

COMMISSIONED REPORT

Siting and Design Guidelines for Mobile Telecommunications Developments in the Highlands and Islands

Report No. F00AA508

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Report No: F00AA508 Contractors: Part I Turnbull Jeffrey Partnership Part II horner+maclennan for Derek Lovejoy Partnership

Background

Part I of this study was commissioned in November 2000 by Scottish Natural Heritage, The Highland Council and Highlands and Islands Enterprise. The study reviewed the landscape, visual and natural heritage impacts of existing telecommunications developments and developed best practice guidelines in consultation with a number of mobile telecommunications operators and their agents. The study also considered current planning and development control processes.

Part II was commissioned, as a supplementary study, in January 2002 by Scottish Natural Heritage to investigate the potential future impacts which may be likely as a result of a significant increase in the number of telecommunications developments.

Main Findings

The main factors which determine the visual and landscape character impacts of any proposed mobile telecommunications developments are: the character of the landscape and how it is considered; and the siting and design of the mast, ancillary equipment and associated infrastructure including access tracks, fences and power source.

When selecting a radio base station site or assessing a selected site the following should be considered:

- the more simple and compact the layout of the radio base station the better;
- the more features which can be concealed from significant viewpoints the better;
- it is important to assess the relative advantages and disadvantages of mast sharing, site sharing and new site alternatives; and
- avoid developing masts within or on the edge of areas which possess qualities of 'wildness'.

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PART I

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1. Introduction

This chapter explains the commissioning details, the need for the study, and the purpose of this document.

1.1 The study

The Turnbull Jeffrey Partnership (TJP) was commissioned by Scottish Natural Heritage (SNH), The Highland Council (THC) and Highlands and Islands Enterprise (HIE) in November 2000 to prepare these Siting and Design Guidelines for Mobile Telecommunications Developments in the Highlands and Islands of Scotland.

This document addresses siting and design issues in terms of the landscape, visual and ecological impacts of mobile telecommunications developments and broadcast sites and it does not address any other environmental impacts which may arise from mobile telecommunications developments.

Although this report is intended primarily to assist

Planning Officers and SNH Area Officers in assessing proposed mobile telecommunications developments it is likely also to be of interest to mobile telecommunications operators and could potentially have a much wider readership.

1.2 The need for siting and design guidelines

The telecommunications industry worldwide is in a period of rapid expansion and innovation with increasing competition. The Scottish Executive Development Department (SEDD), through their National Planning Policy Guideline NPPG 19: Radio Telecommunications (NPPG 19), recognises that Scotland must have an advanced telecommunications network of the highest quality in order to maintain and improve its position in the global market and to help reduce the disadvantages of a peripheral location in Europe. This is particularly important for rural areas such as the Highlands and Islands. However mobile telecommunications is one sector of the industry which raises natural heritage issues.

Until recently, most mobile telecommunications sites (ie those that are not located in National Scenic Areas (NSAs) and masts less than 15m in height) have been developed under Permitted Development Notification procedures, often taking little account of environmental factors. The result has been that many mobile telecommunications installations have had an adverse impact on the landscape of the Highlands and Islands. The purpose of this document is not to justify, explain or criticise past development nor to quantify the level of impact of existing radio base stations: rather, existing radio base stations have been studied with the intention of informing these guidelines to aid future development.



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In areas of the Highlands and Islands the population is too low and the terrain too extensive to justify much in the way of improved wire/fibre optic based services and broadband access will almost certainly come from a wireless signal. Third and subsequent generation services may be the primary means of broadband access in the Highlands and Islands in the future.

SNH, THC and HIE recognise the considerable economic benefits coming to the Highlands and Islands of Scotland from the provision of a high quality telecommunications service. It is, however, also recognised that future expansion of mobile telecommunications infrastructure has the potential to result in adverse environmental impacts and that this potential is of concern to a wide range of public agencies and organisations as well as to members of the general public.



Given the inevitability of this continuing expansion, the

changing technologies associated with new communications media and the recent changes to legislation, SNH, THC and HIE all consider it to be vital to establish clear siting and design guidelines to ensure that future development results in acceptable environmental impacts.

Various documents providing broad policy and guidance relating to the siting and design of mobile telecommunications exist: NPPG 19; PAN 62; The Highland Structure Plan; mobile telecommunications operators' handbooks; and Scottish Natural Heritage's Landscape Character Assessments. It is intended that these guidelines will complement this suite of information.

1.3 Existing guidance

National Planning Policy Guidance (NPPG 19)

It is the aim of the Scottish Executive Development Department (SEDD), as defined in the National Planning Policy Guideline 19: Radio Telecommunications (NPPG 19) published in July 2001, that mobile telecommunications equipment "should become an accepted and unobtrusive feature of urban and rural areas". NPPG 19 recognises that siting and design are key issues and that telecommunications developments should be sited and designed to minimise their visual impact. Key issues arising from NPPG 19 are summarised in Appendix VII.

Planning Advice Note (PAN 62)

A Planning Advice Note (PAN 62) was published by the Scottish Executive Development Department in September 2001. Key issues arising from PAN 62 are set out in Appendix VII.

PAN 62 recognises that radio telecommunications have an important role to play in supporting the further social and economic development of Scotland and notes "the challenge is to ensure that radio telecommunications development can be made an accepted and unobtrusive feature of urban and rural areas, through high standards of siting and design and sensitive, imaginative and creative design solutions".

PAN 62 gives good practice advice on the process of site selection and design.

The Highland Structure Plan December 1999, Approved March 2001

The Highland Structure Plan (THSP) Policy G2 states that:

"Proposed Developments will be assessed on the extent to which they: are compatible with service provision (water and sewerage, drainage, roads, schools,



electricity); are accessible by public transport, cycling, walking as well as car; maximise energy efficiency in terms of location, layout and design, including the utilisation of renewable sources of energy; are affected by significant risk from environmental hazards including flooding, coastal erosion, land instability and radon gas, unless adequate protective measures are incorporated, or the development is of a temporary nature; are affected by safeguard zones where there is a significant risk of disturbance and hazard from industrial installations, including noise, dust, smells, electro-magnetism, radioactivity and subsidence; make use of brownfield sites, existing buildings and recycled materials; impact on individual and community residential amenity; impact on non-renewable resources such as mineral deposits of potential commercial value, prime quality or locally important agricultural land, or approved routes for road and rail links".

THSP Policy G3 states that:

"Where environmental and/or socio economic impacts of proposed developments are likely to be significant by virtue of nature, size or location, The Council will require the preparation by developers of appropriate impact assessments. Developments that will have significant adverse effects will only be approved if no reasonable alternatives exist, if there is demonstrable over-riding strategic benefit or if satisfactory overall mitigating measures are incorporated".

THSP Policy U4 states that:

"The council will give favourable consideration to proposals for the erection of radio masts and other telecommunications structures provided there is compliance with Strategic Policy G2 and that:

• existing masts or other structure cannot be shared;

- existing services are not interfered with;
- there is no discernable risk to public health;
- the operator is licensed (except in domestic circumstances);
- the proposal forms part of a network (except in domestic circumstances); and
- redundant masts and equipment are removed (without prejudice to their possible re-use elsewhere)".

Mobile telecommunications operators' handbooks

Most mobile telecommunications operators have produced their own handbooks which address the general issues of siting and design.

Landscape Character Assessments published by SNH

This series of documents covers the whole of Scotland including the Highlands and Islands area. They highlight the key landscape characteristics to which a development should relate and provide outline guidance for general development. In some cases they also provide specific guidance for mobile telecommunications development in relation to the specific Landscape Character Types of the Highlands and Islands.

Siting and Design Guidelines for Mobile Telecommunications in the Highlands and Islands

The Highland Council, Scottish Natural Heritage and Highlands and Islands Enterprise are keen to ensure that future mobile telecommunications installations are designed and located in a manner which is appropriate to the different landscape character areas of the region. These guidelines have been prepared to assist in achieving this aim.

It is recognised that the main factors which determine the visual and landscape character impacts of any proposed mobile telecommunications development are:

- the character of the landscape and how it is experienced; and
- the siting and design of the mast, ancillary equipment and associated infrastructure including access tracks, fences and power source.



2. Background to Mobile Telecommunications

This chapter provides a summary of the background to mobile telecommunications in the Highlands and Islands, identifies the key points in relation to both existing and proposed legislation and provides an introduction to the technical issues.

2.1 History and development of mobile telecommunications in the Highlands and Islands

Appendix I sets out a summary of the history and development of mobile telecommunications in the context of the Highlands and Islands and provides the following key information:

- details of the 1996 expansion programme; and
- predicted environmental impacts of the expansion programme.



2.2 Previous legislation

Appendix II provides an overview of the legislation which was in force at the time of undertaking the study. The key issues in that legislation were:

- operators had the right to install apparatus on land which was:
 - i) private, with the prior agreement of the owner;
 - ii) private by means of compulsory purchase order; and
 - iii) in the public highway under the Public Utilities Street Works Act 1950.
- ground based masts under 15m high were classed as Permitted Development and did not require an individual planning application unless they supported microwave antennas and were located in an NSA; and
- under the 1984 Telecommunications Act the Telecommunications Code placed certain amenity obligations on operators when using their permitted development rights.

2.3 Current legislation

Appendix III provides an overview of the legislation which was introduced in July 2001. The main implications of this legislation for future mobile telecommunications developments in terms of siting and design issues are:

• planning permission will be required for all ground based masts erected for the support of antennas;

- an increase in the number of designated areas within which Permitted Development Rights (PDR) are restricted;
- tighter controls placed on PDR for apparatus, including antennas and equipment housing, on buildings and other structures; and
- a requirement to give planning authorities 28 days notice of the installation of equipment housing and antennas under PDR.

2.4 Background to technical issues

Appendix IV describes the technical issues of mobile telecommunications in more detail. The key issues are summarised below.

First Generation System (1G)

The analogue system, or Total Access Communications System (TACS), known also as 1G, was introduced with the issue of two licences to Vodafone and BT Cellnet in 1984. This system had few features other than allowing users to make and receive phone calls and, at first, only high power handsets for use in cars were available which meant that fewer radio base stations were required than are needed today.

TACS had limitations and the Group Special Mobile (GSM) system was developed to replace it. BT Cellnet shut down its TACS network at the end of 2000 while Vodafone's was decommissioned in April 2001.

Second Generation System (2G)

The development of the first digital system, GSM, known also as 2G represented a significant change in mobile telecommunications towards a system capable of carrying both voice and data, and offered performance improvements over 1G. Vodafone's 2G services were launched in 1993 and those of BT Cellnet in 1994 with One2One and Orange entering the market, using the Personal Communications Network (PCN) which operates at different frequencies to GSM, in 1993 and 1994 respectively.

By the mid 1990s user demand for hand held units, with lower powered batteries, and an increase in the number of users meant that additional radio base stations were required (each base station being capable of handling only a limited number of simultaneous calls).

For example, Orange launched its service in 1994 with just under 1500 sites, anticipating expansion to 3000. Customer demands and expectations, together with operational performance of sites, or lack of performance, has meant that the number of sites continues to grow towards 10,000.

GSM and PCN has limitations in as much as the data transfer rate is slow and operators believe, due to the success of the internet, that there is a demand for higher speed data transfer services and for a single solution which will eventually meet all communication needs.

Third Generation System (3G)

The Third Generation System, 3G, known as Universal Mobile Telecommunications System (UMTS) which it is intended will be adopted globally (2G systems vary world-wide) is capable of very high data transfer rates and an improvement over 2G is that the range of services which it can carry will be greater.

The four existing 2G operators in the UK, together with a fifth, Hutchison 3G, have been awarded licences to operate their 3G systems from 2001. The licences require that all five operators provide service to 80% of the UK population by the end of 2007. Under the terms of these licences none of the operators are obliged to provide coverage for the Highlands and Islands as they could achieve the 80% threshold by concentrating on just the main population centres across the UK. The precise implications in terms of the requirements for additional radio base stations are as yet unknown but it is safe to assume that additional radio base stations will be required given that the 2G and 3G systems are likely to



operate in tandem for some time. However, in the short to medium term 3G coverage is likely to be restricted to the more populated areas of the UK.

It is also likely that 3G radio base stations will require to be located at much more frequent intervals than those for 2G, although operators will utilise their existing infrastructure wherever technically possible. Predicted cell sizes are between 2–4km for rural areas and 0.5–1km for more heavily urbanised areas. 3G operators estimate that approximately 50,000 sites will be required by 2003 (over an existing total of 22,500) and NPPG 19 speculates that this total may grow ultimately to 80,000. However, as can be seen from the 2G forecasts, these predictions may be totally out-stripped in reality.

3. Mobile Telecommunications Equipment

This chapter describes the radio base station infrastructure required by mobile telecommunications operators, explains which elements can be shared, outlines the current situation regarding site and mast sharing and highlights some issues regarding future site and mast sharing, construction, maintenance and decommissioning considerations.

3.1 Infrastructure requirements

The Mobile Telecommunications Programme Environmental Study Report (EDAW 1996) describes the original typical requirements of Vodafone and BT Cellnet and these are summarised in Appendix VI. It should be noted that the Vodafone/BT Cellnet joint project shared much of the ancillary kit and that much of Vodafone's network has been constructed using a methodology which negates the need for permanent generators,



access tracks and overhead power lines. Photographic examples throughout this document illustrate that there is no 'typical' requirement and that the sites developed vary considerably in format with PCN and GSM operators generally choosing different equipment.

The basic infrastructure requirements for a single operator's radio base station are as follows:

- a site and/or structure;
- control equipment and housing;
- antenna and cable connection;
- a link to the fixed line network; and
- an electricity supply and electrical cabinet.

Other equipment and structures which may be required in certain locations includes:

- microwave dish or dishes;
- a maintenance ladder;
- a cable ladder;
- a perimeter fence;
- an access track; and
- liquid petroleum gas (LPG) power generator.

The illustration overleaf shows how these elements may combine to transform a basic radio base station into a complex development.



Radio base station with overhead electricity supply.....equipment compound.....and access track

While different mast designs and antenna configurations are available, not all are interchangeable or, if they are, there may be other consequences to take into account.

For example, a very slim mast supporting an omnidirectional antenna system will not have the same operational characteristics as a fully sectored antenna array which has to be supported by a larger structure. For an omnidirectional antenna system:

- the geographical spread of coverage would be less;
- building penetration would be weaker;
- interference within vehicles would be greater; and
- call handling capacity would be more limited.

To overcome the deficiencies there might be a requirement for a greater number of masts and/or for greater mast height.

3.2 Infrastructure which will always be required

Site or structure

A number of options exist for the siting of radio telecommunications developments. The complete radio base station can be located at roof level on an existing building (in both urban and rural situations) with control equipment located in a cabin at roof level. Existing buildings (or restored ruins) can also be used to both mount equipment (antenna, microwave dish) and to house the control equipment.

In certain situations, existing electricity pylons can be used to mount antenna and microwave dishes with ground based control equipment in a cabin adjacent.



Roof mounted equipment

Where no existing structures exist, a new structure in the form of a mast will be required.

Two basic design alternatives for masts are currently utilised: the lattice mast and the monopole (this is the term in general use to describe all columnar-type masts). Cable stayed masts have not been widely utilised to date for mobile telecommunication masts.

The lattice mast

The lattice mast comes in a variety of detail designs and sizes depending on the location and the needs of the operator(s). The design of lattice masts is beginning to evolve as some operators try to improve its visual appearance in response to environmental concerns.

