

GTech Surveys Limited

Mid-Phase Construction Television Signal Survey

Paterson

Planning Condition 21

CHANGE HISTORY

Issue	Date	Details of Changes
0.0	24/10/2021	Working draft
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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



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Executive Summary

A mid-phase construction signal survey and reception impact assessment has been undertaken to determine the effects on local television reception arising from the part completed Paterson development. The work has been conducted with the following associated planning condition (number 21) in mind;

21) During the construction of the development and within one month following the substantial completion of the development hereby approved, the City Council may request in writing a TV, Radio Impact and WIFI Assessment study of the existing television signal within the potential impact area (as previously identified in the GTech Surveys Limited - Baseline Television Signal Survey & Television Reception Impact Assessment stamped as received on 28th May 2019) to be undertaken and compared with the Assessment study undertaken in 2019. The study shall identify such measures necessary to maintain at least the pre-existing level and quality of signal reception (as identified in the submitted Baseline Television Signal Survey & Television Reception Impact Assessment) and a timetable for the implementation, if required, of any remediation measures. The study shall be submitted to the City Council as local planning authority for approval and any remediation measures shall be implemented in accordance with the approved study.

Reason - To ensure that the development at least maintains the existing level and quality of television signal reception, as advised in Planning Policy Guidance Note 8: Telecommunications.

During December 2018, a pre-construction reception study was undertaken. The findings are presented in the report; “GTech Surveys Limited - Baseline Television Signal Survey & Television Reception Impact Assessment”, dated 24th April 2020. The report concluded that interference to the reception of digital terrestrial television (DTT – Freeview) services may occur in areas to the immediate southeast of the Site (Rathen Road and Wilmslow Road) and mitigation (antenna betterment, repositioning etc.) may be required to restore good reception.

During October 2021, the survey area was visited to assess the existing reception conditions and to determine if the Paterson development in its current form has caused any signal or reception degradation. Whilst it has not been possible to compare the pre-construction reception data to the mid-phase construction reception data (because all Winter Hill television transmitter parameters have changed since December 2018), it has been concluded that in its current form, (through the assessment of available signal levels and qualities), either or through a combination of, the development, the use of construction cranes or the construction compound, degradation has occurred to reception conditions in an area to the immediate southeast of the Site (Rathen Road and Wilmslow Road). In this area, the level of available signal is reduced.

For any affected Freeview viewers to the immediate southeast of the Site where signal reception has been degraded, the betterment of antennas is likely to restore services. Betterment of antenna systems could include any of the following and all should be considered;

- Replacement of components not fit for purpose (damaged, water ingress in cables / antennas, electrically faulty, old brown type coax etc.)
- Replacement or installation of a mast head amplifier and new antenna
- Replacement of old coax cable to better signal throughput and to reduce unwanted electrical pickup
- Installation of a higher gain antenna
- Good earthing on antenna systems and associated components to help reduce unwanted electrical system noise
- Installation of a higher antenna (above ground level) in a location as far away from the Site as possible i.e. on another chimney stack etc. in a more southeasterly location

Coverage may improve once tower cranes have been removed and the construction compound dismantled. It is recommended that all antenna work (relocating, betterment etc.) is undertaken by a registered installer (Confederation of Aerial Industries (CAI) Accredited) and that all system components used are CAI Certified.

1 - Introduction

This report details the findings of a study to determine the effects the Paterson development (in its current condition) has had on local television reception to satisfy the requirements of an associated planning condition¹ as a result of reported television interference;

21) During the construction of the development and within one month following the substantial completion of the development hereby approved, the City Council may request in writing a TV, Radio Impact and WIFI Assessment study of the existing television signal within the potential impact area (as previously identified in the GTech Surveys Limited - Baseline Television Signal Survey & Television Reception Impact Assessment stamped as received on 28th May 2019) to be undertaken and compared with the Assessment study undertaken in 2019. The study shall identify such measures necessary to maintain at least the pre-existing level and quality of signal reception (as identified in the submitted Baseline Television Signal Survey & Television Reception Impact Assessment) and a timetable for the implementation, if required, of any remediation measures. The study shall be submitted to the City Council as local planning authority for approval and any remediation measures shall be implemented in accordance with the approved study.

