



a sense of place

Design Guidelines for development near high voltage overhead lines

design guidelines
for development
near high voltage
overhead lines



National Grid

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Design Guidelines for development near high voltage overhead lines

Statement of support

As organisations committed to best practice in urban design, regeneration and land use planning, we are pleased to offer our support for the Sense of Place initiative. We believe that these guidelines will be of value to many groups and individuals involved in the design and development process, offering innovative and practical guidance on the development of land near high voltage overhead lines.



'A consequence of current policy is that significant urbanisation is being planned on the edges of towns where a common constraint is overhead power lines which typically converge to serve concentrations of urban consumers.

In situations where overhead lines cannot be diverted away from development and/ or placed underground, they should be accepted as an unavoidable feature of the landscape the impact of which is to be mitigated by skilled urban design.

The TCPA is pleased to endorse the urban design guidance prepared by National Grid for situations where overhead power lines may have to remain.'

TCPA TOWN AND COUNTRY PLANNING ASSOCIATION
PLANNING FOR PEOPLE AND PLACES SINCE 1999



a sense of place

Design Guidelines for development near high voltage overhead lines

Introduction

The 'Sense of Place' Design Guidelines have been developed by National Grid in partnership with David Lock Associates to address the issues associated with developing sites crossed by, or in the vicinity of, pylons and high voltage overhead lines.

They specifically relate to the existing high voltage overhead lines (275kV and 400kV) operated by National Grid, but could in certain circumstances also apply to lower voltage overhead lines on steel pylons (132kV and below) operated by the local distribution companies.

Why do we need this guidance?

This work has been carried out in recognition of the increasing pressure for the sustainable development of land. A renewed focus on previously developed land is leading to the redevelopment of former industrial areas and the regeneration of our towns and cities. The sustainable urban extension of existing settlements is promoting a compact urban form that minimises the need to travel. Many of these potential development sites are crossed by overhead lines, some of which are high voltage overhead lines.

National Grid sometimes receives requests to move overhead lines, or put them underground, when development is proposed nearby. National Grid's approach is to seek to retain its assets in situ, though it recognises that there may be exceptional circumstances that would justify the request where, for example, the proposal is of regional or national importance. Leaving aside the cost and technical complexity of moving or undergrounding existing overhead lines, the National Grid network is a fundamental and permanent part of our national infrastructure and should be treated as such.

Nevertheless, National Grid recognises that the presence of high voltage overhead lines across a site presents a constraint on development. These guidelines look to promote the successful development of sites crossed by existing overhead lines and the creation of well-designed places. The guidelines demonstrate that a creative design approach can minimise the impact of overhead lines whilst promoting a quality environment.

Guidelines for residential and commercial development

The guidelines primarily address issues relating to residential development, as this is clearly one of the more sensitive forms of development in close proximity to overhead power lines. However, the design principles equally apply to other forms of development.

These guidelines also set out some of the technical issues faced by developers of such sites. The appendices contain useful information on possible technical considerations, including noise, interference, electric and magnetic fields (EMFs) and the operational and maintenance requirements of National Grid.

Produced in consultation with the development industry

The guidelines have been produced in consultation with a wide range of interest groups, organisations and individuals from the development industry. It is with thanks to the participation of these organisations and their most valuable comments that the guidelines have reached this final form.

This work and further information is available on the Sense of Place website at <http://www.nationalgrid.com/uk/senseofplace>

Feedback on the guidelines is welcome. If you have any queries or comments on this work, please contact National Grid.

Who is this guidance for?

Maintaining and enhancing the quality of the built and natural environment is increasingly important to all of us.

The aim of this design guidance is to meet these aspirations by promoting the highest possible quality in the design of development on land crossed by existing high voltage overhead lines and to suggest ways in which the environmental impact of high voltage overhead lines can be diminished.

These guidelines provide a practical tool-kit of design principles for all parties:


- **Developers, landowners and designers:** These guidelines will help provide greater clarity about the design constraints posed by high voltage overhead lines, along with greater awareness of the opportunities, through good design, to improve the environment and therefore the value of development.
- **Local authorities:** The guidelines will promote awareness of the potential to develop and improve the environmental quality of land close to high voltage overhead lines, and provide a suggested policy and supplementary planning guidance on the development of land crossed by high voltage overhead lines.
- **Communities:** The guidelines provide a useful additional resource for communities taking part in planning events in setting out the potential for the successful development of land close to high voltage overhead lines.



With careful design, a high quality environment is possible near high voltage overhead lines.



the need
for design guidelines



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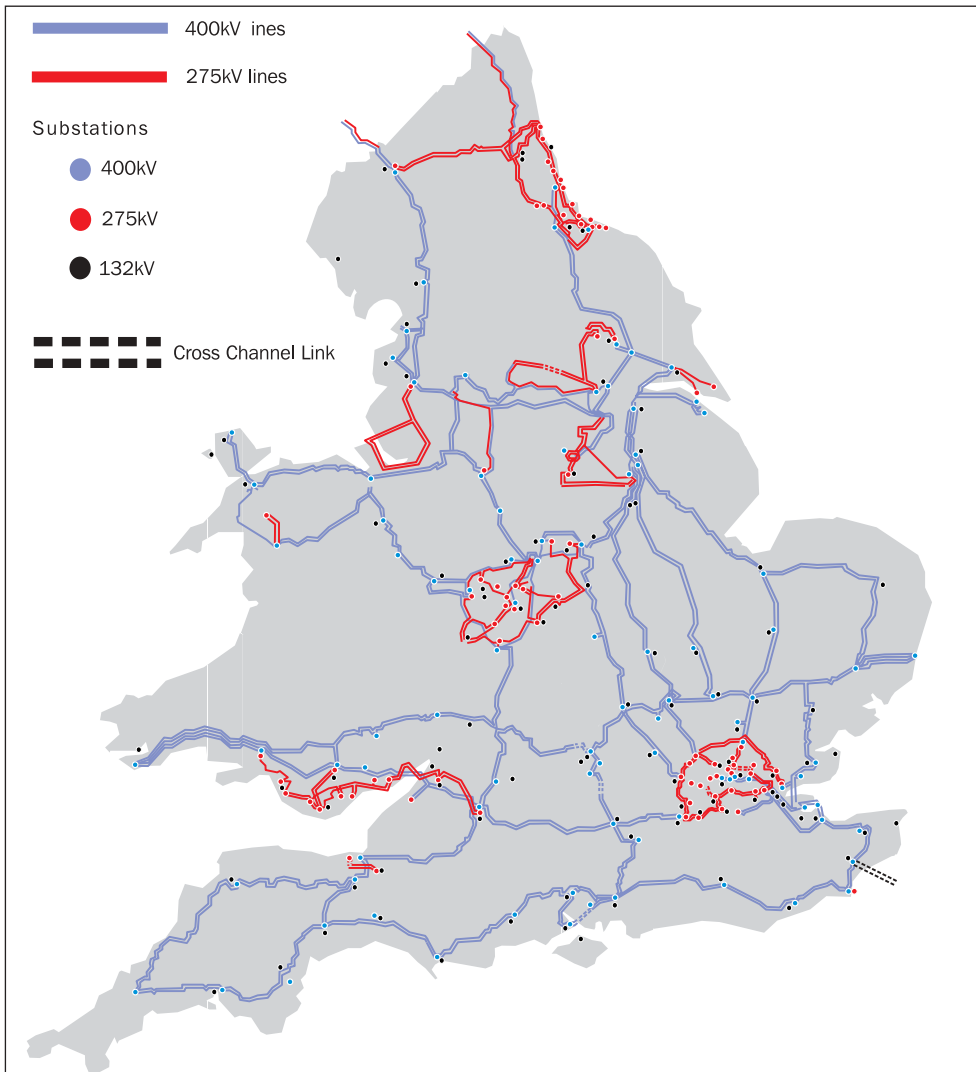


The need for design guidelines

National Grid is the electricity transmission business in England and Wales. The electricity transmission system consists of over 7,000 route kilometres of high voltage overhead lines. Historically, where development took place close to these high voltage overhead lines, little attention was paid to the design and layout of development and its relationship to the electricity equipment. The result has been the creation of what we might now consider poor environments – and we know we can do better.

The increasing pressure for development and the urban renaissance planning agenda are leading to more development sites being brought forward through the planning process on land that is crossed by National Grid equipment. A snapshot of development plans in England and Wales showed that 48 sites crossed by National Grid overhead lines are currently allocated for built development, and this figure is likely to increase.

The high standards of design and sustainable development forms advocated by the emerging planning and urban design agenda require a more creative approach to new development around high voltage overhead lines: the need for guidance is clear.



Map of National Grid electricity transmission system.



Development and overhead power lines: National Grid's role and responsibilities

National Grid provides the transmission of electricity from the point of generation across the country to the major centres of demand, which are the main urban areas where most people live and use electricity. The National Grid system is integrated throughout England and Wales and has links to Scotland, the Isle of Man and France. For the most part the system crosses rural areas and skirts the major urban conurbations. It also feeds directly into the industrial areas of the country where heavy industry has high electricity demands. The National Grid system is a fundamental part of our national infrastructure.

Much of the National Grid system was developed in the 1950s and 60s, when the main concern was to bring electricity to the centres of demand. Since that time we have all become used to the benefits brought by electricity whilst at the same time becoming increasingly aware of our environment. Issues to do with environmental quality, health and safety and social responsibility are now actively considered and incorporated into all parts of National Grid's business.

While National Grid owns the land occupied by its substations, only exceptionally does it own the land which is crossed by its electricity lines. National Grid cannot therefore prevent development close to or under overhead lines, providing statutory safety clearances are maintained. National Grid does not benefit financially from the development of this land, but does have responsibility for the equipment and for maintaining the safe supply of electricity as required by statute under National Grid's licence to operate.

National Grid is not a statutory consultee in the planning application process. Where high voltage overhead lines are present on a site, it is recommended that National Grid is consulted at the earliest possible opportunity in order that advice and guidance on development near high voltage overhead lines may be taken into account.

These guidelines therefore set out National Grid's commitment to the highest standards of design in new development around or near high voltage overhead lines, and promote creative design solutions that are compatible with its statutory duty to maintain the national electricity infrastructure.



National Grid is committed to promoting environmental quality, health and safety and social responsibility.



The context for these guidelines

Recent Government policy statements on creating well designed environments and an emphasis on the quality of the public realm, together with the broader professional and public debate about urban design and regeneration issues, all help to create a clear context for these guidelines. Design is seen as central to achieving the objectives of sustainable development. Design can not only raise the visual quality of the urban environment, but can assist in stimulating varied communities that offer greater choices to residents and workers and also rely much less on private car use. Achieving the objectives of sustainable development implies a more compact urban form, to which fresh design ideas can add value and bring high levels of amenity and quality.

A key element of planning policy is the re-use and redevelopment of previously developed 'brownfield' land in preference to the use of undeveloped 'greenfield' land. Much brownfield land is land that was formerly occupied by heavy industrial uses such as manufacturing, with significant power demands that would historically have been linked into the National Grid. Consequently, many of these derelict sites are crossed by high voltage overhead lines.

A good example of this scenario is within Thames Gateway to the east of London, identified as a huge opportunity for integrated brownfield development, economic growth, environmental improvement and urban renewal. The area contains National Grid high voltage overhead lines bringing power into the centre of London. National Grid is working closely with developers and key national delivery agencies in applying these guidelines to individual sites within this area to promote high quality innovative design solutions.



Thames Gateway - Royal Docks

"With the establishment of the ExCel exhibition centre, the City Airport and the University of East London, the Royal Docks have already been transformed from a derelict expanse to a high quality development area with modern infrastructure and facilities."

Draft London Plan. Para. 2B.57.

As well as issues of urban renewal, the sequential approach to new residential development set out in Planning Policy Guidance Note 3: Housing (PPG3) is leading to the promotion of more sustainable urban extensions to towns. PPG3 advocates that where suitable brownfield land is not available, housing development should be located in sustainable urban extensions to settlements so that the proximity to existing jobs and services can help reduce the need to travel.



*Fairford Leys, Aylesbury.
An example of
successful integration
between development
and overhead lines.*

Historically, high voltage overhead lines would tend to skirt the periphery of settlements. However, the increasing expansion of our towns and villages is bringing such land, including the electricity equipment sited on it, into the heart of new housing and other developments for the first time. A typical example of this is at Fairford Leys to the south-west of Aylesbury where new development accommodates the existing high voltage overhead lines.



*National Grid encourages
developers to plan and lay
out their development
taking the presence of the
overhead line into account.*



Sustainable urban extension at Fairford Leys, Aylesbury.

Where development is proposed near to high voltage overhead lines requests are often made to divert or underground the electricity equipment. It is often the case that developers and local authorities have past experience of moving and undergrounding lower voltage overhead lines on a development site and expect that high voltage overhead lines can be treated in the same way. Due to environmental, technical and cost reasons National Grid prefers to retain its lines in situ, and encourages developers to plan and lay out their development taking the presence of the overhead line into account. National Grid recognises that there may be exceptional circumstances where development is of national or regional significance that may justify the moving or undergrounding of an existing overhead line, but it is likely that, for most development, the line will remain in situ.

Further details of National Grid's approach to the issues of relocating overhead lines and undergrounding are set out in appendices 5 and 6.



Acknowledging the wider debate

In considering the content and scope of this guidance, it is acknowledged that other, wider, issues can arise which need further explanation.

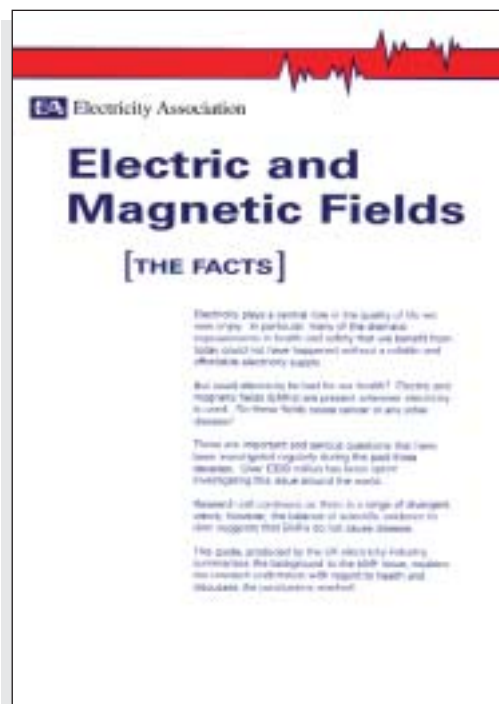
For example, there may be questions about the appropriate distance to locate uses and activities (particularly residential development) from the lines, and there may be some public concern about possible health implications of power lines which impact on residential choice.

There are important safety factors which can restrict certain activities near high voltage overhead lines – flying kites and fishing for example. Further information on these safety factors is contained in the appendices.

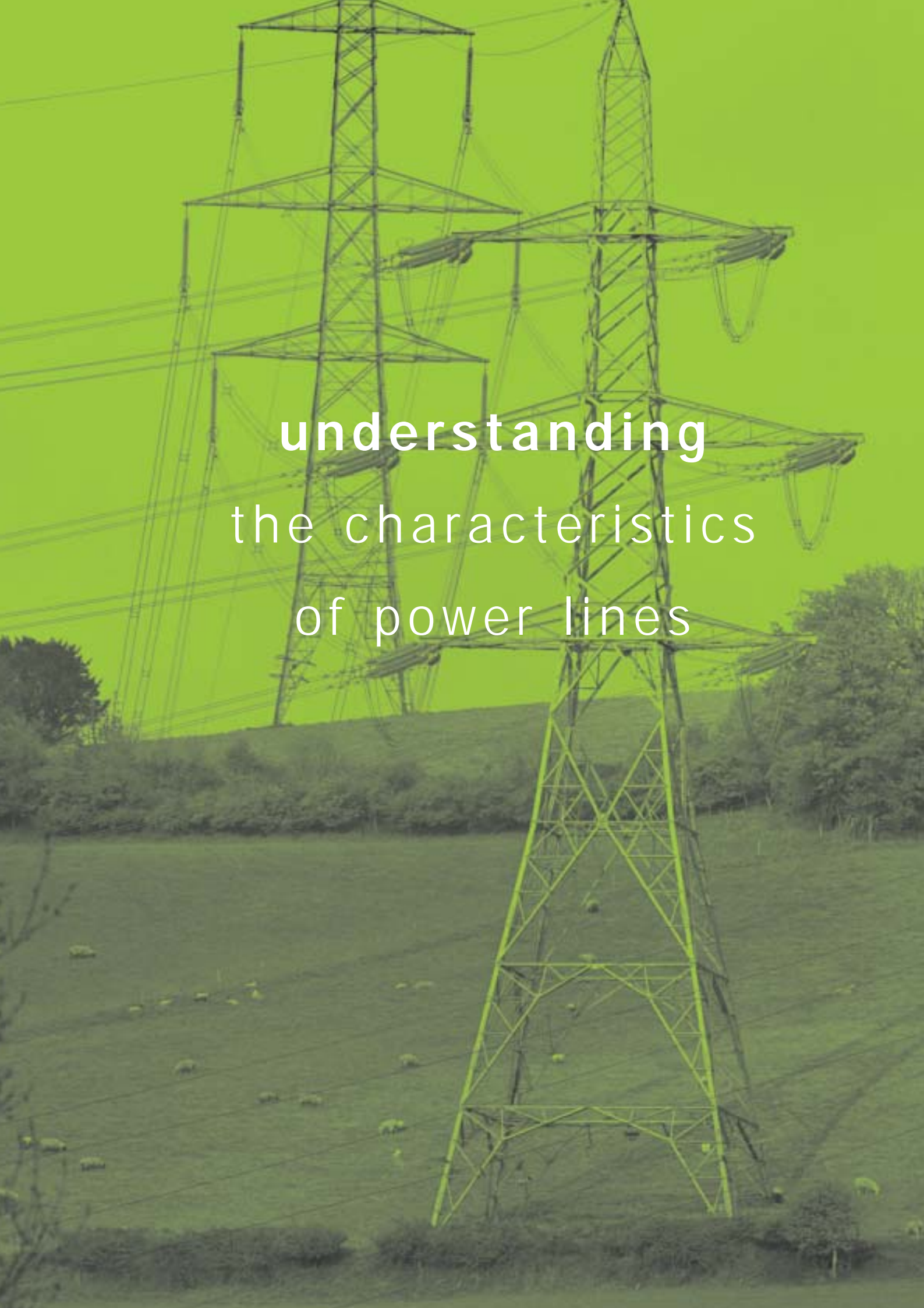
Potential public concern about the health implications of living near power lines is an issue that National Grid takes very seriously, and the company is committed to providing timely and open information on this subject – a good starting point is to refer to www.emfs.info. It is worth noting here that electric and magnetic fields (EMFs) can arise from many sources including household appliances, electrical distribution and transmission facilities and equipment, mobile telephones and radio-transmission devices.

Whilst research continues to improve our understanding of the effects of EMFs, the balance of current international scientific evidence is against EMFs from high voltage power lines causing ill health. No causal link has been established between cancer (or any other disease) and EMFs and there is no established mechanism by which these fields could cause or promote disease. Consequently, neither the UK Government nor the National Radiological Protection Board (NRPB) have recommended any special precautions for the development of homes near power lines on EMF grounds. Further information on this issue can be found at appendix 11.