The monopole

The monopole comes in one basic design, but has been developed by some operators to conceal antenna and to mimic other vertical features in the landscape such as flagpoles, telegraph poles, lamp posts and coniferous trees. Some operators now can also use real trees to take equipment.



Lattice mast





Cross polar antenna





Antenna and cable connection

Antenna design alternatives include: omnidirectional antenna, typically mounted on lattice masts; cross polar antenna, typically mounted on lattice masts or monopoles; panel antenna, typically mounted on lattice masts; and concealed antenna within monopole structures serving different purposes. Each of these has a different appearance, and some are illustrated on page 10.

Control equipment

The equipment cabin houses the control equipment and, currently, most commonly needs to be located no further than 30m from the mast. Some operators incorporate the electrical cabinet within the equipment cabin while others do not. In addition to 'off the peg' steel or glass reinforced plastic (GRP) cabins, control equipment can be housed in purpose built structures or in restored ruins and can be semi concealed by being recessed into hill slopes.



Control equipment cabin

Link to the fixed line network

The radio base station is linked to a Mobile Telephone Exchange (MTX) which is linked to the Public Switched Telephone Network (PSTN) thereby enabling access to the national and international Networks. The link between the radio base station and the MTX is provided by either:

- a communications cable (ie fibre optic) utilising the fixed line network; or
- where there is a direct 'line of sight' between the radio base station and another installation (another radio base station or relay station) in the network.

An electricity supply and electrical cabinet

The electricity supply may be from the National Grid via below ground or overhead lines. An electrical equipment cabinet will also be required and may be a stand alone structure or built in to the control



Green cabin with integral cabinets; grey cabin with stand alone cabinet



Overhead electricity supply

equipment housing. Alternatively, where no source of electricity exists, an on-site generator or renewable energy source will be required.

3.3 Infrastructure which may be required in certain situations

Microwave dish

Where it is not possible to link to the fixed line telecommunications network, microwave dishes will be required to link the radio base station to the mobile telecommunications exchange (MTX). A direct link is only possible where a direct 'line of sight' exists between the radio base station and the MTX. Where this line of sight does not exist, base stations can be linked by microwave dishes before being linked by a fixed line to the MTX. Alternatively, intermediate relay stations can be used to establish a connection between the radio base station and the MTX. Microwave dishes vary in diameter commonly between 0.4–1.2m with the dish size being dictated by the distance between sites.

Maintenance ladder

The maintenance ladder is an optional structure associated with lattice masts although it is often required for health and safety reasons where it is impossible for a moveable access platform to gain access to repair or maintain antennas. The ladder is generally incorporated into the centre of the mast. Monopoles do not include maintenance ladders.



On site generator



Microwave dish



Cable ladders

The connection from the mast mounted equipment to the ground based control equipment can either be directly from the mast (below or above ground) or via a cable ladder. Columnar mast connections tend to be below ground and the cables are concealed within the shaft of the mast. Lattice mast cables are visible on the mast and can be connected to the control equipment either 'directly' (where the equipment cabin is immediately

Maintenance ladders



Cable ladder

adjacent to the mast) or 'indirectly' (where the mast and cabin are not immediately adjacent to each other). Where the connection is 'indirect' the cables may be buried below ground or be housed on cable ladders of various lengths.

Perimeter fence

Where existing radio base stations have perimeter fencing, this varies from simple post and wire, to timber post and rail in rural situations to chainlink security fencing in urban and peri urban areas. On some sites fencing is essential in order to comply with health and safety at work legislation. In addition, fences are often required to prevent access to equipment cabins which contain very sensitive and expensive equipment.

Access track

Where radio base stations are located adjacent to existing roads or tracks it may be necessary to construct a hard standing for maintenance vehicles. Where radio base stations are remote from existing roads, access tracks for construction and/or maintenance may be required. It is possible to provide construction and maintenance access by ATV and in some circumstances construction materials may be transported to site by helicopter with ATV access for labour and other materials being required. Where an electricity generator forms part of the development access and parking will be required for fuel tankers as well as for maintenance vehicles.

3.4 Examples of masts currently available

Many different mast designs are currently available and the design of masts is continuing to evolve. Some examples of the types of lattice mast currently in use are shown below.





Typical post and rail fence



Access track

The monopole is also available in a number of different designs ranging from the simple monopole surmounted by antennas to those designed to mimic other features such as telegraph poles, lampposts, flagpoles and even coniferous trees.



In addition, radio base station equipment can be accommodated in a number of other ways as shown below.



Roof mounted equipment



Equipment within an observation tower



Equipment within a restored building, with antenna disguised as chimney

3.5 Infrastructure sharing

Infrastructure sharing falls into two categories:

- mast sharing; and
- site sharing.



Lattice mast sharing



Monopole sharing

Some existing infrastructure is shared by two or more operators with some of the largest hilltop masts, developed originally for the emergency services, providing sites for mobile telecommunications operators' equipment. In some circumstances two or more masts may be located on a single site with several users sharing the electricity supply and access but no other facilities.

The infrastructure which can be shared by operators comprises:

- accommodation (the site) including perimeter fencing;
- electricity transmission lines but not the electrical cabinet;
- masts and maintenance ladders (if structurally capable of taking more than one operator's equipment);
- the ground based control equipment housing (although in practice operators tend to prefer to use their own cabins); and
- cable ladders (in circumstances where the site has been laid out with this objective in mind).



Site sharing and mast sharing

The infrastructure which cannot be shared, is largely dependent on the technical requirements of operators, and comprises:

- base transceiver equipment (control equipment);
- antennas;
- cable links to the fixed line network;
- electrical cabinets; and
- microwave dishes.

3.6 Other infrastructure which may be required

Relay stations

Where no direct 'line of sight' or cable connection is possible between a radio base station and the mobile telecommunications exchange a relay station, or stations, will be required. These are typically timber posts surmounted by microwave dish(es). Microwave relay stations can also be positioned on existing structures such as buildings and electricity pylons.



Relay station

3.7 Infrastructure implications arising from the introduction of 3G technology

It is inevitable that more infrastructure will be required given that the 2G system will continue to operate at least until the expiry of existing licences. Until 3G coverage is complete, 2G systems will still be required.

The precise infrastructure requirements are not likely to differ significantly from 2G although the radio base stations will be sited at closer distances with cell sizes of between 2–4km in rural areas and 0.5–1km in more heavily urbanised areas.



Illustration provided by Hutchison 3G

The introduction of 3G is likely to have serious

implications in terms of the numbers of masts and sites required as operators with existing 2G infrastructure are likely to wish to reserve additional capacity on their sites and masts for their own 3G infrastructure rather than negotiate site sharing with other operators' 2G infrastructure. Recent changes to legislation means that mast heights will now tend to be of greatly varying heights, balancing operational requirements with environmental criteria; rather than the standard 15m which has been common in the past, as this was the threshold for Permitted Development Rights. Operators can, however, be expected to use existing telecommunications sites whenever available.

In summary, more radio base stations will inevitably be required in the future but the true volume of this is not yet known. Similarly, it is unclear as to when the 'roll out' of 3G might occur in the Highlands and Islands of Scotland as the licence requirements, to provide coverage to 80% of the population by 2007, may mean that areas of low population density will not be provided with 3G coverage until some time after this date.

3.8 Equipment erection, maintenance and decommissioning

In addition to there being a variety of different equipment required for radio base station developments there are also variables in terms of construction

operations and maintenance requirements.

Access

Access for construction and maintenance will be dependent on the location of the radio base station and will take one of the following formats:

- directly from existing road or pre existing track constructed for other purposes;
- directly from existing mobile telecommunications access track;
- via an extension to existing mobile telecommunications access track;
- via a new access track;



Access directly from trunk road

- access using ATV with no track; and
- construction access using helicopter and ATV with ATV access for maintenance with no track.

It should also be noted that maintenance access can also be on foot although there are Health and Safety restrictions in regards to the transport of tools and equipment.



Access via existing metalled track

Construction

The materials required for construction will vary depending on the precise nature of the development but are likely to include the following:

- the equipment and structures of the radio base station including all foundations (concrete ready mixed or mixed on site), plant and ancillary structures; and
- materials for access track construction including geotextile membranes, roadstone, drainage pipes.

Works will also vary in regards to:

- the extent of the site;
- delineation of the construction area;
- preparatory works;
- platform construction or use of exposed rock;
- plant and access required to install underground electrical supply;
- depth and backfill of trenches;
- vehicles required to import and export materials, labour required, noise and dust (in some circumstances); and
- construction period and reinstatement of disturbed areas.



New access track over flat moorland



Mast close to road – access on foot or by ATV

Mobile Telecommunications Radio Base Station

equipment which will always be required



equipment which may be required



Equipment which can be shared by more than one operator

Equipment which cannot be shared by more than one operator

Maintenance considerations

Maintenance considerations include frequency of visits (including fuel deliveries to electricity generators) and means of access which may be of particular concern if more than one operator is using an ATV over hill ground as a means of access resulting in erosion and damage to vegetation.

Decommissioning considerations

All 2G and 3G licences under the new legislation require that radio base stations and their associated infrastructure be removed and the area reinstated to the satisfaction of the Planning Authority when the equipment is no longer required or on expiry of the licence.

The nature of decommissioning will essentially be dependent on the type of site but is likely to include removal of all equipment, breaking out of foundations and removal of all materials arising from site. Access track, fencing and powerline removal and reinstatement will also be likely to be required in areas where no continued use is being made of such facilities by other operators/users.

Summary

The diagram opposite summarises the equipment required, the design options and other considerations for mobile telecommunications radio base stations.

4. Landscape, Visual and Ecological Impacts

This chapter acts as an overview of the issues related to mobile telecommunications development in the Highlands and Islands of Scotland by:

- explaining the issues which require to be understood in order to assess the natural heritage impact of a proposed development; and
- introducing the assessment of landscape, visual and ecological impacts.

4.1 The issues

In order to undertake an assessment of the likely natural heritage impacts of proposed mobile telecommunications developments it is necessary first to understand the context in which such development will be located and then to understand the nature of the proposed development.

The key issue concerning mobile telecommunications in relation to their landscape and visual impacts is siting



because a well designed mast of an appropriate colour cannot rectify poor siting.

Although mobile telecommunications masts generally tend to be utilitarian in their appearance it is clear that some are less visually intrusive and incongruous than others. This primarily relates to their form, with lattice masts of tapering design generally appearing to be more elegant than those with a parallel structure. Tapering masts also appear to be more anchored to the ground and more visually stable as a result. That said, the introduction of large pieces of equipment close to the top of the mast detract from this impression.

In addition to location and overall design, the colour and materials of a mast are important in determining whether a mobile telecommunications radio base station will catch the eye or not.

Understanding the character of the landscape

The impacts of a proposed radio base station development will be dependent on how the character of the development relates (influenced by siting and design) to the key characteristics of the landscape in which it is to be situated.

The national programme of Landscape Character Assessment (LCA) undertaken by SNH describes the key characteristics intrinsic to each landscape character type at a regional level and these documents should be consulted prior to considering landscape character issues at the local level.

LCAs do not place value on one type of landscape over another. In some locations, however, the value of specific aspects of certain landscapes are recognised by designation (National Scenic Areas, Areas of Great Landscape Value, National Parks). Such designations do not preclude telecommunications developments; but it will need to be demonstrated that a development does not affect the integrity of the designated landscape.

Understanding the issues which influence visual effects

In selecting or assessing a site for telecommunications development it is important that an understanding is gained of who will see the development and from where it is likely to be seen. This is likely to include local people in their houses or places of work; locals and visitors travelling by sea, rail, road or on foot; or people visiting outdoor sites such as picnic areas, places of interest such as monuments, 'beauty spots' and the like.



To assess the significance of the impact of telecommunications developments on people, it is necessary to establish the level of intervisibility between the development(s) and these 'receptors'. This can only be accurately determined in the field although some indication of the likely prominence of such development can be ascertained through the use of computer software which analyses intervisibility.

The distance over which a telecommunications development may be visible will vary depending on weather conditions and season (changing colour of the landscape and quality of light) and will also depend on the character of both the development and the landscape in which it is situated.

Understanding nature conservation issues

The significance of potential impacts of a proposed radio base station development on ecological interests will be dependent on the inherent value of any nature conservation resource likely to be affected.

The first step in gaining an understanding of the ecological context of a proposed development will be to collect data relating to designated sites and non designated sites which are of nature conservation values ranging from international importance to local importance.

It should be recognised that radio base station developments and their ancillary structures, especially tracks, may have the potential to cause both direct and indirect effects on sites of ecological interest which are not in the immediate vicinity of a development site.



Understanding the proposed development

In order to assess the landscape, visual and ecological impacts of a proposed radio base station it will be necessary to fully understand the nature of the proposed development.

The level of understanding of the proposed development will be dependent on familiarity with the technology combined with the quality of information provided by operators. It is important that the technology is understood and the potential impact of using a 2G site for additional 3G use, or future sharing with another operator, is considered from the outset. The introduction of 3G could have significant ramifications in terms of future cumulative landscape, visual and ecological impacts due to the likelihood of a considerable number of new radio base stations, shared sites and mast shares being required.

The level of information provided by the operator will be crucial in facilitating an accurate assessment of the likely impacts of any proposed radio base station. Appendix VII provides a checklist of the information which should be required from a mobile telecommunications operator. This checklist reflects the requirements of NPPG 19 which lists information which should be provided by operators and exceeds the level of information which was required to be provided along with permitted development notifications. The purpose of this checklist is to assist Planning Officers and SNH Area Officers to assess proposed telecommunications developments.

5. Siting and Design Guidelines

This chapter summarises the key issues influencing operators' choice of development, highlights 'first principles' in relation to location issues and describes basic principles of siting and design to be considered in terms of landscape, visual and ecological impacts in relation to a range of typical examples of Highland and Island landscape character types.

5.1 Operators' siting considerations

Appendix V presents an overview of the operators' site selection process and the technical factors to be considered such as:

- most suitable location for effective coverage/capacity of network;
- availability of site;
- mast height and design;
- number of antenna required; and
- amenity considerations.

It should be remembered that the operator's optimum site need not be the only option to provide acceptable coverage.

5.2 First principles

When selecting a radio base station site or assessing a selected site the following considerations should always be borne in mind:

- even in circumstances where development of the operator's selected site will result in an acceptable level of impact on visual, landscape and ecological resources **there may well be a better site in the** *locality;*
- *it may be preferable to install radio base station equipment on an existing structure* (building, pylon or existing mast) rather than introduce a new mast structure;
- *it may be better to accept an additional structure in the form of an intermediate relay station* if this facilitates a better radio base station location being developed in terms of impacts on landscape, visual and ecological resources;
- the entire radio base station and ancillary features must be considered as a whole and, in most circumstances, the more simple and compact the layout of the radio base station the better;
- in general, the more features which can be concealed from significant viewpoints the better;
- in locations where existing radio base station masts exist, ensure that lessons are learned from the siting and design of these existing examples and that any new radio base station builds on these lessons;
- the relative advantages and disadvantages of *mast sharing, site sharing and new site alternatives should always be assessed;*



- no hard and fast rules can be applied: each and every proposed location must be considered on its own merits in its specific context; and
- avoid developing masts within or on the edge of areas which possess qualities of 'wildness' or 'wild land'.

5.3 Individual mast siting

This section sets out some broad guidelines for mast siting, relating these to some of the typical Landscape Character Types of the Highlands and Islands. This information is published as regional reports in the SNH Review Series.

Landscape Character Types: Upland Types, Mountain Types and Hill Types.