Reason - To ensure that the development at least maintains the existing level and quality of television signal reception, as advised in Planning Policy Guidance Note 8: Telecommunications.

¹ - It should be noted that no pre-construction assessment of radio or Wi-Fi coverage was undertaken and the possible impacts and effects of the proposed development upon radio or Wi-Fi coverage were not considered or investigated. The baseline study and this study focuses only on the reception of television reception and consequently, this report cannot be used to fully discharge this planning condition because it does not relate to either radio or Wi-Fi networks, radio or Wi-Fi services or radio or Wi-Fi systems, either within the consented development or externally to the consented development.

It should also be noted that on 27 March 2012 Planning Policy Guidance Note 8 (PPG8) was replaced by the National Planning Policy Framework (NPPF). The proposal date of planning application was 28 May 2019 (Application number: 123748/FO/2019) and still referenced PPG8, then over 7 years obsolete.

A television signal reception survey has been conducted to assess the mid-construction phase reception conditions around the Site.

During December 2018, a pre-construction television reception impact assessment was undertaken to assess the possible reception impacts within the study area. The assessment concluded that there was the possibility of digital terrestrial television (DTT – Freeview) interference in areas to the immediate southeast of the Site.

During October 2021, the study area was revisited to assess the existing reception conditions and to determine if the consented development had caused any signal or reception degradation. During the survey, signal measurements were undertaken to record the current reception conditions and signal levels. Analysis has been undertaken to assess the differences between the pre-construction and mid-phase construction survey data and to determine the impacts of the development upon local television reception conditions. The effects on digital terrestrial television and digital satellite television reception have been assessed. This report concludes summing the overall effects the development has had on television reception for local residents.

This report follows the following structure:

Chapter 1 introduces the work and the associated planning requirement

Chapter 2 describes the pre-construction and mid phase-construction television services in the survey area; the locations of local transmitters, the situation regarding the ongoing digital television upgrade project², the orientation of incoming signals etc.

Chapter 3 describes the pre-construction and mid phase-construction television reception conditions around the development and within the survey area from the results of the October 2021 mid phase-construction survey and December 2018 pre-construction assessment

Chapter 4 identifies any differences between the pre-construction and mid-phase construction survey data³

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

Chapter 6 presents the conclusion

This study was undertaken in October 2021. The report also details the existing reception conditions for future reference.

² <https://www.freeview.co.uk/sites/default/files/2020-07/700mhz-clearance-events-granada-region-16-july-2020.pdf>

³ Since the December 2018 baseline signal survey, the entire suite of terrestrial television transmissions from the main regional television transmitter at Winter Hill has changed due to the reallocation of radio spectrum for 4G mobile phone networks (major transmission changes occurred in October 2019, 19 February 2020 and 12 August 2020). Consequently, a like-for-like comparison between the pre-construction and the current reception environment is not possible and as such, this assessment informs a new baseline.

2 - Pre-Construction and Mid-Phase Construction Television Services

Pre-Construction Television Broadcast Services

Analogue Terrestrial Television

The area around the Site is no longer served by analogue television transmissions due to the completed Digital Television Switchover. All analogue services were switched off in 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 310° (with respect to true north) and 25km away. The transmitter is shown with respect to the proposed development 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*.

