National Grid

IFA2 Converter

TV and Radio Reception Study

OVE-IFA2-REP-001

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1 Introduction

1.1 Scope of Study

The scope of this study is the assessment of the potential impact of the proposed development - IFA2 Converter Station, located at Daedalus Airfield in the borough of Fareham, on the reception of terrestrial television (TV) and broadcast radio services from the Rowridge Transmitter in the surrounding area.

1.2 Broadcast Radio and TV Services

Whilst broadcast radio services are largely received via wireless/radio transmissions, currently in the UK there are four ways in which users receive television services: cable, satellite, terrestrial and Internet Protocol Television (IPTV). Cable television services are received via cables connected directly into a receiver. Satellite and terrestrial TV services are received via an antenna connected by cable to a receiver. IPTV can be received on the conventional TV or computer via an IPTV set-top box which is usually connected to an IP network via Asymmetric Digital Subscriber Line (ADSL) or optical fibres.

In the UK, digital terrestrial TV services are received subject to the payment of an annual licence fee. Satellite and cable TV services are received only on subscription, with the exception of FreeSat which is a subscription free satellite TV service.

According to the Ofcom Technology Tracker Half 1 2017[1] published in April 2017, on average across the UK:

- 30% of consumers main type of television is terrestrial
- 15% of consumers main type of television is cable
- 38% of consumers main type of television is satellite
- 10% of consumers main type of television is via a broadband line
- 5% have no TV.
- 2% of consumers did not know their main type of television

1.3 Proposed Development

The proposed IFA2 Converter Station is located North-East of the Daedalus Airfield, and approximately 400m to the South-West of the Peel Common round-about.

[1] https://www.ofcom.org.uk/__data/assets/pdf_file/0015/101292/technology-tracker-data-tables-h1-2017.pdf

The proposed location of the converter station is shown in drawing OVE-IFA2-DRW-001.

2 Policies and Guidance

2.1 National Planning Policy

Guidance on the consideration of interference with TV and radio transmissions when planning developments is available from the National Planning Policy Framework, 2012[2].The National Planning Policy Framework 2012; Section 5 'Supporting High Quality Communications Infrastructure', paragraph 44, bullet point 2 states the following regarding telecommunication interference:

'Local planning authorities should not impose a ban on new telecommunications development in certain areas, impose blanket Article 4 directions over a wide area or a wide range of telecommunications development or insist on minimum distances between new telecommunications development and existing development. They should ensure that:

- *They have considered the possibility of the construction of new buildings or other structures interfering with broadcast and telecommunications services.'*

2.2 Regional Planning Policy

2.2.1 Core Strategy, Development Sites & Policies

The Fareham Core Strategy (2011)[3] and Development Sites and policies (2015)[4] do not cover specific planning policies that address the impact on TV and radio reception from new developments.

[2] Department for Communities and Local Government, March 2012, National Planning Policy Framework.
[3] http://www.fareham.gov.uk/pdf/planning/CoreStrategyAdopted.pdf
[4] http://www.fareham.gov.uk/PDF/planning/LP2DSPAdopted.pdf

3 Assessment Methodology

3.1 Technical Background

3.1.1 Large Structures

New buildings or structures may affect the transmission paths of TV, radio and other telecommunications services. In the case of terrestrial TV, users may be affected by blocking off TV signal access from the terrestrial TV transmitter from which services are being received or signals being reflected by its facades.

3.1.2 Impact During Construction

During construction, large temporary structures such as cranes may cause some disruption to terrestrial TV reception in the vicinity of the development. However, such temporary structures are unlikely to affect broadcast radio receivers.

As the fixed part of cranes consists usually of a lattice structure, this part is not likely to impact on terrestrial TV reception. Moving parts of cranes, i.e. the boom, may result in a temporary pixelation on TV screens while in movement. As movements are intermittent and infrequent, effects due to construction equipment are not subject to a detailed investigation in this study.

3.1.3 Signal Transmission

In the UK, terrestrial TV signals are transmitted as electromagnetic waves in the Ultra-High Frequency (UHF) band of the electromagnetic spectrum.

