

GTech Surveys Limited

Television Signal Survey & Television Reception Impact Assessment

Titan Property Developments

CHANGE HISTORY

Issue	Date	Details of Changes
1.0	09/04/2015	Working Draft
1.0	05/05/2015	First Draft Issue
1.0	30/10/2015	First Issue - minor editing
Author: G Phillips		Reviewer: A Barker

Contents	Page
Executive Summary	
1 - Introduction	4
2 - The Mechanisms of Interference to Television Broadcast Services	6
3 - Available Television Broadcast Services in the Study Area	11
4 - Description of the Current Television Reception Conditions	13
5 - Predicted Impacts and Effects	16
6 - Suitable Mitigation Measures	19
7 - Evaluation of Residual Effects after Mitigation	20
8 - Investigating the Causes of Interference	21
9 - Conclusions	22
Appendix	23

GTech Surveys Ltd.

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

In addition to these broadcast services, we review and prepare ES & EIA Telecommunications Chapters and documents, liaising with telecommunication providers and advising developers with respect to associated Section 106 (Town and Country Planning Act 1990, England and Wales) and Section 75 (Town and Country Planning Act 1997, Scotland) agreements and other planning conditions. We also verify television transmitter coverage and performance and are actively involved with the UK's Digital Television Upgrade project, working with Digital UK, Ofcom, Arqiva and at800.

GTech Surveys is a Consultant Member of the Confederation of Aerial Industries and only professional broadcast engineers undertake our fully insured products and services. More information about the Confederation of Aerial Industries and CAI consultants can be found on their website - www.cai.org.uk

Executive Summary

Impact assessments have been undertaken to determine the potential effects on the local reception of television broadcast services from the proposed Titan Property development in Reading. Impacts to the reception of analogue terrestrial television, digital terrestrial television (Freeview) and digital satellite television services have all been assessed.

From the results of modelling and field survey work, no adverse impacts have been identified for the reception of any television broadcast network. No interference is expected for any television service and subsequently, no pre or post-construction mitigation measures are required.

Overall, the proposed development is likely to have a neutral effect on the reception of television broadcast services for local residents.

This report follows the following structure:

Chapter 1 provides an introduction to the work

Chapter 2 discusses the different forms of structure-generated signal interference and how these can impact the reception of different television broadcast platforms

Chapter 3 provides a description of available television services in the study area i.e. the locations of regional and local television transmitters, the situation regarding the ongoing digital television upgrade project, introduction of Local TV and new HD services, the orientation of incoming signals etc

Chapter 4 provides a description of the current television reception conditions around the proposed development and within the study area from the results of the baseline signal survey

Chapter 5 describes the predicted and theoretical impacts of the proposed development upon television broadcast reception before any mitigation measures are applied

Chapter 6 identifies any suitable mitigation circumstances and measures for any potentially affected television viewer

Chapter 7 contains an evaluation of the residual effects following mitigation

Chapter 8 describes a methodology and framework for determining the causes of interference

Chapter 9 is the conclusion

This study was undertaken in April 2015 to investigate whether the proposed development could cause interference to local television broadcast service reception. The report also details the current reception conditions for future reference.

1 - Introduction

This report outlines the findings of a comprehensive study and field survey to determine the viewing preference of residents located around the proposed Titan Property development, Reading, and identifies what effects the development may have on the reception of television broadcast services.

A desktop study was first undertaken, based on broadcast transmission information, plans of the development and maps of the area. The relevant TV survey area for the development was identified and a site visit was then subsequently conducted to establish the current television reception conditions. Modelling techniques and field assessments of viewers' choice of television transmitter have then been used to predict the potential effects upon television broadcast reception in the area. The impacts of the development are consequently analysed, and together with various mitigation options, conclusions are drawn on the overall effects of the development on the reception of television broadcast services for local residents.

The effects on analogue terrestrial television, digital terrestrial television and digital satellite television service reception are discussed. The report also details the current reception conditions for future. Figure 1 shows the general location of the proposed development.