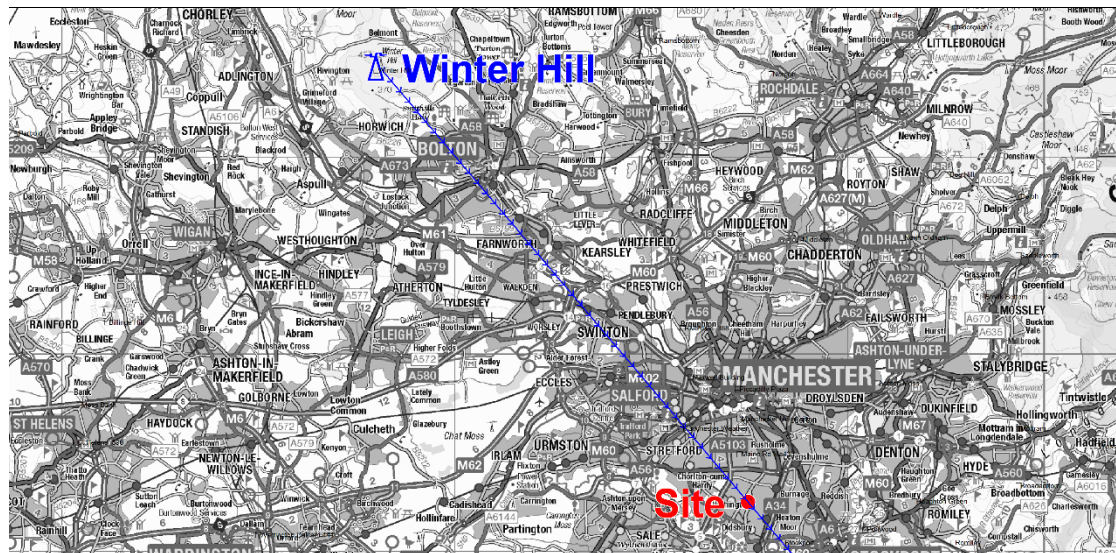


Figure 1 - The Location of the Winter Hill Transmitter, the Site and the direction of the incoming DTT signals at the Site

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 22.9 degrees are required at this latitude. Optimal receive dish azimuths are 143.8 degrees with respect to true north.

Mid-Phase Construction Television Broadcast Services

Analogue Terrestrial Television

The area around the development is still 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 study, significant changes have occurred to terrestrial television transmissions from the Winter Hill transmitter due to the introduction of new 4G mobile phone networks in the region. Major transmission changes occurred during October 2019, 19 February 2020 and 12 August 2020 to the digital terrestrial television services emanating from the transmitter. These are summated;

The DTT transmission antenna at Winter Hill was replaced, so changing the radiation pattern for all digital multiplexes

The ERP (effective radiated power) of the COM7 (HD) multiplex was reduced from 25.7 kW to 22.9 kW

The removal of the COM8 high definition multiplex (collection of television channels and services), decreasing the number of main multiplexes transmitted from Winter Hill from eight to seven

All UHF transmission channels used for the transmission of digital multiplexes at Winter Hill were changed and reallocated including;

The BBC A multiplex moving from UHF channel 50 to 32

The D3&4 multiplex moving from UHF channel 59 to 34

The BBC B (HD) multiplex moving from UHF channel 54 to 35

The SDN multiplex moving from UHF channel 58 to 29

The Arqiva B multiplex moving from UHF channel 55 to 49

The COM7 (HD) multiplex moving from UHF channel 31 to 55

Technical transmission information for each service at the aforementioned transmitter site is detailed in Table B, found in the Appendix - *Television Transmission Frequencies*. Up to date technical information regarding the Granada TV region and Winter Hill transmitter group can be found on the Digital UK website - <http://www.digitaluk.co.uk>

Non-Terrestrial Television Services - Freesat & Sky

For the reception of the 28.2 degrees east ASTRA satellite cluster, dish elevations of 22.9 degrees are still required at this latitude. Optimal receive dish azimuths are still 143.8 degrees with respect to true north.

3 - Pre-Construction and Mid-Phase Construction Signal Surveys and Findings

Pre-Construction Survey Overview

During December 2018, signal measurements were undertaken up to two kilometres away from the Site. The study mainly focused around the Site and in areas to the immediate southeast. Additionally, investigations were carried out in all areas where modelled predicted interference could occur. These areas are identified in Figure 2, and the signal measurements are detailed in Table C, found in the Appendix. During the survey, 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