In the UK, broadcast radio signals are transmitted at Very High Frequency (VHF) using frequency modulation (FM) from a network of radio transmitters, and also at lower radio frequencies - short wave (SW), medium wave (MW), and long wave (LW) - which use Amplitude Modulation (AM). Radio signals are affected in a similar manner to television signals, although due to the wavelengths involved, can diffract around corners, and propagate through materials more easily. In addition, the reduced signal strength is less noticeable to the listener compared with television signals. Thus, the proposed development is considered to have no impact on LW to VHF frequencies and effects are not considered further in this assessment.

Similarly, frequencies used for Digital Audio Broadcast (DAB) services are in the VHF frequency range. A key feature of DAB radio is that it is a Single Frequency Network (SFN) which enables the receiving unit to simultaneously process multiple transmission of a particular frequency from various transmitters and automatically select the best received signal and/or combine the signals to ensure full reception. Therefore it is very resilient to interference from structures both static and moving.

Each type of service, i.e. broadcast radio, terrestrial TV, is transmitted using a different frequency and wavelength, which means that each type of signal will behave differently in certain situations.

3.1.4 Signal Shadows

Electromagnetic waves propagate in straight lines; visible light is an electromagnetic wave with a range of frequencies much higher than those used for TV and radio transmission. Just as something obstructing a light source creates an optical shadow, objects in the line-of-sight of any electromagnetic transmitter create a shadow of electromagnetic signal behind them. These obstructions may be natural, for example a hill, or man-made, as in the case of a tall building. Within a signal shadow the received strength of a signal will be reduced. The shadow produced using straight-line geometry is called the 'hard' shadow.

There are, however, two factors that affect the strength and size of the signal shadow.

Electromagnetic signals can diffract around obstacles, the amount of diffraction being dependent on its frequency. Low frequency (long wavelength) signals diffract through the largest angles and high frequencies the least. Radio Frequency (RF) signals (LW, MW, SW, VHF and UHF) have longer wavelengths than light and therefore can diffract through larger angles. Due to diffraction, the length of a signal shadow is effectively reduced, and the hard shadow region is tapered as seen in Figure 1.

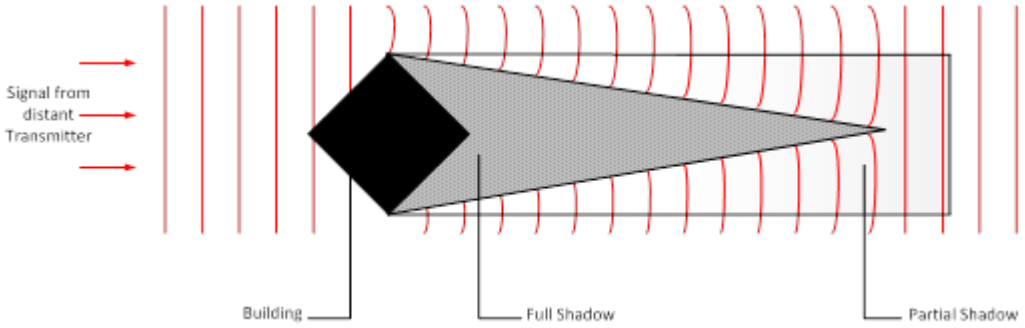

Figure 1: Signal Shadows

3.1.5 Signal Reflections

As in the case of light, any electromagnetic signal can be reflected. Thus, a receiver may receive two or more signals from the same source, a direct signal and one or more reflected signals. The reflected signals travel further and arrive at the receiver later than the direct signal. A typical directional aerial usually receives signals only from within about 30° on either side of the direction in which the antenna points. In many cases where reflected signals are present, the aerial should therefore reject the reflected signal, as shown in Figure 2.