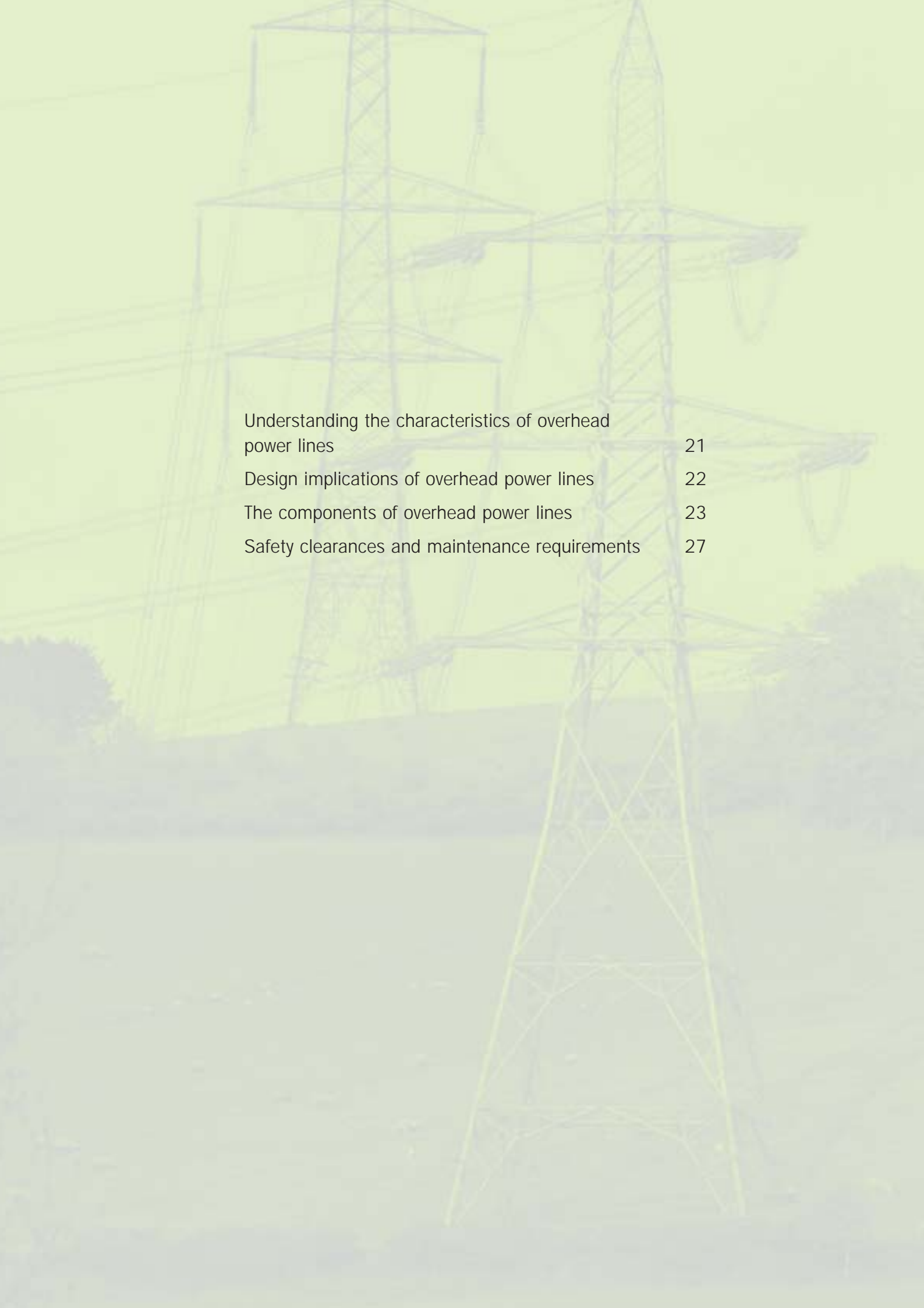
Nevertheless, as these guidelines show, where development is proposed on a site crossed by an overhead line there are good operational and amenity reasons - not to do with EMFs - for not siting built development directly beneath overhead lines.



The electricity industry provides extensive information and advice on electric and magnetic fields (EMFs).



understanding
the characteristics
of power lines



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Understanding the characteristics of overhead power lines

In developing the guidelines and in order to understand the issues raised by development near to high voltage overhead lines more fully, research has been carried out at over 40 sites across England and Wales where development co-exists with overhead power lines.

This research has provided a wealth of information on the characteristics of overhead power lines and how development relates to them; sometimes successfully, and sometimes less successfully.

This section sets out the outcome of this research and describes the design implications of developing near to high voltage overhead lines, including a basic description of various components of a transmission route and National Grid's safety and maintenance requirements.



Gravelly Industrial Park, Birmingham - an example of successful commercial development near overhead power lines.



How not to approach the siting of homes near overhead power lines.



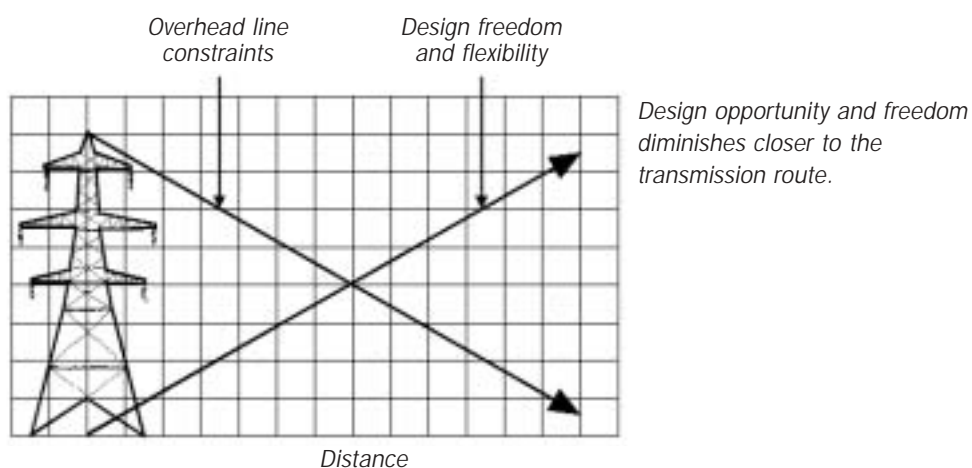
Design implications of overhead power lines

This guidance starts from the position that good urban design is always beneficial. With regard to high voltage overhead lines, the following basic premise should be observed:

Poor urban design will lead to poor quality places, regardless of the presence of pylons and overhead lines, but good design can lead to positive place making and improve the quality of places close to pylons and overhead lines.

The opportunity to practice good design needs to be based on an understanding of the physical characteristics and the constraints presented by high voltage overhead lines. There are two important concepts to keep in mind:

- **One solution does not fit all:** The nature and extent of the impact and constraint caused by an overhead power line varies across a site and between different sites, and consequently the design response needs to vary.
- **The design constraint increases with proximity:** The design constraint caused by an overhead line becomes more difficult to tackle the closer you are to that line. Therefore the attention to design and detail needs to increase rather than decrease closer to the lines.



The need for a comprehensive master plan

There are parts of a development site where the constraints and impacts of the overhead power line determine the form of future development. Similarly, there are usually parts of a site where the constraints are sufficiently reduced so that it is possible to apply a more conventional development form and layout. The site must therefore be conceived and designed as a whole, and a comprehensive master plan should form the basis for good design across the whole site.

The use of a comprehensive master plan allows a varied response to each site's particular characteristics and constraints, including the way an overhead power line can affect different parts of the site. Competent master planning requires a good grasp of the opportunities and obstacles on any land, and a sound site survey and analysis is fundamental. Good urban design principles should prevail throughout the site, and although they will be relatively straightforward to apply in areas that are less constrained by high voltage overhead lines, the presence of overhead power lines is no reason for those principles to be ignored.

The components of overhead power lines

In many cases, a starting point for good design close to high voltage overhead lines will be to identify the positive attributes of the site and to consider how these can be worked to maximum benefit and incorporated or enhanced in the development.

As part of this assessment, it is helpful to understand the essential components of the electricity equipment you might be dealing with and how they impact upon the master planning exercise.

Overhead power lines consist of three main components:

- Pylons (also called 'towers')
- Lines (also called 'conductors' or 'wires')
- Transmission route.

The design implications of each of these components are explored further below.

Pylons

Pylons are the most significant and visually dominant component of overhead power lines. It follows that they should therefore be the principal object of efforts to diminish the visual impacts of the overhead power lines on development land.

However, not all pylons are the same. A typical National Grid overhead line route uses three main types of pylon:

- Suspension towers which support the conductors on straight stretches of line
- Deviation towers at points where routes change direction
- Terminal towers where lines terminate at large substations or are connected to underground cables at a sealing end compound.

Different engineering and environmental demands require a range of pylon designs.



Suspension Tower.



Deviation Tower.



Terminal Tower.



Efforts to reduce or to offset visual impact should consider how pylons of different type, size and orientation can have a greater or lesser impact upon development. Careful observation of these characteristics should therefore be made as part of an initial site analysis.

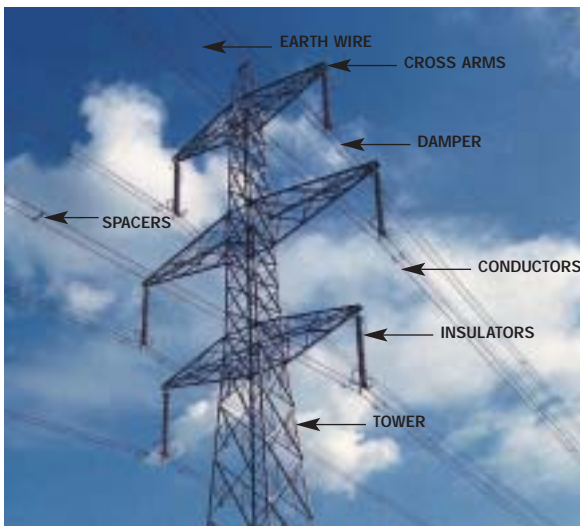
Further information on the design of pylons can be found at appendix 7.



The visual impact of pylons varies when viewed from the side, front or obliquely.

Lines

Lines (the conductors) and pylons ultimately form a composition with a collective visual impact. However, the lines are a finer and less substantial part of that composition. The number of conductors on a circuit will depend on the operating voltage and load carried by a circuit, with up to four conductors forming a phase, with three phases per circuit and typically two circuits per overhead line route at high voltage.



The components of overhead power lines.



Where development occurs on land crossed by high voltage overhead lines, in order to lessen the impact views can be of the lines rather than the pylons. Where the pylons are obscured, our research shows that this lessens the perception of the transmission infrastructure - an important factor in considering development layout and orientation.

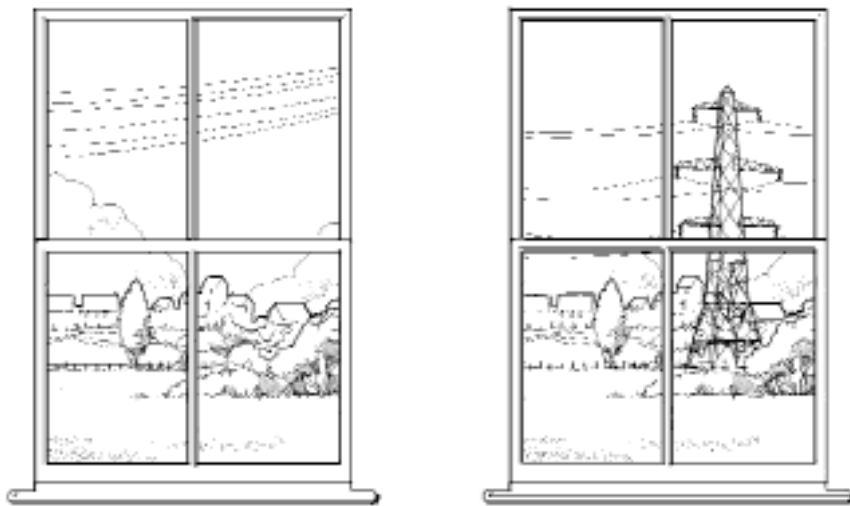
Different components of the overhead power line have different visual impacts.



Pylons and lines.

Lines with pylon removed.

Pylon with lines removed.



Views of pylons have a greater impact than views of lines.

The transmission route

Routeing practice for new high voltage overhead lines is to route in straight lines and turn corners as few times as possible. Where an overhead power line changes direction, this results in the need for bulkier deviation towers and a potential view of more pylons and more lines. By running in straight lines the overall visual impact of the transmission route is reduced.



By running in straight lines the overall visual impact is reduced.

Whilst the pylons and overhead lines are often the most distinct and memorable part of the transmission route, the quality of the land through which it passes contributes to its distinctiveness, visual impact and overall perception. The form and layout of development adjacent to the transmission route should aim to diminish the visual impact of the high voltage overhead lines and promote the highest possible environmental quality.

The impact of the transmission route can be dealt with in different ways and this should be considered at the earliest stage of site planning, and undertaken on a site-wide basis rather than when considering more detailed areas at a later stage. Whilst it is important to understand how design ideas might be constrained by the requirements of the transmission route, it is equally helpful to consider how the requirements of the transmission route can provoke new and innovative design and layout ideas.

Safety clearances and maintenance requirements

As well as the 'hardware' of overhead power lines, it is also helpful to understand what governs the management of National Grid equipment and the implications this has for the design of development. It is vital that appropriate safety clearances and the need to provide suitable access for maintenance are taken into account at the earliest stage of any design process.

Safety clearances



Safety clearances must always be observed - contact National Grid for advice.

Contact or near contact by people or objects with high voltage equipment is extremely dangerous and must be avoided. Overhead electricity conductors are not insulated and any object that approaches too closely may cause a flashover of electric current with the likelihood of fatal or severe shock and burns to any person nearby.

In order to prevent such incidents minimum safety clearances for all overhead power lines are prescribed. These safety clearances are legally binding. The statutory safety clearances must be maintained between conductors and the ground, trees, buildings and any other structure such as street lighting columns. The clearance required will depend on the operating voltage of the line, its construction and design, the topography of the location over which the line passes and the type of development proposed. Particular care should be taken by people involved in unloading, stacking or moving material underneath conductors and in the construction of buildings or other structures in the vicinity of an overhead power line.

Underground cables also give rise to specific safety requirements. The area directly above the cables and for a significant distance on either side must be kept clear of buildings, structures and tree/hedgerow planting.

National Grid should always be contacted for detailed advice on any specific site. Further information on safety clearances can be found at appendix 9.

Maintenance Requirements



National Grid's maintenance requirements should be taken into account when designing development near to overhead lines.

From time-to-time access is required onto land to inspect, maintain and refurbish high voltage overhead lines. National Grid's rights of access to undertake such works are contained within the wayleave agreement or permanent easement with the landowner. Overhead power lines are inspected on a routine basis both by foot and helicopter and climbing inspections of pylons also take place.

Refurbishment of overhead power lines can involve the replacement of conductors, insulators and associated fittings, the painting of pylons and works to the pylons and their foundations. New technology is helping National Grid all the time to reduce the disruption of its maintenance operations. However, at present, during major refurbishment safety scaffolding may need to be erected over underlying properties, roads and other development.


National Grid has found that minor refurbishment works such as painting are generally required every seven years, whilst more extensive works occur much less frequently.

National Grid recognises that maintenance, repair and refurbishment activities can cause disruption and adversely affect the general amenity of an area, and seeks to minimise the effects of such disruption. However, the company has a statutory duty to maintain the transmission system and power supplies and therefore needs quick and easy access to its equipment, to ensure that it can be maintained and where faults occur returned to service as soon as possible.

National Grid's 'Development Near Lines' brochure provides further information on all these safety and maintenance issues. 'Development Near Lines' is available free of charge from National Grid.

A photograph of a woman and a young child sitting on a wooden dock by a pond. The woman is wearing a light-colored hoodie and is looking towards a duck standing on the dock. The child is wearing a hat and is also looking at the duck. In the background, there is a large brick building with many windows and some trees. The text "creating a sense of place: design guidelines" is overlaid on the image in a white, sans-serif font.

creating
a sense of place:
design guidelines



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Approaches to site layout and design

Taking account of the different characteristics of the essential elements of overhead lines, an approach to site layout and design has been developed based on two primary aims:

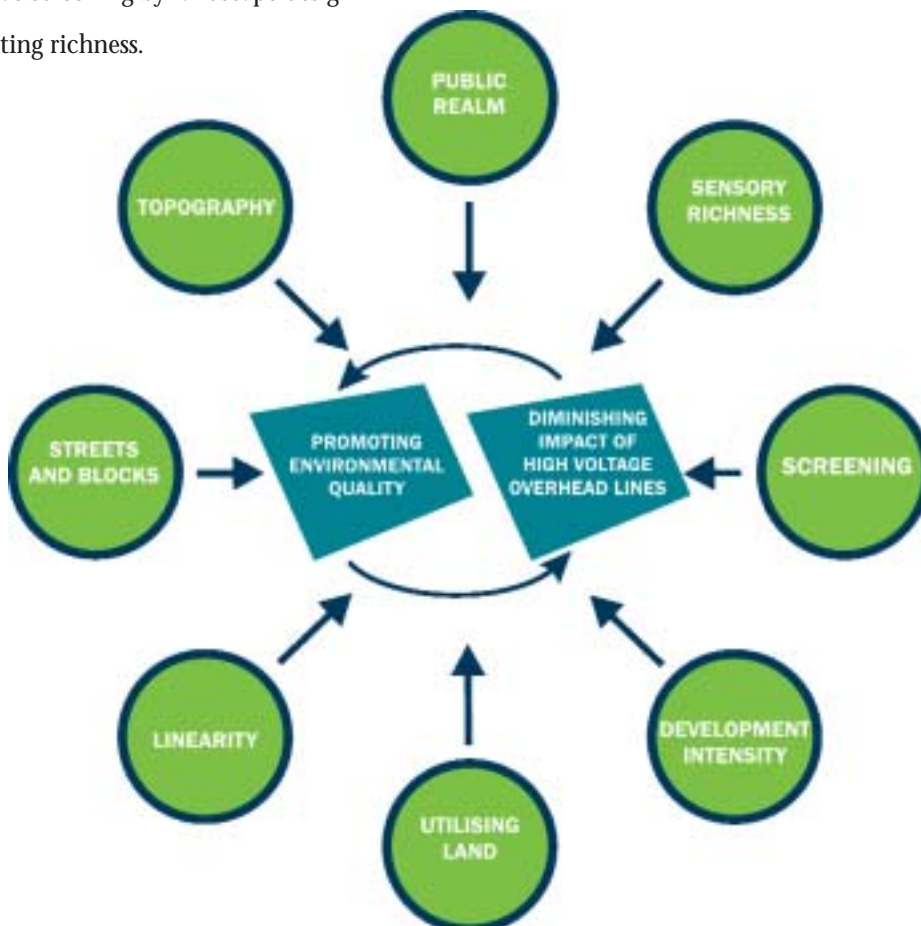
- Diminishing the impacts associated with high voltage overhead lines
- Promoting the environmental quality of an area.

Clearly, high voltage overhead lines are major pieces of infrastructure that have a visual impact upon their surroundings. Such equipment cannot be screened from all parts of a site; it is therefore necessary to establish where efforts to diminish impacts will be most effective.

While the need to promote environmental quality is a fundamental aim of all good design, it is of particular importance in areas close to high voltage overhead lines. Only by pursuing both of these aims can the full design potential of areas close to high voltage overhead lines be realised.

Eight generic design principles have been developed to create an understanding of how these primary aims can be addressed as part of the master planning process:

- Prioritising the public realm
- Encouraging development intensity and enclosure
- Orientation of streets and blocks
- Understanding the effects of topography
- Breaking down linearity
- Utilising land close to overhead power lines
- Effective screening by landscape design
- Promoting richness.



Prioritising the public realm

The first priority should be on promoting the environmental quality and diminishing the impact of pylons on the public realm.

Most people will experience a place from the public realm: that is streets, squares and parks. Local residents, workers and visitors all use the public realm in one way or another, and will all base their perceptions of the environmental quality of a place and notions of civic pride on its environmental qualities.

It therefore follows that where the overhead line impacts upon the public realm, the potential visual impact of that overhead line would be experienced by more people and would impact more severely on the perception of environmental quality than, for example, if the impact was solely on private areas.

Therefore, in promoting a sense of place, the first priority should be on promoting the environmental quality and diminishing the impact of pylons on the public realm.



Our perception of environmental quality is greatly influenced by our experience of public places.

Development density

By giving careful consideration to the width of streets and the height of buildings, the visual impact of pylons on the public realm can be greatly diminished.

The current urban renaissance planning and design agenda promotes a compact urban form featuring a mix of uses and the efficient use of land through the use of higher density development.

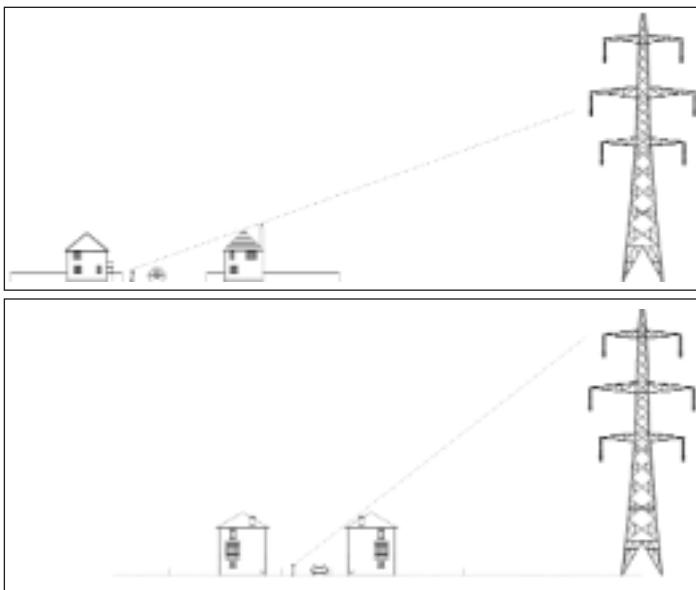
This leads to an intense built form with taller buildings, smaller gardens (front and back), and narrower streets employing more interlinked building forms than might have been considered in the recent past. This dense urban form provides good opportunities to screen views of pylons and diminish their visual impact.