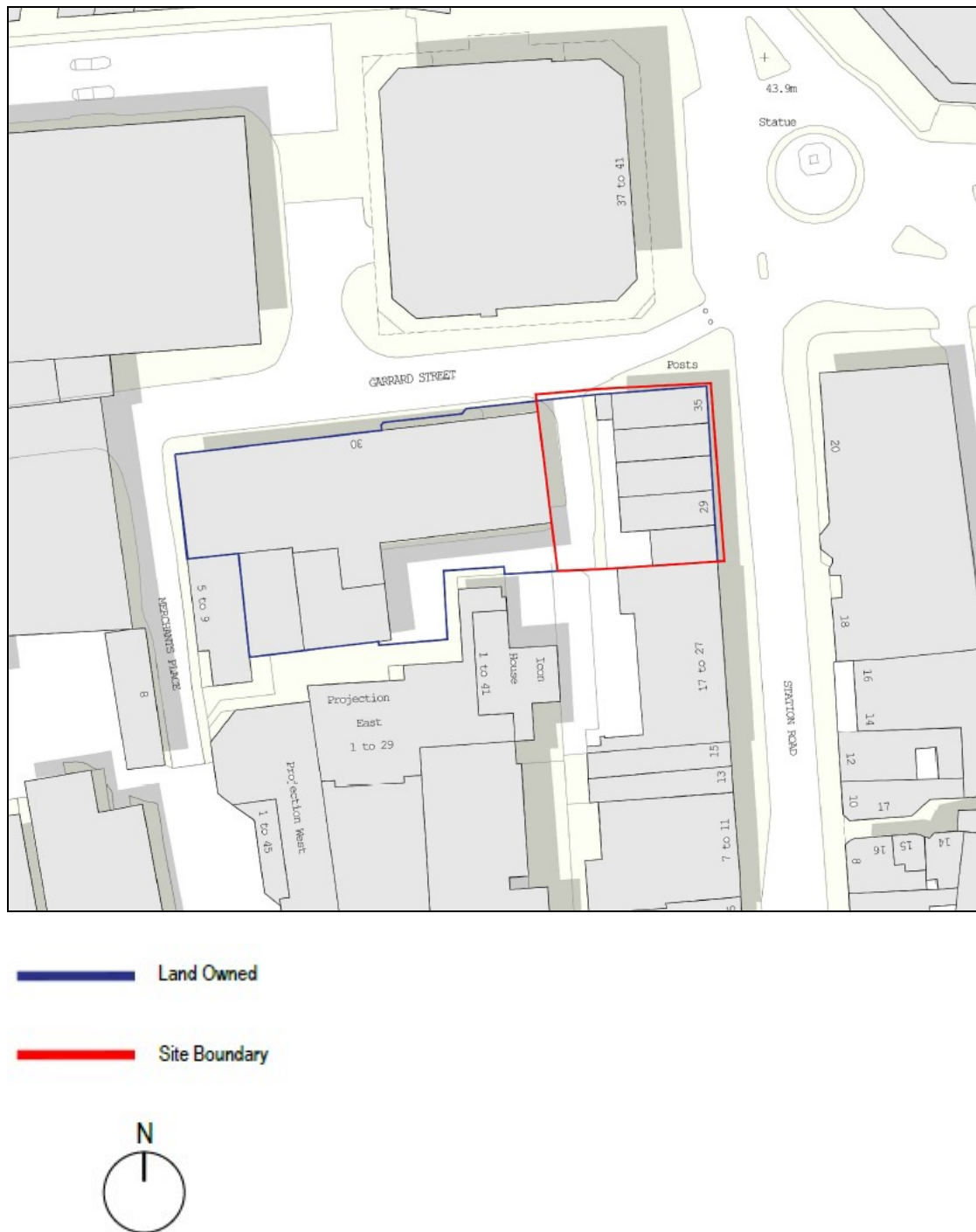


Figure 1 - The location of the proposed development

2 - The Mechanisms of Interference to Television Broadcast Services

Terrestrial Television Services

Any structure will produce two zones of potential disruption to television reception. One zone is where the development creates a 'shadow' (affects all television broadcast platforms) and the other where it gives rise to a 'reflection' (usually affects terrestrial analogue television only). At the frequencies used for broadcasting, the processes of creating a 'shadow' or a 'reflection' are somewhat more complicated than with visible light, but thinking of the problem in these terms is still a helpful way of approaching the matter.

'Shadowing' Effects

In the area behind the structure, the television transmitter is effectively screened from the viewer and the strength of the signal is reduced - Figures 2 and 3.

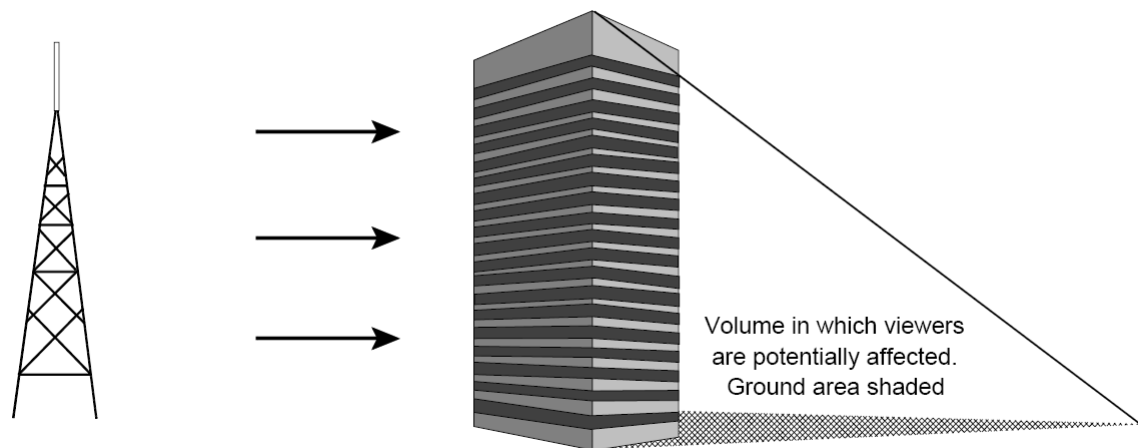


Figure 2 - Affected area in the 'shadow' zone behind the structure

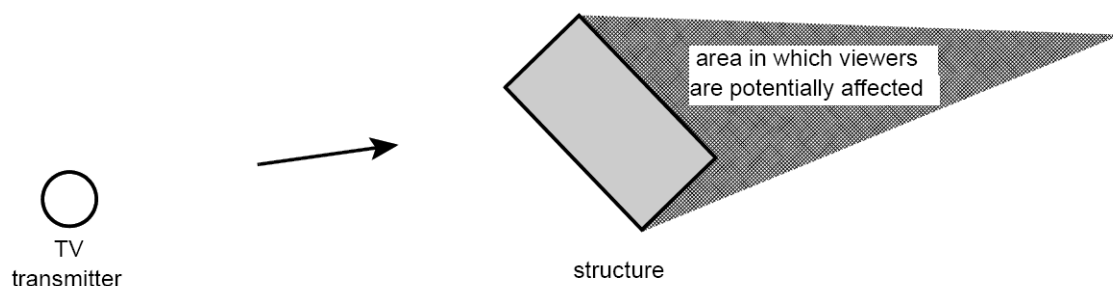


Figure 3 - Plan view of the 'shadow' zone

Television signals do not create such a 'hard' shadow as visible light, and for the purposes of explanation, a 'shadow' zone must be considered which is divided into three sub-zones.