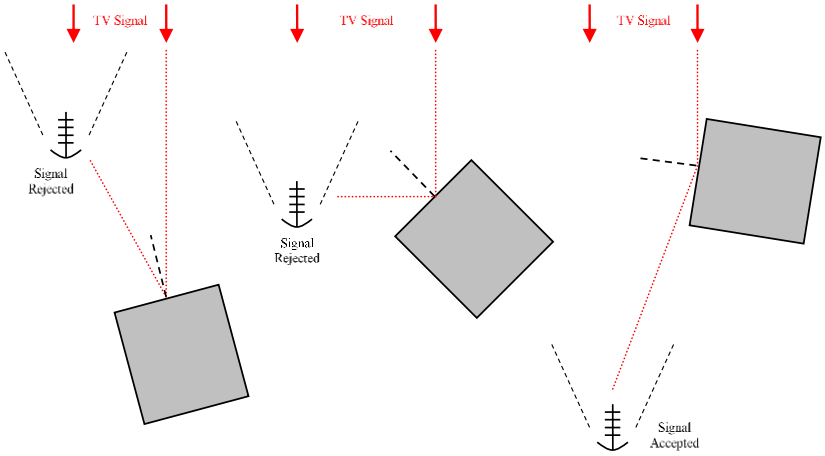

Figure 2: Signal Reflections

The composition of the reflecting material also has an impact on the strength of the signal reflection, with metal impregnated glass and flat polished metallic structures being the most reflective surfaces.

The method of reception of digital terrestrial TV has the ability to reject the relatively weaker reflected signals, and so the presence of reflected signals has little or no impact.

3.1.6 Digital TV

Digital terrestrial TV can be affected greatly by shadowing, as reception is largely perfect or non-existent. Because of this, the digital TV assessment presented in this document was subjected to a detailed investigation.

3.2 Assessment Method

The study is based on:

- The location of the proposed development in relation to the location of the Rowridge transmitter;
- The physical massing of the proposed development; and
- Principles of electromagnetic wave propagation.

The study of impacts is undertaken using a three-dimensional model of the development, provided by the developer.

The quantitative analysis, which includes modelling in AutoCAD, is based on first applying geometrical optics to identify broadly the areas around the development where television and radio reception could be affected. Principles of radio signal transmission from transmitting to receiving antennas are then used to study the impact of the major structures in the proposed development on radio and TV reception (or shadow created) in the area surrounding the development.

The quantitative assessment is in accordance with OFCOM guidance on desktop assessments set out in their publication "Tall structures and their impact on broadcast and other wireless services" dated 26 August 2009.

3.2.1 Significance Criteria

The significance of the impacts on TV reception is assessed by considering the size of the area, the number and types of properties affected, the type of television service commonly employed in the affected area, as well as the predicted effect on signal reception.

Significance criteria will have a direct bearing on the estimated cost of mitigation. The following significance criteria are used, on the basis of the number of households where TV reception may be affected:

- No impact – No households
- Negligible – less than 30 households.
- Slight – 30-100 households.
- Moderate – 100-500 households.
- Major – greater than 500 households.

3.2.2 Limitations

An unavoidable limitation on the information gathered on the areas surrounding the new development is that there will always be some developments in progress in the areas being considered and these changes may not be reflected in maps and aerial photographs produced at a particular point in time and used for this investigation.

3.3 Baseline Conditions

Publicly accessible transmitter information has been used to deduce the current profile of television and radio reception near Lee-on-the-Solent and Fareham area in Hampshire.

Digital terrestrial TV reception in is mainly from signals received from the Rowridge transmitter (LR National Grid Reference SZ4458686534), located approximately 12 miles away at a bearing of 219 degrees to the proposed development site. The terrestrial TV coverage from Rowridge transmitter in the vicinity of the proposed development is shown in Figure 3 below.