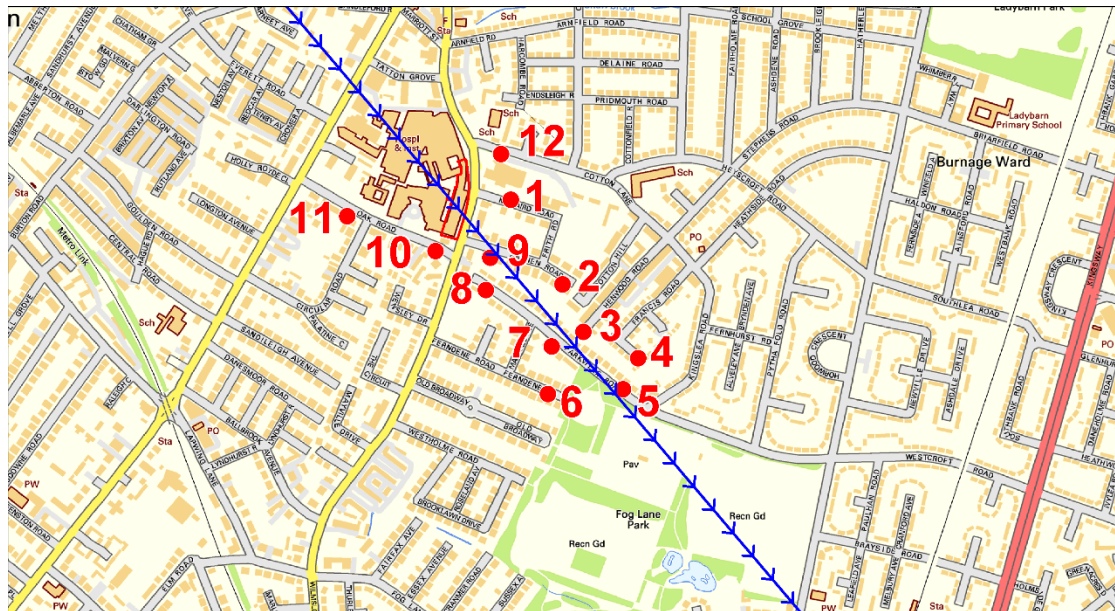


Figure 3 - Surveyed Locations. The blue arrow indicates the direction of the incoming DTT signals from the Winter Hill transmitter

All television measurements were carried out using a log-periodic receive antenna, mounted on GTech Surveys's broadcast survey vehicle, at a receive height of 10m AGL (industry standard height for such work - used to mimic standard aerial installation height on domestic properties). 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 Results and Observations

In general, building use around the proposed development was mainly for light industrial and commercial use. There were residential areas adjacent to the scheme (Rathen and Kinnaird Road) and to the south on Oak Road. All signal receive antenna systems were mounted on building sides or rooftops. All terrestrial television antennas were directed towards the Winter Hill transmitter.

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 well in excess of recommended minimum amounts and the technical quality of received signals was found to be good. DTT services provided good coverage and service throughout the study area.

Digital Satellite Television - Freesat & Sky

A number of properties were noted to have satellite dishes installed, particularly along Rathen Road, Kinnaird Road and Oak Road. Satellite dishes may also be mounted on rooftops which would not be visible from street level. No existing interference was identified for any satellite television platform.

Mid-Phase Construction Survey Overview

During October 2021, the study area was visited, and signal measurements were undertaken in areas around the Site and up to two kilometres away from the Site. Additionally, investigations were carried out in all areas where predicted interference could occur (areas to the immediate southeast of the Site). The general survey locations are identified in Figure 2, and the signal measurements are detailed in Table D, found in the Appendix.

During the survey, 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

Survey Results and Observations

Building use around the development remains unchanged. Three tower cranes are in use at the Site and a significant construction compound has been built to facilitate the building work. All signal receive antenna systems are still mounted on building sides or rooftops. All terrestrial television antennas are still directed towards the Winter Hill transmitter. The development and general construction site (in current form) can be seen in Images 1 - 4.