i. Within a few tens of metres from a solid structure, over the region where optical view of the transmitter is lost, the reduction in signal strength is critically dependent on the specific design and composition of the structure. For most brick and concrete buildings the reduction is severe and in some cases almost total.

ii. Further away from the structure (e.g. beyond 250 metres, but this varies depending on its size) the limit of the 'shadow' zone and signal reduction are determined by diffraction at the edges of the structure and reflection off surrounding structures. The simple condition of whether or not a location has an optical view of the transmitter is not enough to classify the potential interference zone adequately. In general, the effect is that the signal appears to bend around the sides of the structure; the shadow zone reduces in size and the signal strength is reduced by much less than simple ray optics would suggest.

iii. Even further away from the structure (e.g. 5 km) complex multiple reflections and diffraction, caused by structures in the locality, may result in the 'shadow' zone becoming almost non-existent, against interfering signals that arrive on significantly different bearings. This can result in an increase in the ratio of wanted to unwanted signal as presented to the television receiver.

'Reflection' Effects

The second zone of potential interference is produced by 'reflection' or 'scattering' of the incident signal, see Figure 4. Analogue television reception is more likely to be affected than digital terrestrial reception, which is more robust due to the technical makeup of the digital signal.

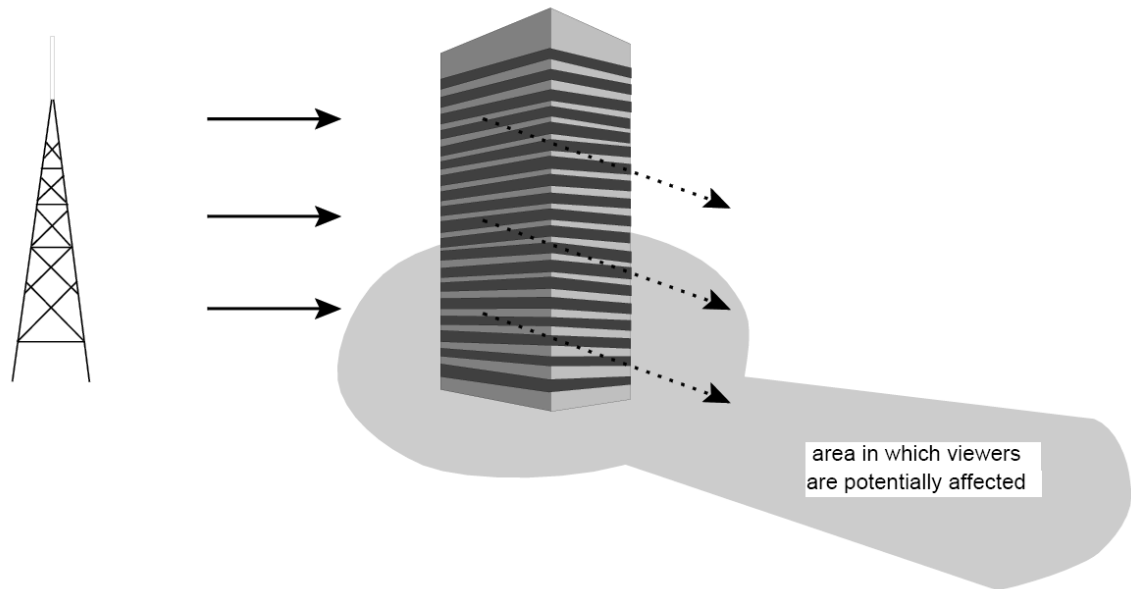


Figure 4 - Affected areas in the 'reflected' zone of the structure

Consider Figure 5, the direct signal travels a distance $P1$ to the viewer, whilst the signal reflected from the structure travels slightly further, distance $(P2 + P3)$. Although travelling at the speed of light, the different path lengths can mean that one signal arrives with a significant delay relative to the other. This results in a second image appearing on the viewer's screen, displaced from the first. This type of interference is known as 'ghosting'. If the reflecting signal is complex, several 'ghost' images can result.