- Avoid hilltop locations or sites where skylining will result wherever possible: a location close to the selected site but seen below the skyline from the key viewpoints greatly reduces the impact.
- Where hilltop or skylining locations are unavoidable, consider who will see the development, how frequently, for how long and from where, in conjunction with the topography.
- Locating a mast behind the brow of a hill can make its apparent height less from some viewpoints.













- When selecting hillside locations, consider whether the development will be backclothed for all potential viewers.
- Take best advantage of the combination of topography and vegetation.
- Locate masts on natural sites (localised level areas on hillsides) to minimise the need for levelling and the potential for erosion.
- Try to link to existing built/ vertical features so that the radio base station appears less incongruous in the landscape.

Landscape Character Types: Moorland Types



- Relate the development to existing built features in the landscape rather than introducing new focal points.
- Take advantage of local topographical variations to conceal ancillary equipment.







- Avoid introducing tracks which will lead the eye to the radio base station.
- Ensure tracks are designed sympathetically to the landform with the minimum of cut and fill required.







Landscape Character Types: Strath Types and Glen Types



- Site masts sufficiently far back from the roadside to ensure effective backclothing (ie so that the mast does not breach the skyline).
- In glens, consider siting the radio base station on the opposite side from the public road to ensure backclothing in views, provided intrusive access and power, or intrusion on areas of wildness will not result.
- Situate masts behind the brow of local undulations on strath sides to reduce the extent of mast visible from the main viewpoints.







- Avoid locations where masts would dominate in enclosed glens.
- Consider the cumulative impact of repeated masts in prominent locations visible from roads running through glens – not only those intervisible but also those seen sequentially.





General guidance applicable over the Highlands and Islands

- Avoid locations close to road corridors where no screening trees or scrub exist unless there is a relationship to other roadside furniture or structures.
- Avoid locations on the outside of bends where a mast would form a focal point for drivers travelling in both directions and where a location outwith the main corridor of vision would render the mast less conspicuous.
- Take advantage of roadside vegetation.

• Take best advantage of any existing vertical structures in roadside locations.













- When siting masts in forestry, consider the age of the trees and any proposals for felling.
- Masts will usually appear less intrusive if located close to existing buildings or vegetation.
- If suitable features exist (eg ruins), investigate the feasibility of using these for supporting apparatus in favour of erecting new structures.



5.4 Radio base station equipment

Mast selection

Although there are just two basic mast designs commonly used, in certain circumstances alternative design options may be more appropriate.

Where vertical features present in the surrounding landscape include electricity pylons, a tapered lattice mast with a grey finish may be the most appropriate solution.

Where backclothing will be provided by terrain or vegetation with a mosaic of colours, a coloured lattice mast may be the best solution and one with a high void to solid ratio will be more effective in minimising the visual and landscape impact.

Where vertical features in the surrounding landscape are restricted to overhead electricity supply wooden pole, telegraph poles and other simple structures, a monopole may be the most appropriate choice of mast.

In certain situations, other options from the array of 'stealth' designs (flagpoles, telegraph poles etc.) may require to be considered but the benefits of their use must be considered in the light of the fact that most innovative designs may only accommodate a single operator. In very specific locations, new design or different technical alternatives may have to be considered if alternative locations cannot be found.

The following bullet points and diagrams illustrate principles of selection of radio base station equipment.

 Lattice masts generally appear less intrusive when of tapering design. 				
 Lattice masts may introduce a utilitarian, industrial appearance which is 	<u>م</u> ا		<u> </u>	
inappropriate in some landscapes.	⁸	ġ.	<u> </u>	
- Lattice masts with a grey finish may be the best solution for skylining situations although it should be acknowledged that a galvanised finish may be highly reflective until weathering occurs and get darker over time.
- Lattice masts with a grey finish may be the best solution where the backcloth includes rock outcrops, cliffs or scree of predominantly grey tones.
- Grey lattice masts may be the best solution where backclothed by deciduous woodland but breaking the skyline. Monopoles painted in an appropriate colour may be more appropriate where there is a woodland backdrop and no skylining.
- In urban and peri urban situations consider the use of monopoles with or without 'lighting brackets'.
- Innovative masts in the form of flagpoles may be appropriate in locations adjacent to rural hotels or visitor centers.

The site

 Keep the layout of ground based equipment as simple as possible (particularly in mast/ site share situations).

















Control equipment and housing

 Equipment housing need not be located adjacent to the mast (separation distances of 100m plus are possible, although a larger cable will be required to reduce signal loss): look for the best location.



 Use cabins with integral cabinets wherever possible; use the smallest size of cabin possible; reference to other structures in the surrounding area should be made to inform any decision relating to the siting, character and design of a purpose built structure.

Antenna and cable connection

 Omnidirectional antenna may be the least visually intrusive solution for a lattice mast for a single user – where multiple omnidirectional antenna are used, those located at variable levels add visual clutter to the mast structure.



- For monopoles, antenna which appear to be integral to the mast or are capable of being housed within the mast structure (eg flagpole/lighting column designs) will present a more simple form.
- Undergrounding of cables will almost always be the best option unless vegetation is of significant nature conservation value or detrimental hydrological impacts would result.

Link to the fixed line network

• Wherever possible, a direct connection to the fixed line network will be preferable to the introduction of microwave dishes and relay stations although operator's requirements to retain control of the transmission of the signal may mean that the link has to be via microwave dish as this can be more reliable and cost effective.

Electricity supply

- If the nearest available electrical supply is remote and no overhead lines exist in the locality, explore renewable energy options or consider the use of an on site generator subject to noise and tanker access considerations.
- Remember that the generator need not be located immediately adjacent to the mast although power loss can occur if the generator is remote from the base station: select the best possible site.
- Avoid introducing an overhead electrical supply which will break the skyline.
- Consider full or partial undergrounding of electricity supply.
- Select a route for the overhead electrical supply which relates to the landscape characteristics, to 'fit' the lie of the land and not lead the viewer's eye to the mast.

Microwave dish

- The smaller the dish and the fewer of these mounted on single masts, the better (in general, the dish size is dictated by the distance between sites).
- Painting the dishes white renders them highly reflective and they become visible over long distances especially when seen against a hill or wooded backcloth.
- Generally paint the dish the same colour as the mast.







Maintenance ladders

• Avoid the use of maintenance ladders wherever possible – where necessary, locate the ladder so that it appears to form part of the mast and of a minimal mass rather than appearing as an additional structure.

Cable ladders

 Cable ladders can add significantly to the adverse visual impact of a radio base station and should be avoided wherever possible except in situations where the ground based equipment is completely concealed from view. If cable ladders must be used, ensure they can be shared and design them to be as simple and as low as possible.



Perimeter fencing and walls

• The need for fencing should be carefully considered. If there is a need to enclose the site, the design of fencing and gates should reflect the character of existing fences, walls and gates the landscape in which the radio base station is located.



Unsympathetic corrugated iron fence

Colour

- Use a consistent colour scheme for all component structures of the radio base station. Ensure that equipment finishes and colours do not vary and result in visual confusion.
- Where considering painted finishes remember seasonal changes – assess the colour of the surroundings and choose a colour which compliments these at most times, accepting that it may not exactly match in any one season.



Visual confusion results from use of several colours

- In skylining situations, masts should generally be light grey in colour.
- Camouflage paint finishes will only be successful if custom designed and applied well and where the mast is seen against a backcloth of landcover from most key viewpoints.



Green mast in skylining situation

- Increasing the void:solid ratio of lattice masts, so that they appear as light as possible, will be more successful in minimising their impact than applying colour in an attempt to mimic background tones.
- In peri urban situations, monopoles should be finished to blend in with other vertical features (ie painted the same colour as adjacent structures such as lamp posts).
- Where backclothing is moorland, a recessive shade of brown will generally be the most appropriate.
- Green paint finishes rarely succeed in matching the greens of nature and colour selection should reflect surrounding shades in a neutral fashion rather than attempt to mimic these.
- In some situations where the mast will be seen against a variety of backdrops it may be preferable to create a positive image with a contrasting colour rather than attempting to camouflage the mast.
- Any paint finish employed should be matt to reduce reflectivity.



Unsuccessful attempt to mimic grassland colour

• White colour of microwave dishes and antenna usually draws attention to the mast.

Access

General guidance relating to access tracks can be obtained in the publication 'Vehicular Tracks in Upland Scotland' (CCS 1978) and it is anticipated that SNH will soon be in a position to provide further guidance on completion of an intended research project into the subject.

Where sites are located close to the existing road network or rural tracks, it may be possible to provide construction and maintenance access directly off the carriageway or track with only either a hard standing or a short length of access track being required. In these circumstances, the landscape, ecological and visual impacts are likely to be insignificant.

The following points should be considered:

- it is important to recognise that for some radio base stations access on foot/helicopter for maintenance purposes may be the only acceptable option in environmental terms;
- the adverse impacts of radio base station developments can be reduced if alternative forms of access can be utilised (via the sea, helicopter, on foot or by ATV);
- temporary methods of construction such as floating or rafted tracks which can be removed on completion of construction should be considered;
- on sites where the maintenance of existing hydrological patterns is important, single or multiple culverts may be required to maintain water flows below tracks lying on embankment or at grade. Waterproof membranes may be necessary to retain hydrological patterns on the uphill side of tracks where the cross section is in cutting;
- the routing of access tracks should be designed sensitively to reflect the character and be sympathetic to the topography of the locality;
- ensure that the access track does not draw the eye to the base station itself;
- where tracks are to be surfaced, ensure that materials with recessive colours similar to the surrounding ground cover are used; and
- minimise the length and width of all access tracks while ensuring that the most appropriate route is selected.







5.5 Mast sharing

The issues of mast height and design have relevance to the situation of mast sharing. The principal operator will usually occupy the prime site, at the top of the mast, with later operators taking lower sites which provide reduced areas of coverage, possibly necessitating additional masts to provide infill. Alternatively, to ensure that subsidiary operators attain good coverage without the need for infill masts, the existing mast may have to be extended (if the structural design of the mast allows this) or a new, taller replacement mast installed.

Each operator's equipment must have a vertical separation of a minimum of 1m between antennas which means that mast heights may have to be increased by as much as 3m per additional operator depending on mast design, strength, loading etc.

As operators cannot usually share equipment, additional cabins and cabinets will also be required. However, replacement, shared cabins should also be considered.

Some advantages of mast sharing are:

- retention of just a single vertical feature in the landscape;
- ground based apparatus contained within a single compound;
- shared electricity supply (no additional overhead lines/generators); and
- shared access if by existing track.

Potential disadvantages of mast sharing include:

- increased height of mast;
- potential for visually confusing clutter of ground based equipment if not shared and of contrasting form and colours and if equipment housing is poorly sited within the compounds;
- additional antennas, microwave dishes and cabling adding to the bulk of the structure and rendering it more visible;
- potential for disturbance to vegetation if ATV access or a need for formal access track for maintenance purposes;
- additional operators will mean additional equipment, giving rise to potential for a cluttered appearance;
- increased mast height may render the mast more visible;



 mast sharing may be preferable to an additional mast in close proximity; and



 mast sharing rather than proliferation is often the best solution in simple and large scale landscapes (eg moorland).

5.6 Site sharing

Where it is not possible for existing masts to accommodate additional equipment, or where is considered that an increase in height of a single mast is not a viable or preferred solution, existing sites may be shared provided sufficient land has been acquired by the primary operator.

Site sharing may have certain advantages such as:

- ground based apparatus contained within a single compound;
- shared electricity supply (no additional overhead lines/generators); and
- shared access if by existing track.

Potential disadvantages of site sharing include:

 twin masts being more prominent in the landscape than a single vertical feature if the masts are not in close proximity;

Double mast seen as single feature

Double mast seen as separate feature

- visual confusion if masts are of different types (ie one lattice, one columnar), designs, height, proportions, colour;
- potential for visually confusing clutter of ground based equipment if finishes are of different colours;
- potential for disturbance to vegetation if ATV access or need for formal access track;
- site sharing may not be the best option where other vertical features are located at some distance from each other as this will result in a contrast of landscape pattern;

 in site sharing situations masts of similar appearance should be used to minimise visual confusion;

- in some situations, such as simple open landscapes, it may be preferable to group masts together rather than have them dispersed;
- in other situations dispersal may be more fitting to the intrinsic landscape character; and
- it may be preferable to group the masts closely together so that they 'read' as a simple feature.

5.7 Multiple masts

The ongoing programme of 2G mast installation, together with the future roll out of 3G infrastructure will result in many more radio base stations being required in the Highlands and Islands.

When undertaking assessments for proposed masts, the potential impact of future development should also be considered:

- establish whether future mast sharing is a viable option;
- establish whether the site is large enough to permit site sharing (if this is considered appropriate); and
- establish whether 2G and 3G infrastructure can be shared.



5.8 Assessing the impacts of proposed radio base station developments

In assessing the impacts of proposed radio base stations the following key questions should be addressed.

Landscape character

- Referring to the Landscape Character Assessment (available from SNH), which Landscape Character Type(s) will be affected by the proposed development?
- What are the key characteristics of these Landscape Character Types?
- How might the proposed development affect these characteristics?
- What are the key forces for change for the Landscape Character Types likely to be affected? Are mobile telecommunications developments discussed specifically in the Landscape Character Assessments or does the general guidance provide assistance?
- Referring to the Landscape Character Assessments, how is the landscape valued?
- Is the quality of remoteness listed as a key characteristic?
- Are there other built features in the vicinity? If so, do these include existing mobile telecommunications radio base stations, electricity pylons, telegraph poles overhead electricity lines or other vertical features?
- Is the development located in a designated area or will it be visible from a designated area?
- If so, for which characteristics or qualities is the landscape designated? Will the development affect the interview of this designation?



the integrity of this designation? Will this depend on siting and design and if so, how?Which elements of the proposal are likely to have the most significant impacts on landscape

- character? Can these be modified to reduce the level of impact to an acceptable level?
- Should an alternative site be considered?

Visual effects

- What are the key characteristics affecting how the landscape is experienced (topography, vegetation, access etc)?
- Who will mainly see the radio base station (residents, visitors, tourists, workers)?
- How will these people see the radio base station (from isolated locations, from a distance, from close range, while moving through the landscape etc)?
- Which elements of the proposal are likely to have the most significant visual impacts? Is the overall structure likely to appear visually light, elegant and balanced or unbalanced, heavy in structure or appear industrial in image?

- Can the proposed development be modified to reduce the level of impact to an acceptable level?
- Should an alternative site be considered?

Ecology

- Is the development located in a designated area?
- If so, for what nature conservation interests is the area designated?
- Is the development located in an area of regional or local nature conservation value?
- Will any nature conservation interests be adversely affected by the proposed development?
- Which elements of the proposal are likely to have the most significant impacts on ecological interests?
- Can these be modified to reduce the level of impact to an acceptable level?
- Should an alternative site be considered?

The development: single masts

- How will the scale and form of the proposed development relate to any existing vertical features (natural and man-made) in the landscape?
- How will the scale of the proposed development relate to the perceived scale of the landscape itself if no vertical features exist?
- Will it, for example, diminish the apparent scale of mountains by acting as a reference feature of a known size?
- Will the proposed radio base station be located on the skyline or be a focal point from main viewpoints? Are alternative sites available? Is it feasible to relocate the development?
- Will the proposed radio base station be perceived as a single, individual element or will it be so closely located to other radio base stations that these will be perceived collectively as one element from significant viewpoints? If the latter, would this result in visual confusion and if so, would an alternative site be preferable? Are alternative sites available? Is it feasible to relocate the mast? Is mast sharing an option?
- Will the ancillary features be prominent and result in significant adverse impacts? If so are there mitigating measures which could be undertaken to render these features less prominent and to reduce their impacts to an acceptable level?