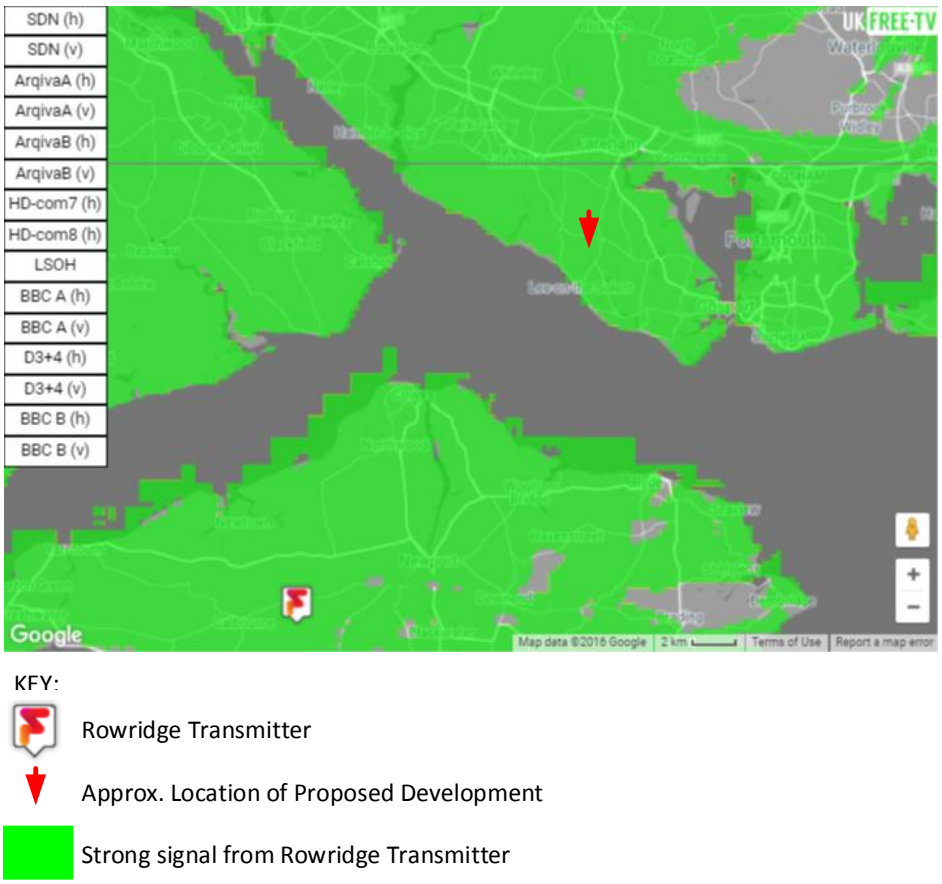

Figure 3: Terrestrial TV coverage from Rowridge Transmitter[5]

The quality of terrestrial television reception achieved is dependent on the equipment used at the receiving site. In many cases, a standard roof-top directional Yagi-type antenna is sufficient to obtain adequate signal reception, although in some cases, a high gain, more directional antenna, and / or masthead amplifier is employed.

FM BBC radio signals are transmitted from the Rowridge transmitter[6]. A number of other transmitters transmit a variety of FM and AM (MW) broadcasts. Radio stations, with consent from Ofcom, may select transmission sites as they see fit.

The DAB radio service[7] in Fareham area is provided by the Rowridge, Chillerton Down, Salisbury and Midhurst transmitters with a number of relay transmitters strategically located in Hampshire area.

It is possible that there is already a deterioration of signals in the Fareham area caused by existing tall buildings, additionally smaller structures may cause more localised signal disruption.

[5] https://ukfree.tv/transmitters/tv/Rowridge

[6] https://ukfree.tv/radio/prediction

[7] http://www.ukdigitalradio.com/coverage/currenttransmitters/details.asp?postcodeInput=PO139PB

In practice, it is difficult and almost impossible to identify the existing structures that cause such deleterious effects because they may be located anywhere within a large radius from the area under consideration.

4 Potential Impacts

4.1 Broadcast Radio

The radio frequencies used for the transmission of broadcast radio - LW to VHF - are such that signals can penetrate to some extent through obstacles and signals readily diffract around corners. Thus, the proposed development is unlikely to cause any significant interference to radio reception and thus there will be no impact.

Similarly, frequencies used for DAB services are in the VHF frequency range. As explained above, DAB radio uses the SFN technology to select the best of multiple simultaneous transmissions. As such, any blocking of a DAB signal by the proposed development would only be caused if there are no alternate DAB radio signal sources available. Hence, the proposed development is considered to have no impact on DAB radio service.