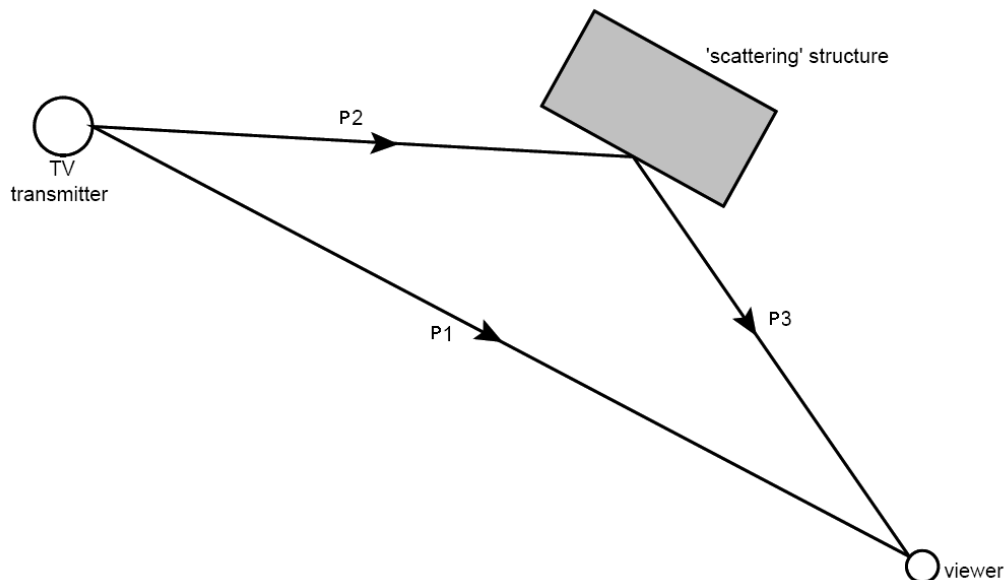


Figure 5 - Direct and Indirect Signal Paths

To avoid interference it is necessary to ensure that the ratio of wanted signal along the direct path (P1) to the unwanted signal along indirect paths (P2+P3) is sufficiently high. Domestic TV receiving antennas generally have a significant directional response to incoming signals, which means that the antenna may discriminate against interfering signals that arrive on significantly different bearings. This can result in an increase in the ratio of wanted to unwanted signal, as presented to the television receiver. This is shown in Figure 6.

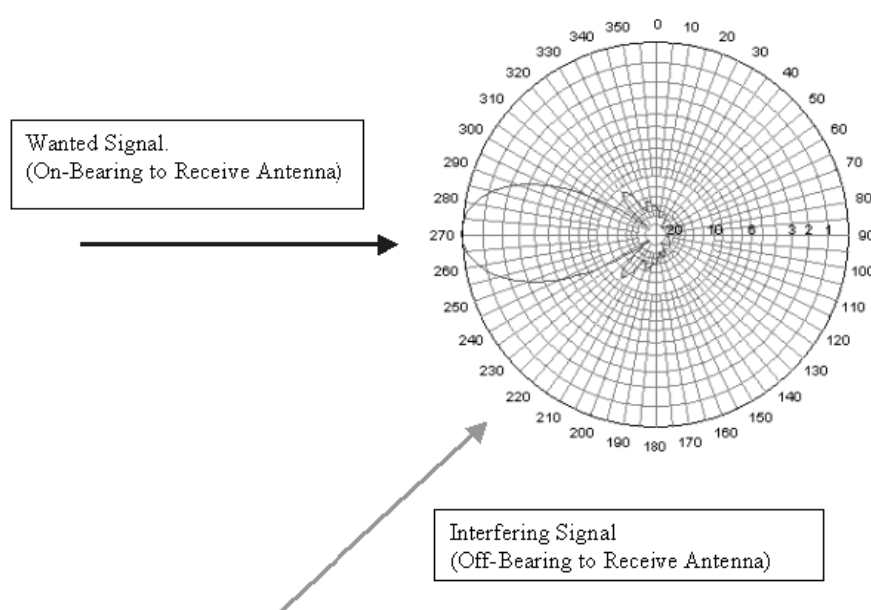


Figure 6 - Typical Domestic Television Receive Antenna Response

Digital Terrestrial Television (DTT) - Freeview

Analogue television is susceptible to many forms of interference. One of the disadvantages analogue systems have is that once the signal has been corrupted, the information contained within the signal is also disrupted and consequently, is evident upon viewer's screens in the form of interference.

The digital television broadcast platform offers many advantages over older analogue broadcast technologies. Due to the way picture signals are encoded and broadcast, digital television offers a much more resilient platform against the types of interference encountered by analogue television broadcast networks. The construction of digital signals ensures that they are much more impervious to the effects of interference from indirect secondary reflections, which consequently ensures good quality and coherent data stream integrity at the receiver, resulting in an interference free picture. Disruption to DTT services is normally caused by a poor quality receive antenna system or locally generated wideband electrical noise. Technical information regarding the Freeview signal can be found in the Appendix.

Digital Satellite Television Services - Freesat & Sky

Digital satellite television services are provided by geo-stationary earth orbiting satellites positioned above the equator. To ensure good reception of digital satellite television services, satellite receive antennas (satellite dishes) are normally positioned away from trees and other clutter and are orientated to face the southern (south southeast) skies.

Disruption to digital satellite television services is normally caused by an obstruction on the line of sight from the satellite to the receive antenna e.g. a tall building or tall trees. Adverse weather can also influence reception. In the United Kingdom, Freesat and Sky services come from the 28.2 degrees east ASTRA satellite cluster.

Figure 7 below shows typical clearance distances and obstruction heights for interference free satellite television reception.