By comparison much of Britain's twentieth century suburban development is characterised by relatively wide streets, and two storey detached and semi-detached development set in large plots. This form of development offers less opportunity to obscure views of pylons and to diminish their visual impact.



Then and now, the difference in development density.

A more enclosed and compact form may enable development to be sited closer to high voltage overhead lines without increasing the visual impact upon the public realm. By giving careful consideration to the width of streets and the height of buildings, the visual impact of pylons on the public realm can be greatly diminished.



Narrower streets with taller buildings enables development to be sited closer to pylons without increasing visual impact.

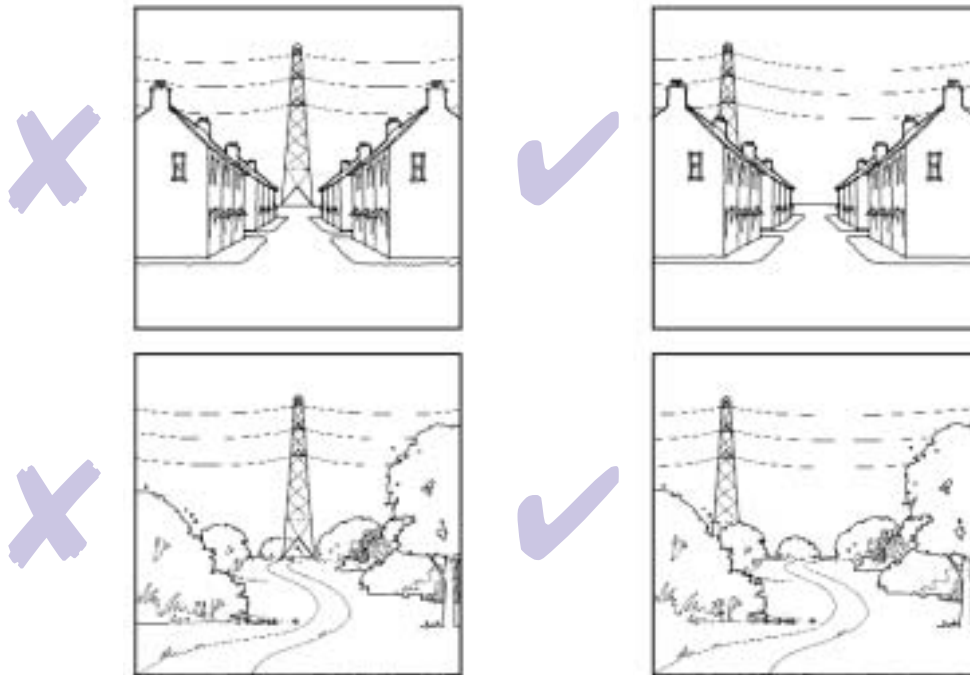
The large scale built form and infrastructure associated with industrial estates and business parks tends to diminish the visual impact of pylons. Nevertheless, even on these sorts of developments, careful attention must still be paid to promoting the environmental quality of the area and considering the wider visual impacts of transmission routes in order to achieve the desired design outcome.



Orientation of streets and blocks

Cranking the alignments of streets and paths or curving them even by relatively small degrees can help offset views of pylons and do much to reduce the perception of their visual impact.

The visibility of pylons and power lines from within a development is affected by the orientation of streets, and similarly by the orientation of public footpaths through public open space. Street scenes can be dominated by pylons where streets are aligned in such a way that they frame a view towards a pylon.



Offsetting the views of pylons will help to make them less prominent.

Careful consideration should therefore be given to the orientation of streets and the disposition of public open spaces so that they do not frame views towards pylons. Cranking the alignments of streets and paths or curving them even by relatively small degrees can help offset views of pylons and do much to reduce the perception of their visual impact.

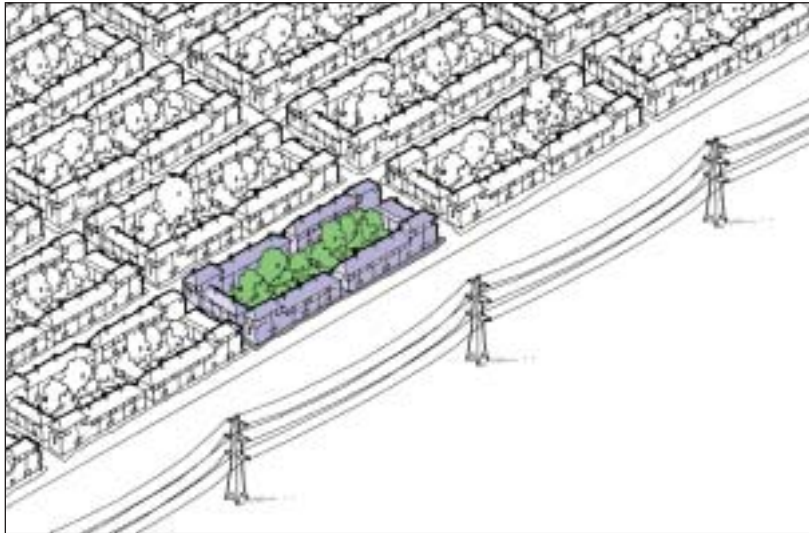
Views towards pylons may occur at some distance from the pylon, and can also be framed by new street scenes and public open spaces at some distance from the pylons, particularly where there may be changes in level across a site. It is therefore important to also consider the orientation of streets and paths further away from the transmission route. This would particularly apply to sites that are not crossed by an overhead line, but where an overhead line runs nearby or on the edge of the site.

The plan form and orientation of development blocks is fundamental to the number of properties that have direct views of pylons and overhead power lines.

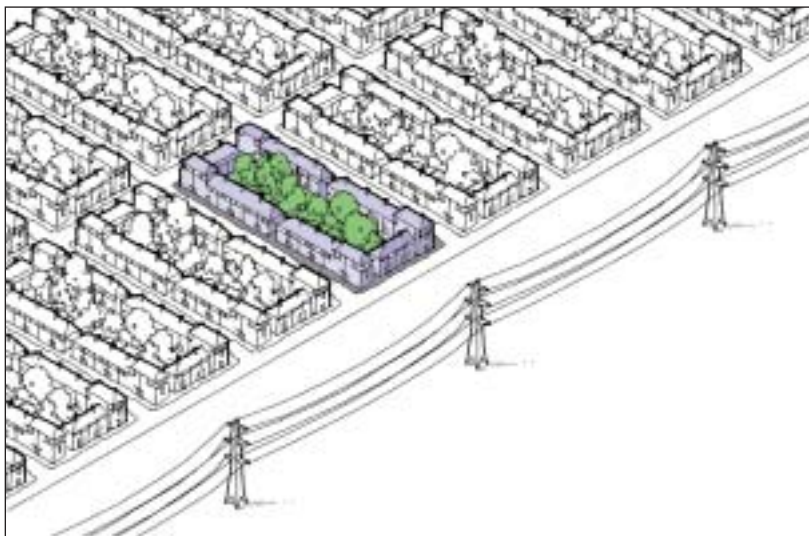
The use of a 'square' development block form will offer little flexibility in responding to pylons and overhead power lines and will necessitate development being placed parallel with the transmission route, regardless of the orientation of the block. This will tend to result in direct views towards the transmission route and increase the visual impact of pylons and overhead power lines from streets, buildings and gardens.



The use of a more 'rectangular' development block form offers the opportunity to orientate the development block such that the majority of development does not front the transmission route. This form of orientation minimises direct views towards the route and can significantly reduce the visual impact from streets, buildings and gardens.



Orientating development blocks parallel to the transmission route could increase the numbers of homes with views of the line.



Whereas orientating development blocks perpendicular to the route can reduce this problem - but might increase the potential impact on the public realm.

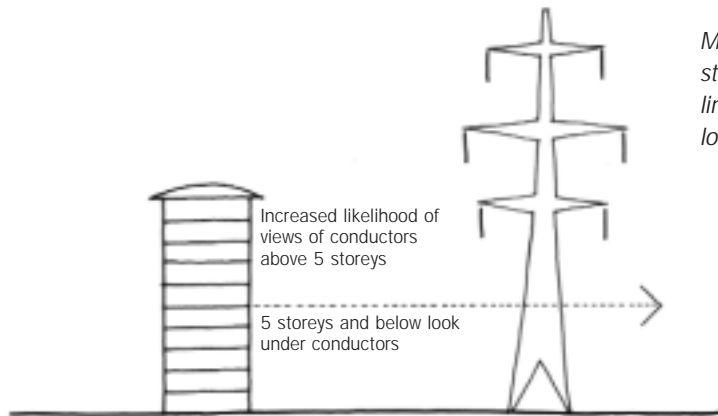


Removing homes from the ends of development blocks takes away almost all private views onto the route - and creates opportunities for structural screening and ancillary uses.



While direct views of transmission routes should be minimised, emphasis should be placed on orientating development blocks to reduce direct views of pylons as these are the most obtrusive element. Development can often successfully be orientated to front onto the overhead power lines between pylons without significant visual impact as part of a varied design response to the transmission route. This point is discussed further under 'Linearity'.

In terms of scale, most conventional development forms of up to four/five storeys will look out beneath the lowest conductors of a high voltage overhead line.



Most buildings of up to four/five storeys have views beneath the lines, whereas higher buildings will look out onto the lines.



Topography

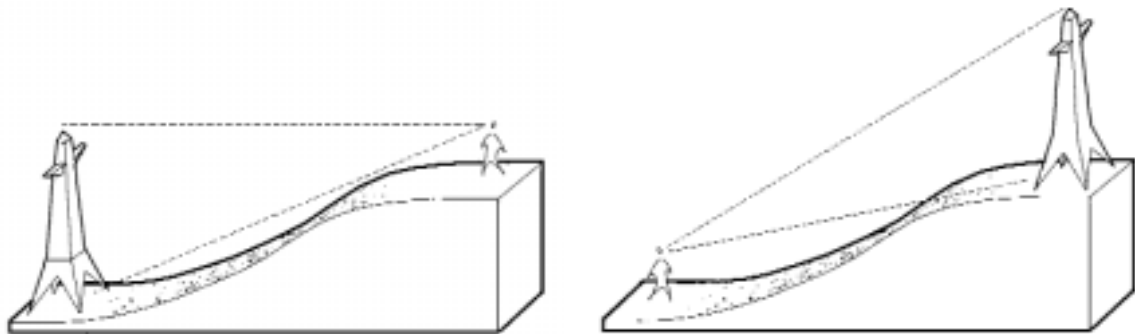
An understanding of the effect of topography will help to establish which pylons may be more prominent, and will help to inform site layout and design decisions to reduce visual impacts.

The topography of a development site can affect the perception of pylons and high voltage overhead lines and is an important design consideration.

Where pylons are set in an elevated position and are viewed from lower ground, the scale and visual impact of the pylons is emphasised. Conversely, where pylons are viewed from an elevated position the visual impact is much reduced. This effect was recognised in the original planning of the National Grid system and a set of design parameters (the Holford Rules) were used to minimise the visual impact of new equipment within the landscape. These same Rules form the basis of the appraisal of options for the siting of new National Grid equipment.

As well as the position of the viewer, the perception of the visual impact of the pylons is also affected by their relationship relative to the viewer's horizon. Pylons set across the brow of a hill will be silhouetted against the sky and will appear more prominent than pylons set in a similarly elevated position but with rising land or built development behind them.

An understanding of the effect of topography will help to establish which pylons may be more prominent when viewed from a development site. Even subtle changes in level across a development site can be of great importance in this respect. While the visual impact of a prominent pylon is difficult to overcome, an understanding of its impact will allow design priorities within a scheme to be



Pylons are more prominent against the skyline.



Even subtle changes in topography can affect our perceptions of pylons.

Wherever it is proposed to alter the ground level in the vicinity of high voltage overhead lines, National Grid must be consulted to ensure that appropriate safety clearances are maintained at all times. Further information can be found on this at appendix 9.

Breaking down linearity

The design objective should be to break down the linearity of the transmission route into inter-related cells or places rather than treating the route as one continuous strip. This will enable a variety of design responses that will allow the transmission route to be experienced differently from various locations within the development, helping to diminish the prominence of the transmission route.

Transmission routes run in straight lines with cranks in direction at deviation pylons. The linear character of the transmission route can be either reinforced or counteracted by the character of development below and around the overhead power lines.

The arrangement of buildings, boundaries, fences, paths and planting in parallel with the transmission route over long distances will tend to highlight the presence of overhead power lines and the linear nature of the route and will make them more obtrusive. However, where one or more of these elements is varied and is not parallel, the linearity of the transmission route and its overall prominence can be diminished.

The design objective should therefore be to break down the linearity of the transmission route into inter-related cells or places rather than treating it as one continuous strip. This will enable a variety of design responses that will allow the transmission route to be experienced differently from various locations within the development and will help diminish the prominence of the transmission route.



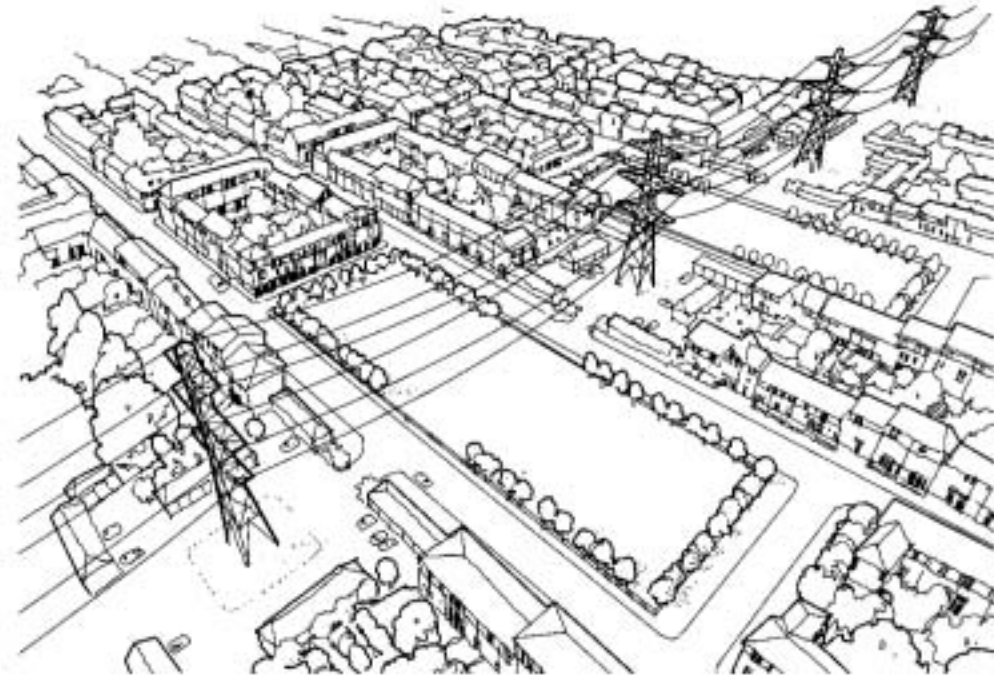
Warning - The arrangement of buildings boundaries, fences, paths and planting can reinforce the linear nature of a transmission route.

This may be achieved through a number of measures including:

- Varying the distance of development from the overhead power lines
- Varying the orientation of development towards the overhead power lines
- Breaking the transmission route into cells using roads, bridges or other features
- Creating deliberate places within these cells with a variety of uses such as garden squares and parking courts
- Creating meandering paths and varied planting in open spaces beneath the overhead power lines
- Providing a mix of activities beneath and adjacent to overhead power lines as discussed further under 'Utilising land close to overhead power lines'.



The perception of the linearity of a transmission route also depends on whether the viewer is static or moving. A person travelling in a car will experience the transmission route very differently to a person standing or walking and the design response should aim to reflect this. For example, where a main road runs close to an overhead power line, the design objective should still be to break the transmission route into cells or places. However, the scale of these cells would be larger given the nature of movement. Similarly, varying the alignment of the road may alter the perception of linearity.



A mix of land uses and design responses helps to break down linearity.



Utilising land close to overhead power lines

Land beneath and adjacent to overhead power lines can be efficiently used in many practical and profitable ways that benefits development and helps break down linearity.

Land not given over to a useful purpose represents an unsustainable under-utilisation of a scant and valuable resource. It is therefore vital to consider ways of putting the land beneath and around overhead power lines to good use in ways which benefit a development. A variety of land uses, as well as promoting diversity and activity, can also contribute towards breaking down linearity.

To minimise disturbance and to facilitate easy maintenance, National Grid prefers that built development does not take place beneath lines. However, land beneath and adjacent to overhead power lines can be efficiently used in many other practical and profitable ways.

The table below gives examples of land use activities which may be appropriate beneath and adjacent to overhead power lines. Some of these land uses are complementary and can be accommodated as secondary uses, for example a sustainable urban drainage system might also form part of a public open space. It should be noted that these are general guidelines only and are subject to the safety clearances and maintenance access requirements set out in appendix 9.

As a matter of course it is recommended that National Grid is consulted on any site-specific proposal.

Potential land uses beneath power lines	
Land use	Comment
Public Open Space - passive	The quality of the public open space is key to ensuring its success as part of a design solution. Particular attention should be paid to creating visual interest on the ground, strategic planting and the orientation of paths in order to diminish the visual impact of the pylons. See appendix 3 for further details on planting near high voltage overhead lines. Wherever it is proposed to alter the ground level in the vicinity of high voltage overhead lines, National Grid must be consulted to ensure that appropriate safety clearances are maintained at all times (see appendix 9). Where the land may be used for recreational activities reference should be made to appendix 4.





<p>Public Open Space - active</p>	<p>Active recreational uses may take place close to overhead lines subject to the nature of the activity, the layout of pitches and the level of supervision. Where active recreational spaces are being considered, early liaison with National Grid is advised. National Grid will consider the issues raised by each individual case on its merits and where appropriate with the advice of the National Playing Fields Association.</p> <p>Two particular activities that raise serious safety issues and that need to be strictly controlled are fishing and kite flying. The floodlighting of recreational pitches also raises safety problems where high voltage overhead lines are present, and needs to be borne in mind when considering the design of sports pitches and their maintenance. Where the land may be used for recreational activities reference should be made to appendix 4.</p>	
<p>Allotments and Community Orchards</p>	<p>The use of land for allotments and community orchards is appropriate subject to maintaining safety clearances (see appendix 9). See appendix 3 for further details on planting near high voltage overhead lines.</p>	
<p>Nature and Conservation</p>	<p>The retention or creation of nature conservation areas may be particularly suitable where public access to the area is restricted or prevented. See appendix 3 for further details on planting near high voltage overhead lines.</p>	
<p>Structural Landscape</p>	<p>Structural landscaping can provide an impressive and valuable component of any master-planned scheme and diminish the visual impact of transmission routes. See appendix 3 for further details on planting near high voltage overhead lines. Wherever it is proposed to alter the ground level in the vicinity of high voltage overhead lines, National Grid must be consulted to ensure that appropriate safety clearances are maintained at all times (see appendix 9).</p>	

Parking

Parking ancillary to all types of land uses can be successfully accommodated beneath high voltage overhead lines. In residential developments garaging can also be accommodated close to the lines.



Non-Residential Storage Uses

Ancillary external storage uses such as a builders merchant, service yard or distribution centre can be successfully accommodated beneath high voltage overhead lines, subject to careful observance of safe working procedures and statutory safety clearances (see appendix 9).



Water Bodies, Drainage and Flood Attenuation

Often required as part of a master-planned development to ensure sustainable drainage patterns, water bodies can provide high levels of visual amenity and sensory richness. Wherever it is proposed to alter the ground level in the vicinity of high voltage overhead lines, National Grid must be consulted to ensure that appropriate safety clearances are maintained at all times (see appendix 9).



Movement - roads, cycleways, paths etc.

For recreation or function, roads, cycleways and paths can be successfully accommodated beneath high voltage overhead lines. Design efforts should seek to orientate alignments away from pylons, and to provide natural surveillance where possible from surrounding development. Wherever it is proposed to alter the ground level in the vicinity of high voltage overhead lines, National Grid must be consulted to ensure that appropriate safety clearances are maintained at all times (see appendix 9).