Image 1 – Taken from Rathen Road towards the Site. Note the antennas mounted to the rear of the property in the image



Image 2 – Taken from Rathen Road towards the Site. A close up of the installed antenna showing a communal antenna system with a VHF radio antenna, a DAB radio antenna, a UHF television antenna and a digital satellite television dish present



Image 3 – Taken from the corner of Rathen Road / Wilmslow Road away from the Site. Note the faulty / broken television antenna



Image 4 – Taken from Rathen Road towards the base of one tower crane and the construction compound. Note the construction compound form and massing

Analogue Terrestrial Television

Due to the completed Digital Television Switchover, analogue television signals are still not available in the study area.

Digital Terrestrial Television - Freeview

DTT services were available at all surveyed locations from the Winter Hill transmitter. Away from the Site, received signal levels were in excess of recommended minimum amounts and the technical quality of received signals was found to be good. Nearer the Site, the effects of signal attenuation on received signals was evident and received levels were lower compared to locations not located in the signal shadow created by the tower cranes, construction compound buildings or new development.

Digital Satellite Television - Freesat & Sky

A number of properties were noted to have satellite dishes installed, particularly along Rathen, Kinnaird and Oak Road. Satellite dishes may also be mounted on rooftops which would not be visible from street level. No existing interference has been identified for any satellite television platform.

4 - Analysis between Pre-Construction and Mid Phase-Construction Survey Reception Data

Analogue Television Services

A comparison between pre-construction and current analogue reception conditions was not possible because no analogue services were present during the 2018 pre-construction reception assessment work.

Digital Terrestrial Television Services

Due to the complex and widespread changes that have been made at the Winter Hill transmitter as a result of spectrum clearance for 4G mobile phone use, no like-for-like assessment can be made with respect to how the reception environment has changed since the pre-construction time period and now. However, based on signal measurements, received signal levels in the signal shadow area of the development are reduced in line with expectations. Elsewhere, reception conditions are still good. The combination of the half-completed development, installation of tower cranes and the construction compound are likely to be the cause of the signal attenuation.

Digital Satellite Television - Freesat & 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 Survey Findings after Data Analysis

Broadcast platform	Has interference occurred?	Mitigation required?
Analogue TV	Not possible	N/A
DTT - Freeview	Yes, likely	Antenna betterment on a case by case basis
Digital Satellite TV - Freesat & Sky	No	No

Table 1 - Summary of Television Interference

Actual Effects on Television Reception - Conclusions

Interference to analogue television services was not possible

Interference to DTT service reception has occurred in areas to the southeast of the Site where signal shadowing / attenuation has occurred. Overall, the survey work has indicated that digital terrestrial television reception has been disrupted in areas to the southeast of the Site by signal attenuation generated by the development, use of tower cranes and the construction compound. Mitigation is required and this is discussed in Chapter 5

Interference to digital satellite television reception is unlikely to have occurred

5 - Mitigation Measures

With respect to the requirement of mitigation, planning condition 21 states;

During the construction of the development and within one month following the substantial completion of the development hereby approved, the City Council may request in writing a TV, Radio Impact and WIFI Assessment study of the existing television signal within the potential impact area (as previously identified in the GTech Surveys Limited - Baseline Television Signal Survey & Television Reception Impact Assessment stamped as received on 28th May 2019) to be undertaken and compared with the Assessment study undertaken in 2019. The study shall identify such measures necessary to maintain at least the pre-existing level and quality of signal reception (as identified in the submitted Baseline Television Signal Survey & Television Reception Impact Assessment) and a timetable for the implementation, if required, of any remediation measures. The study shall be submitted to the City Council as local planning authority for approval and any remediation measures shall be implemented in accordance with the approved study.

Mitigation Measures

Due to the different performance characteristics of each antenna system in use (some will include mast head amplifiers and better individual components and others will be more prone to the impacts and effects of externally generated interference), mitigation will have to be identified and supplied on a case-by-case basis.

For any affected Freeview viewers to the immediate southeast of the Site where signal reception has been degraded, the betterment of antennas is likely to restore services. Betterment of antenna systems could include any of the following;

- Replacement of components not fit for purpose (damaged, water ingress in cables / antennas, electrically faulty, old brown type coax etc.)
- Replacement or installation of a mast head amplifier and new antenna
- Replacement of old coax cable to better signal throughput and to reduce unwanted pickup
- Installation of a higher gain antenna
- Good earthing on antenna systems and associated components to help reduce unwanted electrical system noise and unwanted electrical pickup
- Installation of a higher antenna (above ground level) in a location as far away from the Site as possible i.e. on another chimney stack etc.