The development: mast sharing

- Will mast sharing require increased mast height? By how much as a minimum?
- If so will additional unacceptable impacts accrue from an increase in mast height in relation to the scale of the landscape? If so, would an alternative site be more acceptable? Is there an alternative site available?
- Will the additional ancillary features be prominent and result in significant adverse impacts? If so, are there mitigating measures which could be adopted to render these less prominent and to reduce the impacts to an acceptable level?

The development: site sharing and multiple masts in close proximity

• Will the addition of a further vertical feature in the landscape give rise to visual confusion or increase the level of impact by being seen as one of a series of such features while moving through the landscape?

- Will the proposed radio base station be perceived as a single element or will it be so closely located to other radio base stations that these are perceived as one element, or as a group feature?
- Would it be preferable to have a new taller mast to provide accommodation for all operators with equipment in the vicinity?
- If other radio base stations exist, will a further mast 'swing the balance' to the extent that these become key characteristics in the landscape and change the intrinsic character of the landscape? Will the resultant effect be a change in character to one with an industrial appearance?

6. Appendices

Appendix I History and Development of Mobile Telecommunications in the Highlands and Islands

This appendix provides a summary of the history and development of mobile telecommunications in the context of the Highlands and Islands.

Early in 1996 the then Scottish Secretary, Michael Forsyth, announced a proposed development programme for the expansion of the mobile telecommunications network in the Highlands and Islands. This was made possible by a successful application, by Highlands and Islands Enterprise (HIE), to the EU Objective One Programme which secured funding to the value of £3.8m. HIE contributed £200,000 to the programme and this public package secured a joint Cellnet and Vodafone investment of £42m. Neither Cellnet nor Vodafone were prepared to invest independently due to the relatively low population density of the Highlands and Islands combined with the mountainous terrain for which it is difficult to provide radio coverage.

The programme required an expanded network of approximately 250 transmission sites with approximately 40% of these being anticipated as being on 'greenfield' sites with the remainder being on sites shared with, for example, the emergency services. The majority of these new sites were to be mast-based and developed under Permitted Development Rights.

The proposed expansion was designed to provide services to 95% of the population and 'in-car' coverage to 90% of the A and B roads in Highland Region.

As a condition of the provision of funding by the EU, HIE was obliged to supply information relating to the principal characteristics of the project and descriptions of the predicted environmental impacts during the construction and operation phases.

In 1996 HIE commissioned a study of the proposed development programme for a major expansion of the mobile telecommunications network across the HIE area. This study had three specific objectives:

- to identify site specific and programme wide environmental impacts which could be expected to result from the proposed development programme;
- to identify those areas of the current telecommunications regulatory process in which the consideration of environmental issues could be improved upon; and
- to prepare practical and commercially viable environmental management guidelines based on a review of best practice and the identified environmental impacts, to be used by the telecommunications companies in the implementation of the telecommunications expansion programme.

The study identified the principal environmental impacts of the HIE Programme as:

- visual impact is likely to be the principal source of site specific environmental concern, particularly with respect to the amenity of scenic areas and local properties;
- landscape impacts could be significant, particularly within National Scenic Areas and in other designated landscape areas where development potentially compromises 'wild land' characteristics;

- the environmental impact of any new access roads may be significant and the need for these should be minimised;
- cumulative impacts are most likely to be significant in terms of the number of designated sites affected by the Programme, and through any co-location of masts at relatively close proximity to or, particularly, within scenic areas;
- site specific construction and operational impacts of masts and related infrastructure located in designated sites for nature conservation, including disturbance to wildlife at critical periods (eg breeding times); and
- the environmental impact from electro-magnetic radiation is likely to be insignificant.

Most of the identified site-specific environmental impacts can be mitigated by careful siting of masts. For the most sensitive sites the use of appropriate design and construction techniques can play a key role in reducing environmental impacts. Increased opportunities for widespread consultation ahead of and in connection with applications for telecommunications developments will help to improve the avoidance or mitigation of environmental impacts.

A set of guidelines were developed in discussion with HIE, Vodafone and Cellnet which reflect the unique nature of the environment, economy and communities of the Highlands and Islands.

Appendix II Legislation Prior to 2001

This Appendix and the one following provide an overview of the legislation relating to mobile telecommunications developments which has particular relevance in the context of this report. Appendix II outlines legislation prior to 2001 – much of which is still in force today – and Appendix III describes the key provisions of recent (post-2001) legislation.

Prior to 2001 the following two bodies of inter-related legislation were of particular relevance in the siting and design of mobile telecommunications developments:

- The Telecommunications Act 1984 and its related Code and Licences; and
- The Town and Country Planning (General Permitted Development) (Scotland) Order 1992 and the Town and Country Planning (General Development Procedure) (Scotland) Order 1992. (Both Statutory Instruments of the 1972 Town and Country Planning (Scotland) Act).

In July 1980, the then Industrial Secretary Sir Keith Joseph, announced the Government's intention to restructure the General Post Office (GPO) and relax the monopoly over terminal equipment and value added services. The following year the British Telecommunications Act received Royal assent and this formalised the split between postal services (Royal Mail) and telecommunications services (British Telecom – BT). From this date, independent suppliers of telephones were permitted to enter the market.

The Government issued a White Paper in July 1982, proposing the sale of 51% of BT and the creation of a regulatory body, the Office of Telecommunications (OFTEL).

In May 1983, the Government granted Telecom Securicor Cellular Radio Ltd (Cellnet) an Operating Licence for cellular telecommunications and granted a second Operating Licence to a subsidiary of Racal Electronics plc, trading under the name of Vodafone.

The 1984 Act defined the Telecommunications Code which laid down the conditions under which Telecommunications Code Systems Operators are required to operate as part of their licence. Operators included: Cellnet, Vodafone, Mercury, One2One, Orange, Norweb and BT. Operators' licences contained different conditions (largely because they used different systems) and this led to inconsistencies.

Where developments did not require a full planning application, some licences nevertheless required operators to notify the planning authority, which then had 28 days to respond or to impose conditions upon the installation.

Such licence conditions required that the operator must install the apparatus '...in accordance with such of these conditions as are reasonable in all the circumstances of the case taking into account the desirability of protecting the visual amenity of the locality, the technical requirements of the licensee's system and the cost of installation'.

The key clauses of the 1984 Act which are summarised in the Scottish Office Circular 5/1992 Annex D are:

• operators had the right to install apparatus on private land with the prior agreement of the occupier;

- operators' activities should not interfere with access to other land, without the agreement of the occupier;
- operators had the right to apply to the Courts for a compulsory purchase order to install their apparatus on land where prior agreement with the occupier was not forthcoming;
- operators had the powers to carry out works in the street and install apparatus in, on, or under the street (subject to Public Utilities Street Works Act 1950);
- operators had the right to fly lines over any land without the occupier's consent (although any termination points require consent);
- operators were required to obtain the agreement of water and sewerage companies prior to the placing of telecommunications apparatus within conduits under these companies' control;
- owners or occupiers of land could object to overhead apparatus where such apparatus was at least 3m above ground;
- operators were required to fix a notice giving details of how and where to object to the installation of such overhead apparatus;
- operators had the right to require the occupier of land to lop a tree if it overhung the street and interfered with telecommunications apparatus;
- provision was made to require an operator to alter or remove apparatus in the way of development;
- operators had to remove apparatus when it is no longer required; and
- provision was made for when a local authority, public utility or another code system operator wanted to alter the apparatus of a code system operator in the course of any street works.

The 1992 Town and Country Planning Orders gave wide Permitted Development rights to Telecommunications Code System Operators for the installation of masts and their infrastructure. The following restrictions applied however:

- the total height of the whole apparatus was not to be more than 15m above the ground; and
- it was not permitted to install a microwave* antenna in an NSA.

*Note

'microwave' is defined as being over 1000MHz so Vodafone and Cellnet's digital Global System for Mobile (GSM) antennas which operate at 900MHz fulfilled the PD requirements and could be installed in an NSA as long as the other conditions mentioned above were complied with.

Appendix III Current Legislation

Permitted Development Rights

Class 67 of the Town and Country (General Permitted Development) (Scotland) Order 1992 (as amended by the Town and Country Planning (General Permitted Development) (Scotland) Amendment (No. 2) Order 2001) grants limited permitted development rights to telecommunications developments. An overview of the key provisions is set out below:

- all ground based masts (irrespective of height) require planning permission;
- within limits, some telecommunications developments on buildings or other structures are classed as permitted development. In summary, this includes the following:
 - on buildings over 15m in height 8 antennas all of which neither exceed 2.8m in height or 1.3m $\,$
 - wide nor when measured together with any supporting structure exceed 4m in height; or
 - on buildings not over 15m in height either 4 antennas all of which neither exceed 0.9m in any direction nor when measured together with any supporting structure exceed 4m in height or, 8 antennas all of which neither exceed 0.5m in any direction nor when measured together with

any

- supporting structure exceed 4m in height; and
- on a dwelling house, 2 antennas all of which neither exceed 0.5m in any direction nor project above the highest part of the roof.
- detailed permitted development limits are also set out for radio equipment housing (either on the ground or on a building), small antennas and access tracks;
- there are no permitted development rights in certain designated sites and areas, including: conservation areas (whether or not covered by an Article 4 Direction removing class 67 as permitted development); NSAs; National Parks; historic gardens or designed landscapes; SSSIs; European Sites (nature conservation); category A listed buildings (or their setting); scheduled ancient monument (or its setting) unless:
 - the development is carried out in an emergency; or
 - the development comprises not more than 2 small antennas on any part of a dwelling house that does not face a road.

Conditions applying to Permitted Development

Class 67 of the Town and Country Planning (General Permitted Development) (Scotland) Order 1992 (as amended by the Town and Country Planning (General Permitted Development) (Scotland) Amendment (No. 2) Order 2001) sets out the following conditions on permitted development.

All permitted development proposals involving the construction or installation of one or more antennas will:

• require to be notified to the local planning authority 28 days before development commences (unless in an emergency) including a description (with specifications) of the apparatus and a plan showing the development's location and layout (this applies to equipment housing as well);

- require the submission of a detailed description of the equipment and its location and a declaration that the proposed equipment and installation complies with International Commission on Non-Ionising Radiation Protection (ICNIRP) public exposure guidelines; and
- all permitted development proposals are subject to the condition that any antenna or supporting apparatus shall so far as is practicable be sited so as to minimise its effect on the external appearance of the building.

In exercising Permitted Development, operators are required to fulfil the Telecommunications Code.

Other information requirements

Developers will be expected to provide supporting information and details on the siting and design of the development proposals. Assessment and evaluation of the potential impact of proposals upon landscape character and visual amenity should accompany this information.

Appendix IV Technical Issues

Current systems

Prior to 1992, mobile telecommunications operated utilising analogue technology known as the Total Access Communications System (TACS). Equipment for the analogue network tended to be concentrated around the major centres of population and along the major transport arteries. The operators were anxious to provide the maximum coverage in the minimum period of time and tended to seek planning permission for tall masts, often on high ground, transmitting signals over the maximum area.



Analogue coverage with digital infill.

The reasons for additional mobile telecommunications radio base station sites being required to provide coverage for the digital system in the Highlands and Islands were:

- digital technology uses telephones with smaller battery packs which operate at lower power levels with an ability to transmit power over shorter distances;
- digital technology, although providing many enhanced features and benefits over analogue, has limitations which reduce the distance over which the radio signal can be used; and
- to provide coverage to the maximum area (ie not restricted to areas of high population/transport networks).

Vodafone and Cellnet which were granted licences in 1983 operate the digital Global System for Mobile (GSM) which is internationally recognised and enables users to use handsets throughout Western Europe. This system utilises the 900MHz frequency which is not recognised as being microwave in the context of planning legislation (microwave being defined as being over 1000MHz).

Mercury, One2One and Orange use the Personal Communications Network (PCN) which is two way radio technology with higher frequencies (1800MHz) and digital technology. PCN provides greater capacity within the cells but covers smaller areas so more radio base stations are required. PCN is recognised as a microwave system in the context of planning legislation. In 1997 an additional radio spectrum at 1800MHz was allocated to Vodafone and Cellnet.

For each of the operators it is only possible to provide for a limited number of simultaneous mobile telephone conversations at one time without the introduction of cell planning or splitting of existing cells.

For example, Vodafone's frequency range actually lies between 890 and 995MHz within which they are allocated 55 duplex channels, allowing 55 simultaneous telephone conversations. Increased capacity is provided by subdividing cells (introducing more radio base stations) and operating each of these on a discreet part of the radio spectrum at a reduced power level. For example, where an existing cell provides say 55 channels (simultaneous telephone conversations), the capacity can be increased by subdividing the cell into 7 sub cells to provide say 15 voice channels in each sub cell or 105 channels in total.

Cell planning

Geographical areas are divided into smaller areas, or cells, which represent the area of coverage possible from a radio base station located within the cell. Cell planning considers the following restrictions:

- the area is determined by the number of calls anticipated as there is a limit to the number of radio channels allocated to each cell;
- the same radio channel cannot be used in adjacent cells otherwise interference between calls might result; and
- adjacent radio channels within the spectrum cannot be used in the same cell otherwise interference and noise might occur during calls.



Limits for cell sizes vary but can be as large as a 15km radius in areas of flat terrain where population levels are low and as small as 0.5km radius in densely populated areas.

The system is designed to provide continuous call coverage for mobile users and for this reason the signal coverage from each radio base station requires to overlap with adjacent cells in order that calls can be routed via the radio base station with the strongest signal. This is one factor for the siting of a radio base station as, if it is located too far from adjacent cells the call cannot be re-routed and will be 'dropped'.



As the number of users of the network increases, additional capacity is provided for by cell splitting which is employed in urban areas to cope with high use demand and increased levels of signal loss due to the density of buildings. In rural areas, fewer radio base stations are required due to lower numbers of users and less obstruction to the signal from buildings. In the Highlands and Islands, and other areas of mountainous terrain, topography plays its part in signal obstruction. If good coverage is to be achieved it is inevitable that, in some areas, masts will require to be located in prominent hilltop locations or a higher density of masts at lower locations will be required.

Future systems (3G technology)

The cell size for 3G for rural areas is envisaged to be 2–4km across and for more heavily urbanised areas 0.5–1km across. The reasons for the small cell size include the facts that:

- 3G operates at a much lower power output than previous systems (handsets and base stations) while seeking to maintain high data transfer rates;
- 3G operates at higher frequency (2100khz) which means the signal travels less distance; and
- the need to minimise interference between cells results in the need for a large number of small cells.

The standard equipment, for example, for Hutchison 3G will be:

- 3 antenna of 1.7m length, usually mounted at a height of 10–20m depending on the surrounding topography;
- 2-3 microwave dishes for communication between base stations;
- an equipment cabin of around 5m³; and
- a power source.

Hutchison 3G will also have larger sites called Transmission High Sites which collect all the signals from the individual base station in an area to transfer into the communications ring which will generally be a large fibre optic cable. These Transmission High Sites require taller towers or buildings with up to twenty 0.6m diameter microwave dishes.

2G and 3G can share a site although there are specified distance thresholds between the different operators.

Appendix V Site Selection by Operators

This appendix describes the process of site selection by operators.

Radio base station sites are initially selected by the operators through computer simulation which provides a cell site co-ordinate to identify the optimum location from the point of view of service. This also generally informs on the height of the mast required, the type of antenna and may also identify a number of options. Specific siting of the equipment at a given location is subject to a variety of technical, operational, amenity and environmental considerations and thus the radio base station may be constructed in a location different from that predicted by the computer simulation.