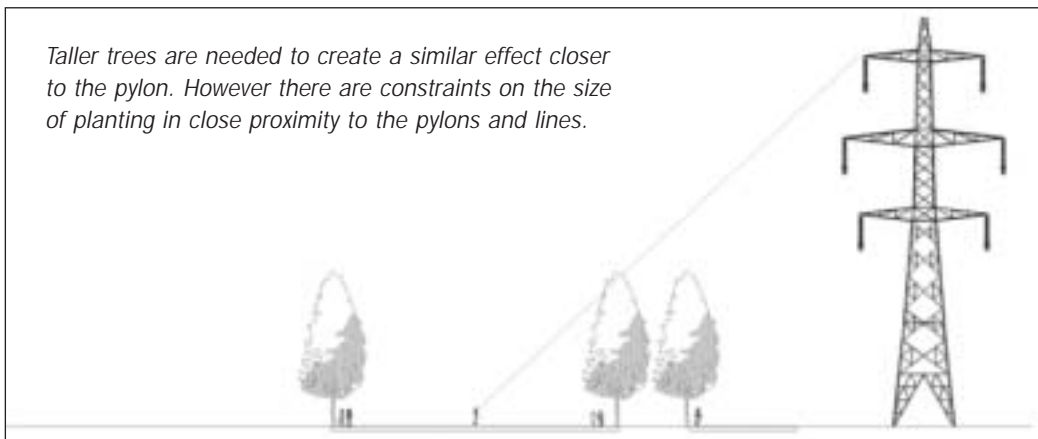
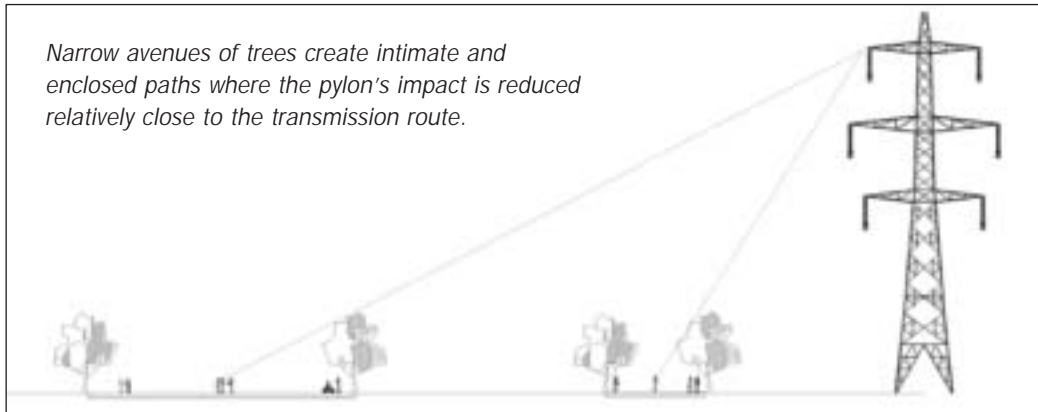




Screening by landscape design

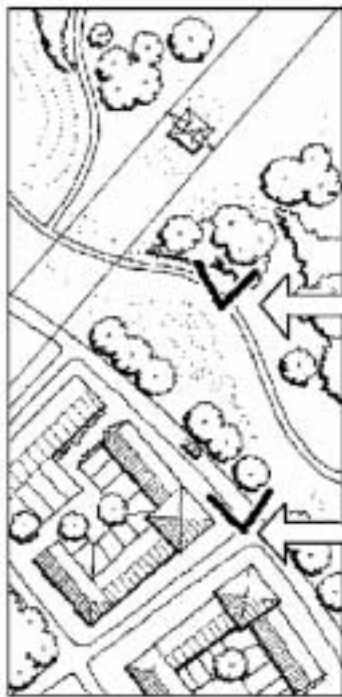
Layers of strategic screening can enhance the quality and intimacy of the immediate setting causing the perception that pylons have receded into the distance.

Planting is an essential component in environmental quality and will form a key element of any master-planned approach. Planting, along with development intensity, can play an effective role in screening views of pylons and overhead power lines. Such screening can partially or completely obscure views of pylons and overhead power lines from within developments, and can be highly effective at differing distances from pylons.



Screening can enhance the quality and intimacy of the immediate setting causing the perception that pylons have receded into the distance. The effectiveness of any screening depends on the distance of the viewer from the overhead power line and from the screening.

Layers of screening between the viewer and the overhead power line can create a series of silhouettes stretching into the distance, which create a depth in the field of vision so that pylons are perceived to be further away and less prominent. Consideration should therefore be given to the use of screening in layers with varying heights to match site circumstances.



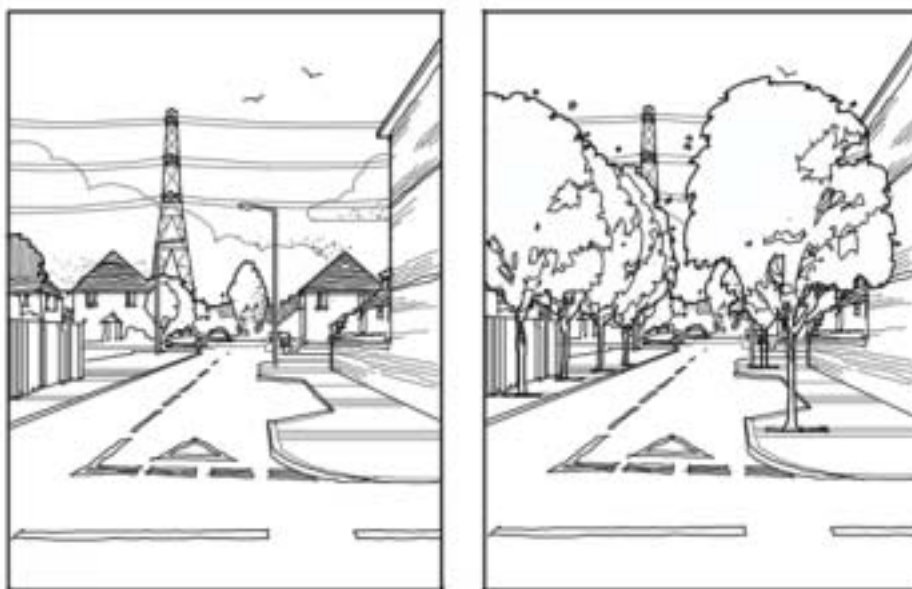
Planting at the base of pylons can reduce the impact at the pedestrian level.



Carefully placed groups of trees can reduce the impact from a distance.



Mature street trees can very effectively screen views towards pylons and enhance the environment. Where the branches of mature trees arch over the street, views of pylons can be obscured for much of the year. Such planting can also be employed within informal open spaces to effectively screen views towards pylons from footpaths and other routes.



Street planting can also be 'retro-fitted' to existing environments to soften the visual impact of pylons and overhead power lines.

In considering the strategic use of planting as a form of screening, careful attention must be paid to safety clearances. Planting may take place below overhead power lines subject to adequate maintenance access being provided. However, it is vital that appropriate species are selected for locations below and adjacent to the transmission route to ensure that safety clearances are maintained and that the species are not likely to grow to heights that would infringe the safety clearances. Appendix 3 provides further information on planting near high voltage overhead lines.

While planting is probably the most effective means of achieving screening, the potential from a change in landform, boundary treatments and built form should also be considered. A combination of each of these four elements is particularly effective in achieving the desired effect. Wherever it is proposed to alter the ground level in the vicinity of high voltage overhead lines, National Grid must be consulted to ensure that appropriate safety clearances are maintained at all times (see appendix 9).

Promoting richness

The detailed design of the public realm and built form will provide a further level of visual and tactile interest that can further enhance the character and quality of a place.

A key component in creating a high quality environment is the number of different visual and sensory experiences that are on offer. An environment which offers many interesting vistas and visual details, sounds, textures and even fragrances will help to diminish the impacts of the overhead power line and promote environmental quality.

Many of the design principles and techniques identified will promote richness on the ground that will detract from the presence of pylons. Promoting a variety of land uses along the transmission route and the use of planting are two examples that can add to the range of experiences offered by an environment.

The detailed design of the public realm and built form will provide a further level of visual and tactile interest that can further enhance the character and quality of a place. The use of a variety of built forms, different types of streets and street furniture, a range of materials and distinctive design details can all help to add to visual richness.


The presence of water can also add to the richness of an environment through reflections and associated sounds. Running water, associated vegetation such as reed beds and other planting can play an important role in bringing a variety of sounds into the area around pylons. As well as adding to the sensory richness of the environment, this will assist in diminishing the perception of any noise produced by an overhead power line.



Different visual and sensory experiences help to promote environmental richness.

A photograph of two men standing in a field, looking at a map together. The man on the left is wearing a dark jacket and light-colored pants. The man on the right is wearing a light-colored jacket, a flat cap, and dark pants. In the background, there is a tractor and several power line towers. The entire image has a blue color cast.

how to use
this guidance



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How to use this guidance

The Sense of Place guidelines are a valuable tool to stimulate creative solutions to the design and layout of development on land crossed by high voltage overhead lines. The guidelines provide practical advice for all parties involved in the development of land affected by high voltage overhead lines.

National Grid is not proposing a single solution. The relevance of each of the design principles will vary depending on the circumstances of each individual development site and each individual development proposal – for example: a developer proposing to develop a distribution facility and/or business park may not attach the same priority to the use of screening as might a developer proposing a residential site.



The guidelines are a valuable tool to stimulate creative solutions to the design and layout of development on land crossed by high voltage overhead lines.

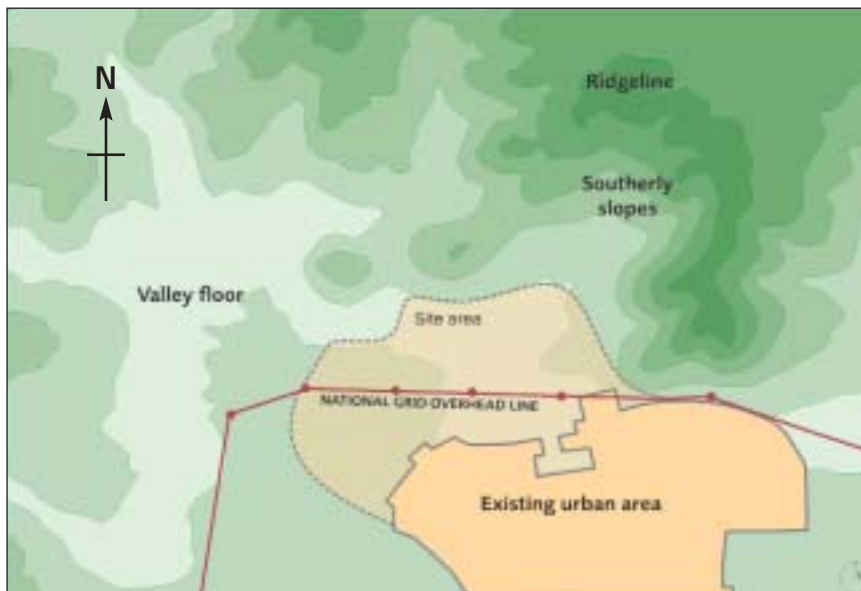
Putting it all together

The guidelines can assist designers seeking to develop an integrated design solution to sites crossed by high voltage overhead lines. In order to demonstrate the application of the guidelines, a conceptual master plan for a typical sustainable urban extension to a settlement has been developed.

Good urban design principles are advocated, and there are many publications on this issue available to assist the master planning process. The purpose of this section, however, is to demonstrate the detailed application of the Sense of Place guidelines within the master planning process.

The initial stage in any master plan approach is a thorough survey of the site and the surrounding area. This should include an appraisal of the types of pylons present, their orientation and their three-dimensional scale, taking account of topography. This should also include those pylons that lie within view of a site.

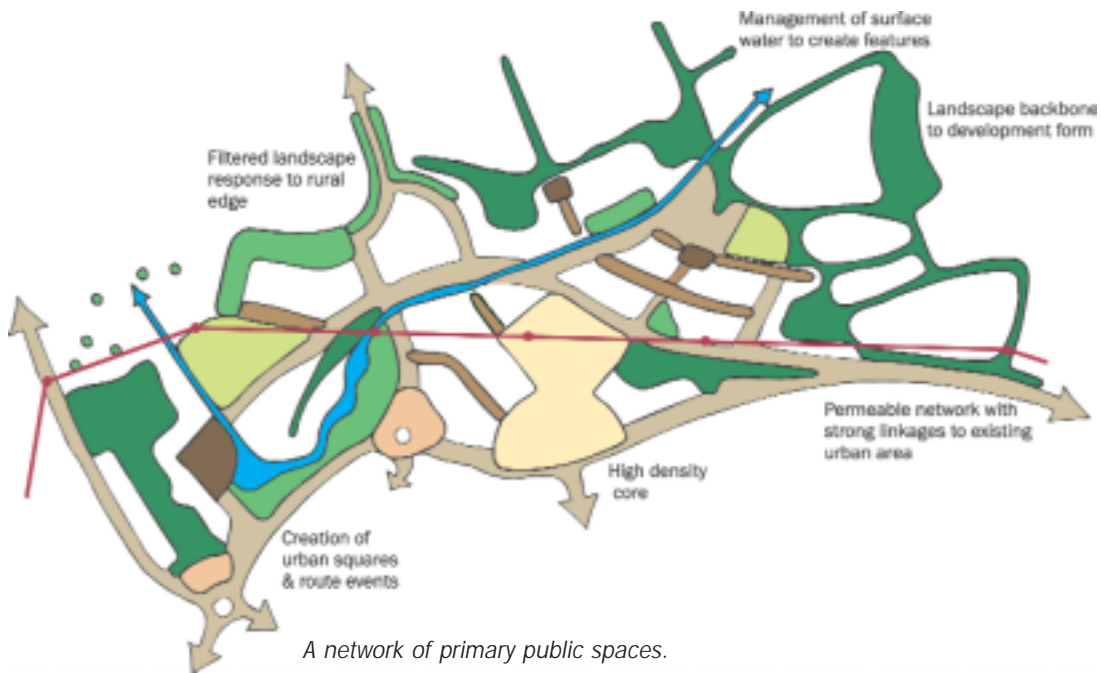
In terms of topography, our demonstration site is predominantly within a valley floor with rising land to the north and east. The National Grid overhead power lines are sited within the base of the valley. Low-lying land towards the western end of the site forms part of a fluvial floodplain.



The demonstration site lies predominantly within the valley floor.



The first step is to establish a network of primary public spaces designed to diminish the impact of the overhead power line. By looking closely at how the site can link with existing streets and local facilities, by considering topography and the presence of other constraints, and by understanding the nature of the overhead power line, the best areas for new homes and other complementary uses such as a local centre of shops and offices can be identified.



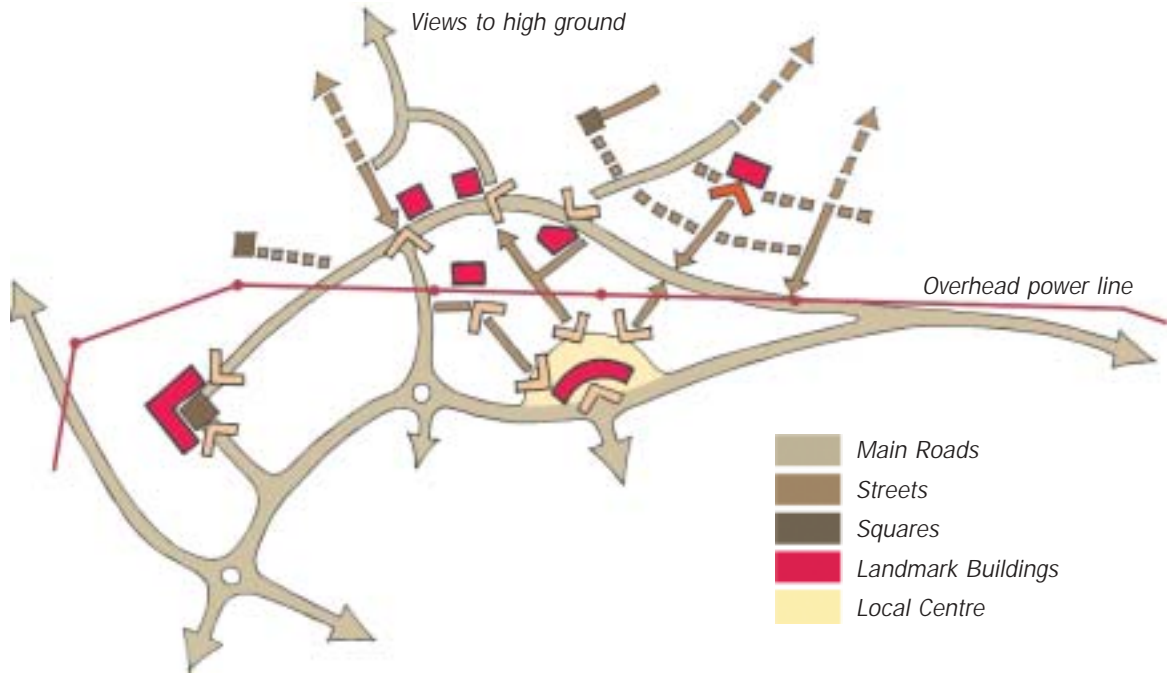
The density of development has a key role to play in screening views of the overhead power line. By placing higher density blocks, with closer-knit development and taller buildings, closest to the overhead power line, views of the line are screened from most public areas. In the conceptual master plan, this is achieved with blocks of a density of 50 dwellings per hectare of land. The proposed local centre is also designed to be high density which is in keeping with its character and use, as well as helping to reduce the impact of the overhead power line. This plan also shows linkages into existing street networks and services including a railway station. Elsewhere on the site density is reduced to 30 dwellings per hectare towards the edges of the development.



Land uses and densities.

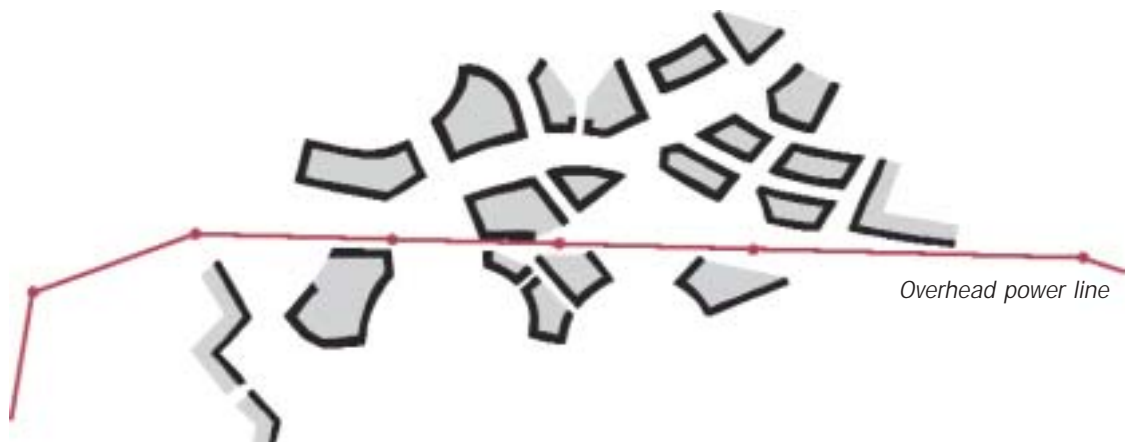
- 30 dwellings per hectare
- 40 dwellings per hectare
- 50 dwellings per hectare
- Local Centre

The conceptual master plan creates a movement network linking primary public spaces into existing street and path networks. The alignment of streets and paths across the whole site ensures that there are no overt views of pylons, helping to reduce their impact and avoid the impression of a linear corridor. Landmark buildings are used to terminate main views and to provide focal points within the urban area, drawing attention away from the overhead power lines.



Alignment of streets.

Development blocks are orientated to minimise direct views of pylons. Some development may front onto the overhead power lines (although preferably not pylons) as part of a variety of design responses to the transmission route. Development blocks adjacent to overhead power lines can also be left open-ended, with the resultant space being used to create public gardens, squares or parking courts.



Alignment of blocks.



A key design objective is to break down the linearity of the transmission route into inter-related cells and places. Though constrained, the land beneath overhead power lines can be used positively to provide amenities for adjoining occupiers such as car parking, or to achieve other objectives such as providing flood attenuation. The conceptual master plan pays attention to how the land beneath overhead power lines will be experienced depending on whether the viewer is standing in the street or other open public space or is moving, for example driving a car.