These are common and simple mitigation solutions for similar situations where local television reception conditions have been affected by adjacent construction work. A registered installer should be able to advise on the most effective mitigation measures once the existing installed antenna system has been inspected and construction-generated interference has been identified.

It is recommended that all antenna work (relocating, betterment etc.) is undertaken by a registered installer (Confederation of Aerial Industries (CAI) Accredited) and that all system components used must be CAI Certified. More information regarding the CAI & Registered Installers can be found on the CAI's website - <http://www.cai.org.uk/index.php>

The CAI's Certification scheme ensures that the cables and antennas have passed minimum requirements for the use of DTT and digital satellite television reception. The use of non-certified products in an antenna system would degrade overall performance and effectiveness of the system, increasing the risk from interference. More information on CAI Certified Products can be found on the CAI's website -

<https://www.cai.org.uk/index.php/services/product-certification-scheme>

6 - Conclusions

A signal survey has been performed to assess the possible effects and impacts on the reception of television broadcast services from the Paterson development, as required in planning condition 21.

21) During the construction of the development and within one month following the substantial completion of the development hereby approved, the City Council may request in writing a TV, Radio Impact and WIFI Assessment study of the existing television signal within the potential impact area (as previously identified in the GTech Surveys Limited - Baseline Television Signal Survey & Television Reception Impact Assessment stamped as received on 28th May 2019) to be undertaken and compared with the Assessment study undertaken in 2019. The study shall identify such measures necessary to maintain at least the pre-existing level and quality of signal reception (as identified in the submitted Baseline Television Signal Survey & Television Reception Impact Assessment) and a timetable for the implementation, if required, of any remediation measures. The study shall be submitted to the City Council as local planning authority for approval and any remediation measures shall be implemented in accordance with the approved study.

Reason - To ensure that the development at least maintains the existing level and quality of television signal reception, as advised in Planning Policy Guidance Note 8: Telecommunications.

The study has 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, locations were visited which were located in and near to the theoretical signal shadow zone.

Digital Terrestrial Television (DTT) - Freeview

As predicted during the pre-construction reception impact assessment, reception conditions have been degraded in some areas to the immediate southeast of the Site, however, the severity of the degradation will be dependent upon many factors, primarily the condition of the antenna system in use. Modern systems with good quality components will be impacted less severely than those systems which may be operating in a suboptimal way. It is not possible to understand the extent of the signal shadow area because the baseline reception data is no longer valid as a result of the technical changes that have occurred at the Winter Hill television transmitter site (October 2019, 19 February 2020 and 12 August 2020) since the pre-construction signal survey (December 2018). However, it is unlikely to extend beyond 200m from the southeast corner of the Site and not all users located in this area will be adversely impacted or effected. Should interference be reported in this general area, antenna betterment is likely to restore the reception of DTT services.

Digital Satellite Television

The development is unlikely to have had any adverse effect upon the reception of digital satellite television services such as Freesat and Sky. No interference has been identified.

Overall, from results of the signal survey and data assessment, it has been concluded that the development (in its current state) has caused some interference to the reception of Freeview services in an area to the immediate southeast of the Site. Whilst it is not possible to quantify the extent of the interference, poor quality antenna systems will be more prone to the impacts and effects of any interference. A number of solutions are available that will enable the restoration of reception of services upon validation of construction-generated interference by a registered antenna engineer.

APPENDIX

Television Transmitter Frequency Tables

Signal Survey Measurements

An Overview of Signal Measurements

Calculation of Received Field Strength

Survey Equipment

Mapping Data

Television Transmitter Frequency Tables

Digital TV Multiplex	Multiplex Operator	UHF Channel Number *	Channel Frequency Fc (MHz) **	Transmitter Power (kW)
BBC A	BBC	50	706.000	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	31	554.000	22.6

Table A - 2018 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	49	698.000	100.0
Arqiva B	Arqiva	37	602.000	100.0
COM7 - HD	Arqiva	55	746.000	22.9

Table B - 2021 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 $F_c = 8n + 306$, where 'n' is the UHF channel number.