Mast height influences the radius of coverage

The area which can be served by a radio base station depends on a number of factors:

- the higher the mast the greater the coverage although the further one is from the mast, the weaker the signal;
- the presence or absence of obstructions which can cause *shadowing*;

the presence or absence of materials which may cause

reflection; and



Shadowing by topographical features

Reflection by building materials



Attenuation by vegetation

• the presence or absence of materials which may cause *attenuation*.

Clearly these factors influence both the mast height and the choice of site. Higher masts mean greater coverage per mast and a consequent requirement for fewer masts. In rural locations *reflection* by building materials is less likely to influence mast location than in urban areas but *shadowing* and *attenuation* are both likely to influence both mast height and location and it should be understood that even if locations in woodland or forestry are possible, the antenna will always require be visible above the tree canopy.

Appendix VI Vodafone and Cellnet Requirements

This appendix summarises the radio base station requirements identified for Vodafone and Cellnet in 1995 (EDAVV Report).

- The size of the compound will be minimised to the area of the equipment cabin and mast. A site with
 a 12m mast would typically require a site compound with an area of about 36 square metres (9 x
 4m). A single foundation base of reinforced concrete will be provided, and ducts for electricity and
 BT will be provided. Security measures will be incorporated in the design and the outer fence will be
 stock proof if necessary. Typically there will be no external lighting.
- The equipment cabin would be formed of GRP (or similar) for robustness, security and durability. Where environmental considerations demand sensitive planning and design, the cabin can be painted or clad to give the appearance of a traditional building or to aid its assimilation into the landscape. The cabin can be delivered to the site in a prefabricated form to ease assembly and installation or in a component form in order to overcome any potential site access restrictions with prefabricated delivery. For technical reasons, the radio equipment should be sited close to the aerial system (usually within 30m).
- The masts will be of lattice design, and provision is to be made for extending the masts at a later date. Masts can be within a woodland area provided that the aerials are above the trees and not obstructed by foliage. Vodafone reported that they have been advised that approximately half of the proposed new 'greenfield' sites could require masts higher than 12m to cope with surrounding afforestation. Generally the height of masts depend on the radio frequency used and the local topography. The higher the aerials, the more vulnerable it becomes to the elements and the greater the losses of the signal in the cable connecting the aerial to the transmitter. System designers therefore have an incentive to keep the height of the support structures to a minimum. Both Cellnet and Vodafone will each be providing two omnidirectional antennas and shared microwave dishes.
- All equipment will be served by one 63 amp supply, under one meter. A mains failure relay is to be linked to either operator's central switch centre. Electrical hazard warning labels are to be installed on all distribution equipment.

Appendix VII NPPG 19 and PAN 62: Summary of Issues

This appendix summarises the main issues arising from the NPPG 19 and PAN 62.

In November 2000 a Consultation Paper on Proposed Changes to Permitted Development Arrangements for Telecommunications Developments and Draft National Planning Policy Guideline (NPPG) was issued.

In July 2001 the National Planning Policy Guideline 19: Radio Telecommunications was published.

NPPG 19

The NPPG sets out general principles for siting and design of mobile telecommunications apparatus:

- expansion must be undertaken in a manner that keeps environmental impact to a minimum;
- the aim is that equipment should become an accepted and unobtrusive feature in urban and rural areas;
- operators should always be consulted during the preparation of local plans and supplementary guidance;
- operators should seek to ensure that replacement or upgraded equipment is less visually intrusive than that which currently exists;
- operators should consider replacing existing equipment of concern to the local community with a more environmentally friendly solution;
- planning authorities should encourage designs which will result in the minimum of environmental impact;
- planning authorities and the operators should establish an informed working relationship;
- planning authorities should identify a member of staff as the first point of contact and for liaison generally, and become familiar with the types of equipment being used and keep in touch with future trends;
- they should also be aware of the obligations that licences place on the operators in terms of meeting reasonable customer demands and service provision, plus the technical requirements and constraints under which the industry operates;
- planning authorities should not question the need for service provision nor seek to prevent competition between operators, but determine on planning grounds;
- generally, for appropriate new buildings and structures, planning authorities should encourage designs which would allow new telecommunications infrastructure to be installed within or on them with minimum environmental impact;
- operators should ensure that staff or their agents are fully conversant with Scottish legislation, policy and procedure as well as being familiar with the site for which planning permission is being sought;
- design professionals should be engaged as appropriate;
- network roll out plans should be discussed with planning authorities taking into account wishes for commercial confidentiality; and
- operators and planning authorities should be able to identify locations where special care will be required.

The NPPG states that siting and design are key issues and that more environmentally sensitive solutions can be achieved through greater use of smaller, less visually intrusive and lower powered equipment. The need to consider all the component parts of telecommunications developments is stressed and that equipment be so sited as to minimise its visual impact.

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The NPPG recognises that a range of design and camouflage techniques exist and recommends that operators and planning authorities should discuss different options and opportunities to design equipment as a positive feature.

In respect of equipment on buildings, the NPPG states that such equipment should be sympathetic to the architectural form and designed and positioned as sensitively as possible.

The NPPG states that telecommunications apparatus must be sited carefully in rural areas and notes the significance of breaching skylines and disturbing habitats. Further, the NPPG recognises that telecommunications apparatus located in a prominent position can change the character and detract from the quality of the landscape and that cumulative impact can also be of concern.

The NPPG requires planning authorities to be aware of the implications of preventing coverage in an area and to explore solutions such as: disguising the antennas; site and equipment sharing; minimising mast size; and avoiding hill top sites or skyline if at all possible. Reference should be made to the Landscape Character Assessments published by Scottish Natural Heritage.

Site and mast sharing is recognised as being an option to be encouraged if it presents the best environmental solution although it is acknowledged that in some circumstances two masts might be preferable to one larger mast.

The NPPG states that operators' applications for planning permission should be accompanied by supporting material which presents the proposal in its full context. This would include:

- a description of how the proposed equipment fits into the operator's wider network;
- a consideration of the siting and design options which satisfy the operational requirements, and the reasons for the chosen solution;
- details of the design, including height, materials and all components of the proposal;
- details of any proposed landscaping and screen planting;
- information on the method and timing of construction, particularly in sensitive rural areas;
- how the cumulative effects involving equipment already on site or nearby were considered; and
- further information in some circumstances on the visual impact (eg a photomontage) to show the proposed equipment in its wider setting very exceptionally a landscape or visual impact assessment may be needed.

The NPPG recognises that cumulative effects may need to be considered regarding infrastructure already on site and in the near vicinity.

PAN 62

PAN 62 was published in September 2001 by the Scottish Executive Development Department. It gives advice on the process of site selection and design and illustrates how the equipment can be sensitively installed. It also explains why additional base stations are needed to serve the growth in customer demand and in response to changing technological requirements, including the third generation of mobile phones.

General principles for siting and design in PAN 62 include the following:

Minimising contrast

- minimising contrast between equipment and people's expectations of a particular scene; and
- minimising contrast between equipment and its immediate setting or background by:
 - selecting a shape and material appropriate to the character of the area;
 - keeping the shape simple with clean lines;
 - developing a composition where the properties seem in proportion and balanced;
 - minimising the number of separate visual elements in a base station; and
 - using regularity, order and symmetry in positioning equipment.

The series of options

Small scale equipment

- paint them to be sympathetic to their setting;
- place them in areas of shadow on elevations such as under eaves or plinths;
- avoid clutter;
- avoid positions that lie across or cut into architectural detail; and
- ensure that cable runs are unseen wherever possible.

Concealing and disguising

- install inside buildings behind screening;
- incorporate into flagpoles or sculptural elements attached to buildings;
- disguise as street furniture, such as street lighting or hidden behind street signs;
- attach antennas to trees with rubber ties;
- disguise as artificial trees (with care); and
- disguise as/conceal within public work of art.

Mast sharing

- mast sharing may have less impact than an additional mast;
- mast sharing can result in larger, more visually intrusive installations;
- mast sharing may be constrained because:
 - existing masts would not provide suitable coverage due to their height and locations;
 - there would be radio frequency interference; or
 - the mast is not strong enough.

Site sharing

- site sharing will appear more visually acceptable if the masts and other base station elements equipment housing, power supply, access tracks and fencing appear as a single group;
- landscape and visual assessment techniques may help in deciding which approach minimises the landscape and visual impact.

Installations on existing buildings and other structures

The aim is that equipment on a building or other structure should:

- be coloured to match the background;
- be in proportion to the size of the building or structure;
- relate to the architectural form;
- have a minimal impact on the roof line;
- respect important views or skylines; and
- avoid a visually damaging cumulative effect.

Ground based masts

- locate where there are already engineered forms and structures;
- locate within trees or use other landscape features to help conceal;
- use simple structures; and
- colour grey or leave unpainted with galvanised finish when silhouetted against the sky. Paint brown or green when backclothed by the ground or vegetation.

Other base station components

Equipment housing

- paint to blend in with background;
- disguise as street furniture;
- design to be a positive feature that compliments the urban landscape;
- in rural areas screen with planting or rocky outcrops; and
- consider placing partially or completely underground.

Equipment compound

- form and colour should be appropriate to the setting;
- in rural areas there may be no need for fencing or a post and wire fence may suffice;
- security measures should be appropriate to circumstances; and
- the impact can be reduced if the compound is not surfaced or by using natural surface materials which match the landscape character.

Power supply

• options include overhead lines, underground lines, generator, solar, wind or hydro power.

Access tracks

- access tracks can sometimes be more prominent than masts;
- locating a mast next to an existing track is preferable;
- the impact of a new access track can be reduced by:

- relating it to field boundaries and other features;
- following the boundaries of natural vegetation;
- avoiding adverse impact on sensitive archaeological sites; and
- using appropriate materials.

Siting and design

Urban areas

Areas that already have engineered forms and structures may offer the best opportunity for siting equipment. Less visually sensitive areas where the use of standard equipment may be more readily acceptable include:

- industrial areas;
- large traffic junctions;
- land adjacent to railways;
- landfill sites;
- waste water treatment sites; and
- on or near electricity pylons, water towers, floodlighting towers and gasometers.

Rural areas

It is best practice to avoid prominent locations visible from visitor attractions, scenic viewpoints, or the main line of vision from a road. If unavoidable, then it is preferable that equipment is disguised and concealed. A landscape architect can advise on:

- areas to avoid;
- the location with the minimum landscape impact; and
- mitigation measures to reduce the landscape impact.

People use familiar features to gauge the scale of a landscape, but some landscapes can seem larger than they really are because of a lack of scale indicators. A new radio telecommunication installation could act as a scale indicator and reduce the sense of space. Disguising and concealing techniques are appropriate for such areas. If a new mast is unavoidable its impact can be minimised by making it slim and simple in form.

Natural heritage

The key natural heritage issue will be the equipment's landscape impact. Other important issues are:

- loss of habitat;
- disturbance to wildlife;
- indirect habitat damage;
- impact on earth heritage.

Appendix VIII Radio Base Station Assessment Proforma

Assessment of proposed radio base station development

1. Notification/Planning Application	
Type of submission	Date received by SNH
Assessed by SNH Area officer	Date for response to THC
Has the operator provided an adequate descriptic fits into the operator's wider network?	on of how the proposed apparatus
Has the operator provided an adequate descriptic options for satisfying the operational requirements and design of the installation?	on of the steps taken to consider the and the reasons for the chosen site
Has the operator provided adequate details of the materials etc?	e design, including the height,
Has the operator provided confirmation that the si public exposure guidelines?	te will be operated to meet ICNIPR
Has the operator provided details of any proposed	d landscaping and screen planting?
Has the operator provided further information on t photomontage to show the proposed equipment in Is such information required?	he visual impacts such as n its wider setting.
Has a Landscape and Visual Assessment been unc Is such an assessment considered to be necessary	dertaken by the operator? ?
2. Site Identification	
SNH Reference No.	Operator's Reference No.
SNH Reference Name	Operator's Reference Name
Descriptive address	Operator
(append OS map)	Operator's Agent
	Operator's OS Reference
3. Proposed Site	
Complete this column for new sites only	Complete this column for shared sites only
Are there other existing sites in the vicinity which provide similar area coverage?	Original operator(s) responsible for construction
If yes, provide details.	Principal operator
If no, is there likely to be demand by further operators?	Secondary operator
If yes, can this site/support structure accommodate other operators?	Other operators
If yes, describe likely implications of future mast/ site sharing if known.	Describe the implications of this proposal for existing equipment.

4. Proposed Equipment Support structure (tick as Roof mounted Existing building appropriate) and describe the structure including Existing mast height, dimensions of main Lattice mast support(s), colour, height of Columnar mast existing mast if mast share Pylon requires greater height and Other presence or absence of cable ladder). Antenna type(s) (tick as Omnidirectional appropriate) and describe Cross polar no, no. per level and Panel heights, cable connection concealed (via cable ladder, underground, overground). Describe control equipment cabin(s) (size, materials, colour, integral cabinet, concealed, visible). Link to fixed line network Cable connection (tick as appropriate) and Microwave connection to describe. MTX Connection via relay station Electricity supply (tick as Overhead, wood pole appropriate and describe, Below ground including electricity cabinet On site generator size, location, colour). Describe perimeter fence if any. Describe proposed access arrangements. Describe earthworks/screen planting proposed (if any). 5. Site Knowledge Is a site visit required? Yes/No Date of site visit 6. Landscape Context SNH Landscape Character Type (cross refer to report no. and list 5-8 key landscape characteristics, describe guidance provided). Is the site in, visible from, or likely to affect any designated areas? If so describe the designations

Assessment of proposed radio base station development (cont.)

and likely impacts.

Assessment of proposed radio base station development (cont.)

Topography (tick as appropriate).	Flat Rolling Undulating Hilly Mountainous Glen Strath Lochside Coastal	Vegetation in the vicinity (tick as appropriate)	None Coniferous plantation Mixed/broadleaved woodland Hedgerow trees Other issues (comment on harvesting period/ restructuring/age/maturity etc)
Presence of development.	Within urban area On urban fringe Industrial area Isolated buildings Rural/adjacent to transport corridor Rural/remote Pylons and power lines Wood pole overhead lines Wind farms Other	Vegetation on the site/ along access route	Arable Improved grassland Unimproved grassland Moorland Semi-natural vegetation Ancient woodland Planted woodland Forestry Other (specify)
Nearest road (no/or describe).		Distance to nearest road	
Nature of main viewpoints (n = near m= medium d = distant)	Dwellings Places of work Trunk roads A roads B roads Minor roads Tracks Railway Campsite Picnic site Viewpoint Other outdoor sites (specify)	Background view for main viewpoints	Industrial buildings Housing/mixed townscape Farm buildings Coniferous plantation Mixed/broadleaved woodland/trees Arable/improved grassland Unimproved grassland Moorland Vegetation with rocks/scree visible Other (specify)
Describe the overall character of the development. If a mast is proposed is it likely to appear distinctly industrial/ rural, Aesthetically light/ heavy, Aesthetically balance/unbalanced, Simple/complex.		1	1
Will the development appear fitting or incongruous?			
Describe which elements of the proposal are likely to result in the most significant impacts.			

Assessment of proposed radio base station development (cont.)

Can these be modified to reduce the impact to an acceptable level?	
Should alternative sites be explored?	
For mast sharing, site sharing, multiple masts: describe the overall impacts on the landscape.	

Appendix IX Field Survey Records of Radio Base Stations Visited

This Appendix is available as a separate unpublished document.

