct indication of decoding margin when, as is often the case, there is co-channel

© GTech Surveys Limited 2023

interference as well as noise in the channel. The higher the MER value, the **better** the reception conditions. The measurement equipment provides a maximum MER measurement value of up to 35 dB.

In situations where there is no multipath propagation so that the channel frequency response remains reasonably flat, CNR and MER are in principle the same thing. In practice, the accuracy of the measured CNR is limited by the noise floor of the measurement equipment and by the presence of other disturbances on adjacent UHF channels. Likewise, both the receiver's noise floor and other issues resulting from its practical implementation degrade the MER estimate.

Channel State Information (CSI)

Some flavour of CSI is used internally by all commercial DTT receivers to achieve the recommended target system performance[6]. The CSI counts the effect of both the noise present in the channel and the shape of the transmission channel itself. In other words, the CSI gives a measure of the reliability of the received DTT signal. We measure the average of the CSI across the UHF channel occupied by the DTT signal. The higher the percentage value of CSI, the **less** reliable DTT reception is.

As explained, the CSI can be used as a means to measure the noise margin in a DTT installation. Let us call CSI_{QEF} the percentage CSI measured at the point where the measurement equipment displays the reference QEF BER. The noise margin in dB is then approximately given by –

$$NM\ (dB) = \frac{CSI_{QEF} - CSI}{2.6}$$

This empirical approximation represents a good estimate for NM below 8dB. The CSI alone, on the other hand, has a wider measurement range, providing meaningful results for NM of up to 15dB.

6 - *J. Lago-Fernández, "Using Channel State Information (CSI) to Characterize DVB-T Reception", IBC, Amsterdam, 12-17 September 2002*

© GTech Surveys Limited 2023

Survey Equipment

1 x Promax Prolink 4C Premium – Serial Number PK4COPAB11B / 060419030005 Running firmware version 2.47

1 x Sony Wide screen CRT Reference Receiver KV-16TIU – Serial Number 4014480

1 x Amphenol Jaybeam Professional Broadcast Wideband Log Periodic 8 element antenna (details below)

Amphenol JAYBEAM 468-860 MHz

A Log Periodic antenna designed for UHF Broadcast, TETRA and Cellular communications applications. This antenna is often used in a stacked array to form a rugged, high power, extended range antenna. Produced to the highest quality standards, these robust antenna designs will insure reliable operation in harsh environmental conditions.

LPU/Rx

V-Pol or H-Pol | Log Periodic | 70° | 7.9 dBd

Replace "x" with desired model number option.

Electrical Characteristics		
Frequency band	468-860 MHz	
Model number options (x)	Model Number LPU/R-N LPU/R-7/16	Connector type N-Female 7/16-DIN Female
Polarization	Vertical or Horizontal	
Horizontal beamwidth	70°	
Gain	7.9 dBd	
Impedance	50Ω	
VSWR	<1.3:1	
Maximum power	250 W	
Connector type	see model number options above	
Lightning protection	DC grounded	
Mechanical Characteristics		
Materials	Aluminium Alloy	
Dimensions (Length x Width)	1210 x 320 mm	47.6 x 12.6 in
Weight without bracket	3.5 kg	7.7 lbs
Mounting Options		
Mounting	Mounting bracket included to fit 38-50 mm dia. pipe.	

Technical Specification for an Amphenol Jaybeam Professional Broadcast Wideband Log Periodic 8-Element Antenna

All RF cables, interconnects and systems of professional quality and calibrated to determine feeder losses and antenna gains. These are factored into the results, providing accurate descriptions of actual field strength values at 10m AGL for each surveyed location – see *Calculation of Received Field Strength*

© GTech Surveys Limited 2023

Calculation of Received Field Strength

The Field Strength (dBµV/m) is derived from the Terminated Level (dBµV) as measured at the input of the Promax measurement receiver.

Field Strength (dBµV/m) = Terminated Level (dBµV) – Aerial Gain (a) + Dipole Factor (b) + Feeder Loss (c)

where -

Dipole Factor (to matched load)	(b)	$20Log(\frac{2\pi}{\lambda})$ *Where λ = Transmission Wavelength (m)*
Feeder Loss	(c)	3 dB
Aerial Gain (dB_{dipole})	(a)	10 dB

Mapping Data

This report includes mapping and mapping data provided by Ordnance Survey (OS), under the terms of the Open Government Licence, OS data Crown copyright and database copyright (2023).

© GTech Surveys Limited 2023

DISCLAIMER

This Report was completed by GTech Surveys Limited on the basis of a defined programme of work and terms and conditions agreed with the Client. We confirm that in preparing this Report we have exercised all reasonable skill and care taking into account the project objectives, the agreed scope of works, prevailing site conditions and the degree of manpower and resources allocated to the project.

GTech Surveys Limited accepts no responsibility to any parties whatsoever, following the issue of the Report, for any matters arising outside the agreed scope of the works. This work was conducted under GTech Surveys Limited's standard terms and conditions which can be found on our website.

This Report is issued in confidence to the Client and GTech Surveys Limited have no responsibility to any third parties to whom this Report may be circulated, in part or in full, and any such parties rely on the contents of the report solely at their own risk.

The UK's terrestrial television networks are highly complex engineering systems and are constantly being modified, re-designed, upgraded and maintained. The reception conditions detailed in this report were those prevailing at the time of the survey in the survey area. Engineering work at transmitter sites, weather conditions and the time of the year will influence the quality and coverage of terrestrial services and their susceptibility to interference. Whilst every effort was made to accurately measure and assess the available television transmissions and services at the time of the survey, GTech Surveys Limited cannot assume that any part of the television broadcast network or transmission from any transmitter was operating in required specification or correctly to any design criteria. The signal measurements undertaken during the survey work were used to define the possible impacts to television reception for this project. Although best practice has been applied in understanding the potential impacts, due to the complex nature of the subject, GTech Surveys Limited is not accountable in anyway whatsoever if unpredicted impacts occur at any location anywhere in the survey area.

Modelling parameters assume that all installed UHF antenna systems are mounted at least 10m AGL and installed to a modern standard, with all components meeting CAI quality standards. Antennas mounted at lower heights and poor-quality installations will be more prone to the effects of interference from external sources and as such, reception conditions to installations with the aforementioned characteristics have not been accounted for in any impact modelling. Consequently, properties with such installations may be prone to interference effects that have not been identified. Such installations are commonly found in camping and caravan parks, on bungalows and properties where it is not possible to attach an antenna to the exterior roof. Antennas mounted in lofts are also more prone to interference effects arising from the signal attenuation caused by roofing materials. Again, reception conditions to properties with the aforementioned antenna installation characteristics have not been accounted for in any impact modelling and as such, properties with these installations may be prone to interference effects that have not been identified.

Digital terrestrial television (Freeview) coverage may vary as a result of engineering works or any frequency changes authorised by Ofcom. We advise that consumers always check future reception predictions (http://www.digitaluk.co.uk/coveragechecker/) before buying TV equipment. GTech Surveys Limited, Ofcom and Digital UK are not responsible for household TV reception arrangements.

Unless specifically assigned or transferred within the terms of the agreement, the consultant asserts and retains all Copyright, and other Intellectual Property Rights, in and over the Report and its contents.

Any questions or matters arising from this Report should be addressed in the first instance to the Project Manager.

© GTech Surveys Limited 2023