Signal Survey Measurements

Measurement Point Number	Channel Frequency Service	50 706.00 BBC A	59 778.00 D3&4	54 738.00 BBC B -	58 770.00 SDN	49 698.00 Arqiva A	37 602.00 Arqiva B -	55 746.00 COM7	31 554.00 COM8
1	FS	88.6	91.5	77.0	90.8	93.3	89.5	76.0	79.0
	CSI	23.2	25.8	-	22.9	17.9	23.9	-	-
	MER	33.6	30.0	-	29.6	31.7	31.0	-	-
2	FS	84.9	89.5	89.5	89.9	83.6	86.7	80.9	74.4
	CSI	24.5	26.7	-	27.3	26.4	22.5	-	-
	MER	31.5	32.5	-	32.8	32.9	31.2	-	-
3	FS	88.9	82.0	88.8	87.3	89.9	86.1	74.7	77.4
	CSI	21.9	21.1	-	20.4	16.1	19.7	-	-
	MER	31.9	31.5	-	32.6	32.4	31.2	-	-
4	FS	77.1	91.0	92.0	88.8	85.8	92.9	81.5	79.1
	CSI	31.0	25.5	-	28.1	22.4	19.8	-	-
	MER	29.4	32.6	-	32.5	31.0	30.6	-	-
5	FS	89.7	87.8	92.6	84.5	89.5	75.8	77.6	72.0
	CSI	17.3	21.5	-	23.3	26.6	23.7	-	-
	MER	31.0	29.3	-	29.0	30.9	32.5	-	-
6	FS	87.4	80.9	82.8	97.4	89.3	91.3	75.7	77.3
	CSI	19.8	26.4	-	22.0	23.4	19.7	-	-
	MER	31.6	30.0	-	30.1	32.0	31.9	-	-
7	FS	90.6	94.6	79.4	91.3	92.2	94.0	74.4	76.0
	CSI	23.5	22.6	-	24.5	21.2	23.0	-	-
	MER	31.0	32.0	-	29.9	32.0	33.2	-	-
8	FS	90.9	93.4	89.9	94.2	89.5	78.8	80.5	72.0
	CSI	24.0	21.7	-	27.3	27.0	22.4	-	-
	MER	31.0	32.1	-	30.5	31.8	32.5	-	-
9	FS	90.2	82.5	89.9	89.3	92.1	89.3	73.8	76.1
	CSI	21.3	20.0	-	18.9	22.9	17.2	-	-
	MER	30.0	30.7	-	31.1	33.6	30.7	-	-
10	FS	80.2	94.2	88.5	90.1	93.7	93.5	75.8	80.8
	CSI	31.8	26.5	-	28.7	21.3	20.7	-	-
	MER	30.9	30.2	-	32.2	32.1	32.6	-	-
11	FS	87.9	92.3	91.2	95.0	91.9	78.4	77.1	74.0
	CSI	18.7	22.0	-	25.5	25.9	24.2	-	-
	MER	34.1	29.3	-	29.0	30.5	32.3	-	-
12	FS	88.2	79.9	82.0	87.5	89.4	90.5	76.8	77.4
	CSI	19.7	26.0	-	24.9	26.0	20.0	-	-
	MER	32.3	32.3	-	32.0	32.3	32.2	-	-