For further information please contact:

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PART II

The Cumulative Impacts of Mobile Telecommunications Developments in the Highlands and Islands

Supplementary study carried out by

horner+maclennan for Derek Lovejoy Partnership

1. Introduction

Scottish Natural Heritage (SNH) commissioned horner + maclennan (h+m), as nominated sub-consultants to Derek Lovejoy Partnership Ltd, in January 2002 to undertake a study into the potential cumulative impacts which may be likely to be accrued from the completion of Second Generation (2G) roll out, and the introduction of Third Generation (3G) roll out, of radio base stations in the Highlands and Islands of Scotland.

This study is a follow-on to the study commissioned by SNH in 2001 entitled 'Siting and Design Guidelines for Mobile Telecommunications in the Highlands and Islands' (hereafter referred to as 'the original study' and 'the original report'), which commented on the draft National Planning Policy Guideline 19 (NPPG 19) and Planning Advice Note 62 (PAN 62).

2. Background

The project required that the cumulative impacts of mobile development be examined in relation to Landscape Character Types (LCTs).

Cumulative impacts, in this instance, may be defined as impacts which increase in relation to successive or gradual additions to the mobile telephone network physical infrastructure; numerous radio base stations (RBSs) may have an impact on the landscape as collective features as well as individually and, when travelling, the presence of successive visible RBSs along a route will have a perceived cumulative impact even in circumstances where no more than one RBS is visible at any time.

LCTs are distinct types of landscape which are relatively homogenous in character. They are generic in nature but wherever they occur in different parts of the country they share broadly similar combinations of geology, topography, drainage patterns, vegetation and historical land use and settlement patterns. Different LCTs have different capacities to accommodate different types of development depending on the characteristics or elements which combine to make a distinctive LCT.

The study was commissioned in anticipation of a large number of forthcoming mast proposals for the Highlands and Islands and the subsequent need to provide strategic guidance for operators.

As noted in the original study many current masts are the result of a previous, laissez faire planning regime. New planning regulations may effect a positive shift in terms of both the siting and the design of new masts. The aim of this supplementary report is to provide guidance to minimise the overall impact of an increased number of masts throughout the Highlands and Islands.

The brief for the project included three stages of work:

Stage 1:	Review
Stage 2:	Analysis; and
Stage 3:	Best Practice Guidelines

Stage 1: Review

This stage of the project was undertaken to illustrate the different types of multiple developments which might result in cumulative impacts in a range of both road types and LCTs.

Eight road-based study areas were examined to assess the impacts of the existing mobile telecommunications infrastructure – in particular radio base stations (RBSs) but also other infrastructure such as relay stations and mobile telephone exchanges (MTXs). The surveys were carried out along a number of routes where 2G roll out by the four current operators was thought to be almost complete.

Undertaking these studies helped in gaining an appreciation of the impacts of sequences of masts along linear routes through different LCTs in as much as it was possible to make comment on the likelihood of the different LCTs being able to accommodate additional RBSs and on where any additional RBSs might best be situated. This assisted in the formulation of the guidance set out in Section 5.
Stage 2: Analysis

This stage required consultation with mobile telecommunications operators and other interested organisations.

The outputs of this part of the study were envisaged as being a short report describing the issues relating to future 3G development, including a description of the technical issues which constrain site selection, site and mast sharing and mast design, and a description of the possible options available to steer or control future mobile telecommunications development in the Highlands and Islands.

Stage 3: Best Practice Guidelines

This part of the study was envisaged as involving the exploration of possible solutions in terms of minimising the cumulative impacts of the completion of 2G roll out and 3G roll out, relating these back to SNH Landscape Character Types (LCTs) in broad terms.

Changes to the brief

Revisions requested by SNH to reduce the cost of the study included:

- removing the review of LCTs and relying on site specific assessment; and
- reporting Stages 1 and 2 findings at a meeting rather than producing maps and written reports.

Although h+m understood the rationale behind the removal of the requirement to formally report Stages 1 and 2, this report includes such reportage simply because it was considered that the study should be transparent and that presentation of the findings of Stage 1 enabled such transparency. In addition, it was considered important to formally report the findings of Stage 2 because consultations with the operators revealed that the cause for concern in terms of 3G roll out in the Highlands and Islands may be considerably less than was previously anticipated and described in the original report.

3. Stage 1: Review

Site surveys

Eight routes were selected in consultation with SNH to give a representative cross section of LCTs typical of the Highlands and Islands. These routes included areas in the south of Scotland with characteristics which exist in the landscape of the Highlands and Islands. The objective was to obtain an understanding of what the final 2G 'picture' might be in the Highlands and Islands.

These routes were:

- Route 1 A831 and A833 Drumnadrochit/Cannich/Kiltarlity loop;
- Route 2 A68 Dalkeith to Lauder;
- Route 3 A58/A822 Crieff to Dunkeld;
- Route 4 M90 Perth to Kinross;
- Route 5 A939 Grantown on Spey to Cock Bridge;
- Route 6 A836 Bonar Bridge to Tongue;
- Route 7 A9 Inverness to Aviemore; and

Route 8 A832/A890/A87 Garve, Achnasheen, Eilean Donan to Invermoriston.

It was intended that 2 assessors would undertake the site survey work but the timescale for reporting the project, combined with the remoteness and length of some of the routes selected, precluded all sites being assessed by two assessors. The following sites were surveyed by a single surveyor:

- route 2;
- route 6; and
- route 8.

It was also intended that routes should be surveyed in both directions to give a full picture of the impacts of masts. However, route 8 was surveyed only in one direction because of its length (153km).

The surveys were undertaken in mixed weather and visibility conditions and it should be stressed that the recording of RBSs is related to these conditions and to whether the routes were surveyed by one or two assessors and thus may not necessarily present a comprehensive picture.

Such possible inaccuracies do not, however, give less credence to the findings of this part of the study as conditions will vary every time a route is driven and it is recognised that, amongst the general public there will, inevitably, be some confusion relating to the function of distant upstanding man-made features (eg RBSs may be confused with pylons).

It should be noted that the surveys were undertaken by Chartered Landscape Architects experienced in assessing the landscape and visual impacts of different types of development and that the purpose of the surveys was to make professional judgements on these impacts. These judgements may not be those held by members of the public – eg where the surveys report 'visual uncertainty' this means that it was unclear to the surveyors whether an upstanding feature was a RBS or a pylon or some other feature; this may not be an issue of great concern to members of the public.

The full field survey records and accompanying maps are available as separate unpublished documents – see Appendix 1 of this report.

The summary findings of the survey are reported in the tables below using the following abbreviations:

- LCTs = SNH Landscape Character Types;
- c/w = clockwise travelling direction;
- ac/w = anticlockwise travelling direction;
- N-S = north to south travelling direction; and
- S-N = south to north travelling direction.

Route 1 A831 and A833 Drumnadrochit/Cannich/Kiltarlity Loop							
Length of route	No. of LCTs	No. of masts visible	Average distance between masts	% of route no masts visible	% of route 1 mast visible	% of route 2 masts visible	% of route 3+ masts visible
67km	12	10 c/w 8 ac/w	6.8km	83 c/w 89.5 ac/w	11.5 c/w 10.5 ac/w	(300m) nil	nil nil

Comments:

The perception of the presence of masts on this route is that they are relatively infrequent, with long stretches of route (up to 10km) with no views of masts. Those which are most prominent are historic masts on prominent sites which, while now also accommodating mobile phone equipment, were constructed for the emergency services. Views of masts are constrained by the terrain and vegetation (most of the route lies in LCTs 'Wooded Glen' and 'Narrow Farmed Strath') which results in the majority of views being of an intermittent nature, over short stretches of the route. Provided future masts are located at low level and within, or adjacent to, areas of deciduous woodland or forestry, they should be accommodated quite easily. The exception to this will be in areas of LCT 'Rocky Moorland Plateau' where little vegetation exists. In this LCT, future equipment should be located on existing masts where possible (even if this results in an increase in mast height) or on sites adjacent to, but at lower elevation than existing masts. In such circumstances, efforts should be made to ensure that mast design is the same as that of existing masts (unless these are entirely unacceptable).

Route 2: A	A68 Dalkeith	n to Lauder					
Length of route	No. of LCTs	No. of masts visible	Average distance between masts	% of route no masts visible	% of route 1 mast visible	% of route 2 masts visible	% of route 3+ masts visible
18.3km	12	8 (inc. group of 3) NW–SE 10 + 2 distant (Inc group of 3) SE–NW	3.9km	66 NW-SE 59 SE-NW	18 NW-SE 24 SE-NW	11 NW-SE 6 SE-NW	NW-SE 11 SE-NW

The central section of this route is dominated by the presence of the windfarms at Soutra and it is significant to note that no masts were observed over this section. This may be accounted for by the dominance of the windfarms although weather conditions and visibility at the time of survey were very poor. The masts at the northern end of the route are relatively well sited in relation to surrounding topography and vegetation (LCT 'Lowland Hills and Ridges'). The masts in LCTs 'Plateaux Grassland' and 'Rolling Farmland' are particularly prominent although those located close to existing woodland are considerably better sited than the triple masts at site 4. The triple mast site is dominant in views as it is a head-on view travelling north and the fact that each mast is different from the next increases the impact of the group. The average distance between masts is the distance which is likely to be required for 3G cell sizes and it is interesting to note that in this type of landscape views of these are intermittent but the duration of mast views and the distances between these views are much greater than those of the LCTs in the Route 1 study area. Any future masts in the landscape types through which this route passes would best be located on existing masts or on site shares at lower elevation than the existing masts, with efforts being made to ensure that any new mast is a design 'twin' of the existing (unless this is entirely unacceptable).

Route 3: A85, A82 Creiff to Dunkeld

Length of route	No. of LCTs	No. of masts visible	Average distance between masts	% of route no masts visible	% or route 1 mast visible	% of route 2 masts visible	% of route 3+ masts visible
35km	7	8 W-E 8 E-W	4km	93 W-E 83 E-W	7 W-E 7 E-W	nil W–E 2 E–W	nil nil

Comments:

Although the masts over this route are fairly evenly spaced (with the exception the central section of approximately 8km where there are no visible masts), this is not reflected in the incidences of duration of sightings (mast sightings in both directions of travel are much more sporadic that their even physical distribution would suggest). This is true also of the 2 masts at the western end of the route although these are located in a different LCT ('Lowland Hills') to those at the eastern end of the route. On the whole, masts along this route are relatively well sited and views of them tend to be from the immediate vicinity. This is due, in part, to the LCTs 'Upper Highland Glens' and Mid Highland Glens', which are capable of accommodating masts at low level with relative ease. This is less true of 'Lowland Hills' although the existing masts benefit from local topographical features and vegetation. Future masts in the 'Highland Glen' LCTs should be capable of being accommodated with limited cumulative impact being accrued although mast share and site share would be recommended to maximise the lengths of route with no mast views.

Route 4: M90 Perth to Kinross							
Length of route	No. of LCTs	No. of masts visible	Average distance between masts	% of route no masts visible	% of route 1 mast visible	% of route 2 masts visible	% of route 3+ masts visible
24km]]	19 N–S 19 S–N	3km	65 N-S 81 S-N	N-S 10 S-N	10 N-S 0 S-N	21 N–S 19 S–N

Although this route has a very high percentage of its length travelling north with no masts visible, the perception is that there are many. This is because a high proportion of the route (around 20% for both directions) has three or more masts visible. This perception is exacerbated by the fact that most of the masts visible on this route are very close to the motorway and, while these are seen for relatively short periods, they are seen at close range and usually with equipment cabins visible. This route is perhaps not easily comparable with any route in the Highlands and Islands except, perhaps, the A9 (although the LCTs are obviously very different) but it does give a good indication of how frequent 3G masts might be likely to be. The presence of manmade structures around the M90 possibly make it easier to accept the presence of so many masts (even when these are of many and varied designs) but on the A9 between Perth and Inverness and further north, there is very little 'roadside' clutter and masts will be very difficult to accommodate without significant adverse cumulative impacts. Methods to minimise this will be by exploiting the presence of overhead electricity transmission line towers which are approximately parallel to the A9 over much of its length, by maximising the use of existing masts and by ensuring that a uniform mast design is adopted wherever feasible.

Route 5: Grantown on Spey to Cock Bridge							
Length of route	No. of LCTs	No. of masts visible	Average distance between masts	% of route no masts visible	% or route 1 mast visible	% of route 2 masts visible	% of route 3+ masts visible
45km	9	SE-NW 7 NW-SE (Inc double site)	5.3km	90 NW-SE 79 SE-NW	10 NW-SE 17 SE-NW	nil 5 SE–NW	nil 3 SE–NW

Comments:

The perception is that there are very few masts on this route. This is due mainly to the fact that two extensive sections of the route either side of Tomintoul have no views of any masts. Those masts which are visible at the north western end of the route are seen at some distance and those at the south eastern end are viewed in the context of the clutter of man-made structures at the Lecht ski slope. Additional masts can probably be accommodated in the vicinity of the ski slope, on the emergency services site (1) and in the 'Strath' type LCTs around Grantown on Spey and at Tomintoul provided these are located at low level and sited in association with existing woodland, forestry or buildings. Any masts proposed for the 'Upland Hills and Glens' type LCT would be likely to be highly prominent almost wherever they might be sited but sites on the lower slopes where back clothing could be achieved for the majority of sites would be preferred. Again a mast of uniform design would reduce the visual uncertainty (ie more attention being given to an object due to not being familiar with what that object is).

Route 6: A	836 Bonar	Bridge to To	ongue				
Length of route	No. of LCTs	No. of masts visible	Average distance between masts	% of route no masts visible	% of route 1 mast visible	% of route 2 masts visible	% of route 3+ masts visible
68.75	5 plus 'Coniferous Woodland'	S–N 8 N–S	10.25km	78.83 S–N 81.8 N–S	18.97 S–N 17.1 N–S	2.2 S-N 1.1 N-S	nil nil

On this route, the perception is that there are few masts in the landscape. This is due to the fact that over an extensive central section no masts are visible combined with the fact that many portions of the route only have long range views to distant masts. In general, the RBSs are relatively well sited and manage, on the whole, to take advantage of the screening qualities of existing forestry plantations or the back clothing properties of rocky hillsides. Future 2G masts along this route could be accommodated by mast or site sharing. For 3G, existing masts or site sharing should be a priority with infill masts, to provide network coverage, being of a design which matches, for example, masts 5, 6, 7 and 8. Siting of such masts will be quite difficult over the northern section ('Sweeping Moorland'), given the scarcity of woodland and forestry cover and the absence of upstanding manmade features – existing individual masts in this area tend to be much more prominent than those to the south.

Route 7: A9 Inverness to Aviemore

Length of route	No. of LCTs	No. of masts visible	Average distance between masts	% of route no masts visible	% of route 1 mast visible	% of route 2 masts visible	% of route 3+ masts visible
48km	11	11 SE-NW 14 NW-SE	4.3km 66 NW–SE	75.5 SE-NW 26.NW-SE	21 SE-NW 1.5 NW-SE	2 SE–NW 5 NW–SE	1.5 SE-NW

Comments:

Driving this route, the perception is that there are a lot of masts at particular points on the route, most notably at the Slocht where multiple masts are visible in conjunction with pylon lines, and at Bogbain where the bulky radio transmitter is seen in the foreground with a tall mast on the Black Isle being visible in the distance. Over other lengthy sections of the route there are long range views of distant masts, particularly when travelling north, which combine with intermittent short range views (over short distances) to road side masts. This route has a number of masts located close to the road and, in general these have been well sited and are not visible from any great distance due to either back-clothing or concealment by vegetation. Sections of the route where it will be difficult to accommodate further masts are those areas around the Slocht where the route passed through LCTs 'Rolling Uplands' and 'Uplands and Glens Strathdearn Hills'. Elsewhere the presence of roadside vegetation and/or man made structures will assist in absorbing further masts without undue cumulative impacts.