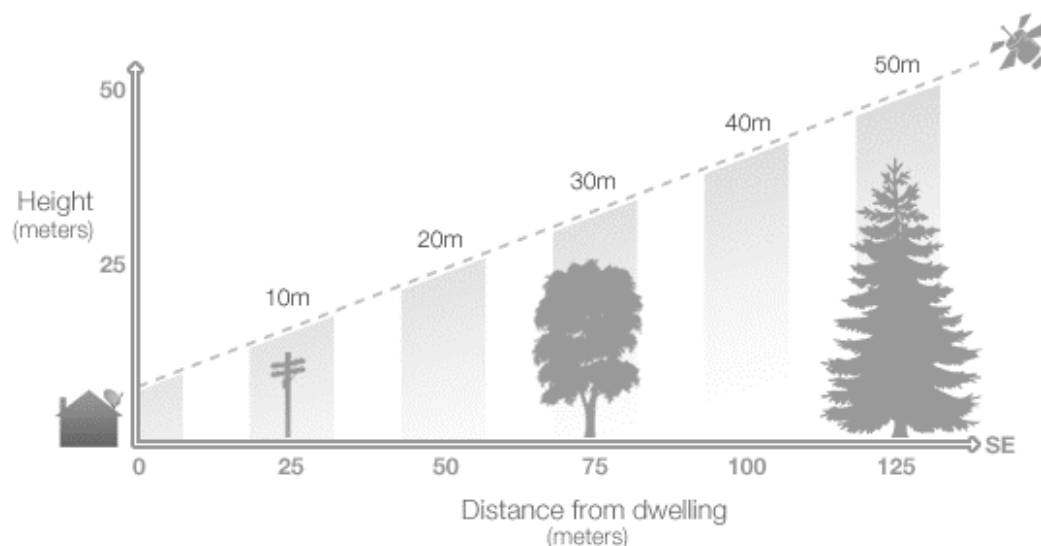


Figure 7 - Typical Clearance Distances and Obstruction Heights for Interference Free Satellite Television Reception

3 - Available Television Broadcast Services

Terrestrial Television Services

Analogue Terrestrial Television

The area around the proposed development is no longer served by analogue television transmissions due to the completed Digital Television Switchover. All analogue services were switched off in the Meridian television region during 2012. Further information regarding the Digital Television Switchover can be found below.

Digital Terrestrial Television (DTT) - Freeview

The area is served by DTT services from the Hannington transmitter (NGR SU 52740 56807), 25 kms to the southwest of the proposed development. The Hannington transmitter is shown with respect to the proposed development in Figure 8.

Technical transmission information for each DTT service at the aforementioned transmitter site is detailed in Table A, found in the Appendix.

Digital Television Switchover

During 2012, Digital Television Switchover was completed at the Hannington transmitter. For more information regarding the UK's Digital Television Switchover, please refer to the Digital UK website

www.digitaluk.co.uk

Up to date technical information regarding the Meridian TV region and Hannington transmitter group switchover, can be found on the Digital UK website

www.digitaluk.co.uk/when_do_i_switch/meridian

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 25.1 degrees are required at this latitude. Optimal receive dish azimuths are 144.5 degrees with respect to true north.

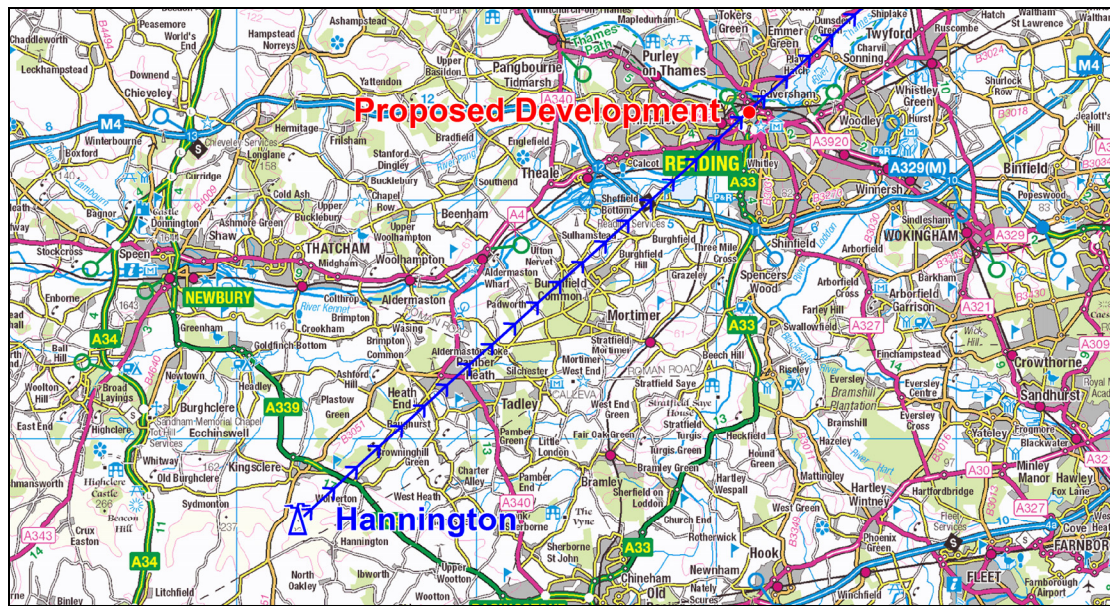


Figure 8 - The Location of the Hannington Transmitter, the Proposed Development and the direction of the incoming DTT signals at the site

4 - Description of Current Television Reception Conditions

Relevant Survey Area & Survey Method

Due to the complex nature of television interference in cluttered urban environments, field investigations must be undertaken in the general area around a development site to fully evaluate any potential effects. In this study, field measurements were undertaken up to three kilometres away from the development site, however, the study mainly focused around the site and areas to the immediate northeast. Additionally, investigations are carried out in all areas where predicted (modelled) interference may occur. These are identified in Figure 9, and the measurements are detailed in Table B, found in the Appendix.