Table C - 2018 Measurements of Winter Hill Digital Television Services

Key -

Frequencies listed in MHz

Field strength (FS) values indicated in dB μ V/m

Channel Status Information (CSI) %

Modulation Error Ratio (MER) dB

Measurement Point Number	Channel Frequency Service	32 562.00 BBC A	34 578.00 D3&4	35 586.00 BBC B	29 538.00 SDN	49 698.00 Arqiva A	37 602.00 Arqiva B	55 746.00 COM7
1	FS CSI MER	90.4 23.0 29.4	83.0 21.0 30.1	86.1 - -	92.4 19.9 30.2	87.9 21.7 30.1	88.5 20.7 31.9	80.7 - -
2	FS CSI MER	69.9 21.3 28.3	66.8 22.8 26.3	74.9 - -	67.8 26.3 27.0	73.4 27.8 27.5	67.4 24.1 29.4	62.0 - -
3	FS CSI MER	87.8 27.0 29.4	84.2 25.4 31.4	88.2 - -	87.5 19.4 30.3	86.7 21.0 31.0	90.6 24.3 29.9	82.1 - -
4	FS CSI MER	87.3 20.3 31.7	84.7 24.1 29.4	89.4 - -	89.9 22.1 30.8	95.5 19.4 29.0	88.9 19.9 30.8	86.8 - -
5	FS CSI MER	89.7 19.6 32.4	86.2 19.3 31.5	93.2 - -	87.7 20.1 30.5	92.3 20.7 30.3	84.4 26.0 30.9	78.5 - -
6	FS CSI MER	85.8 22.2 31.2	90.0 18.3 29.5	89.7 - -	87.9 21.5 29.9	84.9 17.0 30.5	90.0 19.1 30.7	82.6 - -
7	FS CSI MER	67.8 24.2 27.6	74.9 23.6 26.1	68.2 - -	71.9 19.0 28.2	69.6 21.2 26.0	70.5 22.1 29.0	61.0 - -
8	FS CSI MER	71.4 22.8 28.7	71.0 18.2 27.5	71.6 - -	72.2 25.7 28.0	73.5 27.6 26.4	69.9 19.6 27.4	65.0 - -
9	FS CSI MER	70.4 22.7 28.8	72.5 28.1 28.1	72.3 - -	74.7 22.9 27.0	70.5 22.0 29.6	73.7 25.0 28.9	65.9 - -
10	FS CSI MER	84.9 26.0 31.6	83.7 25.3 31.5	87.7 - -	89.2 19.5 29.4	92.9 20.8 30.6	81.9 27.8 28.2	88.4 - -
11	FS CSI MER	89.0 20.1 31.0	84.8 27.3 29.9	90.8 - -	85.4 22.2 28.5	88.4 19.2 31.4	93.6 29.2 27.6	84.0 - -
12	FS CSI MER	89.0 18.7 32.4	86.1 19.5 31.0	87.5 - -	91.6 20.5 30.5	86.0 24.5 31.5	90.1 23.1 30.9	80.1 - -

Table C - 2021 Measurements of Winter Hill Digital Television Services

Key -

Frequencies listed in MHz

Field strength (FS) values indicated in dB μ V/m

Channel Status Information (CSI) %

Modulation Error Ratio (MER) dB

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 dB μ V (a maximum signal level of 70 dB μ V and a minimum signal level of 50 dB μ V). 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 [1]. 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

interference as well as noise in the channel. The higher the MER value, the **better** the reception conditions. Our 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 performance⁴. 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 –

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

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.

⁴ - J. Lago-Fernández, "Using Channel State Information (CSI) to Characterize DVB-T Reception", IBC, Amsterdam, 12-17 September 2002

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 Professional Broadcast Wideband Log Periodic 8 element antenna –
Amphenol Jaybeam (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.

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.	
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LPU/Rx
V-Pol or H-Pol | Log Periodic | 70° | 7.9 dBd



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*

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 in the survey vehicle.

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

where -

Dipole Factor (to matched load)	(b)	$20\text{Log}\left(\frac{2\pi}{\lambda}\right)$ <i>Where λ = Transmission Wavelength (m)</i>
Feeder Loss	(c)	3 dB
Aerial Gain (dB _{dipole})	(a)	10 dB

References

The building information found in Chapter 2 was sourced from the following Ofcom document –

http://licensing.ofcom.org.uk/binaries/spectrum/fixed-terrestrial-links/wind-farms/tall_structures.pdf

Mapping Data

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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.

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