Overall aerial perspective.

In breaking down linearity the conceptual master plan provides a range of design responses:

- **Public Open Space**



Land adjacent to overhead power lines is used as part of the outfield for playing fields and other supervised recreation (see appendix 4). The land can also be used for informal open space (dog walking, cycling etc) or as nature conservation areas.

The conceptual master plan also shows land beneath overhead power lines fulfilling a valuable role in accommodating a sustainable urban drainage system. As well as serving a practical purpose, water adds to the sensory richness of an area and provides high levels of visual amenity.

- **Urban Streets**



Creating tighter and higher urban form and reducing on-street parking to allow narrower streets helps to obscure overhead power lines from view. The conceptual master plan accommodates urban streets beneath overhead power lines, with careful attention being paid to the relationship between development and pylons.

- **Car Parking Courtyards**



Car parking courtyards are used in the conceptual master plan around the base of pylons and work well in both residential and non-residential contexts. The need for access to pylons or for maintenance work on the overhead power lines needs to be taken into account.

- **Local Centre**



A Local Centre featuring shops and offices and its ancillary uses such as service yards and car parking forms the focal point of the conceptual master plan. These uses can be appropriately accommodated close to overhead power lines and often need larger buildings which, in turn, are likely to be more in scale with pylons, helping to reduce the visual impact of the pylons. Land beneath the lines can also be used for storage and service areas providing appropriate safety clearances are maintained (see appendix 9).

- **Structural Landscape and Screening**



Appropriate planting can take place up to and underneath overhead power lines, reducing their visual impact and enhancing the overall environment. Attention needs to be paid to the precise species employed, the long-term management and the need to maintain appropriate safety clearances, as set out in appendix 3 and appendix 9. Within the conceptual master plan, strategic planting is used to screen distant views, as well as views from the immediate area around the pylons.

Strategic screening can enhance the quality and intimacy of the area, giving the impression that pylons and lines are further away. Mature trees planted along streets can effectively screen views and enhance the residential environment. Layers of planting are employed in the conceptual master plan to create a series of silhouettes into the distance, creating a depth in the field of vision that helps to reduce the visual impact of overhead power lines. In this way views of pylons can be effectively screened without the need for continuous belts of planting.

- **Transport Corridors and Movement**



The conceptual master plan uses land beneath overhead power lines for streets and paths as part of a range of different uses to ensure the linearity of the route is not reinforced. Overhead power lines have less visual impact when seen from a moving vehicle than when seen from the same viewpoint by a pedestrian. Streets and paths also allow more landscaping to take place in the vicinity of the overhead power lines.

The conceptual master plan demonstrates that it is possible to provide a high quality environment around high voltage overhead lines that reflects the planning and urban design aspirations of the Government's urban renaissance agenda.



Help for developers and landowners

National Grid does not own the land that is crossed by overhead power lines. The line is retained by means of either wayleave agreements or permanent easements with the landowner.

Where the overhead power line is held on a permanent easement the landowner has already accepted a payment for the retention of the line in perpetuity. This grants access rights for National Grid to maintain and repair the overhead power line.

Where the overhead power line is held on a wayleave, the landowner is being paid annually for the rights to keep the line in situ.

Where a loss is suffered due to the presence of an overhead power line, National Grid would negotiate a compensation payment in return for a permanent easement. The landowner/developer has a duty to mitigate loss, for example by applying these guidelines.

In many cases developers and landowners understand at the outset that it is unlikely that the high voltage overhead line crossing a site is going to be moved. National Grid provides information and guidance to developers to assist with the site layout and creation of a master plan that takes the presence of the existing high voltage overhead line into account.



National Grid provides free information and guidance to developers.

Application by local authorities

These guidelines clearly demonstrate the nature of the constraint posed by National Grid high voltage overhead lines, and the opportunities that exist to create attractive and high quality environments on sites crossed by overhead power lines. Local planning authorities, as part of their plan preparation function, can therefore be reassured that the presence of high voltage overhead lines does not rule out the creation of sustainable and successful places. In most cases the allocation of such land for development is a wholly practical and viable option.

The Sense of Place guidelines also have a valuable role to play in assisting local planning authorities in their development control function, in considering planning applications on land crossed by high voltage overhead lines. The guidelines can be employed to promote the highest standards of design on such sites and can be used as a benchmark for assessing the merits of a master plan and its design response to overhead power lines.

Through positive dialogue and consultation, National Grid prefers to work with local authorities to create policies in development plans that are appropriate to the local area and reflect best practice.

For example, it may be useful to local authorities where they are allocating sites crossed by high voltage overhead lines to consider adopting this design guidance as a whole, as supplementary planning guidance, or else to take certain elements of it and incorporate it into supplementary planning guidance.

In such cases it may be helpful to include the following wording in the development plan:

Proposals for development on land crossed by high voltage overhead lines should take account of the presence of the overhead power line at the outset in the layout or master planning process. Proposals for such land should employ appropriate methods to lessen the impact of the high voltage overhead line on future development, and in particular on the public realm.



These guidelines can be employed by local authorities to help promote the highest standards of urban design.



Community involvement

For many years National Grid has been committed to appropriate consultation on its own major infrastructure projects.

Community involvement is becoming more commonplace - pre-application consultation for major development schemes, stakeholder workshops and planning for real exercises are all providing a direct input for local communities into the design of development. National Grid sees the Sense of Place guidelines as a potential vehicle to assist others when consulting on the formulation of development proposals on land near to high voltage overhead lines.

For example, as well as providing clarity and advice on general issues surrounding the transmission of electricity, the guidelines give an insight into the potential for creative design solutions. This will provide a foundation of shared knowledge that can facilitate an informed debate on the issues raised, and allow a greater breadth of development options to be considered.



These guidelines may help local communities in the development consultation process.

Future steps

The Sense of Place guidelines show that innovative design solutions and fresh thinking can be employed to create attractive high quality environments around high voltage overhead lines. This forward-looking approach is National Grid's contribution to the progressive urban design agenda that is seeking to transform the image of our towns and cities.

But it does not stop here. The next step is to apply the guidelines to a live situation. National Grid is in consultation with a number of interested organisations in this regard to investigate the potential application of the guidelines to suitable sites.

National Grid is keen to maintain the healthy and creative dialogue that has characterised the development of these guidelines, and is happy to answer any queries that may have been raised by them. Contact details can be found at appendix 15.

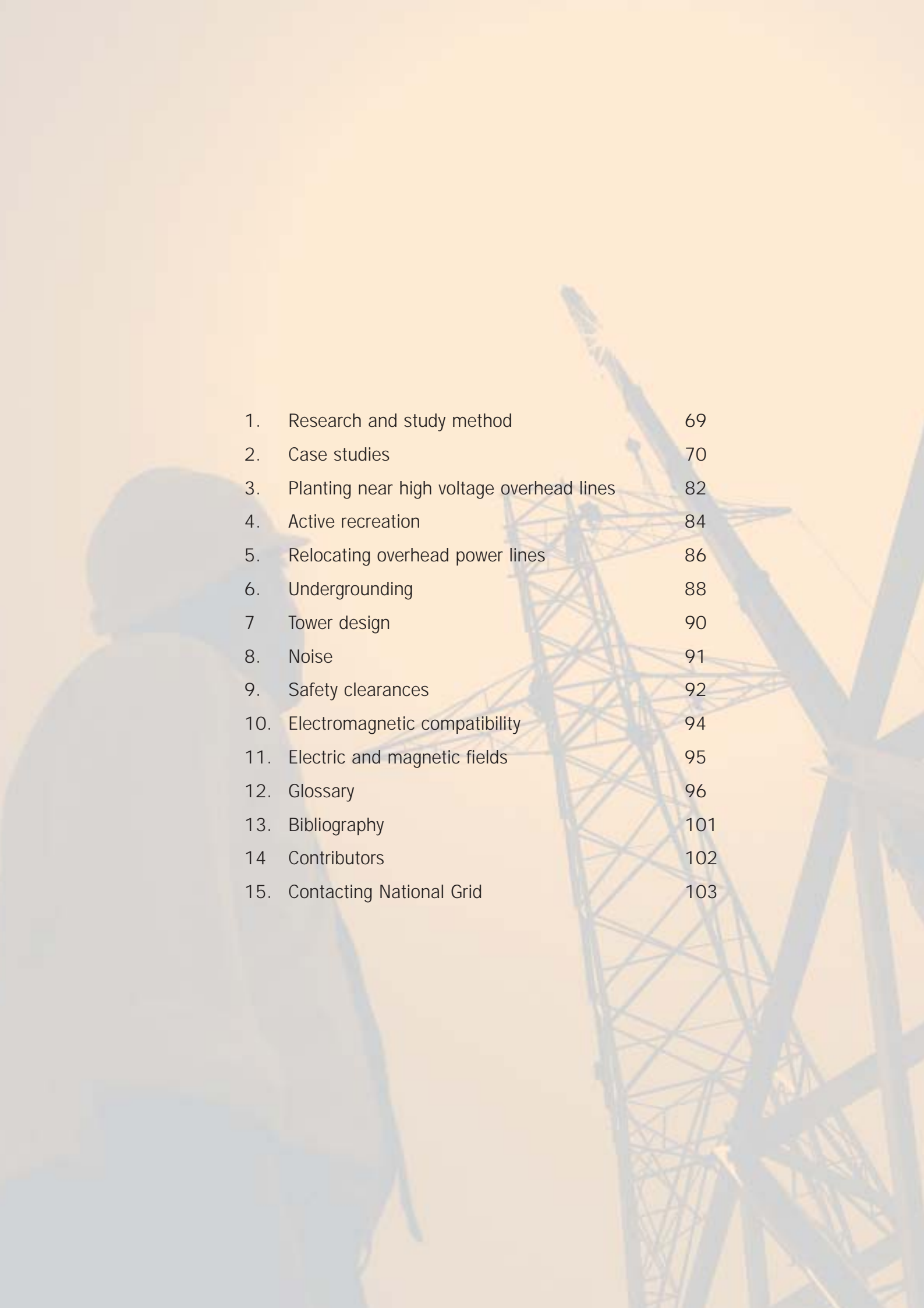


Contact National Grid for further information and potential demonstration sites.

www.nationalgrid.com/uk/senseofplace

appendices





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1. Research and study method

These design guidelines are derived from the results of the following studies and exercises:

Case studies

Over 40 locations across England and Wales were selected in order to examine positive and negative environmental aspects evident in the relationship between pylons and overhead lines and the built form and landscape. The case study locations, identified by National Grid and the consultants, cover a wide geographical spread and include a variety of land uses in urban and urban edge settings.

Each site was visited and information on the characteristics, strengths, weaknesses and opportunities recorded. A photographic record was made and sketches were also prepared. A sample of the case studies can be found in the following pages.

Interviews

Interviews were undertaken with senior development industry figures, particularly housing developers, to understand views, attitudes and general levels of awareness of the issues which the design guidelines seek to address.

Questionnaires

Questionnaires were designed and dispatched to the marketing departments of 20 house builders. The purpose was to identify attitudes and experiences of marketing and selling homes near overhead power lines including any anecdotal evidence on the views of potential purchasers to the presence of overhead power lines.

National Grid Workshops

A workshop was held with representatives from a range of disciplines within National Grid to better understand the company's operational requirements.

Industry Liaison

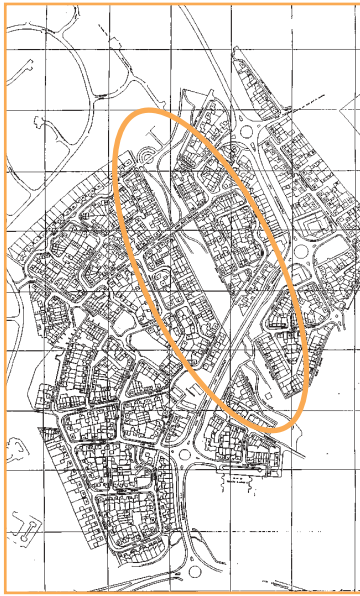
The draft design guidelines were taken to key stakeholder groups through a range of media:

- A web site including a feedback form
- Leaflets distributed at professional seminars and other events
- Presentations to key organisations within the planning and development sector
- Exhibitions at targeted events including at the 2002 Urban Summit in Birmingham.

The feedback received has formed an important input into the final Sense of Place design guidelines.



2. Case studies



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Survey Data

Technical:

Voltage 400kV and 275kV (Two circuits, different voltages)

Land Use:

Fairford Leys is a new residential development situated on the edge of Aylesbury between the A418 and the A41. This is a medium density development based upon a deformed grid layout. The development has a suburban character and is rapidly becoming well established despite some areas still being under construction. The transmission route is accommodated in a number of ways including as part of a riverine corridor running through the development.

Environment:

The landscape of the corridor is based around an area of surface water attenuation and much of the area is taken up with a stream, reed beds and vegetation. The remaining open space is roughly mown grass but, aside from the pathways, is otherwise unstructured. The area is well used by the local residents, especially dog walkers, and has an established wildlife population.

Spatial:

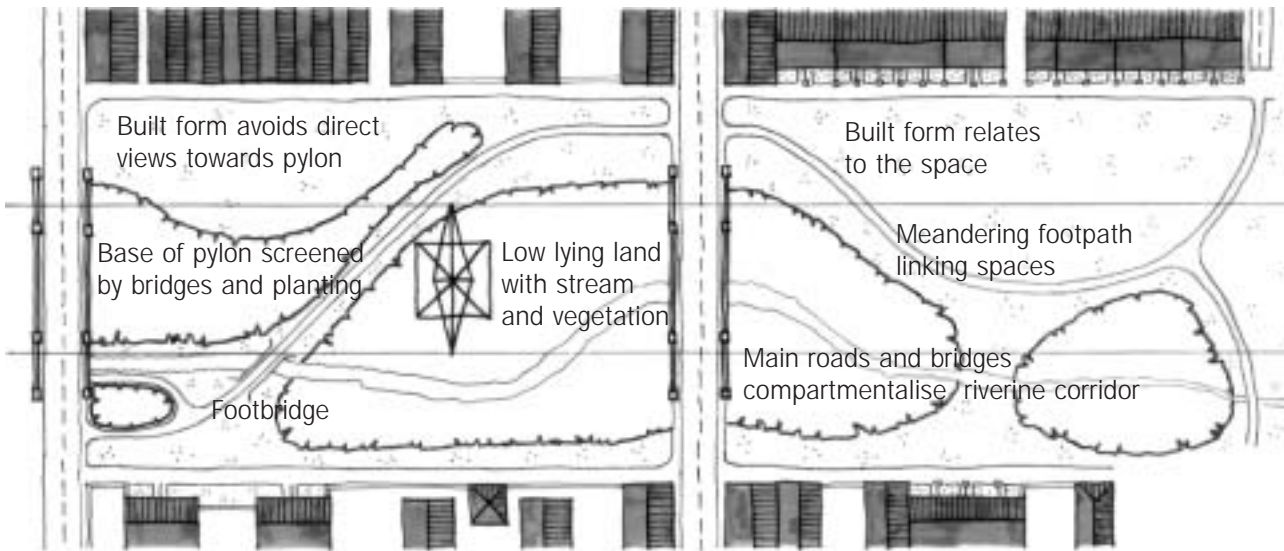
Regarding visual impact, the transmission route is prominent but sits well within an environment that has been specifically designed to accommodate it. The natural vegetation around the stream acts as a screen to the base of the pylons. Road bridges that cross the space create a series of separate landscape cells. The built form consists of terraces with a continuous building line, usually facing into and relating to the open space.

Circulation & Accessibility:

The various forms of circulation define the character of the corridor. The space is compartmentalised by the low road bridges running across the area. There are wide footpaths in front of the houses on both sides of the corridor and other footpaths meander through the space with timber footbridges crossing the stream. The residential cul-de-sacs perpendicular to the transmission route open up views into the area. There are good pedestrian links weaving throughout the built form. There is also street lighting to the residential footpaths on either side of the corridor.



Location: Fairford Leys, Aylesbury
Category: Residential
Local Authority: Aylesbury Vale District Council
Line Name & No: East Claydon-Amersham, ZL382-ZL384



Analysis

Strengths & Weaknesses:

On the whole, this is a well-designed and positive response. The pylons are dominant but are carefully considered and the built form relates well to the open space. There are also residential areas and walled off parking courts which turn their backs to the corridor. Despite the advantages of maintaining a continuous building line, the linearity of the terraces can be monotonous and emphasise the strong linear nature of the overhead power lines. Meandering footpaths provide a counter balance to this so that users are often looking away from the pylons.

Opportunities:

Although this is already a good scheme there are opportunities to create more formal public recreational facilities within the open space. Also, instead of enclosed parking courts, an element of residential parking could be accommodated within the edge of the corridor.



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Survey Data

Technical:

Voltage 400kV

Land Use:

This is a new residential development on the edge of Didcot, adjoining the A4130, and is a typical suburban low to medium density development based upon a cul-de-sac layout. The transmission route has been accommodated within a linear park running through the development; both the development and the linear park are clearly visible from the main road.

Environment:

The open space flows from the A4130 into the site. The vegetation is well established, with a low-lying area that may possibly include surface water attenuation or an emergency flood area. The surrounding residential areas are screened by large swathes of planting.

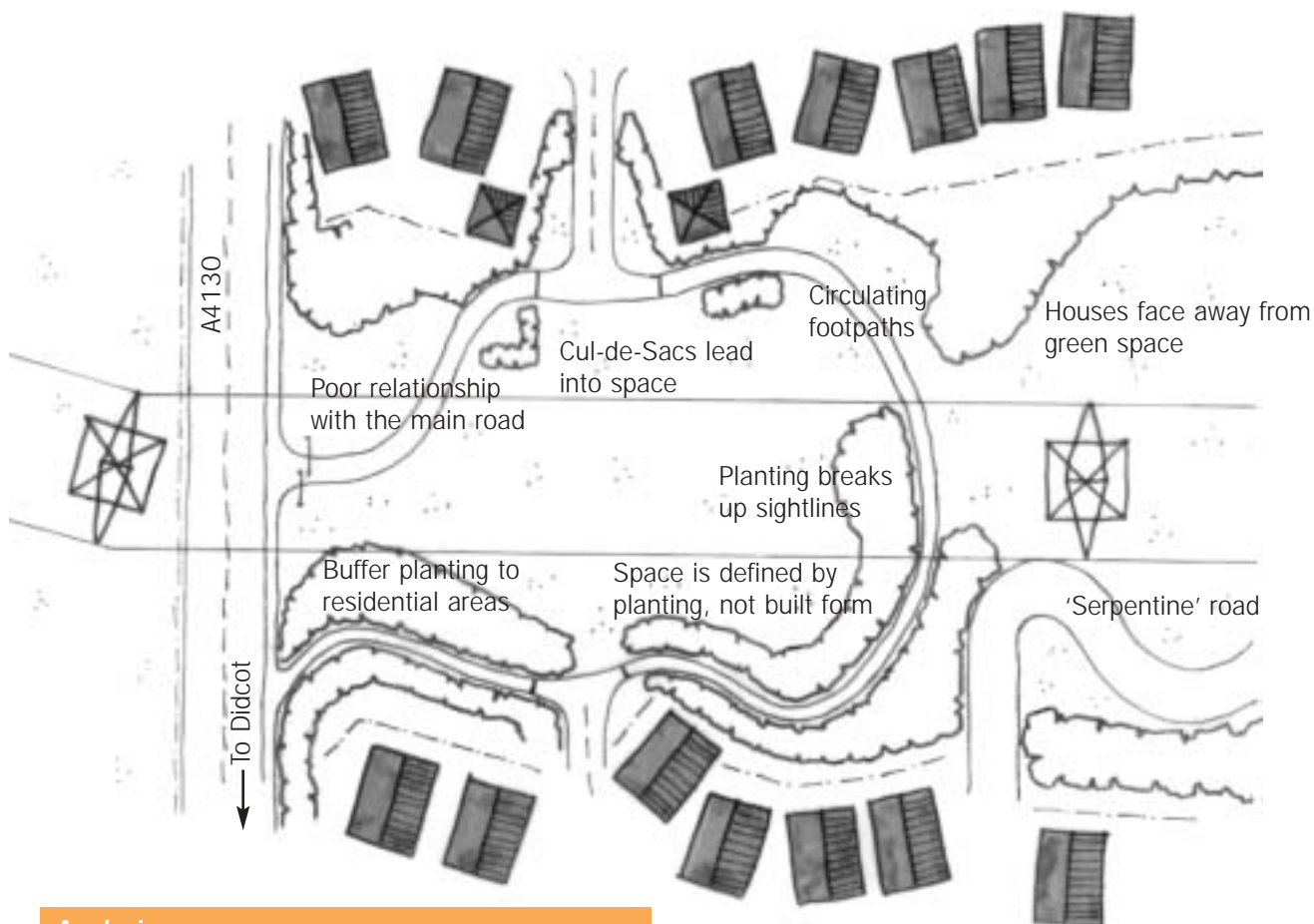
Spatial:

The overhead power lines are prominent but sit well within an environment that has been specifically designed around them. The pylon structures are not hidden; instead the vegetation screens the built form rather than the bases of the pylons. The surrounding houses are orientated away from the open space and screened with both fences and planting.