4.2 Terrestrial Television

4.2.1 Shadows

Terrestrial TV transmissions are affected by shadows and as such the transmission from the Rowridge transmitter is subject to a detailed investigation as part of this study.

The position and massing of the proposed development in relation to the position and height of the Rowridge transmitter dictates that signal shadows are created to the North-West of the proposed development. The position of the development in relation to the transmitter and the ‘hard’ signal shadow, where receiving antennas do not have line of sight of the transmitting antenna, are shown in drawing OVE-IFA2-DRW-001 included in Appendix A.

From initial analysis, the ‘hard’ signal shadow from the Rowridge transmitter continues for approximately 1.2 km from the proposed development to the North - West and has an approximate area of 18.6 ha. The shadow stops approximately 3 metres after Pettycot Crescent. Approximately 82% of the shadow falls across green spaces. Hence, the resulting area that may potentially experience disruption in its signal from the Rowridge transmitter is approximately 3.4 ha.

Using the Census Output Areas (COA) and persons per household (Census 2011) statistics obtained from the Office for National Statistics, the number of households per hectare, for each COA was calculated. Then, the COAs within the ‘hard’ signal shadow were identified and the associated number of households calculated.

Not all households in the shadowed area will currently be using digital terrestrial TV. Using the most recent Ofcom Technology Tracker Half 1 2017 figures mentioned earlier, approximately 30% of households within UK have digital terrestrial TV as their primary source of TV.

Based on number of households calculated, the figures in the Ofcom Technology Tracker Half and taking into account diffraction effects (which further reduce the impact area), the total number of households likely to be affected as a result of shadowing from the Rowridge transmitter is 4.

Whilst any terrestrial TV receiver outside these actual impact areas is not likely to be affected by the shadows caused by the development, within the shadowed areas there is some likelihood that terrestrial TV services may be affected. Increasing uptake of cable, satellite, and IPTV services is also likely to further reduce the number of households affected by shadowing of terrestrial TV caused by the proposed development once it is completed.

Taking all the above considerations into account, the proposed development is likely to have a negligible impact on terrestrial TV services from the Rowridge transmitter due to shadowing of terrestrial TV signals. Potential mitigation measures in the potential areas affected by the shadows caused by the development are identified in Section 5 of this document.

4.2.2 Reflections

TV signals can be reflected when they encounter obstacles. The reflectivity of the material will dictate how much of the signal is reflected, but in general the reflected signal strength will be much less than that of the original incident signal.

Digital transmission effects due to reflections are not noticed because the digital receiving device (the decoder) rejects the weaker signal and picks only the stronger signal. It is possible for signal ‘dead’ spots to be created by a strong signal reflection received in anti-phase to the main transmission; this could affect digital transmissions. However in reality the likelihood of this happening is extremely small. Additionally, in the vast majority of locations where reflections are cast, an adequate and correctly directed receiving antenna should reject the reflected signal (a standard domestic-type aerial rejects signals outside a 30 degree angle off the direction in which it points). Hence, signal reflections from the proposed development can be discounted.

5 Mitigation Measures

5.1 Terrestrial TV

5.1.1 Using Existing Services

Shadows are created by the placement of a solid object in the line of propagating waves. As such once a building or structure is in place, the shadows themselves cannot be mitigated. The only factors that can be introduced in order to minimise the effect on local reception in the shadow area are to the actual reception sites themselves.

The mitigation measures that can be introduced in the potentially affected area to overcome the adverse effects due to the signal shadowing caused by the proposed development are:

- Improving the receiving antenna. This involves the installation of a new higher gain antenna, with improved directionality. A high gain will increase the received signal strength, which will reduce the effect of shadows; and improved directionality will improve the antenna directional response, thus reducing the impact of reflected signals. The effect of shadows may be circumvented in some instances by making better use of diffracted direct signals and/or using reflected signals from other buildings.
- Installing a mast-head amplifier. In some cases, the received signal might be improved by using a mast-head amplifier. This boosts the received signal at the antenna location.
- Relocating or redirecting the receiving antenna. In some circumstances the interference is extremely localised and relocating the receiving antenna at another point in a building may be able to improve the received signal strength sufficiently. This may be because the effect of shadows is obviated by making better use of diffracted direct signals and/or using reflected signals off other buildings.
- Making use of relay transmitters. Digital TV signals from an alternative transmitter may be available at the receiving antenna and they may not be affected by the proposed development. An improved, higher gain antenna may be needed to make use of the low power signal.