In particular, the following data was recorded:

- Field strength (signal level) and technical quality measurements of DTT transmissions from the Hannington 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 Results and Observations

In general, building use around the proposed development is a mix of residential and commercial but mainly commercial use. All signal receive antenna systems are mounted on rooftops, ensuring optimal reception conditions. All terrestrial television antennas are directed towards the Hannington transmitter. To the immediate south, southwest and west of the of the site, the effects of slight signal attenuation are evident and the existing taller buildings around Station Road, Station Hill and Friar Street are likely to be the cause. No existing interference has been identified for any satellite television platform.

Analogue Terrestrial Television

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

Digital Terrestrial Television - Freeview

DTT services were available at all surveyed locations from the Hannington 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 good¹. DTT services currently provide good coverage and service throughout the study area.

Digital Satellite Television - Freesat & Sky

During the survey, it was noted that approximately 30% of households in the survey area had satellite-receiving equipment in place.

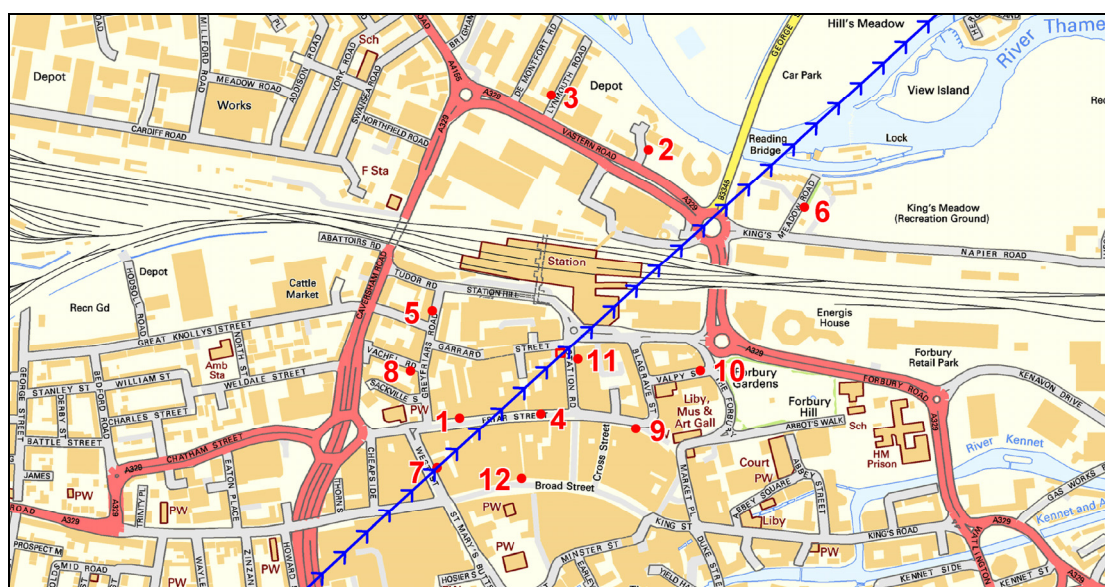


Figure 9 - Surveyed Locations. The blue arrow indicates the direction of the incoming DTT signals from Hannington

¹ – *Signal levels as specified by The Digital TV Group - UK Digital TV Receiver Recommendations, Version 1.4, dated 18 June 2008 and The Digital TV Group - Digital TV Group R Book 5, 2005 Edition*

The BBC A and D3&4 multiplexes operate with 64QAM modulation, coding rate 2/3 & 8K FFT. Minimum recommended receive levels are 46 dB μ V/m.

The SDN, Arqiva A and Arqiva B multiplexes operate with 64QAM modulation, coding rate 3/4 & 8K FFT. Minimum recommended receive levels are 46 dB μ V/m.

The BBC HD and COM 7 multiplexes operate using the DVB-T2 standard - 256QAM modulation, coding rate 2/3 & 32K FFT. Minimum recommended receive levels are 47 dB μ V/m.

Technical information regarding the Freeview signal can be found in the Appendix.

5 - Predicted Impacts and Effects

Methodology

To assess the effects of the proposed development upon television broadcast service reception, the structures were considered to create interference to services in the immediate areas around the site, in signal reflection areas and in the signal shadow zones. These methods, used in conjunction with broadcast transmission information, development plans, maps of the study area and modelling techniques, contribute towards predicting the potential effects upon television broadcast reception in the study area.

The field survey then investigated the areas identified as being at risk of interference and assessed all available services and the transmitter viewing preferences of residents in order to determine if the computed risk is practically valid. The collected data was finally used to determine what actual risks exist and what viable solutions are available to minimise any adverse effects.

Predicted Effects from Modelling

Analogue Terrestrial Television

Due to the completed Digital Television Switchover in the Meridian TV region, analogue television signals are no longer available in the area. Consequently, interference would not be possible to analogue television service reception.

Digital Terrestrial Television - Freeview

Digital television services are much less affected by signal reflections. Modelling has indicated that DTT services are not at risk from signal interference generated from the proposed development. This is due to the current quality of the current DTT services in the area and the favourable proximity of typical residential dwellings (two storey houses) with respect to the proposed development. All terrestrial receiving antennas viewed in proximity of the proposed development site are mounted on top of existing buildings, ensuring optimal reception*. The proposed development is expected to have a neutral affect upon the reception of terrestrial television services.