Circulation & Accessibility:

The cul-de-sacs lead into the linear park area rather than simply terminating at the edge, with footpaths meandering around the perimeter of the park. However, the layout of these pathways appears to be a convoluted circumnavigation around the space rather than linking specific nodes. There is also a serpentine road along part of the park edge.

Location: Didcot (off A4130)
Category: Residential
Local Authority: South Oxfordshire
Line Name & No: Didcot-Moulsford Down, 4YG009



Analysis

Strengths & Weaknesses:

On the whole this is a pleasing and successfully planned open space. However large areas of planting segregate the built form from the open space and reduce opportunities for natural surveillance and activity within the space. Furthermore, some of the pedestrian links are rather weak. The transmission route although prominent, sits well within this large scale space and pylons are partially screened at the base by planting.

Opportunities:

Both the residential area and the park function well but in isolation to each other. Much more could have been made of the interaction between the two areas. In general, there are opportunities for both the development of more formal public recreational facilities and also resident or visitor parking to the edge of the open space.

The pylons could be further screened with foreground planting in order to break down the linear sightlines within the space.



2. Case studies



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Survey Data

Technical:
Voltage 275kV

Land Use:
The site is located adjacent to the M6 in a predominantly industrial area with the M6 flyover to the south and the transmission corridor to the north. The site comprises large scale distribution warehouses, although there are some smaller business units. A small line of terrace houses remains on the site along Standard Way. These look onto the site and over the transmission route.

Environment:
Mature vegetation exists around the base of the pylons, occurring mainly adjacent the motorway. Travelling north, the transmission route forms a green corridor alongside Standard Way. A pond is located within the area beneath one of the pylons.

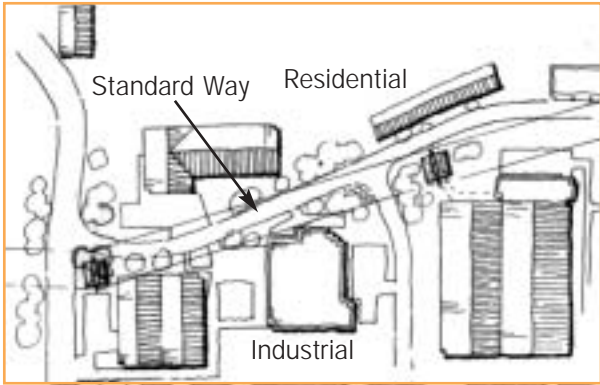
Spatial:
The transmission route initially follows the M6, where the impact is mitigated by the scale of the other elements of infrastructure. When the transmission route moves away from the motorway the pylons become more prominent but are successfully incorporated into the environment as a result of substantial screening and landscaping.

The green corridor along Standard Way with industrial units set back from the road creates a pleasant environment with units and residential buildings fronting the space.

There is a high proportion of screening which is relatively mature. One pylon on the route is hidden by a small hill and another pylon is located on private land, in an area used for storage.

Circulation & Accessibility:
In Gravelly Industrial Park there is good vehicular and pedestrian access to and alongside the transmission route. In other areas the pylons are either on private land, traffic islands or on an island between the motorway and the canal. Here the transmission route cannot be followed by pedestrians as it steps away from the motorway.

Location: Gravelly Industrial Park
Category: Industrial
Local Authority: Birmingham City Council
Line Name & No: Hams Hall-Nechells,
 4VU029-4VU035



Analysis

Strengths & Weaknesses:

The pylons, where possible, have been addressed with good landscaping and utilise building frontages to form a positive space. Near the motorway other pieces of large-scale infrastructure help lessen the impact.

The industrial site relates positively in terms of scale to the pylons. The taller street lighting columns also relate well to the vertical impact of the pylons.

Opportunities:

There is an opportunity to further enhance and continue the efforts made along Standard Way to integrate the transmission route.

The site illustrates that a well landscaped environment with a degree of thought regarding the layout and form reduces the visual impact of the overhead power lines. The scale of the buildings and roads within an industrial area also relate better to the scale of the pylons.



2. Case studies



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Survey Data

Technical:

Voltage 275kV

Land Use:

The site is located to the south of Quinton near Lapal in the West Midlands. It is adjacent to the M5 with the A456 running through the northern part of the site.

North of the A456 the site is grazing land and accommodates a pylon.

South of the A456 and east of the M5 is a residential development of detached properties sheltered from the M5 by mature trees creating a leafy suburb. The houses date from the 1980s.

Environment:

North of the A456 the site is characterised by cattle grazed pasture.

The southern area of the site is a housing estate surrounded by mature trees which provide a wildlife habitat as well as sheltering the houses from the noise of the motorway.

Spatial:

There is a contrast between the north and the south of the site. The pylons have a significant visual impact in both areas but the impact in the housing estate is more marked as pylons appear more intrusive in a residential environment.

In the housing estate, the transmission route has essentially been ignored by the developers with dwellings directly underneath cables. Pylon YJ021 is placed in private property behind the building line in two privately owned gardens.

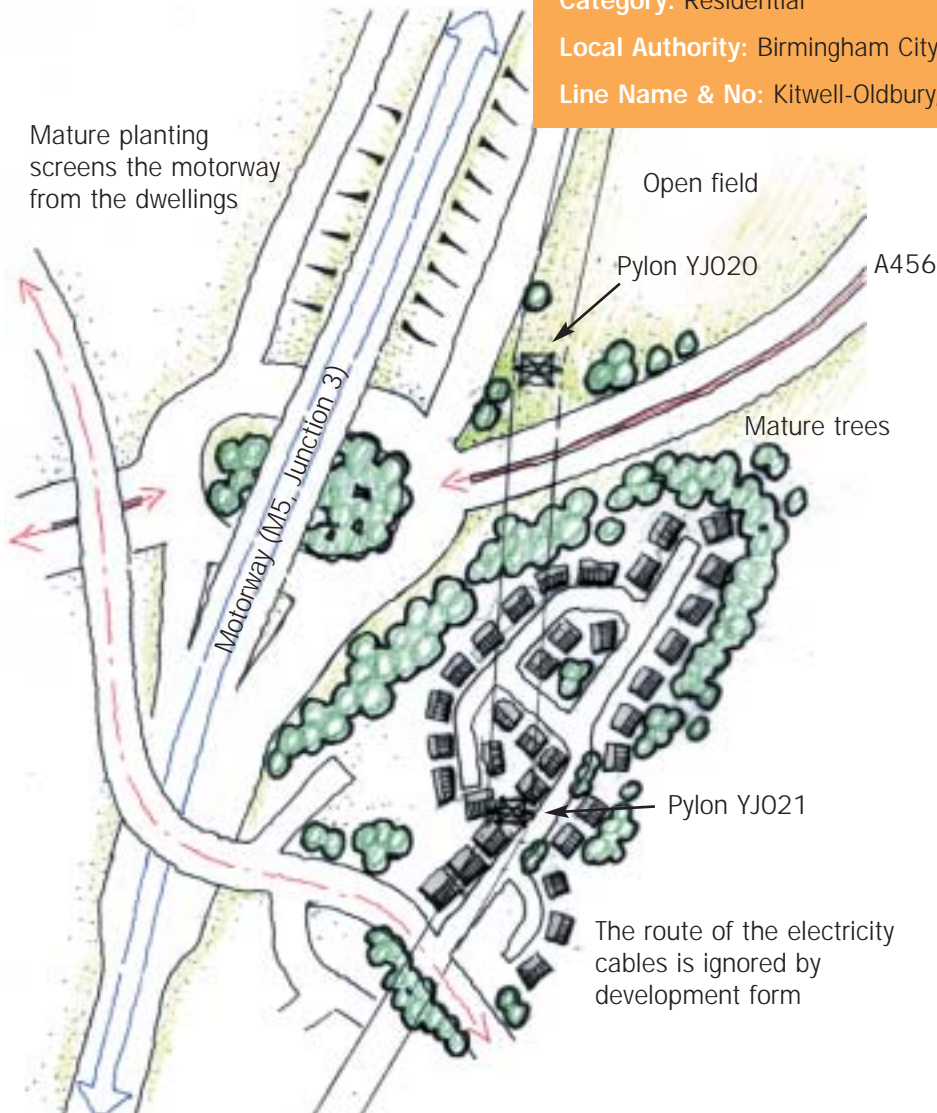
Circulation & Accessibility:

Both pylons are on private land and there is no defined route between them. The access road for the site is to the south, with the development form based upon a series of cul-de-sacs.



2. Case studies

Location: Nr Lapal, Halesowen, West Midlands
Category: Residential
Local Authority: Birmingham City Council
Line Name & No: Kitwell-Oldbury, YJ020-YJ021



Analysis

Strengths & Weaknesses:

Whilst still prominent, the visual impact of the northern pylon is lessened by large scale infrastructure elements in close proximity.

Despite the fact that the pylons relate well to the surrounding mature trees, the lasting image of the estate is of housing closely abutting and beneath high voltage overhead lines.

Opportunities:

Due to the layout of the development, which essentially ignores the transmission route, little can be done to improve the residential site to the south. To the north some planting around the base of the pylon would screen it at eye level. Combined with improved landscaping, this would improve the visitor's first impressions of Lapal.





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Survey Data

Technical:
Voltage 275kV

Land Use:
The transmission route follows an undeveloped land corridor adjacent to a housing development on the outskirts of Bedworth at Bedworth Heath. It forms a concrete corridor from the countryside into the suburban housing estate. The corridor serves as an incidental space and is used by children as informal play space. The housing types of the surrounding areas include semi-detached and terraced developments with some social housing.

Environment:
The transmission route is predominantly concrete hardstanding. However, significant areas of wild vegetation are beginning to become established. The area beneath the high voltage overhead lines is almost an accidental space; no attempt has been made to incorporate it into the existing built form and it serves no obvious function. There are a number of concrete floor slabs in this area, although the history behind these features is not known. One pylon also terminates a view along a street, highlighting its prominence.

Spatial:
The predominance of concrete and the visual dominance of the pylons serve as the key negative features of this estate. The development form ignores the space completely, buildings look away from the space and roads on either side of the corridor do not join, although cars frequently cross the hardstanding areas.

Circulation & Accessibility:
Cars are able to cross the space in certain areas despite there being no road within the corridor. Bollards have been put in place to stop cars travelling down the corridor. Circulation is predominantly pedestrian.



Location: Nr Bedworth, Warwickshire
Category: Residential
Local Authority: Nuneaton and Bedworth District Council
Line Name & No: Hams Hall-Coventry, 4ZWW049-4ZWW050



Analysis

Strengths & Weaknesses:
 The land beneath the overhead power lines is a very poor environment, with no obvious function resulting in an oppressive dumping ground with no natural surveillance. The urban form does address the power lines but in such a manner that they are greatly emphasised, as opposed to their effect being minimised.

Opportunities:
 There is an opportunity to create a usable and attractive open space, which could be either in the form of a green corridor extending into the estate or a more formalised children's play area.



2. Case studies



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Survey Data

Technical:

Voltage 400kv and 275kv (Two circuits, different voltages)

Land Use:

This is a low density post-war housing development based upon a grid layout. The development is located in a rural area on the outskirts of Greater Manchester. The houses are mainly terraces or semi-detached and the area is exhibiting some signs of neglect.

Environment:

The pylons in this area are located in corner/roadside sites, garage courts or back gardens. There has been very little effort to integrate these structures into their environment. The example shown is sited on a small plot to one side of a crossroads behind a bus stop.

Spatial:

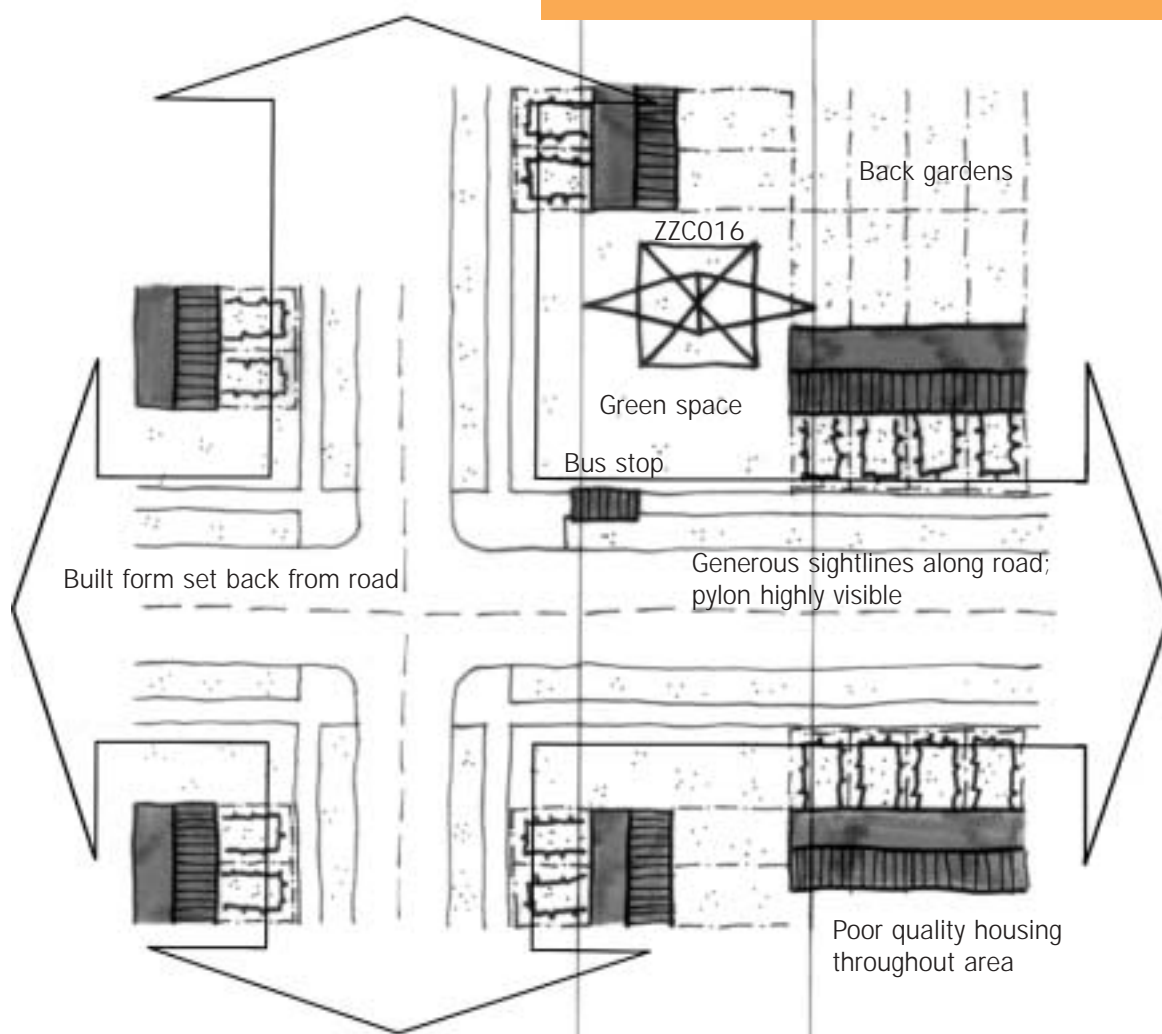
The terraced nature of the built form and the long sightlines in all directions make this pylon very prominent and invasive. Also, no effort has been made to screen the pylon at ground level.

Circulation & Accessibility:

The site is accessible on foot and incorporates a bus stop.



Location: Broadbottom, Nr Stalybridge, Manchester
Category: Residential
Local Authority: Tameside Metropolitan Borough Council
Line Name & No: Stalybridge-Stockport Tee, ZZC016



Analysis

Strengths & Weaknesses:

The development response to the pylon is poor and has placed the pylon in a prominent corner site at a crossroads. This location emphasizes the visual impact of the pylon from four directions.

Opportunities:

There are limited opportunities to make more of the green space, eg. the proximity of the bus stop as an arrival point within the public realm, and to provide screening or planting at ground level.



3. Planting near high voltage overhead lines

Trees grow, bend and flex in the wind and even fall; as a result they can come into contact with the live conductors of an overhead power line. Specified distances (electrical safety clearances) between overhead power lines and obstructions such as trees have been nationally determined to ensure safety to the public and to prevent electrical flashover of the line, which could result in power failures (see appendix 9). National Grid undertakes regular assessments of the likely danger to its system and the public arising from overhead power lines near to trees. Where woody vegetation is found to infringe statutory safety clearances then it must be cut and/or removed such that reasonable growth and safe access for future works can be achieved without returning every year to the same site.

National Grid cannot prevent trees and vegetation being planted beneath its overhead power lines since it does not own the land. To ensure that future safety problems will not occur and to reduce the need for significant ongoing tree management works, National Grid recommends that only low height and slow growing species are utilised in areas beneath overhead line conductors. Similarly, when planting is proposed very near pylons consideration should be given to the need to maintain access to the pylon base and allow overhead line maintenance activities to take place safely and without causing damage to existing habitats and landscapes.

The diagrams opposite illustrate planting zones beneath and adjacent to a high voltage overhead line where the height of trees and woody vegetation must be restricted to ensure electrical safety clearances can be maintained. In considering the type of planting that may be appropriate, reference may be made to the mature height of trees as set out in NHBC Technical Standards, chapter 4.2 'Building near trees', Appendix 4.2 – B 'Water demand and mature height of trees'.

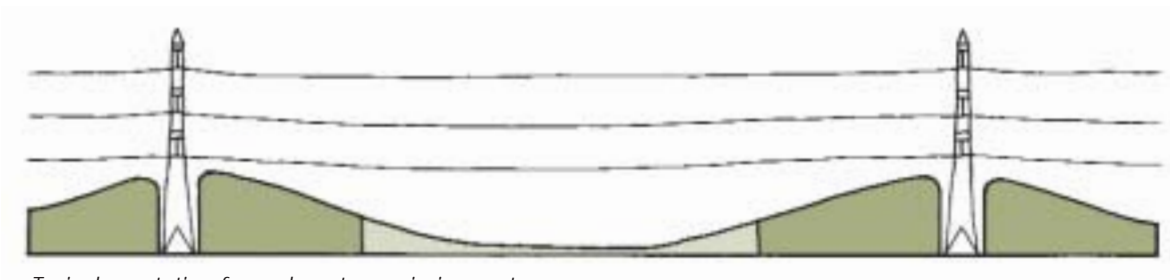
These diagrams are for illustrative purposes only. The specific clearance available at a particular location and therefore the precise extent of any planting zone will be dependent on the following factors:

- the design of the overhead line and type of pylon
- its operating voltage
- the spacing between pylons
- local topography
- proposals to alter ground levels.

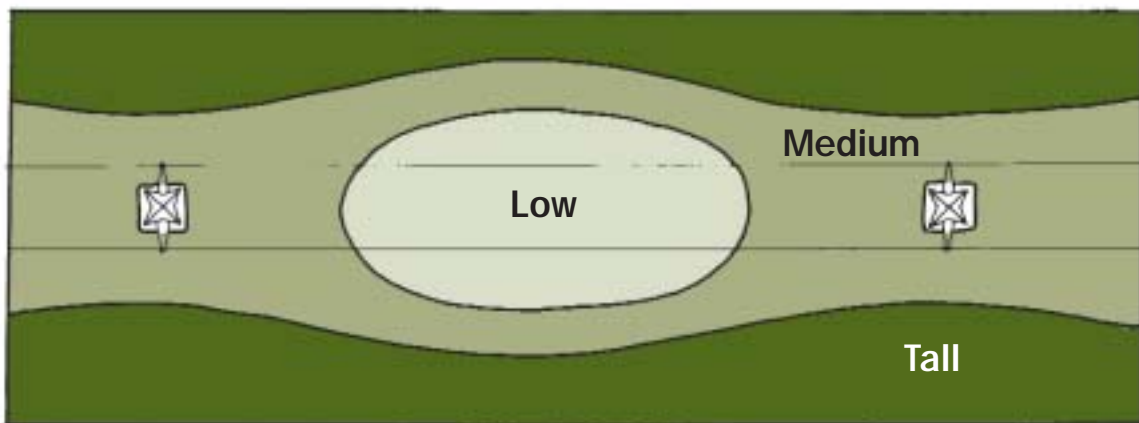
Detailed technical advice together with profile drawings of a specific high voltage overhead line span should be obtained from National Grid prior to any landscaping scheme being finalised.