Route 8 A	832, A890,	A87 Garve,	, Achnnashe	en, Eilean I	Donan to Inv	vermoriston	
Length of route	No. of LCTs	No. of masts visible	Average distance between masts	% of route no masts visible	% or route 1 mast visible	% of route 2 masts visible	% of route 3+ masts visible
153km	12	17 including a relay station and a site share	7.85	73.7	25.25	1.05	nil

This route was only surveyed in an anti-clockwise direction. The perception over the first section of this route (to Achnasheen) is that there are not very many masts in the area. This is due mainly to the fact that, although intermittent views are available of masts to the north west of the road, principal views are to the south west. Between Glencarron Lodge and Loch Carron no masts are visible for 15km. Along the south side of Loch Carron, a distant mast is intermittently visible and mast 5 comes as something of a shock on rounding a bend to find it occupying the entire foreground of the view. The high impact of this mast really is down to the fact that no masts are seen for a considerable distance and then one, distant mast is observed. Beyond Loch Carron, a 10km stretch of road has no views of any masts until the descent to Auchentyre commences and a distant mast is seen skylining. Mast 7 which is a historic, emergency services mast, is located above Eilean Donan Castle and views of the castle from certain sections of road are detracted from by the presence of this mast in the view. Along Loch Duich, views over the loch are largely unaffected by the presence of a high level mast in Rattagan Forest. The second mast which exists near the viewpoint is not visible. Passing through Glen Shiel, the driver is aware of the fact that no significant man-made features (other than the road) are present and no masts are seen until just south of Cluanie. The remainder of the drive along Loch Cluanie is characterised by views of mast 12. Thereafter, through Glen Moriston, infrequent and short duration views are obtained of single masts. In terms of future masts, the LCT 'Rolling Hills' can be expected to accommodate additional masts without significant impacts provided they are located so as to take advantage of local topography and existing vegetation. It will physically be difficult to construct further masts along the section of route which passes along the edge of LCT 'Rocky Moorland'. Similarly it will be difficult to accommodate masts in Glen Shiel (LCT 'Interlocking Sweeping Peaks') and the section along Loch Cluanie ('Rugged Massif') would best be served by mast sharing. Glen Moriston (LCT 'Wooded Glen') should be able to successfully accommodate further masts with careful siting.

Summary

The perception of the impacts of RBS masts can be expected to vary from person to person.

Routes 2, 3 and 4 give an indication of the possible impacts which might result from the introduction of 3G RBSs in the Highlands and Islands given that the average spacing between these RBSs is around 4km which is likely to be the cell size for 3G.

4. Stage 2: Analysis

Survey findings

The eight surveys undertaken were informative in developing a greater understanding of the links between multiple development and cumulative impact in a range of different LCTs.

Each of the routes surveyed demonstrated key issues in relation to the cumulative impacts of RBS developments including the following:

- **Route 1** Complex topography and significant areas of vegetation physically screen views and reduce the perception of their presence in the landscape (RBSs are visible for over 10% of this route in both directions but the perception of their presence is much less).
- **Route 2** Other memorable features in the landscape reduce the perception of the impacts of RBSs (Soutra windfarms is the most dominant element along this route although RBSs are visible in series or in groups for up to 25% travelling north).
- **Route 3** Even and frequent spacing of RBSs does not necessarily mean that they will be perceived as regular features in the landscapes with complex topography (RBSs on this route are at 4km spacing but sightings of them are sporadic and limited to less than 10% of the route).
- **Route 4** Cumulative impacts of multiple RBSs are proportionally higher than the duration of their visibility would suggest compared to series of RBSs (this route has up to 65% of its length with no RBSs visible but a up to 21% with 3 or more masts visible).
- **Route 5** Long sections of route with no RBSs visible reduce the perception of the presence of RBSs overall (two extensive sections of route with no masts visible meant that although RBSs were visible for approximately 20% of the route's length, the overall impression was of less).
- **Route 6** The presence of vegetation is crucial, particularly in landscapes where the topography is simple, in reducing the perception of the presence of groups of RBSs or series of RBSs (the central and southern sections of this route accommodate existing masts reasonably well, compared to the northerly, almost tree-less section).
- Route 7 Siting close to roads and other infrastructure can be preferable to hilltop locations (the addition of further RBSs close to the A9 has not significantly increased the perception of the presence of longstanding hill top RBSs whereas further RBS development in skylining situations has resulted in cumulative impact).
- **Route 8** Siting RBSs series of masts and groups of masts outwith the panorama of principle views substantially reduces the perception of their presence in the landscape (although there are a number of masts over the first section of this route, views are directed away from them whereas the single mast at the end of Loch Carron draws the eye towards it).

The perception of the impacts of RBSs can be expected to vary from person to person and is likely to be influenced by such factors as:

- familiarity with the route and the surrounding landscape;
- expectations of the area (especially for remote areas of the Highlands and Islands);
- purpose of the trip;
- type of road and speed of driving (related to the purpose of the trip: it should be noted that all of the surveys were undertaken driving at speeds considerably less than the roads' design speeds);
- sensitivity to the presence of RBS (the surveyors undertaking the study, SNH area officers and Highland Council Planning officers can be expected to have a heightened awareness of RBSs);
- the presence of other, similar, features such a electricity pylons and an ability to distinguish between these and RBS, particularly at distance; and
- sensitivity to network coverage (ie how important continuous, or near continuous, service is to the individual).

All of the above being equal, cumulative impacts of RBSs would be dependant on the frequency and duration of visibility which would be related to the:

- character of the landscape in which the RBSs are situated;
- the character of the landscape through which the observer is travelling; and to
- visibility (influenced by weather conditions, direction of view, time of day etc.).

Routes 2, 3 and 4 give an indication of the possible cumulative impacts of 3G RBSs in rural situations given that the average spacing between these RBSs is between 2 and 4km which is the anticipated required spacing for 3G equipment in such locations. Impacts are, of course, not wholly dependant on spacing of equipment but are influenced by the character of the landscape in which they are located, whether they are visible in series, in groups etc.

One of the principal findings of the survey works was that, from a route driving, or cumulative, perspective the proliferation of different mast designs existing is a matter of concern which relates to an ambiguity regarding the purpose of these structures. It is considered that ambiguity of function leads to more concentrated attention being afforded to a feature and that it may be possible to reduce the cumulative impacts of RBSs by attending to this issue.

By way of comparison, there is no such ambiguity in relation to electricity pylons or wood poles. They are linked by overhead lines, are known features in the landscape, their purpose is understood and the frequency of their presence is, generally, accepted albeit that their adverse visual impact and impact on landscape character is also acknowledged.

The main emphasis of the original report was on the siting and design of RBSs on a site by site basis but this study has revealed that there may be merits in taking a more holistic view to ensure that RBSs become accepted and unobtrusive features of urban and rural areas which is the aim set out in PAN 62.

Siting nevertheless remains a critical issue. Furthermore, the detailed design of RBSs needs to be considered from a wider perspective than is currently, perhaps, the case.

Consultations

The following were contacted for consultation purposes:

- O₂ formerly known as BT Cellnet;
- Hutchison 3G to be known as 3;
- T-Mobile UK formerly known as One2One;
- Orange;
- Vodafone;
- Scottish and Southern Electricity (SSE) (owners of telecommunications infrastructure which is made available to operators); and
- Crown Castle International (owners of telecommunications infrastructure which is made available to operators).

Consultees' responses

The consultees responded to questions concerning 3G equipment and roll out, site selection, mast sharing, site sharing and mast design and this information has greatly assisted the development of a better appreciation of the differences between 2G and 3G infrastructure requirements and has thus made it possible to improve the level of understanding of the possible future cumulative impacts of 3G roll out.

Likely scenarios regarding 3G roll out in the Highlands and Islands

It seems unlikely that the roll out of 3G and service availability will extend through the Highlands and Islands to the extent that it will in other areas of the UK. This is due, in part, to unknown demand but also to simple economics: the Highlands and Islands have 2G coverage as a direct result of ERDF assistance which made it possible for Vodafone and Cellnet (now O_2) to install their infrastructure in an area which was financially unviable for them without grant aid. Furthermore because of the higher frequency band utilised and the subsequent requirement for reduced distances between masts, 3G technology will be harder to link with a continuous coverage in the more remote, mountain landscapes.

Operators have conceeded that they are unlikely to roll out 3G in the Highlands and Islands other than at major towns and on important transport links, because their alternative 2.5G GPRS network will be able to provide many of the services of 3G. The installation of 2.5G simply means that existing 2G RBSs will be converted and that there will be no change to the appearance of the 2G RBSs. 2.5G will provide some but not all of the services of 3G – e.g. data transfer will not be as fast.

The operators' 3G licences require them to cover 80% of the UK population by 2007. However, it is understood that this figure could be achieved without providing any coverage in Scotland.

Hutchison 3G have confirmed that their 3G network will be in place in Aviemore and Inverness by mid-2003.

SSE have expressed a view that the foregoing may well be correct and, further commented, that it was their understanding that operators had delayed their 3G roll out by about 2 years.

3G equipment requirements

The precise equipment requirements for 3G seem to differ between operators but the main issue is that all 3G RBSs will need to be located at much closer intervals than 2G RBSs. It is thought that 3G may require a minimum of a doubling of masts in the Highlands and Islands and this is only on the basis that existing 2G RBSs are too far apart to supply 3G coverage and ignoring the fact that 2G coverage remains incomplete.

Hutchison 3G's cell size for 3G is likely to be between 2–4km whereas Vodafone consider that a cell size of between 3.5–6.5km is likely for rural areas, with the cell size for low population densities such as the Highlands and Islands being likely to fall at the upper end of the size range.

Mast height also seems to vary from operator to operator with Hutchison 3G estimating a minimum mast height of 25m (for technical reasons) and Vodafone quoting a mast height of between 15–20m.

The basic equipment will not vary significantly in visual terms from the appearance of 2G RBS but will depend on how many operators are located on one site.

The route survey undertaken revealed that operators are making efforts on remote routes to install their 2G infrastructure on existing masts and it is likely that all operators will try to maximise mast or site sharing for 3G.

Site selection

The main issues constraining site selection for operators for both 2G and 3G RBS sites are those of economics and technical feasibility namely:

- will the site provide the coverage required?
- is it commercially viable?
- is it acquirable?
- is there access to build the site and to maintain it?
- can power be provided at a reasonable cost?
- can it be linked to the network at reasonable cost?

Operators identify broad sites for optimum coverage and then try to find a visually/environmentally acceptable location within the area. Where there is an existing mast, all operators report that they will actively explore the possibility of mast sharing or site sharing. This is a requirement of their licences and can result in substantial development cost savings – a fact which is of particular relevance in the Highlands and Islands where revenue from users is significantly lower than more populated areas of the U.K.

In circumstances where there is a particularly sensitive issue relating to siting and design, operators have confirmed that they have either employed specialist environmental advice, or that they would in future.

Mast sharing

None of the operators reported any technical difficulties in relation to mast sharing in terms of either 2G/3G sharing or 3G/3G sharing other than those already known for 2G/2G sharing ie:

- 1m vertical separation between equipment mounted on the mast (meaning, generally, a 5m extension to existing masts);
- inability of monopoles to take equipment for more than one operator/service without the size of the structure being dramatically increased; and
- structural capabilities of the mast (especially in the Highlands and Islands with high wind loadings);

All telecommunications operators are required to consider mast sharing wherever practical as part of their service agreements. A number have entered into agreements with at least one other operator to mast share on sites in the Highlands and Islands. Orange and T-Mobile UK for example currently have a joint build programme in the Highlands and Islands. In addition, operators will continue to use third parties such as Crown Castle International.

Site sharing

None of the operators reported any technical difficulties in relation to site sharing and all operators acknowledged the merits of site sharing where mast sharing was either impractical or not desirable for reasons of visual impact and impacts on landscape character.

Crown Castle International suggested that they could, perhaps in conjunction with Highland Council, have a role in creating suitable sharing opportunities by developing, or adding to, existing mountain refuges/ emergency and/or visitor centres to incorporate communications development in areas where there is already development, often with power and access. This would not only assist in minimising the impact of telecommunications development but could be harnessed to the improvements of facilities for the enjoyment of visitors and locals alike.

Mast design

The operators use a small range of suppliers but there is a myriad of designs available. The major technical factors in mast selection are weather (wind loadings) and weight of equipment.

In terms of specific design development of masts for 3G in the Highlands and Islands, none of the operators reported any significant work being undertaken in this area at present and Hutchison 3G reported that such design development would be undertaken only if and when it was required for their 3G roll out programme.

Alternative support structures are being explored by most of the operators and these include electricity pylon mounting although SSE are still investigating the use of pylons with regards to protecting the electricity network against surges if lightning strikes an antenna. SSE confirm that each pylon can take only one operator and that the electricity supply for the RBS has to be taken from the nearest low voltage transformer which may be remote from the RBS site.

 O_2 have confirmed that while pylon mounting is feasible there are restrictions in terms of the distances which must be maintained between the electricity cables and the telecommunications equipment which means that only the larger electricity pylons are suitable for equipment mounting.

Vodafone have indicated that direct mountings onto rock faces is not a viable or practical option due to the International Commission on Non-ionising Radiation Protection (ICNIRP) requirement to have an exclusion zone surrounding their equipment.

Vodafone have trialed the technology to mount equipment on live trees and have taken this one step further by entering into a contract grow agreement with Bellwood to produce trees specifically to be planted in locations where a new copse of trees (with one tree taking the equipment) might be more visually acceptable than a conventional mast. Hutchison 3G are also looking at this option although they have encountered networking difficulties as well as height problems. It might be a viable solution for a small number of sites.

Future development in the Highlands and Islands

The following important issues have arisen with regard to the completion of 2G and the roll out of 3G:

- 3G may not be rolled out in the Highlands and Islands to the extent that it will in the central belt of Scotland;
- the nature of GPRS technology means that operators' 2.5G networks will be able to provide many of the services of 3G, albeit at slower data transfer rates and it seems unlikely that 3G coverage will be provided in the Highlands and Islands except possibly at major towns and along major transport links;
- Hutchison 3G anticipate providing 3G coverage along the A9 and up to Inverness;
- 2G roll out is near completion and operators seem to be attempting to maximise mast and site sharing in order to complete their networks; and
- while Hutchison 3G (as the only operator with no 2G infrastructure on which to build) have
 permission to roam the O₂ network for a limited period, and while the Stewart Report recommends
 roaming, there are major legal issues relating to roaming within the UK Offtel is exploring this issue
 which is potentially anti-competitive and could hinder network development.

Planning policy

Policies covered in The Highland Council Structure Plan Written Statement were referred to previously in the original report.

Options to steer or control future development in the Highlands and Islands

Notwithstanding the fact that 3G may not happen in the Highlands and Islands outwith Inverness and the A9 corridor, some key issues require to be addressed in relation to the completion of the 2G networks, the possible 'infill' of additional 2G masts if user demand increases and for a predicted limited roll out of 3G:

- the first step in minimising cumulative impacts will be to ensure that there is free and open dialogue between the operators and the Planning Authorities and Scottish Natural Heritage as advisors to Planning Authorities on natural heritage issues;
- operators should provide Planning Authorities with as much information as possible with regard to their wider network plans;
- it is incumbent on operators to undertake their own assessment of the likely visual and landscape impacts and to put forward proposals for the best feasible site; and
- the situation regarding roaming should be monitored and, if this is to prove a viable alternative to additional RBSs (more likely in rural areas with less demand on the individual networks), due consideration given to it.