* - Modelling parameters assume that all installed 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 sub standard / poor quality installations will be more prone to the effects of interference from external sources.

Digital Satellite Television - Freesat and Sky

Tall structures, trees and buildings can disrupt digital satellite television reception by causing obstructions on the line of sight to the signal receive dish from the serving satellite. This is discussed further in Chapter 2.

Using the mathematical tangent function and based on the height of the building and the angle and orientation of the incoming satellite signals, interference to digital satellite television reception is not expected for any local resident, as there are no visible low mounted digital satellite signal receive dishes located within any of the theoretical signal shadow zones of the proposed development.

Predicted Effects Taking Into Account Survey Findings

The predicted effects are discussed below and summarised in Table 1.

Analogue Terrestrial Television

Now that Digital Television Switchover has occurred in the region, analogue television signals are no longer available in the area. Consequently, no interference is possible to the reception of analogue television services.

Digital Terrestrial Television - Freeview

Due to the existing good coverage and the lack of viewers to the immediate north-northeast of the site (within any signal shadow zones), the proposed development will not impact the reception of DTT services.

Digital Satellite Television - Freesat and Sky

The proposed development will not impact digital satellite television reception, as there are no satellite signal receive dishes located in any theoretical signal shadow zones.

Broadcast platform	Area(s) of predicted interference	Risk of interference	Antenna protection (Chapter 2)	Alternative good digital reception
Analogue TV	None	No	N/A	N/A
DTT (Freeview)	None	No	N/A	N/A
Digital Satellite TV	None	No	N/A	N/A

Table 1 - Summary of Predicted Interference

Predicted Effects - Conclusions

- Interference to analogue television service reception would not be possible.
- Interference to DTT service reception is not expected.
- Interference to digital satellite television reception is not expected.

6 - Mitigation Circumstances & Measures

Mitigating Circumstances

None applicable.

Mitigation Measures

None required.

7 - Evaluation of Residual Effects

As no mitigation measures are required, no residual effects exist.

8 - Investigating The Causes of Interference

As no interference is expected, no frameworks or procedures are required for any interference investigation work.

9 - Conclusions

A desktop study and baseline signal reception survey have been performed to assess the possible effects and impacts on the reception of television broadcast services from the proposed Titan Property development. The study has focused on the reception of the three television broadcast platforms that could possibly be impacted by the proposed development - analogue terrestrial television, digital terrestrial television and digital satellite television services.

Analogue Terrestrial Television

Due to the completed Digital Television Switchover, it is now not possible for the proposed development to impact analogue terrestrial television reception, as analogue television transmissions were switched off throughout the region during April 2012.

Digital Terrestrial Television (DTT)

From modelling (no viewers are located in any areas where interference could occur) and analysis of current local reception conditions, the proposed development is not expected to have any effect upon the reception of DTT services. DTT is more commonly known as 'Freeview'. Coverage in the study area is currently good and the proposed development is unlikely to alter reception conditions.

Digital Satellite Television

Due to the location of the proposed development, the orientation of the incoming satellite signals and the lack of satellite signal receive antennas in any theoretical signal shadow area, the proposed development is unlikely to impact the reception of digital satellite television signals. No interference is expected.

Overall, due to these findings, it is expected that the proposed development will have a neutral effect upon the reception of television broadcast services for local residents. No pre or post-construction mitigation measures are required and no interference is expected for any broadcast platform.

APPENDIX

Television Transmission Frequencies

Survey Measurements

Definitions and an Overview of BER, CBER, CNR and MER Measurements

Survey Equipment

Digital TV Multiplex	Multiplex Operator	UHF Channel Number *	Channel Frequency Fc (MHz) **	Transmitter Power (kW)
BBC A	BBC	45	666.000	50.0
D3&4	Digital 3 & 4	42	642.000	50.0
BBC B (HD)	BBC	39+	618.167	50.0
SDN	SDN	41	634.000	25.0
Arqiva A	Arqiva	44	658.000	25.0
Arqiva B	Arqiva	47	682.000	25.0
COM7 (HD)	Arqiva	32	562.000	36.7

Table A - Hannington Digital Terrestrial Television Services

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

* - 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.

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

Information correct at time of writing. Information provided by DigitalUK and Arqiva