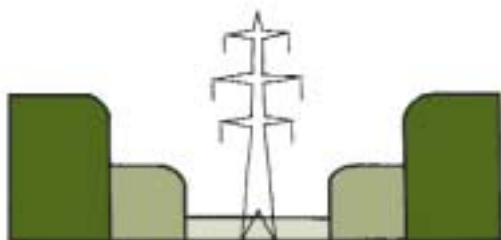
3. Planting near high voltage overhead lines






Typical vegetation form along transmission route.



Typical form of planting zones.



Typical vegetation form crossing transmission route at mid-point.

Zone Characteristics	
	Tall - Forest Scale Trees Eg: Ash, Beech, Horse Chestnut, Lime, Oak
	Medium - Garden and Orchard Scale Trees Eg: Apple, Cherry, Hawthorn, Mountain Ash, Pear, Plum
	Low Eg: Hedgerows, Allotments, Arable Crops, Reed Beds, Meadows/Wild Flowers, Grassland



4. Active recreation

General recreational use of land beneath and alongside high voltage overhead lines is possible where appropriate safeguards are implemented. There are many examples around the country of where recreational uses sit very well with an overhead line route. For example, golf courses and country parks.

From a safety point of view, two specific recreational activities are problematic in spaces around overhead lines: kite flying and fishing. In both these cases the situation may occur whereby the kite string or the fishing tackle may come into contact with the overhead line and potentially cause fatalities. National Grid is keen to reduce the opportunities for these activities to take place near to overhead power lines.

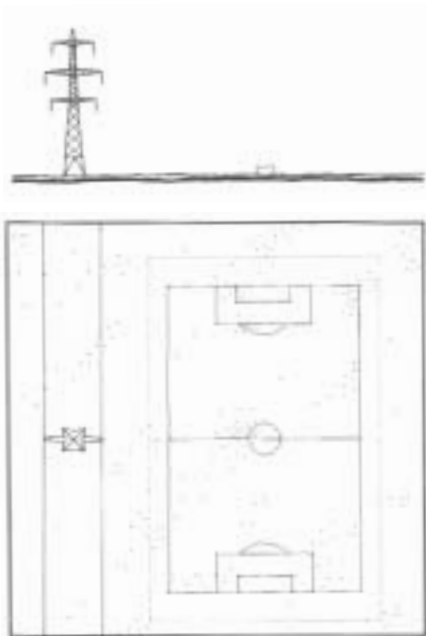


Diagram 1: example of a closed/supervised sports area.

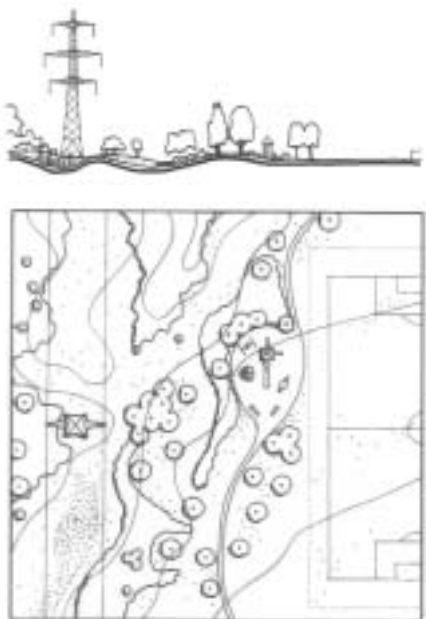


Diagram 2: Example of an unsupervised/open access sports area.

There are two distinct types of recreational space, closed and supervised sites and unsupervised open access sites. The ways of dealing with activities within these spaces vary according to the level of site supervision and security. For example, a sports pitch crossed by an overhead power line on land belonging to a sole use club, which can only be accessed by its members is unlikely to raise concerns about the potential for that site to be used for kite flying. It is likely to be sufficient to inform members of the dangers from the overhead power line and to erect appropriate signage around the site. See diagram 1 left which gives an example of a closed/supervised sports area.

However, if that same area were to be open to the general public and not subject to strict supervision, the effectiveness of using signage (pictograms are always advised) may be limited and it is likely that other tools would need to be used to discourage activities such as kite flying. Such tools may include the creation of buffer zones such as the planting of trees (see appendix 3), ground modelling, introducing shallow water areas or planting low growing plants that make it difficult to walk through in the vicinity of the overhead power line. Such physical measures would make an area unsuitable for kite flying. See diagram 2 left which gives an example of an unsupervised/open access sports area.





As a general rule, where it is intended to create open space areas near to overhead power lines which are unsupervised/open access areas, a buffer zone where access is restricted should extend 30m from the outer conductor of the overhead line route so that kite flying is discouraged. See diagram 3 below. However, with the appropriate treatment, such as those mentioned above, to deter the flying of kites, the extent of that buffer zone can be reduced so that the area around the overhead power line can positively contribute, both to the open space provision and to the development as a whole.

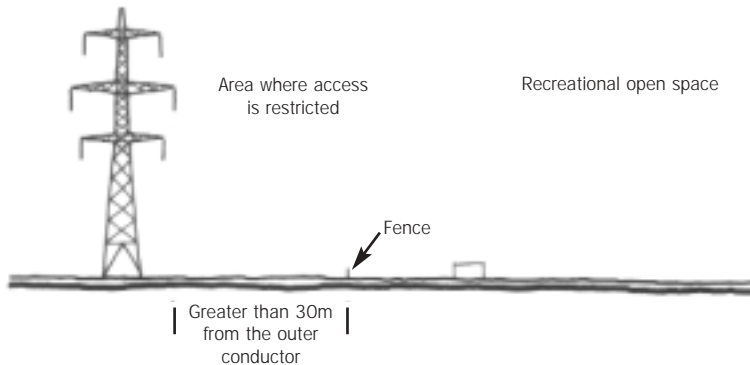


Diagram 3: Example of an unsupervised/open access area where no treatment of the land is intended between the overhead power line and the recreational open space.

It is possible to locate sports pitches and other formal recreational uses directly beneath overhead power lines as high voltage overhead lines are sufficiently high above the ground to allow such activities to take place. However it is preferable to site sports pitches alongside the overhead power lines, or using the overhead power line as the outfield to minimise disturbance to any activity. This will also reduce the potential conflict between overhead power lines and sports equipment such as rugby football goal posts and lighting columns.

The long term use and possible expansion of the recreational facility should also be considered at the initial planning stage. It may be a longer-term aspiration to include floodlighting, or stands/raised seating areas around formal sports facilities and these may have implications for the statutory safety clearances that must be maintained around all overhead power lines.

It should be noted that although spaces may be planned for a specific use, it is likely that children will use that space in ways adults had never thought of. Therefore, where it is proposed to locate focal points for children's activities such as children's play equipment and/or open spaces where kite flying may be possible, buffer/exclusion zones always need to be incorporated, or the facilities modified to exclude children or ensure that appropriate supervision measures are in place.





5. Relocating overhead power lines

A frequently asked question is ‘why can’t National Grid remove or relocate its overhead line?’ In order to answer this question it is important to explain some key issues.

Background

The National Grid is an integrated system and power is not necessarily generated in the area it serves. Most generation occurs in the north of England, and the main centres of demand are in the south, which means transmitting electricity over long distances. This is done most efficiently at high voltage.

National Grid’s overhead lines were predominantly routed in the 1950s and 60s when the overriding concern was to bring electricity to those areas in need. Consequently, National Grid’s overhead lines tend to run through the open countryside and to skirt cities and built-up areas.

However, they also cross the old industrial areas where the major electricity users, such as car manufacturers and chemical plants would have derived their electricity directly from the National Grid at high voltages.

Current planning policy means that the main areas currently planned for development tend to be sustainable urban extensions to existing settlements or the redevelopment of these old industrial sites - both areas that are now likely to have high voltage overhead lines nearby.

Typical constraints to moving lines

All requests for the removal or relocation of high voltage overhead lines are considered on their own merits. Where it is possible to move an overhead line, the cost for this and for dismantling the existing line would be borne by the developer/landowner. It is not acceptable to pass the cost of the relocation on to electricity consumers generally. However, as a general rule it is very unlikely that high voltage overhead lines will be moved.

First, there are significant legal, technical and topographical constraints to moving lines.

All of National Grid’s overhead lines have been given consent under the Electricity Act by the Secretary of State for Trade and Industry and have agreement from the landowners. Any re-routing of the overhead line would invariably require new consents and new landowner agreements. Where the re-routed line would be on an adjoining landowner’s land, the new agreements would be required from a different landowner. New consents for overhead line routes are not easily obtained. Where local authority and public objections are made, a DTI Inspector is appointed and a public inquiry would be held.

In addition, where alterations are made to the electricity network, this requires an ‘outage’ on the network. This means that the electricity has to be routed through the network in a different way to make sure that power is provided to all parts of the country at all times. It is not possible to store large quantities of electricity. As the high voltage network is relatively limited in the UK, the opportunities to have regular outages on the system are also limited, mostly to very carefully pre-planned periods when National Grid can maintain and renew essential equipment, connect new customers and refurbish existing lines.

In terms of land use planning and environmental impact, in most instances the existing overhead line route has been routed to take account of all appropriate local factors. In seeking to amend that route, it might resolve the issue for the developer/local authority interested in one site, but it may have unacceptable knock-on consequences. For example, National Grid would not want to re-route an existing overhead line closer to existing properties in order to allow for new development to take place. Nor would National Grid want to re-route a line in such a way so as to make it more prominent in the landscape (which would also be the case if additional pylons and/or angle towers are required for a diversion).



Closely linked to this is the issue of sustainability. National Grid's equipment is built to have a lifespan of about 40-60 years. It is not easily portable or replaceable; and relocating and reconstructing sections of an overhead line is not something that can be done repeatedly at the request of various third parties. Relocation of a line is also unlikely to solve the problem long term anyway - once the overhead lines had been moved to allow some development to take place, in 20 years' time National Grid may be asked to move the relocated line once again to accommodate additional growth. Clearly, this is not a sustainable way either to manage the planning of our communities or to run an efficient electricity business.

It is accepted that high voltage electricity equipment is big and bulky, and it is for this very reason that it is difficult and costly to move around. Like motorways or railway lines, the electricity system is part of our national infrastructure and is not ordinarily something that a developer would look to relocate.

However, unlike a motorway or a railway line, the equipment only touches the ground at the pylon location, so it does not present a significant physical barrier on the ground to development; it is possible to cross under and around the overhead line. Obviously there is a visual impact associated with the equipment, but this work demonstrates how that impact can be mitigated.

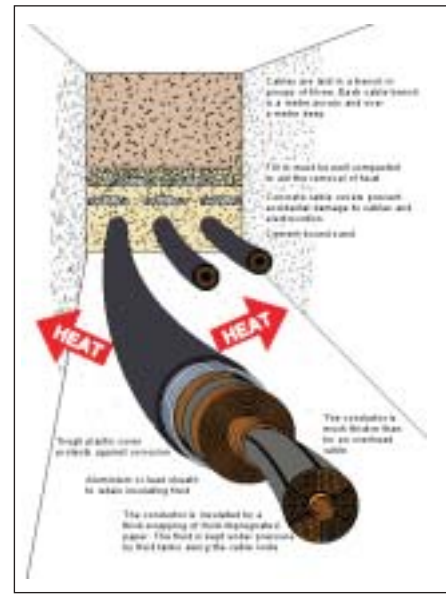
6. Undergrounding

Another frequently asked question is ‘why can’t National Grid underground its overhead power lines in order to enable development to take place and to remove the visual impact of the lines?’ In order to answer this question it is important to get an understanding of the issues surrounding the undergrounding of high voltage overhead lines.

Background

Conductors transmitting electricity need to be insulated from the ground. The main difference between overhead lines and underground cables arises from the different ways in which they are insulated. Overhead lines use air whereas underground cable conductors are wrapped in layers of insulating material. Air is the simplest and cheapest insulation because it removes the heat produced by the electricity flowing through the bare overhead conductors naturally and efficiently.

When conductors are buried underground, high quality insulation is needed to withstand the very high voltage, so layers of insulating material are used. Unfortunately this form of insulation retains heat produced in the conductor and, as the earth does not cool conductors as well as the air, the underground conductors tend to run much hotter than overhead ones.



Underground cable installation.

Impacts associated with Undergrounding

As underground conductors tend to be hotter than overhead ones, this results in the need for a larger conductor underground than would be necessary overhead. This could be up to four times larger and may result in as many as 12 separate cables for a 400kV cable circuit, all of which need to be well spaced. This can result in construction activity the width of a dual carriageway (approximately 60 metres).

This also requires around 30 times more excavation than is associated with an overhead line. This much larger scale of construction can have a greater impact in terms of disturbance to flora and fauna, land use and archaeological sites than the impact associated with overhead lines, where the main impacts are centred on the area where the pylon is constructed. It will also result in a more significant visual impact during construction.



Sealing end compound.

Land is also required for sealing end compounds, which is where underground cables are joined to overhead lines. These compounds contain a substantial terminal tower, a small building and other transmission equipment, and can have a considerable visual impact.

Cost issues

National Grid is required under the Electricity Act 1989 to develop and maintain an efficient, co-ordinated and economical system of electricity transmission. In order to fulfil these requirements, National Grid needs to take into account economic, operational and environmental factors to assess the issues of overhead lines and underground cables.

National Grid has a responsibility to operate the transmission system in an economic manner. There are significant cost differences between a length of 400kV underground cable compared to the same length of 400kV overhead line. It costs between 15 and 25 times as much to install underground cable as to build an overhead line route. The cost difference is not so significant at lower voltage levels (below 275kV), which is why a significant number of lower voltage lines are undergrounded in urban areas.

Where a third party (developer, local authority etc.) seeks the undergrounding of an existing overhead line, the costs associated with the undergrounding are borne by the third party, not by National Grid or electricity consumers generally.

Where underground cables are installed, National Grid requires an approximate width of 30 metres in perpetuity above the cables to be kept free from development or planting in order to allow ready access for maintenance and to ensure that the cables are not disturbed.

Maintenance

In addition to construction costs there are increased maintenance costs associated with underground cables, as they are more complex than overhead lines and it can be a long and costly process trying to locate faults and carry out repairs. There are also operational costs associated with the length of time that the circuit is not in use.

Underground cable tunnels

In recent years technology has allowed for the development of high voltage electricity cables to be placed in dedicated deep-bore tunnels. Though the installation of a deep-bore tunnel is extremely costly, it is an alternative to direct-burial undergrounding in highly constrained urban areas, or in circumstances where the restrictions resulting from a direct-burial cable are not acceptable, such as the swathe of land required, reliability of the cable etc.

Key advantages and disadvantages

Overhead lines (or, more accurately, their pylons) have a visual impact on the landscape, where underground cables in themselves do not. Underground cables can be an appropriate solution to servicing electricity needs where overhead lines are impracticable, or the associated visual impact is considered unacceptable. However, where underground cables are constructed, the land cannot be built upon and trees cannot be planted immediately above or adjacent to the cables, so corridors of considerable width have to be left undeveloped, causing restrictions on land use. There can also be disturbance to flora and fauna and archaeological features associated with the construction of underground cables.

Generally underground cables are less reliable and as such more time is spent on the repair of faults and on maintenance of underground cables than comparative sections of overhead line. Work carried out on an underground cable is also more disruptive due to the need to dig around the cable.

Further information: 'Overhead or Underground: National Grid's Approach' booklet, available free from National Grid.



Internal view of high voltage underground cable tunnel.



Swathe of land required for direct burial.



7. Tower design

National Grid uses a variety of steel lattice tower (pylon) designs for the support of overhead line conductors. The size, height and spacing of transmission towers are determined by topographical, operational and environmental considerations.

A typical National Grid overhead line route will involve the use of three main types of tower:

- Suspension Towers, which support the conductors on straight stretches of line
- Deviation Towers, at points where the route changes direction
- Terminal Towers, which are somewhat heavier in construction and are seen for example at substations or where lines are connected to underground cables.

National Grid engineers are regularly working on new designs which provide alternative choices to the familiar traditional lattice towers, and in 1999 National Grid initiated a research project to develop and evaluate novel transmission tower concepts. Such designs would be considered for use on any major new overhead line route. However, it is not likely that existing pylons would be replaced with any of these new designs.

Further information: http://www.nationalgrid.com/uk/social&environment/tower_design.asp



8. Noise

High voltage overhead lines can generate noise. The level of this noise depends on the voltage of the overhead power line. Sometimes a 'crackling' sound accompanied by a low frequency hum can be heard. Noise from an overhead power line is produced by a phenomenon known as 'corona discharge'. Overhead power lines are constructed to minimise this, but surface irregularities caused by damage, insects, raindrops or pollution may locally enhance the electric field strength sufficient for corona discharges to occur.

The noise levels associated with an overhead power line are weather related, and higher noise levels are likely to occur during damp weather conditions. Overhead power lines are normally quiet during dry weather, except during long, dry spells when airborne debris adheres to the conductors. This noise will disappear when sufficient rain falls to wash the debris away.

9. Safety clearances

Contact by people or objects with high voltage equipment must be avoided. For overhead power lines a statutory minimum clearance must be maintained between conductors and the ground. The higher the voltage of the line, the greater the safety clearance that is required.

Safety clearances must be maintained from buildings constructed under or adjacent to overhead power lines. For technical and amenity reasons National Grid does not encourage built development immediately beneath its lines. Access is required for the maintenance of the lines. The clearances must also be maintained for structures such as street lighting, objects on which a person may stand and new roads and new ground levels (where these will be altered by civil engineering operations) and where planting takes place.

The safety clearances are set out in the Electricity Safety, Quality and Continuity Regulations 2002. Clearances at specific locations will be dependent on several factors including the line's construction, design, and its operating voltages. This is why it is important to contact National Grid before making any changes to ground levels in the vicinity of overhead power lines.

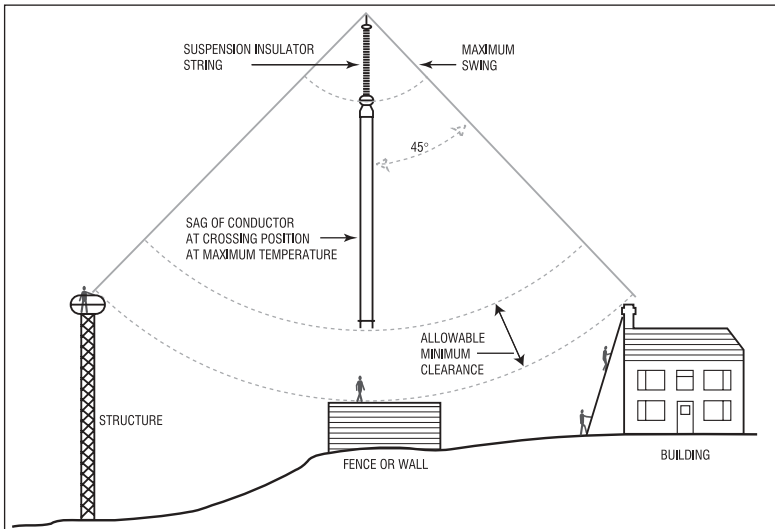
Further information:

ESI Standard 43.8 which can be obtained from the Electricity Association, 30 Millbank, London SW1P 4RD (Tel 020 7963 5801)

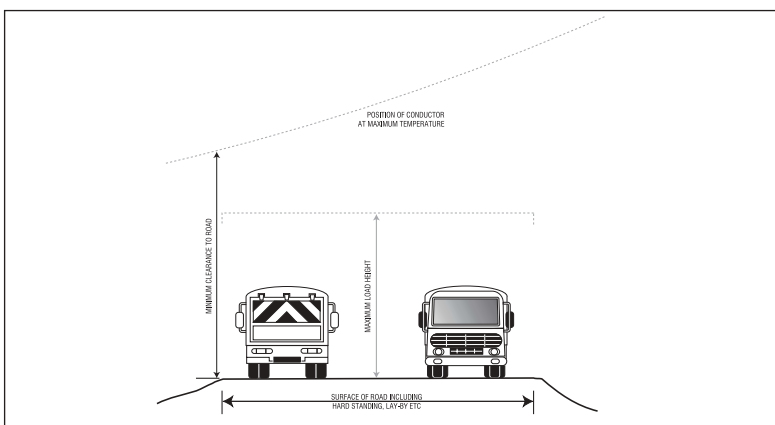
Electricity Safety, Quality and Continuity Regulations 2002. Publication reference URN 02/1544. London, DTI.