5.1.2 Using New Services

With the mitigation measures mentioned above in place, there may be a small number of residences where their preferred primary source of television is still not available.

Viewers in this situation may have to receive TV from an alternative service. This could be in one of the two following forms, with the choice of service in a particular instance being based on service availability and the cost of implementation:

- A digital cable television service;

- A digital satellite television service (BSkyB's new free-to-view service, "FreeSat from Sky).

5.2 Need for Mitigation

The need for taking mitigation measures arises only when television users, i.e. mainly residential households, notice that their reception has deteriorated and the deterioration can be directly attributable to the proposed development. The mitigation investigations can be carried out whenever a problem is reported during or after construction. This will generally only occur when construction of the development is substantially complete. Additionally, a transmitter signal may be affected, but not enough to cause interruption to the service. This study identifies where a signal may be affected, which does not necessarily mean the service will be affected.

Service deterioration can be caused by a number of factors such as the user's antenna, the antenna to receiver cable connection, the receiver, and any buildings and structures in the vicinity of the television user's household. It is only in the event that service deterioration has occurred and the cause of this serious deterioration of the user's television services is due to the proposed development, and not due to any other likely cause, that any mitigation measures would become the responsibility of the developer.

The actual liabilities resulting from the proposed development for restoring TV services are likely to be well below the estimated number of potentially impacted households identified in section 4 because the following assumptions are implicit in the estimates:

- In the impact areas, all receiving antennas point in the direction of the corresponding impacted transmitter and there are no receiving antennas pointing in the direction of any other transmitters.
- Everyone in the impact area notices the interference effects.
- The interference effects are serious enough to warrant correction.
- Any adverse effects are traceable to the proposed development.

5.3 Residual and Cumulative Impacts

Given the nature of the potential impacts, with the outlined mitigation measures in place it is anticipated that all residences in the area should be able to receive an adequate television service (either by terrestrial, satellite or cable). Hence, the residual effect of the proposed development in operation would not be significant.

6 Summary of Impacts

Television and Radio Reception	Impacts		Mitigation Measures	Residual Impacts	
	Nature	Significance criteria Major, moderate, slight, negligible, No impact		Nature	Significance criteria Major, moderate, slight, negligible
Radio Reception	Deterioration in radio reception caused by signal shadows	No Impact	None	None	Not applicable
Terrestrial TV Reception	Deterioration in digital terrestrial television caused by signal shadowing to the Rowridge transmitter.	Negligible	Repositioning or improving receiving antenna Use of alternative services	None	Not applicable

7 Conclusions

From the detailed analysis carried out, it is possible to conclude that the proposed development:

- Is likely to have no impact on the reception of broadcast radio services from Rowridge transmitter.
- Is likely to have a negligible impact on terrestrial TV services from the Rowridge transmitter in areas immediately North-West of the development, due to shadowing of terrestrial TV signals.
- The locations potentially affected may be able to have terrestrial TV services restored by using one of the following methods as appropriate: Installing a higher gain antenna, re-locating the existing antenna or re-pointing the existing antenna to another transmitter where possible or, if any of these solutions are unable to restore service, by installing satellite or cable TV services.
- The residual effect of the proposed development in operation will not be significant.

Appendix A

Drawing

A3

Notes

1. To be read in conjunction with the TV and Radio Reception Study, OVE-IFA2-REP-001.

Legend

- Proposed Development Site
- Rowridge Transmitter Signal Shadow

Revision	Date	By	Chkd	Appd
B	23/06/2017	SB	AO	AT

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Client

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Drawing Title

TV and Radio Transmitter Location

Scale at A3

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Drawing No	Revision
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