Measurement Point Number	Channel Frequency Service	45	42	39	41	44	47	32
		666.00	642.00	618.00	634.00	658.00	682.00	562.00
		BBC A	D3&4	BBC B (HD) +	SDN	Arqiva A	Arqiva B	COM7 (HD)
1	FS	77.7	74.7	77.7	72.6	78.2	78.9	78.3
	CSI	19.2	19.5		20.4	22.5	23.2	
	MER	32.0	32.4		32.0	32.3	31.7	
2	FS	71.8	71.8	71.9	69.0	71.3	72.8	65.6
	CSI	20.0	21.6		19.5	19.3	24.2	
	MER	30.9	30.3		31.0	27.1	28.4	
3	FS	76.7	73.7	74.5	67.2	76.1	74.9	69.4
	CSI	22.8	23.1		21.6	20.8	22.0	
	MER	31.5	29.7		28.6	31.4	30.7	
4	FS	73.4	69.6	72.2	70.4	70.1	69.8	71.5
	CSI	17.9	22.4		22.1	25.0	20.8	
	MER	29.9	30.2		28.8	33.0	30.7	
5	FS	77.6	79.5	75.7	73.7	76.9	79.6	68.9
	CSI	21.3	20.3		24.1	23.4	21.8	
	MER	30.4	31.5		28.7	33.0	33.3	
6	FS	77.2	78.2	77.8	75.3	77.4	79.0	77.1
	CSI	20.9	21.8		19.5	21.2	22.1	
	MER	31.6	31.3		29.5	29.6	28.3	
7	FS	74.5	74.2	76.5	72.4	73.9	72.0	72.6
	CSI	23.0	22.7		24.2	22.2	23.2	
	MER	32.7	33.0		32.0	30.0	31.7	
8	FS	70.2	70.5	69.8	70.3	67.6	67.3	68.2
	CSI	23.8	23.1		23.1	22.4	21.0	
	MER	30.0	30.6		30.4	29.9	27.5	
9	FS	75.6	77.0	80.1	72.8	78.3	78.7	76.5
	CSI	20.4	22.5		19.8	21.3	22.9	
	MER	30.1	28.8		31.2	28.4	30.7	
10	FS	79.1	77.5	79.9	76.2	79.3	82.2	78.6
	CSI	22.8	21.6		23.4	20.9	23.6	
	MER	30.5	30.3		31.7	30.7	29.2	
11	FS	78.3	78.6	77.8	72.8	78.1	77.3	71.9
	CSI	19.1	22.1		21.6	24.1	22.4	
	MER	31.8	30.7		31.2	25.7	29.3	
12	FS	70.5	69.2	68.3	64.1	68.4	69.2	68.7
	CSI	21.8	20.3		22.1	22.6	19.9	
	MER	33.0	30.7		30.6	32.0	30.0	
13	FS	79.5	75.2	70.3	76.2	80.2	78.1	79.2
	CSI	18.4	23.3		28.4	22.4	19.9	
	MER	27.0	27.6		27.0	31.2	29.9	
14	FS	82.2	91.9	78.3	88.4	67.3	76.6	77.3
	CSI	21.7	22.7		19.1	20.7	28.9	
	MER	32.0	31.2		32.5	30.2	31.8	
15	FS	83.4	81.2	80.5	75.8	78.3	80.1	77.8
	CSI	18.7	18.6		28.8	21.5	19.2	
	MER	28.6	32.7		32.3	31.1	32.0	

Table B - Field Strength Measurements of Hannington Digital Television Services

Key -

Frequencies listed are in MHz

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

CSI Channel Status Information (%)

MER Modulation Error Ratio (dB)

Survey Measurements

Signal Level ^[1]

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

The level of a DTT signal is measured in the usual units of dB μ V, but the values that will be encountered are much lower than for analogue signals (see Table 1, recommended signal levels) and the relative levels will vary from one transmitter to another. 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.

	Max Signal Level	Min Signal Level
Analogue TV	80 dB μ V	60 dB μ V
DTT	70 dB μ V	45 dB μ V (see notes)

Table 1 – Recommended Signal Levels

(1) The 45 dB μ V figure applies where the set top box (STB) or integrated digital TV (idTV) is the first item in the radio frequency (RF) distribution chain. (This is the normal arrangement and is strongly recommended) A 5dB higher level is necessary to take into account the typical low gains and high noise figures for any satellite receiver or video cassette recorder (VCR), either operating or in standby mode, used ahead of the STB or idTV.

(2) The recommended signal levels in Table 1 are measured at the outlet plate except where a satellite receiver or VCR is used ahead of the STB or idTV, in which case they are measured at the input to the STB or idTV. They assume a minimum C/N (carrier-to-noise ratio) requirement, including a satisfactory margin, of 26dB for 64-QAM rate 2/3 and 22dB for 16-QAM rate 3/4.

(3) These levels are recommendations and should be used only as a guide. Individual installations may need more or less signal level in order to achieve an acceptable decoding margin, depending on the particular system configuration.

For satisfactory reception of digital signals, it is important that ALL of the signals applied to the receiver, both analogue and digital, are within the ranges shown in Table 1. Digital signals are generally in the region of 17dB lower in power than analogue, and in some cases significantly lower still. Particular care is needed when ensuring adequate levels of digital signal, that the analogue signals are not too great, causing overload in the receiver. (Although the distortion on the analogue signals may not be very noticeable, the DTT signals could suffer from such high levels of intermodulation products that they can no longer be decoded.)

Similarly, in existing installations where the analogue signals are delivered at around 60 dB μ V, digital signals may only be in the region of 40 to 45 dB μ V and therefore give unreliable service.

These maximum and minimum levels define a so-called window of operation for the receiver. Note that as the difference in power level between the weakest digital signal and the strongest analogue signal increases, the size of the window decreases.

[1] – Source information – “The Digital TV Group - Digital TV Group R Book 2”, 2002 Edition

An Overview of, BER, CBER, CNR and MER measurements and definitions in Layman's Terms

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. That is, how far are the current reception conditions from those yielding the received signal unusable? 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 34 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. 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 in ^[2], 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.

[2] – Source information – J. Lago-Fernández, "Using Channel State Information (CSI) to Characterize DVB-T Reception", IBC, Amsterdam, 12-17 September 2002

Survey Equipment

Survey Vehicle

Survey Vehicle 1 aka 'Mozart' – Ford Tourneo, Moondust Silver

Field Strength Measurements for Digital and Analogue Television Broadcasts

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 – CSA Radiation Systems International

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.

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

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 network is a highly complex engineering system and is 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 study 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 study 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.