Electricity Association Technical Specification 43 – 8 Issue 2: 1988 – Overhead Line Clearances

Health & Safety Executive Guidance Note GS 6 – Avoidance of danger from overhead electric lines 'Development Near Lines', brochure, available free from National Grid



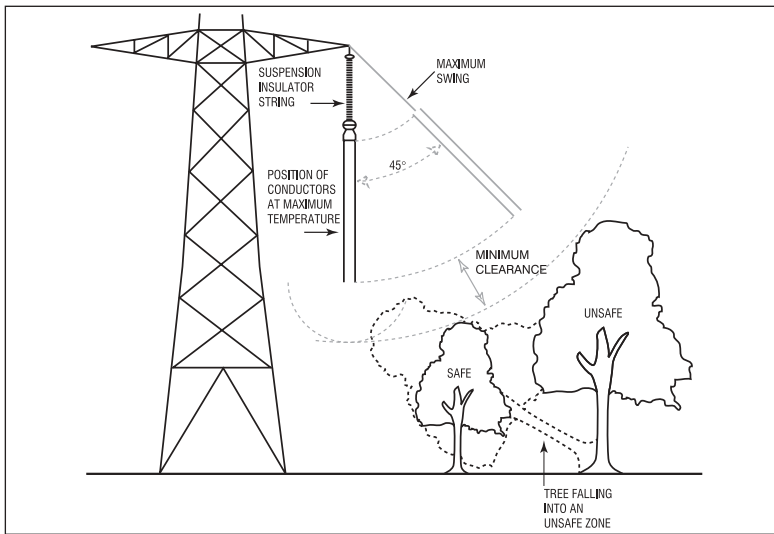
Clearance to objects (on which a person can stand).
(Ref. Item 6 table 1).



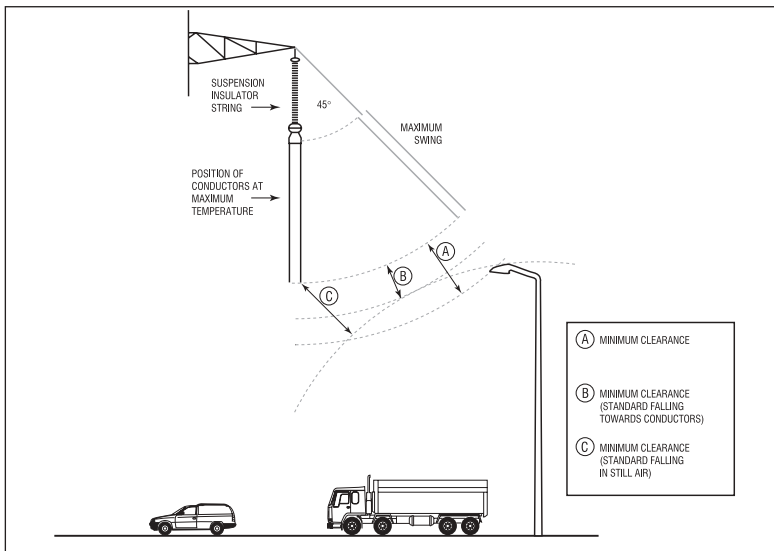
Clearance to roads.
(Ref. Item 2, 3, 4, 5 table 1).



9. Safety clearances



Clearance to trees.
(Ref. Item 8 table 1).



Clearance to lighting standards.
(Ref. Item 11 table 1).

Item	Description of Clearance	Minimum Clearance (metres) at 400,000 volts	Minimum Clearance (metres) at 275,000 volts
1	To ground	7.6	7.0
2	To normal road surface	8.1	7.4
3	To road surface designated "6.1 metres high load" routes	9.2	8.5
4	To motorway or other road surface where "Skycradle" can be used	10.5	9.8
5	To motorway or road surface where scaffolding is to be used on:		
	(i) Normal 3 lane motorways	16.3	15.6
	(ii) Elevated 2 lane motorways	13.3	12.6
6	To any object on which a person may stand including ladders, access platform, etc	5.3	4.6
7	To any object to which access is not required AND on which a person cannot stand or lean a ladder	3.1	2.4
8	To trees under or adjacent to line and:		
	(i) Unable to support ladder/climber	3.1	2.4
	(ii) Capable of supporting ladder/climber	5.3	4.6
	(iii) Trees falling towards line with line conductors hanging vertically only	3.1	2.4
9	To trees in orchards and hop gardens	5.3	4.6
10	To irrigators, slurry guns and high pressure hoses	30.0	30.0
11	To street lighting standards with:		
	(i) Standard in normal upright position	4.0	3.3
	(ii) Standard falling towards line with line conductors hanging vertically only	4.0	3.3
	(iii) Standard falling towards line	1.9	1.4

Table 1: Overhead line conductor clearances.



10. Electromagnetic compatibility (EMC)

Some electronic and radio equipment may be susceptible to the electromagnetic fields and low level radio noise produced by high voltage equipment. Such issues are more likely to have an impact on commercial land uses in the vicinity of high voltage overhead lines rather than on residential developments. EMC issues can be minimised by considering the electromagnetic environment of an area when new electronic equipment is being specified.



11. Electric and magnetic fields (EMFs)

Electric and magnetic fields are all around us. EMFs are associated with all electrical apparatus, including power lines, underground cables and domestic appliances. They diminish rapidly with distance from the source. Electric fields are associated with voltage and magnetic fields vary with the current in the line or appliance.

There are continuing concerns about EMFs. Over the past 20 years, some scientists have linked exposure to everyday levels of EMFs with various health problems, ranging from headaches to Alzheimer's disease. The most persistent of these suggestions relates to childhood leukaemia. But the evidence is not straightforward.

A number of epidemiological studies, particularly in the US and in Scandinavia, have suggested an association between the incidence of childhood leukaemia and EMFs or the proximity of homes to power lines. Other studies, notably the world's largest ever study of its type conducted in the UK during the 1990s, have failed to confirm such associations.

No causal link has so far been established between cancer (or any other disease) and EMFs and there is no established mechanism by which these fields could cause or promote disease.

In the UK the Government relies on the scientific advice of the National Radiological Protection Board (NRPB), an independent body charged by Parliament with giving advice on EMFs, including advice on safe levels of exposure. Government has indicated that it expects industry to follow the present NRPB guidelines, and the electricity industry in the UK has committed itself to following the present guidance on safe levels of exposure given by the NRPB. If Government advised differently, National Grid would, of course, follow that advice.

Neither the UK Government nor the NRPB has recommended any special precautions for the development of homes near power lines on EMF grounds.

National Grid's EMF Helpline deals with enquiries from members of the public, including prospective homebuyers, sellers and their professional advisers who may be concerned about the health implications of nearby electricity facilities. The EMF unit provides relevant information to concerned individuals and will undertake field measurements as appropriate.

Further information:

www.emfs.info

EMF Helpline: 0845 702 3270 or Emfhelpline@uk.ngrid.com



12. Glossary

AMENITY	Relates to the immediate environment around development. Safeguarding residential amenity means that existing levels of privacy degree of overlooking and quality of environment are not compromised by adjacent or surrounding development.
BOUNDARY TREATMENT	Refers to various methods of defining boundaries (e.g. front and back gardens, open spaces, car parks and service areas). Boundary treatments can include walls, railings, hedges and fences, tree and shrub planting. Of particular relevance to urban design is the use of robust boundary treatments defining the boundary between public and private space.
BUILDING LINE	The extent of the built component of a development (external walls/arcades). Usually refers to the front elevation of a building.
CIRCUIT	Term used to describe specific electrical paths on the transmission system. i.e. Overhead Line.
CONDUCTOR	A material through which an electric current can easily flow.
CONTINUITY OF FRONTAGE	Refers to the use of continuous or 'joined up' building frontages and built forms to reinforce the perceived degree of enclosure. This can be achieved by the use of buildings, boundary treatments (e.g. walls/fences/railings) or landscaping.
CROSS SECTION	Scale drawing showing the horizontal and vertical dimensions of each building/street/open space element within a given distance.
CUL DE SAC	A street closed at one end.
DENSITY	A measure of the average number of persons, households or units of accommodation per area of land.
DESIGN PRINCIPLE	An expression of one of the basic design ideas at the heart of a master plan.
DEVELOPMENT BRIEF	A document which sets out requirements for development, in terms of quantum and location of land use, character of development and detailed design. Developers are usually expected to adhere to these requirements.
DEVELOPMENT FRAMEWORK	A document or plan which provides a broad 'framework' or 'structure', within which individual development proposals sit.
DEVELOPMENT PLAN	Statutory documents setting out policies and proposals for an area to guide the development of land in the public interest. Planning applications should normally be determined in accordance with the development plan. The development plan for a given area will include a range of documents including Structure Plans and Local Plans or Unitary Development Plans, Minerals Local Plans and Waste Local Plans.
DEVIATION TOWER	Pylon used where there is a change in the direction of the line.
EARTH WIRE	A conductor connected to earth at some or all supports, which is suspended usually but not necessarily above the line conductors to provide a degree of protection against lightning strikes.



ELECTRIC AND MAGNETIC FIELDS	Electric and magnetic fields are produced by any electrical apparatus, including domestic appliances and overhead power lines.
ELECTRO MAGNETIC COMPATIBILITY	The condition which exists when equipment neither adversely affects nor is adversely affected by its electromagnetic environment.
ELEVATION	Scale drawing showing the vertical projection of any one side of a building.
ENCLOSURE	The use of buildings to create a sense of defined space. Enclosure is achieved where the buildings form a strong continuous edge and where the ratio of the width of the space or street to the height of the buildings enclosing it is sufficient for the observer to feel that they are in an enclosed rather than an open space.
FAÇADE	The face of a building, especially its principal front.
FLASHOVER	A disruptive electrical discharge between equipment at phase voltage and earth, or between two phases, including breakdown across the surface of an insulator as well as sparkover through air.
FORM	The layout, density, scale, appearance and landscape of development.
FORMAL OPEN SPACE	Usually refers to areas of open space which are permanently laid out or enclosed for certain sports activities (e.g. sports pitches, courts, greens).
FRONTAGE	That part of a building/group of buildings which significantly contributes to the character of an area and defines the street.
GARAGE COURT	A courtyard area providing access to garaging for several dwellings. Usually positioned in the centre of a development block or in a courtyard setting. In design terms it is recommended that garage courts serve a maximum of around eight dwellings from a single point of access, and that the garage walls themselves define the court (see 'Parking Court').
GROSS DENSITY	<p>The overall density of a neighbourhood or settlement, including all land uses such as parks, schools, commerce, roads and infrastructure. Residential gross density is calculated as the average number of dwellings within the given boundary, and usually expressed as dwellings per hectare/acre.</p> <p>Can also be expressed as habitable rooms per area (usually used in higher density/city centre calculations).</p> <p>Non-residential density is usually calculated on the basis of plot ratios (see below).</p>
HARD LANDSCAPE	Refers to the use of building materials for landscape purposes. Usually incorporates the use of paving, street furniture, public art, and water features.
INFORMAL OPEN SPACE	Usually refers to areas of open space which are laid out for informal activity (e.g. parkland, village greens, lakeside areas, 'kickabout' areas).
KILOVOLT (kV)	1000 Volts.



LANDMARK	A memorable building or structure which stands out from its background by virtue of its height, size or some other aspect of design. Often significantly contributes to the character of an area. Landmarks are often used as orientation points within the local environment, and aid legibility (see below).
LAYOUT	The way buildings, routes and open spaces are placed in relation to each other.
LEGIBILITY	The degree to which a place (its structure, form and function) can be easily understood and communicated.
LOAD	Customer demand on the transmission system.
MASTER PLAN	A plan or illustration which sets out the overall structure or layout of new development. Often used to convey a development concept or image of the development rather than specify detailed design issues.
MIXED USE DEVELOPMENT	Development which encompasses a variety of different land uses within close proximity. Can refer to adjacent buildings which accommodate different land uses, or different land uses which are accommodated within a single building or group of buildings.
NATURAL SURVEILLANCE	The ability of people to be seen from surrounding built form, often as a means of discouraging crime. Also known as passive surveillance.
NET DENSITY	<p>The defined area of housing (or commercial uses) alone within a neighbourhood or settlement, excluding all land uses such as parks, schools, roads and infrastructure but including incidental green space, internal streets and private drives.</p> <p>Calculated as the average number of dwellings within the given boundary, and expressed as dwellings per hectare/acre.</p> <p>Can also be expressed as habitable rooms per area (usually used in higher density/city centre calculations).</p> <p>Non-residential density is usually calculated on the basis of plot ratios (see below).</p>
OVERHEAD LINE	An electricity line suspended from steel pylons.
PARKING COURT	An area within which vehicles may park, usually positioned in the centre of a development block or in a courtyard setting. May include garages (see 'Garage Court').
PERIMETER BLOCK	<p>All buildings need two faces: a 'front' onto public space (for entrances and the most public activities) and a 'back' where the most private activities occur.</p> <p>Applied consistently, designing development with a 'front' facing outwards onto the public space (street, square or park) and a 'back' which faces inwards to the centre of the block (with private outdoor space), leads to the creation of 'perimeter block' development.</p>



PERMEABILITY	The degree to which an area has a variety of pleasant, convenient and safe routes through it.
PLANNING APPLICATION	Application under the Town and Country Planning Act 1990 (as amended) to carry out development on or to change the use of land. Applications are determined by a relevant planning authority as part of their statutory development control function.
PLANNING GAIN	See 'Planning Obligations'.
PLANNING OBLIGATIONS	<p>A requirement attached to a planning permission to pay specified monies or to undertake specified works to mitigate some of the effects of an approved development when it is implemented.</p> <p>Unlike a planning condition, it is a separate legal agreement and is attached to the land rather than to the developer, and so may be enforced against either the original developer and/or anyone acquiring an interest in the land. A planning obligation may be negotiated during the processing of a planning application, or may be unilaterally declared by the applicant.</p> <p>Typical planning obligations could include the delivery of affordable housing, contributions to educational and community facilities, open space and play equipment, highways improvements. Planning obligations are also known as 'planning gain' or 'section 106 agreements' (see below).</p>
PLOT RATIO	A measurement of density generally expressed as gross floor area divided by the net site area, expressed as a ratio of the square metres or square feet (e.g. a plot ratio of 0.5:1 indicates that the amount of built floorspace covers 0.5, or 50%, of the site).
PRIMARY STREET	A street which by its design can be identified as the most important and connected route through an area. Often accommodating public transport, street planting and higher levels of public activity; primary streets can define and contribute greatly to the character of an area.
PUBLIC REALM	Streets and spaces available for use by everyone without charge - shaped by buildings, landscaping, structures and activities alongside or within them.
RADIO INTERFERENCE	Interference generated by corona discharge from an overhead line at radio frequencies.
SAFETY CLEARANCE	Distance from nearest exposed conductor or from an insulator supporting a conductor which must be maintained to avoid danger.
SECTION 106 AGREEMENT	The legal document which sometimes forms part of a planning consent, and which specifies the obligations which a developer must enter into or satisfy as part of the development permitted (see 'Planning Obligations').
SHARED SURFACE	These are streets within which a single surface treatment is employed. Vehicular movement, parking and pedestrian areas are integrated with no segregation of movement/space.



12. Glossary

STREET FURNITURE	Objects desired or required as part of the laying out of a street. Includes seating, lighting, bins, cycle storage, signage, boundary treatments and planters. Street furniture can also incorporate public art.
SUBSTATION	A location in the transmission system used to control the flow of load and often a location at which voltage is transformed.
SUPPLEMENTARY PLANNING GUIDANCE	Additional guidance covering detailed issues to supplement policies within the Development Plan. Supplementary Planning Guidance, or SPG, does not have the same status as an adopted development plan policy, but may be a material consideration in determining planning applications.
SUSPENSION TOWER	A pylon structure that is used to keep the overhead line conductors off the ground.
SUSTAINABLE DEVELOPMENT	Can be summarised as development that meets present needs without compromising the ability of future generations to achieve their own needs and aspirations (PPG1).
TERMINAL TOWER	A pylon used at a sub-station or cable sealing end to terminate a line which is bulkier and more substantial than a typical pylon.
TOPOGRAPHY	The configuration of a land surface, including its relief and the position of its natural and man-made features.
TOWER	In National Grid, a steel lattice structure for supporting the overhead conductors, usually carrying double circuits, more commonly known as a pylon.
TRANSFORMER	A device for changing one value of alternating voltage to another without altering the frequency.
TRANSMISSION	The means by which bulk electricity is taken from power stations to substations.
TRANSMISSION ROUTE	The land crossed by a high voltage overhead line.
URBAN DESIGN	The art of making places. Urban design involves the design of the built environment, spaces and landscapes and the establishment of frameworks and processes which facilitate successful development.
VIEW	The direct, prominent and unobstructed lines of sight within the public realm visible from a particular point and contributing to the legibility of the area.
VISTA	An enclosed/framed view.
VOLT (V)	Unit of electrical pressure.



13. Bibliography

- Dossier of Case Studies:** David Lock Associates for National Grid, September 2001.
- Electricity Safety, Quality and Continuity Regulations 2002.** Publication reference – URN 02/1544. London, DTI.
- Electricity Association Technical Specification 43 – 8 Issue 2:** 1988 – Overhead Clearances.
- Heath & Safety Executive Guidance Note GS 6 – Avoidance of danger from Overhead Electricity Lines.**
- National Grid: Development Near Lines:** Planning and Amenity aspects of High Voltage Transmission Lines and Substations, 2001.
- National Grid:** Overhead or Underground? National Grid's approach.
- CABE (2000) By Design – Urban Design in the Planning System:** Towards Better Practice. London, Thomas Telford.
- DTLR & CABE (2001) Better Places to Live by design:** A companion guide to PPG3. London, Thomas Telford.
- DETR (1998) Places, streets and movement:** a companion guide to Design Bulletin 32 (compiled by Alan Baxter Associates) London, DETR.
- DETR (2000) Our Towns and Cities:** the future – Delivering an urban renaissance. Cm 4911. London, Stationery Office.
- DETR (2000) Planning Policy Guidance Note 3:** Housing (revised version). London, DETR.
- English Partnerships & The Housing Corporation (2000) Urban Design Compendium** (produced by Llewelyn-Davies). London, English Partnerships.
- ODPM (2003) Sustainable communities:** building for the future. London, ODPM.
- Prince's Foundation (2000) Sustainable Urban Extensions – Planned Through Design.** London, Prince's Foundation.



14. Contributors

Working Group

Catherine Lowe	National Grid
Helen Worsley	National Grid
Hector Pearson	National Grid
Ross Hayman	National Grid
Simon Collier	David Lock Associates
Phil Copsey	David Lock Associates
Joanne Cave	David Lock Associates
Liz Male	Liz Male Consulting
Malcolm Judd	Malcolm Judd and Partners

Other Contributors

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Bellway Homes

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Council for the Protection of Rural England (London Branch)

Countryside Properties

The County Surveyors Society

Department of Trade and Industry

English Partnerships

Fairview New Homes

Heart of Thames Gateway Limited

House Builders Federation

The Landscape Institute

National Playing Fields Association

Office of the Deputy Prime Minister

The Planning Officers Society

Royal Town Planning Institute

Royal Institute of British Architects

Royal Institution of Chartered Surveyors

Thames Gateway London Partnership

Town and Country Planning Association



15. Contacting National Grid

A. For planning application consultations, developer enquiries and advice on safety clearances, please contact the following:

Land and Development Group
National Grid Transco
NGT House
Warwick Technology Park
Gallows Hill
Warwick
CV34 6DA
Tel: 01926 653000

B. For development plan consultations, general town and country planning and amenity issues, please contact the following:

Land and Development Policy Manager
National Grid Transco
NGT House
Warwick Technology Park
Gallows Hill
Warwick
CV34 6DA
Tel: 01926 653000

C. For questions on, or issues with, EMF please contact the following:

EMF Unit
National Grid Transco
NGT House
Warwick Technology Park
Gallows Hill
Warwick
CV34 6DA
Tel: 0845 7023270
email: emfhelpline@uk.ngrid.com
www.emfs.info
www.nationalgrid.com/uk

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