5. Stage 3: Best Practice Guidance

In order to minimise the cumulative impacts of future RBSs the following broad recommendations are made.

Consideration should be given to individual mast applications on a site specific basis and to the implications on the wider network of RBSs. The planning outcome for a single application (granting/ refusal of permission) can have knock on effects for the siting of other RBSs which could mean a series of less than ideal locations being developed.

Mast sharing should be encouraged where it will mean that the existing mast can be dismantled and replaced with a more elegant structure.

Mast sharing may present further opportunities to improve screening of ancillary equipment.

Careful consideration should be given to the benefits of mast sharing in circumstances where an increase in height or bulk of an existing mast would have less impact than the introduction of a second mast.

There will be circumstances where a second, or even a third, low level mast will be preferable but these circumstances are likely to be where masts are located in areas where existing vegetation and good back clothing exist.



Where site sharing is recommended, operators should be encouraged to install a 'twin' design which matches the existing mast as closely as possible. It is likely that there will be few circumstances where the existing mast is of such unacceptable design that the introduction of a second similar mast will not be preferred over the introduction of a contrasting mast.





Mast design should be considered with the following priorities:

- individual sites;
- groups of sites within different LCTs; and
- series of sites along transport corridors.

Mast designs of differing appearance in urban and periurban situations will almost always be required to ensure the best 'local fit' and different mast designs are more readily acceptable in areas where a wide range of man-made structures exists.





In locations where electricity pylons exist, site sharing may be less acceptable – RBSs of different operators being located at similar centres to the electricity pylons will generally minimise 'overlapping' (and the appearance of greater bulk) and result in the RBSs being seen as part of the linear pattern established by the electricity pylons.

The use of pylons where these coincide with Operators' network requirements and where there is a Low Voltage electricity supply to hand should be explored – this may be relevant to much of the A9 corridor.



Planning Advice Note 62 and the original report provide further guidance with regard to siting and design of mobile telecommunications' developments.

Broad LCT-related guidance

In terms of the LCTs which exist in the Highlands and Islands, it is difficult to give precise advice, over and above the broad guidelines outlined above, which could be applied in all circumstances in different LCTs. However, some additional broad guidance and comment relating to some typical Highland and Island LCTs is provided below. The extent of the study precluded providing advice for each and every LCT in the Highlands and Islands and Islands below relates to the Ross and Cromarty Landscape Character Assessment LCTs – many of which can be found in other parts of the Highlands and Islands.

Smooth Moorland

The key characteristics of this LCT are open space; simple composition; vastness; absence of human activity; and sense of remoteness.

Clearly the introduction of man made elements such as RBSs will compromise these key characteristics. Site selection should aim to locate masts adjacent to any existing man made features and to take advantage of back clothing by adjacent 'Undulating Moorland' or 'Sloping Terraced Moorland'. Mast design, site layout and access tracks should be of simple and uniform design with development concentrated to minimise the cumulative impact of dispersed development.

Undulating Moorland

The key characteristics of this LCT are irregular topography; absence of human activity; sense of vastness; barrenness and remoteness.

Again, the introduction of mobile telecommunications infrastructure will tend to dilute these characteristics. Site selection should aim to locate RBSs adjacent to any existing features, including buildings, ruins etc., and multiple mast developments should either be located close together to be 'read' as a single development or sufficiently far apart to be 'read' as single items in the landscape as opposed to scattered, cluttered development. Site location should also take advantage of the local variations in topography with RBSs relating to, for example, local depressions. Mast design, site layout and access tracks should be of a simple and uniform design.

Sloping Terrace Moorland

The key characteristics of this LCT are smaller-scale terraces; asymmetrical form; lack of human activity; and sense of remoteness.

The most significant influence of the introduction of RBSs in this LCT is the potential to interfere with dominant downward visual forces. RBSs should, therefore be located on the lower slopes, away from skylining ridges. Again, mast design, site layout and access should be of simple, uniform design.

Rocky Moorland

This LCT has key characteristics including scattered rocks, boulders and rock outcrops; sense of enclosure contrasting with openness; occasional narrow river gorges; uninhabited; few particular focal points.

RBSs will introduce foci where none may exist at present and the choice of location of any mobile telecommunications development will be important. Sites where back clothing can be obtained will be preferred. SNH's LCA guidance states that 'several new elements can visually reinforce the complex nature of the character type. If continually supplemented they may create a chaotic and confusing pattern'. It will therefore be critical to assess proposed RBSs on a case by case basis, ensuring that multiple locations serve to reinforce the inherent complexity and safeguarding a 'threshold' beyond which visual confusion will result. RBSs, site layout and access tracks should be of simple form and design.

Cnocan

Key characteristics in this LCT are sheltered, deep lochans; patches of green moorland; scrub woodland; occasional isolated houses or scattered development; exposed grey and reflective crystalline rock; and highly complex, random patterns.

Potential exists in this LCT to take advantage of existing point features (eg isolated houses, copses, trees etc.) by locating RBSs close to these and to maximise the back clothing properties of woodland and rocky slopes. SNH's LCA guidance suggests that grouping of development to create a distinct group and pattern of its own is an acceptable solution in this LCT. In this case, masts and site layout should be of uniform design, creating a repetitive pattern of similar elements.

Rugged Mountain Massif

The key characteristics of this LCT are angular, jagged skyline; broad bulk base of individual mountain masses; steep slopes; corries, deep valleys and narrow mountain lochs; basin shaped lochans; and sense of remoteness.

For 3G mobile telecommunications development, it would appear that the upper reaches of the this LCT are unlikely to be affected. However, SNH's LCA guidance highlights the importance of visual link from low lying ground upslope to the mountain peaks. Where RBSs are to be located on the lower slopes, they should either be sufficiently distant from each other to allow this visual flow to remain or they should be clustered close together as described above.

Rounded Hills

This LCT has key characteristics including wide open concave and convex slopes with simple lines; sense of grandeur; vast in scale; smooth texture; deep gullies; interlocking spurs and meandering rivers; lack of human activity; coniferous woodland plantations; and reservoirs.

The successful location of RBSs in this LCT will depend on the application of the broad siting and design principles set out in the original report (back clothing, locating masts over the top of ridges etc.) and, for multiple masts, it is suggested that uniformity should be adhered to in the design of structures and sites to ensure they are in keeping with the simple lines and character of the hill masses within this LCT.

Narrow Farmed Strath

Key characteristics present in this LCT include narrow sinuous channels; sense of enclosure and isolation; restricted views; visually prominent components; regular pattern of fields and trees; seasonal variation; traditional estates; and sense of history and past occupation.

The impacts of RBSs in this LCT are likely to be of short-term duration due to the sinuous nature of the LCT and the roads within it. None the less, the basic siting and design principals outlined in the original report should be adhered to ensure that impacts are minimised.

Wide Farmed Strath

This LCT has key characteristics including wide, flat strath floor; strong definition between the strath and sides and the floor; central visual focus; sense of enclosure; blocks of woodland; range of textures and patterns; riparian woodland; and large estate houses, old walled enclosures and entrance gates, mature woodland and agricultural buildings.

A key consideration in siting RBSs in this LCT will be to avoid impinging on the central visual focus by siting masts on the strath sides, taking advantage of the screening effects of woodland.

Forest Edge Farming

This LCT possesses key characteristics which include semi-improved and improved pasture; strong geometric pattern of enclosures lined by stone walls, gorse hedges and hedgerow trees; sense of

enclosure; diversity of features; seasonal contrast; changes in colour and texture which accentuate the pattern of enclosures; high voltage lines and pylons; large estate houses, old walled enclosures and entrance gates, mature woodland and agricultural buildings; woodland and trees comprising small estate copses, shelterbelts and hedgerow trees; and a patchwork of open and enclosed space.

The fact that pylons and overhead electricity lines are mentioned as a key characteristic in this LCT suggests that multiple mast siting should attempt to mimic this pattern with regular, linear spacing while avoiding views of overlapping RBSs and pylons. The presence of significant woodland tracts would indicate that good siting may be achieved by utilising the screening and back clothing properties of blocks of vegetation.

Linear Crofting

The key characteristics of this LCT include gently sloping land; narrow strips along coastal edges; strong regular pattern of clearly ordered crofting strips extending from the upper moorland down to the coastal edge; series of parallel lines illustrating the slope of the topography; access roads, power lines and clumps of trees; limited visibility; views directed along or diagonally across the linear crofting strips; remnants of past woodland stands; and ruined traditional buildings, abandoned crofts and drainage systems.

The proliferation of ruined and abandoned croft buildings in this LCT would suggest that there is scope to house RBS equipment within restored buildings to minimise the impact of such development on this LCT. Where vegetation exists, opportunities to screen or backcloth freestanding RBSs should be exploited.

Scattered Crofting

This LCT possesses key characteristics including complex pattern of crofting overlain on variable relief; diverse mix of components such as small houses, scrub and trees, field boundaries, outbuildings, roads and power lines; extent of visibility is variable; narrow roads winding though the undulations; constant variation of direction and elevation; and some broad-leaved woodland.

Again, there will be scope in this LCT to re-use abandoned and derelict croft buildings to house RBSs. SNH's LCA guidance states that, in this LCT, it is important to plan strategically and to consider how an individual change will affect the complex relationship between different components of this LCT. In general, RBSs will have less impact if they are located in a close relationship with existing structures or clumps of woodland.

Harbour Settlement

The key characteristics of this LCT include surrounding steep slopes; semi-enclosure; simple visual composition; backcloth to settlement; and jetty area and sea are the main focus.

In this LCT, the back clothing properties of the hillside behind the settlement should be exploited to backcloth any RBS. Where existing features such as lamp-posts and telegraph poles exist, RBSs should generally be of monopole construction with equipment housed in cabinets painted in an appropriate colour for the locality.

6. Conclusion

The Stage 1 Review was undertaken to establish the current picture in relation to RBS developments and their cumulative impact on LCTs which are similar to those found in the Highlands and Islands.

Analysis of the findings of the surveys of the eight routes examined assisted in the development of a better understanding in relation to the cumulative impacts of radio base station developments; each of the routes studied highlighted some key issues in relation to cumulative impacts.

Key issues which were identified during Stage 2 Analysis included the following factors which reduce the perception of series or groups of RBSs in the landscape:

- complex topography and significant areas of vegetation;
- other memorable features in the landscape;
- long sections of route with no RBSs visible;
- the presence of vegetation, particularly in landscapes where the topography is simple; and
- siting RBSs outwith the panorama of principle views.

Other issues identified which relate to the perception of RBSs include:

- even and frequent spacing of RBSs does not necessarily mean that they will be perceived as regular features in the landscapes with complex topography;
- cumulative impacts of multiple RBSs are proportionally higher than the duration of their visibility would suggest compared to series of RBSs; and
- siting close to roads and other infrastructure can be preferable to hilltop locations.

Consultations with operators and owners of telecommunications structures assisted in the development of a greater understanding of the technical requirements for 3G RBSs and helped improve the level of understanding of the possible future cumulative impacts of 3G roll out if and when it occurs in areas of the Highlands and Islands.

Key information identified during these consultations, which assisted in the formulation of the siting and design guidance set out in Section 5 of this report, included:

- likely scenarios regarding 3G roll out in the Highlands and Islands;
- 3G equipment requirements;
- site selection criteria;
- mast sharing issues;
- site sharing issues; and
- masts design.

These consultations also revealed that 3G roll out is unlikely to happen in the Highlands and Islands to the extent that it will in other parts of the country but, nonetheless the guidance described in the main report and in Section 5 of this report should assist in the siting and design of future RBS developments.

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The following key issues require to be addressed in relation to completion of the 2G network, the possible infill of additional 2G RBSs if user demand increases and a limited roll out of 2G along major routes and in major settlements:

- establish free and open dialogue between operators, the Planning Authorities and Scottish Natural Heritage as advisors to the Planning Authority;
- provision to Planning Authorities by operators of as much information as possible with regard to wider network plans;
- operators should undertake their own assessments of the likely impacts (including cumulative impacts) and put forward proposals for the best possible site; and
- the potential for roaming should be explored dependant on the findings of Offtel's investigations in light of the Stewart Report.

Appendix I Survey Records

This Appendix is available as a separate unpublished document.

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ABBREVIATIONS and ACRONYMS

1G	First Generation telecomms technology and equipment
2G	Second Generation telecomms technology and equipment
2.5G	Telecomms technology which is inbetween 2G and 3G
3G	Third Generation telecomms technology and equipment
ATV	All Terrain Vehicle
EDAVV	Environmental agency with offices in UK and abroad
ERDF	European Regional Development Fund
GRP	Glass Reinforced Plastic
GSM	Group Special Mobile
HIE	Highlands and Islands Enterprise
ICNIRP	International Commission on Non-Ionising Radiation Protection
IEGMP	Independent Expert Group on Mobile Phones
LCA	Landscape Character Assessment
LCT	Landscape Character Type
lpg	Liquid Petroleum Gas
MTX	Mobile Telephone Exchange
NPPG	National Planning Policy Guideline
NSA	National Scenic Area
OFTEL	Office of Telecommunications
PAN	Planning Advice Note
PCN	Personal Communications Network
PD	Permitted Development
PDR	Permitted Development Rights
PSTN	Public Switched Telephone Network
RBS	Radio Base Station
SEDD	Scottish Executive Development Department
SNH	Scottish Natural Heritage
SSSI	Site of Special Scientific Interest
TACS	Total Access Communications System
THC	The Highland Council
UMTS	Universal Mobile Telecommunications Systems

REFERENCES

CCS 1978	Vehicular Tracks in Upland Scotland
EDAW 1996	Mobile Telecommuncations Programme Environmental Study Report
Hutchison 3G (end 2002)	Hutchison 3G UK Planning and Environmental Handbook
IEGMP 2000	<u>Report on Mobile Phones and Health</u> (The Stewart Report) <u>http://www.iegmp.org.uk/report/text.htm</u>
SEDD 2000	Consultation on proposed changes to Permitted Development arrangements for telecommunications developments
SEDD 2001	National Planning Policy Guideline (NPPG) 19: Radio Telecommunications
SEDD 2001	Planning Advice Note (PAN) 62: Radio Telecommunications
THC 1999	The Highland Structure Plan (Approved March 2001)
T-Mobile 2002	<u>The T-Mobile Network – Facts about base stations and transmitters</u>
Vodafone 2001	Where do we go from here? Environmental and Planning Handbook

Statutory Instruments and Acts

Statutory Instrument 1992 No. 223 (S.17) The Town and Country Planning (General Permitted Development) (Scotland) Order 1992

Statutory Instrument 1992 No. 2084 (S.213) The Town and Country Planning (General Permitted Development) (Scotland) Amendment (No.2) Order 1992

Scottish Statutory Instrument 2001 No. 244 The Town and Country Planning (General Permitted Development) (Scotland) Amendment Order 2001

Scottish Statutory Instrument 2001 No. 245 The Town and Country Planning (General Development Procedure) (Scotland) Order 2001

Town and Country Planning Act (Scotland) 1972

Telecommunications Act 1994

Public Utilities Street Works Act 1950

Useful websites

http://www.scotland.gov.uk/planning http://www.hmso.gov.uk/legislation/scotland http://www.hmso.gov.uk/si